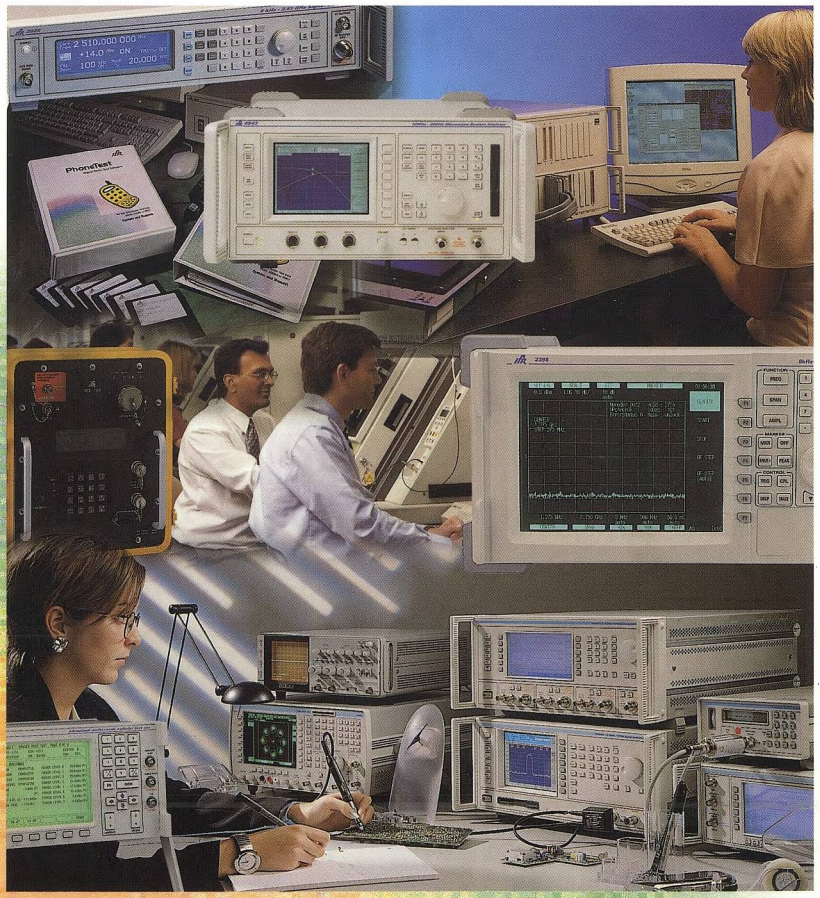
1999/2000

full catalog



TEST AND MEASUREMENT

Test and Measurement Catalog 1999/2000

This catalog features the Electronic Test and Measurement, ATE and Systems and Service expertise of IFR

IFR Past and Present

IFR began life as Instrument Flight Research Corporation in 1968, specializing originally in aircraft instruments and test equipment. In 1971 the company re-focused and concentrated on avionics test equipment. By 1975 the name was changed to IFR, Inc. and a radio communications test set was developed which transformed IFR into a leading RF and avionics test equipment company.



IFR Wichita USA

Growth through new product development and acquisition was then vigorously pursued. In 1992 the company acquired fiber optic test company Photon Kinetics, Inc. USA. York Technology of the UK was later acquired and they merged to create PK Technology, Inc. a major force in optical test.

IFR's radio communications testing expanded into cellular radio, paging and trunked radio. A major US defense contract extended capability into testing frequency agile military radio test systems. Avionics test also gained a wider market share and a line of RF and microwave Spectrum Analyzers was introduced.

Marconi Instruments

Marconi Instruments, which was formed in 1936, developed an extensive range of test and measuring equipment, especially for testing radio transmitters and receivers, microwave equipment and telecommunications systems.



IFR Stevenage UK

Automatic Test Equipment (ATE) products were later introduced and the successful service and repair operation and the "Systems and Solutions" businesses were started. Signal Generators and Cellular Radio Test Sets also played a major role in Marconi's broad product line.

IFR Systems, Inc. acquires Marconi Instruments

In February 1998 IFR Systems, Inc. acquired Marconi Instruments to create a new dynamic test and measurement company.

IFR was attracted to Marconi Instruments because of the wide range of products, a global sales presence in over 100 countries and an extensive service and support network.

Together the two companies provide a wide range of test instrumentation with considerable expertise in wireless test solutions, microwave, avionics, ATE and other areas.

IFR tomorrow

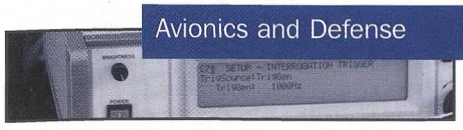
IFR will continue to build on its impressive portfolio of instruments and flexible test and measurement solutions. The wide-ranging support facilities will ensure that customers have reliable, high integrity solutions to their testing requirements.

The following pages feature IFR's full range of electronic test and measurement products, ATE and Systems and Service.

Additional information is available on request or from our website which also includes additional IFR news and facilities.

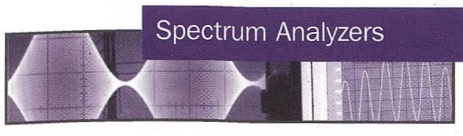






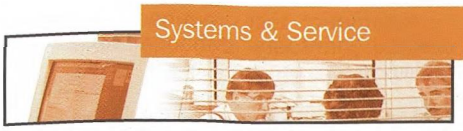












Wireless - Radio Test Sets

IFR pioneered the current generation of radio test sets. Today's wide range of test sets covers numerous wireless applications from HF, VHF and UHF to 2.2 GHz.

General purpose radio test sets are included in IFR's wide range as well as testers for the principal analog and digital cellular systems. Portable units for field service and fully featured units for development and production are available, along with an innovative service and repair tester for GSM hand sets.

IFR-1900 CSA - UWC-136 Digital PCS Radio Test Set



- The industry accepted simulator for TIA/EIA-136 conformance testing
- Tri-band, 400/800 MHz and 1900 MHz PCS test capability
- VSELP and ACELP vocoder for voice quality verification
- Full featured 2 GHz service monitor with spectrum analyzer and tracking generator
- Standard constellation IQ display for transmitter modulation tests

The IFR-1900 CSA Radio Test Set provides the industry's only fully approved test solution for TIA/EIA-136 analysis. It has been rigorously tested by CTIA and performs the critical dual mode analog/digital authentication and protocol compliance tests for TIA/EIA-136 dual mode TDMA. It also provides both base station and mobile phone conformance test capabilities.

Automatic test routines and user defined printouts enhance testing to provide a comprehensive test facility.

COM-120B - Communications Service Monitor



- Split screen digitized full scan spectrum analyzer to 1 GHz
- EasyCom and EasySpan automated test software
- Digitized full scan oscilloscope to 50 kHz
- LIVE-REF and REF-LIVE comparison for spectrum analyzer display
- Enhanced PCMCIA for easy data analysis
- Standard independent tracking generator

The COM-120B Communications Service Monitor is the industry recognized standard in communication service monitors. It is a tough, portable monitor with a full performance spectrum analyzer and digital oscilloscope. Combining over 20 instruments in one unit the versatile COM-120B offers a cost effective alternative to higher cost test sets.

AMPS, EDACS and advanced paging test facilities are all included in this versatile tester.

2945A/2948 - Communications Service Monitors



- Rugged lightweight package
- Fast, full performance spectrum analyzer with 'live' look and listen capability
- Transmitter harmonic and transient analysis
- Low Phase-Noise (2948) version

The 2945A/2948 family of radio test sets are rugged, versatile instruments designed for radio maintenance work in the field or workshop. They all have easy to use soft keys to provide simple and flexible operation.

The spectrum analyzer provides spans from 100 Hz to 100 MHz/div and a sensitivity of 2 mV with a look and listen function which simultaneously demodulates the signal. The 2948 version provides a low phase noise signal generator to allow for the accurate testing of narrow band receivers.

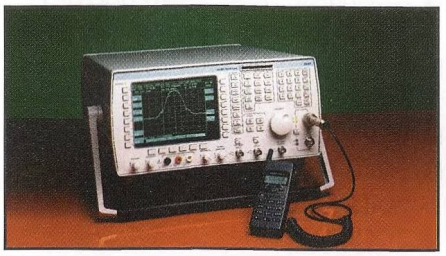
2965A - 100 kHz to 1 GHz Radio Test Set

- Fast and accurate radio testing
- High performance spectrum analyzer with tracking generator
- FFT analyzer for audio and modulation testing
- Supports all major analog cellular standards
- Configurable auto mode

The 2965A Radio Test Set pictured opposite offers the range and versatility needed by development engineers. In addition the 2965A offers the fast and accurate throughput required by modern production facilities. The repair and calibration of mobiles and base stations are further assisted by the auto test routines and a large number of diagnostic tools for repair and calibration are available.

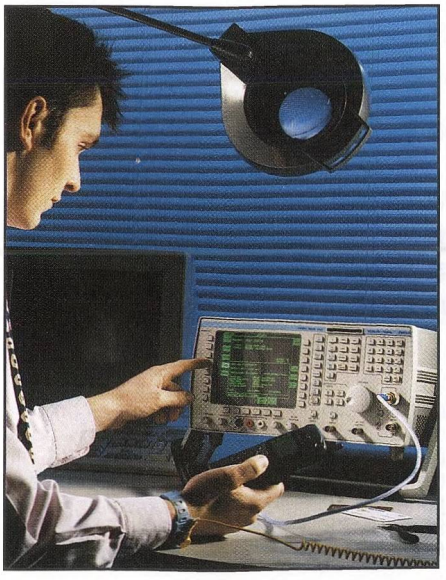
A range of analog cellular and trunking standards, coupled with the ease of use for which IFR test sets are renowned has made the 2965A Radio Test Set the first choice in many major companies and organisations.

2966A/2967 - GSM 900/1800/1900 Radio Test Set

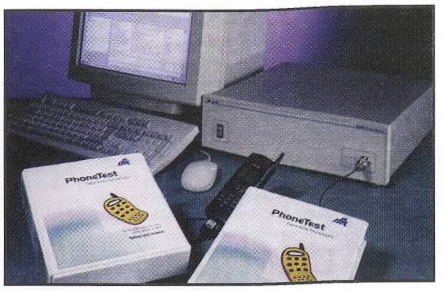


- All GSM standards in one unit (2967) including dual band functionality
- Power, power profile, frequency and phase measurements for normal and access bursts
- Full range of BER measurements for receiver testing
- E-GSM supported
- Manual/Auto modes of operation
- Spectrum analyzer from 100 kHz to 1 GHz and 1.3 GHz to 2.2 GHz
- Digital and analog in one unit

The 2966A/2967 supports all the protocols required to perform parametric measurements on GSM 900/1800/1900 systems and provides numerous other RF instruments for performing diagnostics and radio alignment. High speed testing is ensured by use of pre-programmed test sequences, fully user configurable for depth of test. Remote operation via RS-232 or GPIB further speeds up testing. GSM measurements for both transmitter and receiver are performed to GSM 11.10 specification for Tx power, profile, frequency, phase and Rx BER, FER.



PhoneTest and the 2935 - Workshop Management Software



- GSM phone repair software for repair workshops
- Economical and fast
- PC Integrated test solution
- Available in five languages
- Access to database for management information
- 2935 Test Head provides a high speed dual band test platform
- Suitable for stand alone or networked environments
- Fault recording and statistical analysis
- Warranty claim form generation
- PhoneTest software also operates on the 2966A and 2967

PhoneTest is a complete PC based digital cellular mobile test solution for GSM 900/1800/1900 systems incorporating Dual Band functionality. The measurement system consists of a single desktop unit, "Test Head", controlled by an external PC running a Windows based application program. The PC can be the same as that being used to run manufacturers' test software and alignment programs.

2959 - Advanced Multi-Mode Cellular Test Set



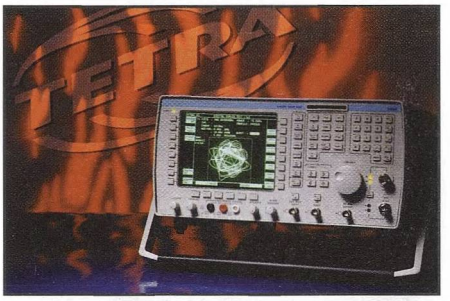
- AMPS, NAMPS and TDMA TIA/EIA-136 handset tester
- Quickly characterizes transmit and receive performance
- Cost effective and highly accurate
- VSELP & ACELP decoder/encoder testing
- Graphic display of performance characteristics
- English and Spanish languages

The 2959 quickly and accurately tests AMPS, NAMPS and the new TIA/EIA-136 handsets including those with VSELP and ACELP vocoders.

With enhanced features such as CDPD (Cellular Digital Packet Data), fast analysis of phone performance, exclusive constellation display, transmit power and receiver performance graphics, the 2959 is a cost effective alternative to conventional comprehensive wireless test systems.

User defined test parameters with easy to understand pass/fail displays ensure thorough but easy testing of a handset's performance.

2968 - TETRA Radio Test Set



- Designed specifically to test TETRA radios
- Tests base stations, terminals and direct mode mobiles
- Simulates TETRA infrastructure
- Comprehensive tests of complete radio performance
- Measures and displays vector errors, frequency errors and power profiles
- Test and diagnostic tools
- Total solution for digital and analog PMR

2968 TETRA Radio Test Set offers many facilities needed in development, production and service testing for the new TETRA market, supporting the test of base stations and mobiles as well as testing the direct mode feature. It performs all the major transmitter measurements displaying the results digitally and graphically. TETRA signals are generated for use in the testing of TETRA receivers. PMR testing is available as standard, with MPT 1327 and GSM radio testing as option.

Signal Generators and Analyzers

IFR's comprehensive range of Signal Generators covers a wide variety of applications.

The range includes low cost AM/FM Signal Generators, digital modulation including TETRA and innovative two source and three source units. Additional functions such as SINAD measurement, fading simulation and avionics test are available as options.

2023A/B & 2025 series - 9 kHz to 2.51 GHz Signal Generators



- 2023A 9 kHz to 1.2 GHz
  2023B 9 kHz to 2.05 GHz
  2025 9 kHz to 2.51 GHz
- Comprehensive modulation facilities AM, FM, DCFM, Pulse, 2 FSK and 4 FSK
- High power option
- SINAD measurement option
- Linear and logarithmic sweep mode
- Simple menu operation
- Sine, triangular and square wave two tone modulation source
- Optional fast pulse modulation

These lightweight and compact general purpose signal generators offer comprehensive, simple to use modulation facilities, including mixed AM/FM from an internal sine, triangle, square or external source together with pulse modulation.

Flexible user programmable frequency sweep capabilities and output level control from -137 dBm to +13 dBm (optionally +25 dBm), together with a class beating phase noise performance makes these generators ideally suited to demanding receiver and IF measurements in a wide range of applications.

2030 series - 10 kHz to 5.4 GHz Signal Generators



- 2030 10 kHz to 1.35 GHz
  2031 10 kHz to 2.7 GHz
  2032 10 kHz to 5.4 GHz
- 0.1 Hz frequency resolution
- 0.1 Hz to 500 kHz modulation oscillator
- Wideband FM with 10 MHz bandwidth
- Single, dual, composite and dual composite modulation modes
- Comprehensive sweep capabilities

The 2030 series of high performance signal generators offers great flexibility with combinations of frequency, phase, amplitude and pulse modulation with three models covering the frequency range 10 kHz to 5.4 GHz.

The instruments include many standard facilities incorporating single, dual composite and dual modulation. Sweep capabilities are fully user controllable.

With an easy to use keypad, large bright LCD display and remote control via GPIB, these generators are suitable for a wide variety of applications.

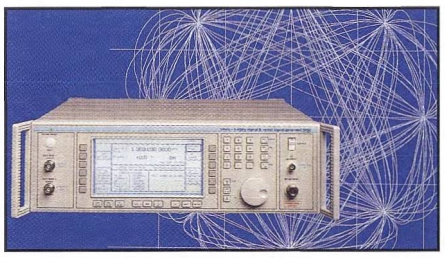
Avionics options are described in the Avionics and Defense section.

2040 series - 10 kHz to 5.4 GHz Low Noise Signal Generators

- Low phase noise: -140 dBc/Hz at 1 GHz (typically -145 dBc/Hz)
- Low residual FM noise: 0.3 Hz RMS at 1 GHz
- Low spurious signals: -90 dBc
- 2040 10 kHz to 1.35 GHz
  2041 10 kHz to 2.7 GHz
  2042 10 kHz to 5.4 GHz
- Comprehensive sweep and modulation capabilities

The 2040 series of low noise signal generators feature excellent noise characteristics and low spurious signals for critical measurements. Microprocessor control coupled with a large screen display provides ease of use via menu driven displays. Remote programming via GPIB, and easy recall of extensive stored setting information, provides high test productivity in ATE systems and production applications.

2050 series - 10 kHz to 5.4 GHz Digital and Vector Signal Generators



- Digital and vector modulation
- PSK, FSK, QAM, GMSK
- Precision I and Q modulation to 10 MHz (1 dB BW)
- 2050 10 kHz to 1.35 GHz
  2051 10 kHz to 2.7 GHz
  2052 10 kHz to 5.4 GHz
- Rician and Rayleigh fading and error simulation
- Envelope control for RF bursts
- NADC, PDC, GSM plus others
- Variable data rate control
- External data/burst inputs

The 2050 series of signal generators are designed to meet the needs of modern digital radio technologies. They combine comprehensive analog modulation, pulse modulation or IQ vector modulation. In digital mode an internal DSP is available to generate complex formats including FSK, PSK, GMSK, DPSK, QAM. Data rates and filter characteristics are selectable to suit

the application. Common modulation formats are pre-programmed and retrievable with a single key stroke. In IQ vector mode the precision modulator delivers 10 MHz bandwidth (1 dB) with better than 1% error, making 2050 the ideal choice for demanding applications.

2026 - 10 kHz to 2.4 GHz MultiSource Signal Generator



- Two or three high quality RF signal generators in one unit
- Ideal for intermodulation and receiver characterization
- Application specific test modes simplify measurement procedures
- User defined frequency and amplitude tracking between sources
- Adjustable carrier phase for peaking of three tone intermodulation or testing IQ modulators
- +24 dBm maximum output

The 2026 offers up to three fully featured RF signal generators in one unit providing a unique solution for complex tests on receivers, components and systems.

Its built in combiner and switched routing eliminates many of the uncertainties introduced by connecting together separate signal generators. The ability to select standard in-built or user-defined tests from the display menu via soft keys is ideal for use in R&D and manufacturing.

Each internal source has AM, FM, DCFM, phase, 2 FSK, 4 FSK and pulse modulation capabilities. These sources can be used independently or combined with other sources.

2050T - Digital and Vector Signal Generator for TETRA



- Advanced digital mode
- <-70 dBc Adjacent Channel Power
- Internal modulator provides $\pi/4$ DQPSK vector modulation with excellent linearity
- Simulates TDMA bursts, produces power ramps with over 80 dB of dynamic range
- Built-in data source generates PRBS modulation
- Burst control
- Excellent vector accuracy
- Baseband IQ output
- IQ vector modulation

The 2050T is a variant of the successful 2050 series of digital and vector signal generators. It has been designed to meet the challenging needs of TETRA radio development and production without compromising any of the 2050's original features.

Delivering better than -70 dBc adjacent channel power the 2050T easily satisfies the TETRA T2 specification for adjacent channel selectivity testing, whilst maintaining better than 1.5% RMS vector error.

With a choice of internal PRBS data to CCITT V.52 or external data clocked in real time, plus features such as Rayleigh or Rician fading, TDMA burst control and artificial modulation impairment the 2050T sets the standard in TETRA testing.

2310 - TETRA Signal Analyzer



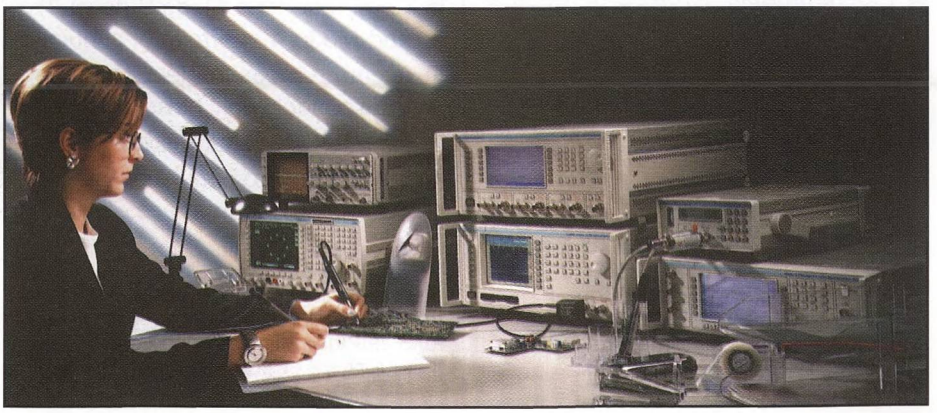
- Accurate TETRA transmitter measurements
- Tests TETRA base stations, terminals and direct mode radios
- All measurements in accordance with ETSI, ETS300 394-1
- 80 dB instantaneous dynamic range for Adjacent Channel Power
- Spectral displays of TETRA signals
- Modulation analysis, with vector and constellation diagrams
- Large color LCD display
- 40 W continuous power handling
- Wideband noise and discrete spurious measurements

The 2310 TETRA Signal Analyzer carries out transmitter measurements on base stations, terminals and direct mode radios according to ETSI specifications.

Modulation quality is measured by comparing the calculated and measured values of the signal magnitude and phase and calculating a percentage error. Graphical displays with constellation, phase trajectory and rotated vector diagrams are available at the touch of a button.

A graphical time domain display shows the rise and fall times of the TETRA burst profile against stored limits.

Other parameters measured include adjacent channel power due to modulation and switching, unwanted power in non-active transmit state, modulation accuracy and carrier frequency accuracy.



Avionics and Defense

The IFR range of Avionics test equipment covers key parametric testing of systems for design, manufacture, test and maintenance of commercial, private and government airborne avionics systems. Defense test and measurement instruments include the RCTS family which provide a cost effective test solution, plus an easy migration path to meet the growing testing demands of advanced military communication systems.

Commercial avionics systems supported:-

Instrument Landing System (ILS)
VHF Omnidirectional Range (VOR)
Marker Beacon (MKR)
VHF Communications (Comm)
Mode A/C and S Transponders (XPDR)
Distance Measuring Equipment (DME)
Traffic Alert and Collision Avoidance System (TCAS)
Microwave Landing Systems (MLS)
Weather Radar (WRX)

Military systems test includes:-

Identify Friend or Foe (IFF) Transponders
IFF Interrogators
TACAN

TCAS-201 - TCAS Ramp Test Set



- Programmable intruder simulation parameters
- Programmable ATCRBS or Mode S reply generator
- Surveillance monitor displays ATCRBS or Mode S interrogations
- 10 selectable programmable scenarios

The TCAS-201 allows verification and certification of an aircraft's TCAS installation, performing many of the required tests for Supplemental Type Certification (STC), during initial installation and subsequent routine maintenance.

IFF-701 - IFF Transponder Test Set



- Accurate measurement of transponder power and sensitivity
- Autotest minimizes test time
- Selectable predetermined limits
- GO/NO-GO or Diagnostic operation
- Mode 4 Stored Code operation

The IFF-701 is a portable battery operated test set for testing IFF transponders installed in airborne, naval or land based platforms.

An 'autotest' function allows the operator to verify the operation of transponders with minimal intervention, over the air or by direct connection to the transponder.

SI-1404 - MK12/Mode S Accessory Unit

- Comprehensive Mode S (level 4) and Mode 4 interrogator simulation
- Accurate measurement of transponder reply pulse parameters
- Time and amplitude diversity test
- Mode 4 crypto simulation plus external crypto interface

The SI-1404 is a Depot Level/3rd Line test accessory, used in conjunction with the ATC-1400A DME/transponder test set for testing IFF transponders in a maintenance or production environment.



The SI-1404 & ATC-1400A form a comprehensive SSR ground station simulator for testing transponders.

Avionics Signal Generators

IFR provides a variety of signal generators specifically for avionics. The NAV 750C, as well as the "Option 6" versions of the 2030, 2040 and 2050 signal generators, provide a high quality test source.

The instruments test ILS, VOR, SELCAL, ADF and marker beacons and are regarded as the industry standard.

Options are also available to test DME and avionics radars. VDR signals can be generated on the 2050 digital signal generator to test digital data links.

TS-4317-X - Radio Communication Test Set



- Easily expandable platform
- Supports all levels of maintenance
- Semi-unattended testing
- More complete testing in less time

The Radio Communications Test System (RCTS) is made up of the TS-4317-X Frequency Agile Communications Test Set and the J-4843A Appliqué unit with the PL-XXX Radio Personality Module or RPM-00X.

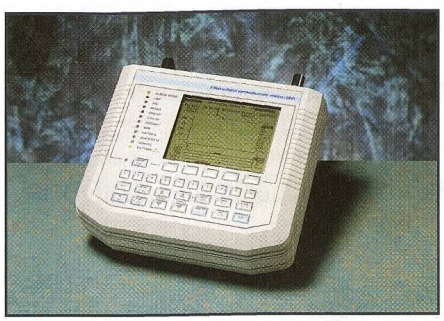
By using these advanced communications test techniques the RCTS family successfully supports Military's Tactical Communications requirements in the following areas: SINCGARS, Have Quick, Special Tactics, Life Support, and Airborne Communications.

The TS-4317-X has been designed to work with an appliqué unit as a natural extension of its operation. The division of functions between the two units is based on the TS-4317-X providing all of the basic measurement and stimulus functions. The appliqué unit is responsible for any special UUT input / output signal routing plus all unique measurements that a specific UUT may require.

Telecommunications

IFR offers a range of data and PCM rate testers up to 140 Mbit/s for Bit Error Rate testing and analysis of the telecommunications infrastructure. Portable testers for qualifying the local copper loop for digital transmission, including ISDN, are also included in the range.

2840A/2841 - Digital Transmission and Communications Analyzer

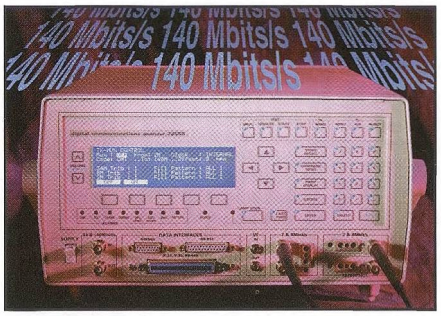


- Compact, handheld data and 2 Mbit/s PCM rate tester
- Data interfaces available: RS-232, X.21, V.35, RS-449 (V.36), codirectional, contradirectional (2841)
- G.826, M.2100 analysis
- n x 64 kbit/s testing, contiguous and non-contiguous including drop and insert
- Alarm detection and simulation
- Internal results storage or print from RAM capability

The 2840A/2841 are small, compact, battery or mains operated transmission analyzers for installation and maintenance measurements on 2 Mbit/s lines and equipment. An independent transmitter and receiver allow generation and reception of framed or unframed 2 Mbit/s PRBS signals up to 2^{23}-1, user programmable 32 bit sequence or variable sine wave test patterns.

Major error types such as line code, frame bit word, pattern and CRC reporting plus error analysis and performance measurements to G.821 and G.826/M.2100 are available. The 2841 adds data interface testing to the 2840A.

2850 series - Digital Analyzer



- Combined data and PCM rate tester
- Up to 140 Mbit/s Mux/Demux capability (2855S)
- G.826 and M.2100 performance measurements and analysis
- RS-232, X.21, V.35, RS-449, data interfaces available plus codirectional and contra-directional structured data interface (2850/51 only)
- Alternative North American and North American hybrid versions available

The 285X Digital Transmission Analyzer series provides installation, maintenance, production test and measurements on PCM lines from 704 kbit/s up to 8448 kbit/s for European systems, and from 1544 kbit/s up to 6312 kbit/s for North American systems. Instrument options are available to extend the European systems up to 34 Mbit/s and 140 Mbit/s with full Mux/Demux capabilities.

In addition to PCM testing, standard data interfaces (RS-232, X.21 etc.) and structured data (X.50) can be tested. Options available include battery or DC operation for field use, and GPIB/RS-232 control interface for production use.

NETLINK 423/424 - Network Transmission Quality Tester



- Service qualification testing
- End to end network testing
- Inter exchange network testing
- Network fault finding
- Customer access network testing
- PABX and special services testing
- Network quality assurance

The NETLINK 423 Network Test Transponder and NETLINK 424 Network Test Responder can be operated individually or as a system across the network to give a comprehensive analysis of the network, find faults and maintain required performance standards.

NETLINK 430 - Digital Line Test Set

- Tests cable pairs for high frequency digital transmission systems
- DPGS, PRA/BRA ISDN, HDSL, ADSL
- Identify fault conditions easily
- Easy to use
- Single user operation
- Battery operated

NETLINK 430 Digital Line Test Set is an integrated multi-function instrument to test the suitability of cable pairs for high frequency digital transmission systems such as Digital Pair Gain Systems (DPGS), primary and basic rate ISDN, HDSL and ADSL.



Microwave

IFR has established an enviable reputation for providing innovative solutions that meet the needs of test engineers working across a range of microwave applications.

The new 6800 series are for engineers working on the design and production of components and subsystems. The 6200B series is a proven tool for installation and maintenance engineers working with microwave systems in the field.

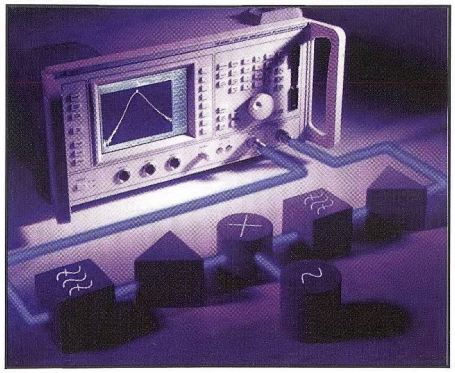
6800 - Microwave System Analyzer

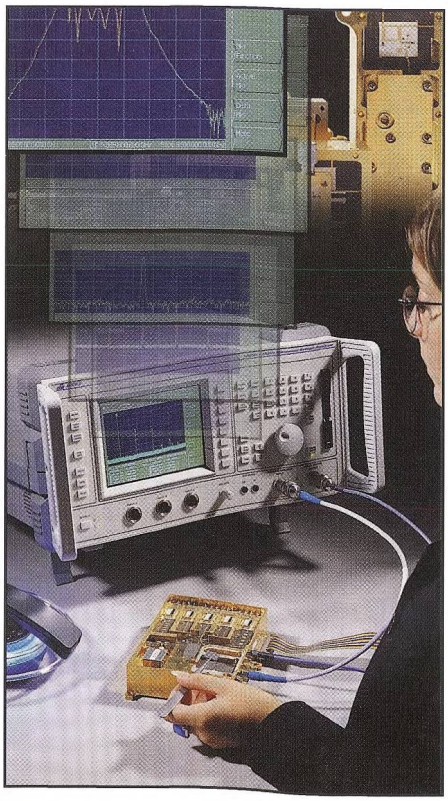
- Integrated synthesized source, scalar and spectrum analyzer
- 3 GHz, 8.4 GHz, 20 GHz and 24 GHz frequency versions
- Spectrum analyzer with full range tracking generator
- Offset tracking on network measurements
- Complete solution to component and subsystem characterization
- Applications interface allows guided and automatic testing
- Modular design for rapid service
- 3.5 in disk drive for results storage

The 6800 series Microwave System Analyzer is a powerful new tool for the microwave industry. Integrated into this innovative instrument are a synthesized source, a three input scalar analyzer and a spectrum analyzer. This allows one instrument to carry out more tests faster and more precisely than ever before.

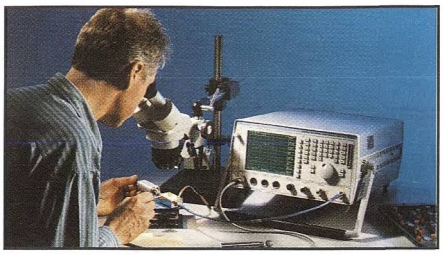
It is ideally suited to the demanding and previously time consuming task of testing RF and microwave subsystems for applications including radio links, radars, satellites and defense systems.

With the ability to generate a signal at the input frequency and to tune an analyzer to the output frequency, the 6800 simplifies previously complex measurements such as conversion loss/gain of mixers and subsystems. It is the ideal instrument for accurate and detailed analysis of frequency conversion devices, speeding up and simplifying this important measurement.





6200B - Microwave Test Set



- Precision scalar network measurements
- 2 GHz, 8 GHz, 20 GHz, 26.5 GHz and 46 GHz versions
- Synthesized signal source with optional step attenuator
- Integral frequency counter and power meter
- Dynamic calibrator and EEPROM corrected detectors for accurate measurements
- Real time fault location with 0.1% accuracy

The 6200B series of RF & Microwave Test Sets (MTS) combine the key microwave instruments for scalar network, power and frequency measurements into a compact and portable product. Five frequency range versions of the MTS are available.

6200B is the ideal instrument for measurements of return loss (VSWR) and fault location on the waveguide or cable feeds to antennas in modern communication systems. The versatility of the 6200B series means that it is ideally suited to installation, maintenance and service applications.

6250 series - Millimeter Wave Reflectometer

- Accurate return loss and insertion loss measurements to 110 GHz
- Millimetric detectors for transmission measurement
- 50 to 75 GHz and 75 to 110 GHz frequency versions

6210 - Reflection Analyzer

- Excellent directivity and test port match for precise measurement of reflection coefficients
- Time domain software for pinpointing impedance discontinuities
- Polar and Smith chart displays for matching devices in circuits

Counters, Power Meters and Spectrum Analyzers

IFR offers a range of general purpose RF and Microwave test and measurement instruments including Spectrum Analyzers, Counters and Power Meters. Applications include design, manufacturing and field maintenance.

Counter Power Meter (CPM)



- A combined Counter and Power Meter in one instrument with one user interface
- CPM 20: 10 MHz to 20 GHz
  CPM 46: 10 MHz to 46 GHz
- Portable and lightweight, weighs only 4.9 kg (10.8 lb) including battery
- Optional DTCXO reduces warm-up
- A large display ensures clear visibility in all light conditions
- Built in digital voltmeter

The IFR Counter Power Meter (CPM) is designed for the demanding environment of the installation and maintenance engineer. CPM is an integrated microwave frequency counter, true power meter and digital voltmeter, which addresses the fundamental measurements made on digital microwave radios.

With its rugged construction, battery operation and excellent accuracy, the CPM from IFR is the first choice for engineers installing and maintaining microwave radio links.

6970 - Hand Held RF Power Meter



- Hand-held for portability
- Battery powered for field use
- Wide frequency range: 30 kHz to 46 GHz
- Power levels from -65 dBm (0.31 nW) to +44 dBm (25 W)
- Audible pass/fail limits alarm

The 6970 provides precision microwave power measurements in a hand portable battery powered package.

6960B - RF & Microwave Power Meter

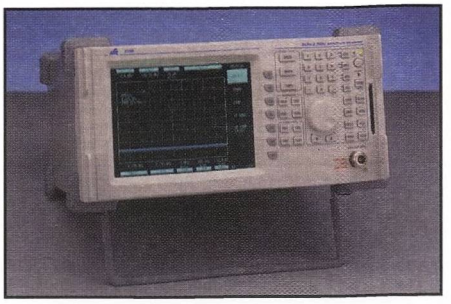


- Bench and ATE applications
- Frequency coverage 30 kHz to 46 GHz
- Wide dynamic range, -70 dBm (100 pW) to +45 dBm (30 W)
- Proven accuracy and reliability

The 6960B RF Power Meter is a precision RF and microwave power meter with comprehensive GPIB facilities for both bench and production applications.

2398 - 2.7 GHz Spectrum Analyzer

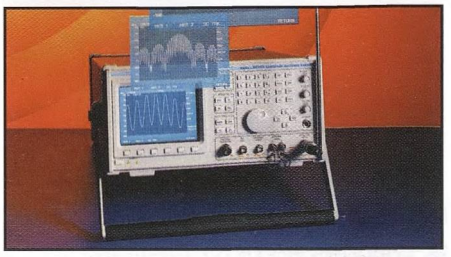
- Lightweight, rugged and portable
- Cost effective
- 9 kHz to 2.7 GHz fully synthesized
- Split screen operation
- AC, DC and battery operated
- 300 Hz minimum resolution bandwidth



The 2398 9 kHz to 2.7 GHz Spectrum Analyzer is the latest in a series of quality spectrum analyzers from IFR. It provides exceptional performance in a lightweight portable unit, combining ease of use and functionality with value for money without compromising the specification.

EMC testing and a GPIB interface are two additional options to increase the range of applications.

2390A series - Spectrum Analyzers



- Ranges from 9 kHz to 2.9 GHz, 22 GHz and 26.5 GHz
- Fully synthesized
- 3 Hz to 30 MHz resolution bandwidths
- External mixing capability to 300 GHz
- In-built AM/FM receiver modes
- Color display

The 2390A series provides fully synthesized frequency coverage up to 26.5 GHz and with external mixers allows coverage up to 300 GHz.

A range of resolution filters from 3 Hz to 30 MHz makes the 2390A series ideal for numerous applications, including close in signal analysis of digitally modulated carriers and pulsed radar applications.

An in-built AM/FM receiver allows surveillance operation with signals viewed on a clear color display and hardcopy output via a parallel port to standard printers.

Applications software makes standard measurements quickly and easily and remote operation over landlines or wireless links can be achieved with the EasySpan software package. Options include tracking generator to 2.9 GHz and EMC pre-compliance facilities with quasi-peak detection.

Automatic Test Equipment

Automatic Test Equipment (ATE) can verify product quality at a number of stages ranging from printed circuit board through to final test prior to shipping. The diagnostics of ATE are such that repairs can be quickly and effectively made to a product which can then remain within the production line flow.

4200 series - Advanced Manufacturing Test System



- Maximum of 2048 pins
- Windows 95 or NT operating system
- Automatic program generation software
- Graphical program debug capability
- Autodebug facility
- Inductive and capacitive vectorless test
- ISP & FLASH programming

The 4220 is the flagship of the IFR range of automatic test equipment. Designed to be the fastest manufacturing test system on the market, it is ideally suited to high volume manufacturing operations where throughput is of paramount importance. With an established customer base, the system tests a wide variety of printed circuit boards covering applications such as telecoms, automotive and consumer electronics.

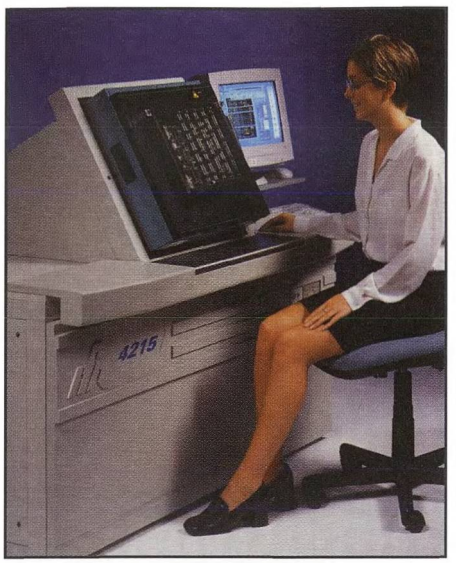
By achieving the highest level of fault coverage and testing products in the shortest possible time, the 4200 series reduces capital investment by providing a single test station within the beat rate of the production line. Quite simply, a single 4200 series tester can perform a task which would require several alternative systems.

5200 series - Power Manufacturing Defects Analyzer

- 1200 components/sec test speed
- Maximum of 2112 pins
- Windows NT operating system
- Power-up testing with programmable supply option
- Automatic program generation software
- Graphical program debug capability
- Autodebug facility
- Optional functional test capability
- Inductive and capacitive vectorless test
- 19 in rack mountable

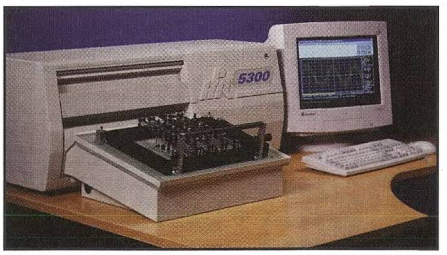
The PC controlled 5200 series Power Manufacturing Defects Analyzer (Power MDA) is a powerful, cost effective and extremely high speed board test system designed specifically for high volume PCB manufacturers, with the ability to accurately test a wide range of component types. Automatic program and manual entry program generation are provided as standard.





5300 series - Combinational ATE Systems

- Analog and digital functional
- Analog and digital In-Circuit
- Reverse trace diagnostics
- Windows NT operating system
- Automatic program generation software
- Graphical program debug capability
- ISDN and Telecoms capability
- Inductive and capacitive vectorless test



The 5300 series are combinational ATE systems designed to provide test solutions for a wide range of applications. The systems use industry standard PCs as the system controller using plug-in instrumentation/function card test resources which provide high performance test facilities. All three systems in this series are highly configurable.

4800 series - Automatic Optical Inspection System

- Detection of reversed and incorrect components
- Detection of component color
- Detection of solder shorts on IC legs
- Detection of solder blow holes
- Detection of bent or missing pins
- Detection of mechanical devices
- Allows for acceptable component variations in manufacture
- Search, blob, calliper, OCR and laser height tools available
- Up to 12 camera positions
- Network repair and off-line programming station
- In-line and off-line versions
- Manual and in-line versions available
- Easy to program using a point and click LabView front end

The 4800 series of Automatic Optical Inspection (AOI) systems are designed to complement IFR's series of electrical test systems in order to offer the user even more choice in terms of test strategy and process monitoring.

The AOI systems are available in four versions each targeted at a different manufacturing requirement and inspection problem from small batch production to high volume. The use of AOI machines complements the traditional electrical inspection process and extends confidence in the build quality to cover areas such as: connector type and color, bent or missing connector pins, color of LEDs, heat sinks, nuts, bolts, screws, labels and other mechanical parameters.



i-Base Information Management System

The i-Base system is a real-time database that collects information from all parts of the manufacturing process including test and repair data from any test station, manual or automatic. This software runs on a PC network and presents the data in a concise form, providing management with operational statistics and warning of impending problems.

The Computer Aided Repair package displays PCB layout information with the faulty components highlighted.



FABmaster - CAD Conversion Software

There are over thirty different CAD systems in common use today, it is therefore difficult for each platform within the production cycle to accept the ever changing output from these systems. The link is an integrated software solution converting and manipulating data for use by each element of the process.

The market leader in this sector is FABmaster™. IFR uses a dedicated version of the software to link to various CAD systems and convert data into a format suitable for the range of Automatic Test Equipment (ATE). This data format is then taken by IFR's computer assisted program generation software to produce the fixtures and programs required by the ATEs.

ATE Programs, Fixtures and Service

- Comprehensive design to build solutions
- Fixturing solutions including kits, customization and turnkey projects
- State-of-the-art techniques: Boundary Scan, Q-Test and simulation
- Designs from circuitry and instrument cards to custom ATE
- Design for test consultancy, installation and training
- Software tools include CAD data handling and PAL to ICT modelling

IFR delivers unrivaled Automatic Test Equipment support services from the largest fixturing and programming bureau in Europe. Three sites in England, Scotland and Germany provide professional test services meeting every customer need.

Systems and Service

The Systems & Service Group provides a wide range of test and measurement services through IFR's global sales channel, delivering total solutions in support of the IFR product range.

Specialized solutions, to meet specific customer needs, are addressed by the Systems Group covering minor modifications of existing instruments to complete factory test system design and production. Total support of delivered products is handled by the Service Group in conjunction with the Customer Services organization.

Systems Group

The Systems Group has access to the highest levels of test expertise in providing fully supported solutions tailored to individual customer needs. With capabilities based on a wide range of product technologies, the group can integrate both IFR and third party products to create the optimum solution for the customer.



For IFR products the Applications team within the Systems Group provides a capability through hardware and software modification to configure standard products to meet special requirements.

Typical examples of the work of the Systems Group are outlined below:

Wireless Test Solutions

Systems have been developed to address production and service requirements in analog and digital cellular systems and for military radio testing.

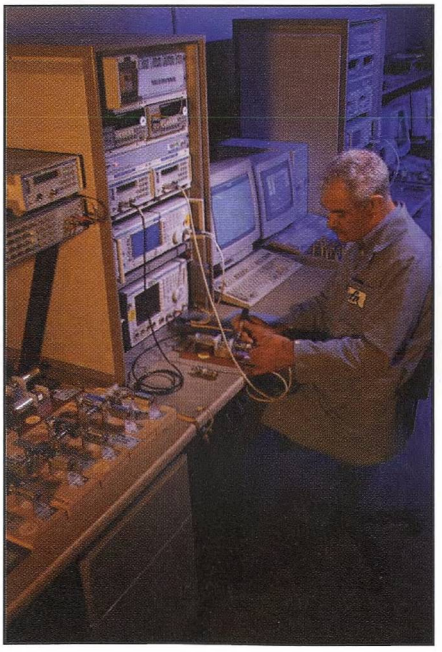
Systems vary in complexity from fully automated production line testers through to semi-automatic bench-top assemblies for workshop use.

Radio Monitoring Systems

Remotely controlled systems for assessing spectrum occupancy for radio regulatory and interference control purposes. The systems can be configured using spectrum analyzers or high grade communications receivers and allow unattended operation for results storage and analysis.

Power Sensor Calibration System

A modular system that can be configured to calibrate a variety of IFR and third party power sensors and detectors. The system is designed for high volume users including military and commercial calibration houses.



MIAMI Remote Network Monitoring

The MIAMI system provides pro-active monitoring and fault finding of telecoms networks from a central site using configurable scans and graphical displays.

2030 Series ILS Monitor

This software is used to control the IFR 2030 series Avionics Signal Generators to test ILS monitors at airports. It sets up the signal generator while displaying the on-line maintenance schedule and provides full results history allowing current measurements to be compared with historical readings.



2850 Series Remote Software

This modular, user-friendly software is a powerful addition to the 2850 series of Digital Transmission Analyzers. Running in Windows it provides a comprehensive, easy to use remote operation and results collection facility, for fast and efficient measurement analysis.

Service Group

The Service Group provides a range of support services associated with test and measurement equipment ranging from routine repair and calibration through to complete facilities and asset management services.

The Service Group facilities provide local access to comprehensive repair and calibration capabilities for IFR and third party products. A range of maintenance and calibration contracts allows customers to budget precisely their support costs.

Asset and Facilities Management

Outsourcing of T&M calibration and repair is of increasing interest to large companies. The IFR Service Group can provide on-site support services to help these companies manage their assets more effectively. Substantial cost savings are now being realized due to an increased focus on core business activities.

EMC Testing

IFR's wide experience of designing products for compliance with EMC regulations is accessible to UK customers. The service provided covers from consultancy through to product certification. IFR's guidance and expertise can save valuable time and cost in introducing new products to the market.

IFR Principal Offices and Sales Outlets

Americas

USA
IFR Americas, Inc.
10200 West York Street
Wichita, Kansas 67215-8999
USA
Tel: *[+1] (316) 522 4981*
Fax: *[+1] (316) 522 1360*
e-mail: *info@ifrsys.com*

LATIN AMERICA SALES OFFICE
IFR Americas, Inc.
99 Trophy Club Drive
Trophy Club
Tx 76262
USA
Tel: *[+1] (817) 430 5842*
Fax: *[+1] (817) 430 5843*
e-mail: *carlos.blanco@ifrsys.com*

Europe North

UNITED KINGDOM
IFR Ltd
Longacres House
Norton Green Road
Stevenage, Hertfordshire SG1 2BA
United Kingdom
Tel: *[+44] (1438) 742200*
Fax: *[+44] (1438) 727601*
e-mail: *info@ifrinternational.co.uk*

NETHERLANDS, LUXEMBOURG
IFR Ltd
Postbus 645, 5000 AP Tilburg
Netherlands
Tel: *[+31] (13) 463 95 40*
Fax: *[+31] (13) 463 96 63*
e-mail: *infobnl@ifr.nl*

BELGIUM
Tel: *[+32] 9 238 22 48*
Fax: *[+32] 9 238 23 05*

Europe Central

GERMANY
IFR GmbH
Münchner Str. 87b, 85221 Dachau
Germany
Tel: *[+49] (8131) 29260*
Fax: *[+49] (8131) 2926130*
e-mail: *info@ifrinternational.co.uk*

Eastern Europe

GERMANY
IFR GmbH
Robert Bosch Strasse 32
63303 Dreieich-Sprendlingen
Germany
Tel: *[+49] (6103) 91180*
Fax: *[+49] (6103) 911811*
e-mail: *info@ifrinternational.co.uk*

Europe South

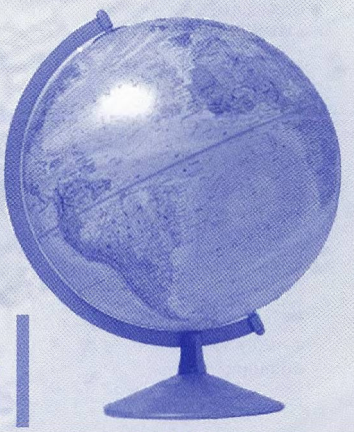
FRANCE
IFR International SA
18 Rue du Plessis-Briard
"Le Canal"
Courcouronnes
91023 Evry Cedex
France
Tel: *[+33] 1 60 79 96 00*
Fax: *[+33] 1 60 77 69 22*
e-mail: *info@ifrinternational.co.uk*

SPAIN
IFR Technologies SA
Europa Empresarial
C/Rozabella, 6
28230 Las Rozas
Madrid
Spain
Tel: *[+34] (91) 640 11 34*
Fax: *[+34] (91) 640 06 40*
e-mail: *info@ifrinternational.co.uk*

Asia

CHINA
IFR International Ltd
Room 706/708
7/F Beijing Towercrest Plaza
No 3 Mai Zi Dian Xi Lu
Chao Yang District
Beijing 100016
People's Republic of China
Tel: *[+86] (10) 64672716*
Fax: *[+86] (10) 64672821*
e-mail: *ifrbj@public.fhnet.cn.net*

HONG KONG
IFR International Ltd
Room 702-703
CC Wu Building
302-308 Hennessy Road
Wanchai
Hong Kong
Tel: *[+852] 2832 7988*
Fax: *[+852] 2834 5364*
e-mail: *ifr_hk@asiansources.com*



global regional support

http://www.ifrinternational.com

IFR Sales Outlets

ARGENTINA
Instruments Sales & Service
VR Marine Electronics SRL
Tucuman 358 Piso 6 "K"
1049 Buenos Aires
Argentina
Tel: [+54] (1) 311 7432
Fax: [+54] (1) 312 2799
e-mail: vrmarine@overnet.com.ar

AUSTRALIA
Instruments & ATE Sales & Service
VICOM Australia Pty. Limited
1064 Centre Road
Oakleigh South
Victoria , 3167
Australia
Tel: [+61] (3) 9563 7844
Fax: [+61] (3) 9579 7255
e-mail: vicom@vicom.com.au

AUSTRIA
Instruments Sales & Service
LB-Electronics GmbH
Döblinger Hauptstrasse 95
A-1190 Wien
Austria
Tel: [+43] (1) 36 030-31
Fax: [+43] (1) 3698443
e-mail: mess@lbe.co.at

AUSTRIA
ATE Sales and Service
IFR GmbH
Münchner Str 87b
85221 Dachau
Germany
Tel: [+49] (8131) 29260
Fax: [+49] (8131) 2926130
e-mail: info@ifrinternational.co.uk

AZERBAIJAN
Instruments Sales
Applied Technologies Inc
12 Mardanov Qardashlari Street
Apt 25
Baku
Azerbaijan
Tel: [+99] 412 980959
Fax: [+99] 412 935174
e-mail: haouil@ati_baku.azeri.com

BAHRAIN
Instruments Sales
Arabian Electric and Electronic
Establishment - AE & EE
PO Box 26180, Manama
Bahrain
Tel: [+973] 256473
Fax: [+973] 273482
e-mail: fisuoyla@batelco.com.bh

BANGLADESH
Instruments Sales
The MOD Syndicate (P) Limited
Plot # 53, Road # 17, Banani C/A
Dhaka-1213
Bangladesh
Tel: [+880] (2) 988 1306
Fax: [+880] (2) 988 3025
e-mail: modunity@bdmail.net

BELGIUM
Instruments & ATE Sales
IFR Ltd
Postbus 645
5000 AP Tilburg
Netherlands
Tel: [+31] (0) 13 463 95 40
Fax: [+31] (0) 13 463 96 63
e-mail: infobnl@ifr.nl

Belgium:
Tel: [+32] (0) 9 238 22 48
Fax: [+32] (0) 9 238 23 05

BOTSWANA
See South Africa

BRAZIL
Instruments Sales & Service
Ascom
Rua Joaquim Dos Reis, 51 S/03
Sao Paulo-SP 04727-150
Brazil
Tel: [+55] (11) 56415074
Fax: [+55] (11) 99988149
e-mail: ascom.alix@uol.com.br

BRUNEI
See Hong Kong

BULGARIA
Instruments Sales & Service
GOPE Electronics
45 "Popova Shapka" Str
1505 Sofia
Bulgaria
Tel/Fax:[+359] (2) 732800
e-mail: gope@mobikom.com

CANADA
Instruments Sales
Navair
2450 Derry Road East
Mississauga, Ontario
Canada L5S 1B2
Tel: [+1] (905) 676 4150
Fax: [+1] (905) 676 9737
e-mail: navair@fieldav.com

CHILE
Instruments Sales
Morgan & Cia SA
Almirante Pastene 256
Casilla (PO Box) 1-T Tajamar
Santiago
Chile
Tel: [+56] (2) 236 1278
Fax: [+56] (2) 235 7552
e-mail: morgan@entelchile.net

CHINA
Instruments Sales & Service
IFR International Ltd
Rm 706/708,
7/F Beijing Towercrest Plaza
No 3 Mai Zi Dian Xi Lu
Chao Yang District
Beijing 100016
People's Republic of China
Tel: [+86] (10) 64672716
Fax: [+86] (10) 64672821
e-mail: ifrbj@public.fhnet.cn.net

CHINA
Instruments Sales
IFR International Ltd
Rm. 411 Jiu An Plaza
No. 258 Tong Ren Road
SHANGHAI (200040)
People's Republic of China
Tel: [+86] (21) 6247 4722
Fax: [+86] (21) 6247 4719
e-mail: shmi@public1.sta.net.cn

CHINA
Instruments Sales
IFR International Ltd
Room 1305 Metro Plaza
183 Tian He Bei Lu
GUANGZHOU 510620
People's Republic of China
Tel: [+86] (20) 8755 4016
Fax: [+86] (20) 8755 4312
e-mail: gzmiil@public1.guangzhou.gd.cn

COLOMBIA
Instruments Sales
Selectronica Limitada
Carrera 71 No. 55-98 A.A.25124
Santafe de Bogota
Colombia
Tel: [+57] (1) 2953215
[+57] (1) 2631220
Fax: [+57] (1) 2632874
e-mail: selectro@openway.com.co

COLOMBIA
Instruments Sales & Service
Rentametric Ltda.
Calle 24 No. 32-67
Santafe de Bogota
Colombia
Tel: [+57] (1) 5709280
Fax: [+57] (1) 2690191
e-mail: rentamet@latino.net.co

COSTA RICA
Instruments Sales
Sonivision S.A.
200 metros al oeste del M.A.G.
Carretera A. Escazu
PO Box 620-1000
San Jose
Costa Rica
Tel: [+506] 231 5685
Fax: [+506] 231 6531
e-mail: sonivi@sol.racsa.co.cr

CROATIA
Instruments Sales
CDE nove tehnologije d.d.
Cesta v Klece 12
1117 Ljubljana
Slovenia
Tel: [+386] (0) 61 15 90 571
Fax: [+386] (0) 61 15 90 544/571
e-mail: matej@cde.sl

CZECH REPUBLIC
Instruments Sales & Service
EMPOS Spol. S.R.O.
Rostislavova 13
140 00 Praha 4
Czech Republic
Tel: [+420] (2) 692 50 80
Fax: [+420] (2) 692 50 84
e-mail: empos@mbox.vol.cz

DENMARK
Instruments & ATE Sales & Service
Stantronic Instruments A/S
Ormhøjgårdvej 16
DK 8700 Horsens
Denmark
Tel: [+45] 75 643366
Fax: [+45] 75 644080
e-mail: info@stantronic.dk

EGYPT
Instruments Sales & Service
Multi-Systems Engineering
21 El Obour Building
Salah Salem, Floor 18
Cairo
Egypt
Tel: [+20] (2) 2632771
Fax: [+20] (2) 4028057
e-mail: menc@soficom.com.eg

FIJI
Instruments Sales
VICOM Australia Pty. Limited
1064 Centre Road
Oakleigh South, Victoria, 3167
Australia
Tel: [+61] (3) 9563 7844
Fax: [+61] (3) 9579 7255
e-mail: vicom@vicom.com.au

FINLAND
Instruments & ATE Sales & Service
Kaukomarkkinat Oy
Kutojantie 4
P. O. Box 40
SF-02630 Espoo 63
Finland
Tel: [+358] (9) 5211
Fax: [+358] (9) 521 5290
e-mail: mittaus.laitteet@kaukomarkkinat.fi

FRANCE
Instruments & ATE Sales & Service
IFR International SA
18 Rue du Plessis-Briard
"Le Canal"
Courcouronnes
91023 Evry Cedex
France
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22
e-mail: info@ifrinternational.co.uk

GERMANY
Instruments & ATE Sales & Service
IFR GmbH
Münchner Str. 87b
85221 Dachau
Germany
Tel: [+49] (8131) 29260
Fax: [+49] (8131) 2926130
e-mail: info@ifrinternational.co.uk

GREECE
Instruments Sales & Service
Theodorou Automation SAICT
3 Aftomedontos Street
116 35 Athens
Greece
Tel: [+30] (1) 7010069
Fax: [+30] (1) 7518829
e-mail: theodorou@otenet.gr

HONG KONG
Instruments Sales & Service
IFR International Ltd
Room 702-703, CC Wu Building
302-308 Hennessy Road
Wanchai
Hong Kong
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364
e-mail: ifr_hk@asiansources.com

HUNGARY
Instruments Sales
Radiant PLC
Kassai u.84
1142 Budapest
Hungary
Tel: [+36] 1 25 25 125
Fax: [+36] 1 25 16 850
e-mail: radiant@mail.matav.hu

INDIA
Instruments Sales & Service
Blue Star Limited
Sahas, 414/2 Veer Savarkar Marg
Prabhadevi, Bombay 100 025
India
Tel: [+91] (22) 430 6155
Fax: [+91] (22) 430 7078
e-mail: dileep.reddy@bluestar.
sprintrpg.ems.vsnl.net.in

INDONESIA
Instruments Sales & Service
PT Panorama Timur Jaya
Jl Paus No. 89 D-E
Rawamangun, Jakarta 13220
Indonesia
Tel: [+62] (21) 4756788
Fax: [+62] (21) 4751688
e-mail: panorama@ub.net.id

IRELAND, REPUBLIC OF
Instruments Sales & Service
Neltronic Ltd
John F. Kennedy Road
Dublin 12
Eire
Tel: [+353] (1) 4503560
Fax: [+353] (1) 4552789
e-mail: neltronic@tinet.ie

IRELAND, NORTHERN
Instruments Sales & Service
Neltronic (N.I.) Ltd
Heron Road
Sydenham Business Park
Belfast BT3 9ED
Northern Ireland
Tel: [+44] (1232) 450607
Fax: [+44] (1232) 451950

ISRAEL
Instruments Sales & Service
IES Electronics Agencies (1986) Ltd
32 Ben Gurion Street
Ramat Gan 52573
Israel
Tel: [+972] (3) 753 0753
[+972] (3) 753 0700
Fax: [+972] (3) 753 0701
e-mail:gideon@ies.com

ITALY
Instruments & ATE Sales & Service
Federal Trade SpA
Via Leonardo da Vinci 21/23
20090 Segrate
Milano
Italy
Tel: [+39] (02) 2134034
Fax: [+39] (02) 2133970
e-mail:federaltrade@ftnetra.ftnet.it

ITALY
Avionics Sales
MPG Instruments SRL
Via Roma 18
Milano
Italy
Tel: [+39] (02) 99482011
Fax: [+39] (02) 99481435
e-mail:mpgmi@rdn.it

JAPAN
Instruments Sales & Service
Kikusui Electronics Corp.
1-1-3, Higashiyamata
Tsuzuki-ku
Yokohama City
224-0023
Japan
Tel: [+81] (45) 593 7580
Fax: [+81] (45) 593 7581
e-mail:hokubo@kikusui.co.jp

JAPAN
Avionics
Kenwood TMI Corp.
1-16-2 Hakusan
Midori-ku
Yokohama-Shi
Kanagawa, 226-8525
Japan
Tel: [+81] (45) 939 7180
Fax: [+81] (45) 939 7089
e-mail:tanaka.s@tmi.kenwood.co.jp

JORDAN
Instruments Sales
Munir Sukhtian Co. Ltd
PO Box 1027
Amman 11118
Jordan
Tel: [+9626] 5524151
Tel: [+9626] 5534152
Fax: [+9626] 5527123
e-mail:msc@firstnet.com.jo

KENYA
See South Africa

KOREA, SOUTH
Instruments Sales
Myung Jin Systems Inc.
Rm No 511, Taeyang Building
44-4 Yoido-dong
Youngdeungpo-ku
CPO Box 1649
Seoul
Korea
Tel: [+82] (2) 780 1691/2
Fax: [+82] (2) 780 1693
e-mail:mjsys@mail.hitel.net

LATIN AMERICA SALES OFFICE
Instruments Sales
IFR Americas, Inc.
99 Trophy Club Drive
Trophy Club
TX 76262
USA
Tel: [+1] (817) 430 5842
Fax: [+1] (817) 430 5843
e-mail: carlos.blanco@ifrsys.com

LIECHTENSTEIN
Instruments Sales
Emitec AG
Hinterbergstrasse 9
6330 Cham
Switzerland
Tel: [+41] (41) 748 60 10
Fax: [+41] (41) 748 50 55
e-mail: info@emitec.ch

LUXEMBOURG
Instruments & ATE Sales
IFR Ltd
Postbus 645
5000 AP Tilburg
Netherlands
Tel: [+31] (0) 13 463 95 40
Fax: [+31] (0) 13 463 96 63
e-mail: infobnl@ifr.nl

Belgium:
Tel: [+32] (0) 9 238 22 48
Fax: [+32] (0) 9 238 23 05

MACAU
See Hong Kong

MACEDONIA
Instruments Sales
CDE nove tehnologije d.d.
Cesta v Klece 12
1117 Ljubljana
Slovenia
Tel: [+386] (0) 61 15 90 571
Fax: [+386] (0) 61 15 90 544/571
e-mail: matej@cde.sl

MALAYSIA
Instruments Sales & Service
Mahkota Technologies Sdn Bhd
Wisma Mahkota
Jalan 215-Templer
46050 Petaling Jaya
Selangor, Malaysia
Tel: [+60] (3) 791 1388
Fax: [+60] (3) 792 1350
[+60] (3) 791 1886

MALTA
Instruments Sales
Pan Services Ltd
New Str, in Bridge Junction
Mosta MST 08
Malta
Tel: [+356] 418527
Fax: [+356] 414397
e-mail: panserv@keyworld.net

MEXICO
Instruments Sales
Insetel S.A. de C.V.
Calle 4 del Blvd A Queretaro 51
54060 Tlalnepantla
Edo de Mexico
Mexico
Tel: [+52] 398 3889
Fax: [+52] 362 0273
e-mail: insetel@mpsnet.com.mx

MEXICO
Instruments Sales
Syscom S.A. de C.V.
Av. 20 de Noviembre No. 805
31000 Chihuahua
Mexico
Tel: [+52] (14) 152525
Fax: [+52] (14) 164298
e-mail: webmaster@syscom.com.mx

MOROCCO
Instruments Sales
Tradec Signal
Place Khaibar
Angle Boulevard de la Gironde
et Rue D'Ifni
Casablanca 03
Morocco
Tel: [+212] (2) 248543/554
Fax: [+212] (2) 248566

NAMIBIA
See South Africa

NETHERLANDS
Instruments & ATE Sales & Service
IFR Ltd
Postbus 645
5000 AP Tilburg
Netherlands
Tel: [+31] (0) 13 463 95 40
Fax: [+31] (0) 13 463 96 63
e-mail: infobnl@ifr.nl

NEW ZEALAND
Instruments Sales
VICOM New Zealand Limited
Lower Ground Floor
156 Vincent Street
Auckland
New Zealand
Tel: [+64] (9) 379 4596
Fax: [+64] (9) 379 4597
e-mail: wallace.brabyn@vicom.com.nz

NORWAY
Instruments Sales & Service
Nortronicom AS
P.O. Box 33 Manglerud
0612 Oslo
Norway
Tel: [+47] (22) 68 09 10
Fax: [+47] (22) 68 18 87
e-mail: nortronicom@nortronicom.no

OMAN, SULTANATE OF
Instruments Sales & Service
Suhail & Saud Bahwan
PO Box 169
Muscat
Sultanate of Oman
Tel: [+968] 793741
Fax: [+968] 796158
e-mail: pandt@ssbahwan.com

PAKISTAN
Instruments Sales & Service
Intermark Ltd
P.O. Box 6159
Hakimsons Building
19 West Wharf Road
Karachi 74000
Pakistan
Tel: [+92] (21) 2314262
Fax: [+92] (21) 231 04801
e-mail: intermark@cyber.net.pk

PHILIPPINES
Instruments Sales & Service
Sunley Inc
MCPO Box 2850
Makati 1268
Metro Manila
Philippines
Tel: [+63] (2) 818-1216
Fax: [+63] (2) 815-0730
e-mail: sunley@ibm.net

POLAND
Instruments Sales & Service
Interlab P.U.H.
Ul. Potocka 14, Paw 3
01-641 Warsaw
Poland
Tel/Fax:[+48] (22) 833 39 56
[+48] (22) 833 39 60
[+48] (22) 833 39 61
e-mail: interlab@interlab.com.pl

PORTUGAL
Instruments Sales & Service
Pinto Basto Electrotecnia e Máquinas Lda
Av. 24 de Julho, 3 - 1º Esq
1200 LISBOA
Portugal
Tel: [+351] (0) 1 3972041
Fax: [+351] (0) 1 3972595
e-mail: carlos.filipe@pintobasto.pt

PUERTO RICO
Instruments Sales
EOA Telecom Group Inc.
La Cumbre
722 Kennedy
San Juan, PR 00926-5629
Puerto Rico
Tel: [+787] 789 0697
Fax: [+787] 789 0697
e-mail: eoaviles@eoatelecom.com

QATAR
Instruments Sales & Service
Business Communications Qatar Ltd
PO Box 150
Doha
Qatar
Tel: [+974] 325851
Fax: [+974] 414100

ROMANIA
Instruments Sales & Service
Celesta Comexim SRL
17 Splaiul Independentei
BL.101 Izvor.Sc.3. Apt.41
PO Box 63-13
70501 Bucharest
Romania
Tel: [+40] (1) 3357140
Fax: [+40] (1) 3355031
e-mail: celesta@fx.ro

RUSSIA
Instruments Sales
Centre for the Development of International Projects
7th Floor, House No.1
Vadkovskii Pereulok
Moscow 103055
Russia
Tel: [+7] (095) 973 3880
Fax: [+7] (095) 973 2145
e-mail: haripbvb@cityline.ru

SAUDI ARABIA
Instruments & ATE Sales & Service
Electronic Equipment Marketing Co
P.O. Box 3750
Riyadh 11481
Kingdom of Saudi Arabia
Tel: [+966] (1) 477 1650
Fax: [+966] (1) 478 5140

SINGAPORE
Instruments & ATE Sales & Service
ROOTS Communications Pte Ltd
150 Kampong Ampat
#06-04 KA Centre
Singapore 368324
Tel: [+65] 283 8500
Fax: [+65] 283 8516
e-mail: jolee@post1.com

SLOVAK REPUBLIC
Instruments Sales
EMPOS Spol. S.R.O.
Rostislavova 13
140 00 Praha 4
Czech Republic
Tel: [+420] (2) 692 50 80
Fax: [+420] (2) 692 50 84
e-mail: empos@mbox.vol.cz

SLOVENIA
Instruments Sales
CDE nove tehnologije d.d.
Cesta v Klece 12
1117 Ljubljana
Slovenia
Tel: [+386] (0) 61 15 90 571
Fax: [+386] (0) 61 15 90 544/571
e-mail: matej@cde.sl

IFR Sales Outlets

SLOVENIA
Service
SIQ Slovenian Institute of Quality and Metrology
Trzaska cesta 2
1000 Ljubljana
Slovenia
Tel: [+386] 61 177 8100
Fax: [+386] 61 177 8444
e-mail: spela.vrbas@siq.sl

SOUTH AFRICA
Instruments & ATE Sales & Service
Measuretest cc
PO Box 6301
Dunswart
1508 Gauteng
Republic of South Africa
Tel: [+27] (11) 918 3805/5943/5685
Fax: [+27] (11) 918 5176
e-mail: sales@measuretest.co.za

SPAIN
Instruments & ATE Sales & Service
IFR Technologies SA
Europa Empresarial
C/Rozabella, 6
28230 Las Rozas
Madrid
Spain
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40
e-mail: info@ifrinternational.co.uk

SRI LANKA
Instrument Sales
Equipment Trades Ltd
2941/1 Galle Road
Colombo 4
Sri Lanka
Tel: [+94] 1 584198
Fax: [+94] 1 500613

SWEDEN
Instruments & ATE Sales & Service
Pronesto AB
Finlandsgatan 18
Box 6014
164 06 Kista
Sweden
Tel: [+46] (8) 444 10 50
Fax: [+46] (8) 751 41 11
e-mail: info@pronesto.combitech.se

SWITZERLAND
Instruments Sales & Service
Emitec AG
Hinterbergstrasse 9
6330 Cham
Switzerland
Tel: [+41] 41 748 60 10
Fax: [+41] 41 748 60 11
e-mail: info@emitec.ch

SWITZERLAND
ATE Sales & Service
Hilpert Electronics AG
Taefernstrasse 29
CH-5405 Baden Dättwil
Switzerland
Tel: [+41] 56 493 01 51
Fax: [+41] 56 493 27 27
e-mail: hilpert_ag@swissonline.ch

TAIWAN
Instruments Sales & Service
HWA Jeat Corp.
6F-3, No. 181 Fu-Hsing N. Road
Taipei 10441
Taiwan
ROC
Tel: [+886] (2) 2719 3216
Fax: [+886] (2) 2719 2886
e-mail: hjctwn@ms2.hinet.net

TAIWAN
Instruments & Avionics Sales
Bolar Enterprises Co. Ltd.
Room 807
No 100 Chang Chun Road
Taipei
Taiwan
ROC
Tel: [+886] (2) 2562 7061
Fax: [+886] (2) 2561 9839
e-mail: bolartwn@ms15.hinet.net

THAILAND
Instruments Sales & Service
Yip in Tsoi & Jacks Ltd
523 Mahaprutharam Road,
Bangrak, Bangkok 10500
Thailand
Tel: [+66] (2) 6390369
Fax: [+66] (2) 2368123
e-mail: jinapim@mozart.inet.co.th

TURKEY
Instruments Sales & Service
Orko Mumessillik
Tunus Caddesi 85/9
06680 Kavaklidere
Ankara
Turkey
Tel: [+90] (312) 426 6047
Fax: [+90] (312) 426 6180
e-mail: orkoas@superonline.com

UAE, ABU DHABI
Instruments Sales & Service
Bahwan Trading Company (LLC)
P O Box 41175
Abu Dhabi, UAE
Tel: [+971] (2) 768909
Fax: [+971] (2) 768907
e-mail: tkmmittc@emirates.net.ae

UAE, DUBAI
Instruments Sales & Service
Bahwan Trading Company (LLC)
P O Box 25173
Dubai, UAE
Tel: [+971] (4) 553883
Fax: [+971] (4) 553776
e-mail: tkmmittc@emirates.net.ae

UNITED KINGDOM
Instruments & ATE Sales
IFR Ltd
Longacres House
Norton Green Road
Stevenage
Hertfordshire SG1 2BA
United Kingdom
Tel: [+44] (1438) 742200
Fax: [+44] (1438) 727601
e-mail: info@ifrinternational.co.uk

UNITED KINGDOM
Instruments & ATE Service
IFR Ltd
The Airport
Luton
Bedfordshire LU2 9NS
United Kingdom
Tel: [+44] (1582) 733866
Fax: [+44] (1582) 417573
e-mail: info@ifrinternational.co.uk

UNITED KINGDOM
Avionics Sales & Service
IFR Ltd
York House, School Lane
Chandlers Ford
Hampshire SO53 4DG
United Kingdom
Tel: [+44] (1703) 260411
Fax: [+44] (1703) 267234
e-mail: ifr.service@btinternet.com

USA
Instruments Sales & Service
IFR Americas, Inc.
10200 West York Street
Wichita
Kansas 67215-8999
USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
e-mail: info@ifrsys.com

VENEZUELA
Instruments Sales & Service
Marcoms De Venezuela C.A.
Edif Exagon, Piso 5, Of. 52D
Av Romulo Gallegos El Marques
Caracas 1070A
Venezuela
Tel: [+58] (2) 242 1110
Fax: [+58] (2) 242 0241
e-mail: marcoms@ven.net

VIETNAM
Instruments Sales & Service
East Asiatic Company Ltd A/S,
Ho Chi Minh City Representative Office
17 Ton Duc Thang Street, 2nd Floor
Ho Chi Minh City
Vietnam
Tel: [+84] (8) 8290499
Fax: [+84] (8) 8230014

VIETNAM
Instruments Sales
East Asiatic Company Ltd A/S
Hanoi Representative Office
27 Ly Thai To Street
Room 002 - 004
HANOI
Vietnam
Tel: [+84] (4) 826 0550
Fax: [+84] (4) 826 0266

ZIMBABWE
See South Africa



IFR Alphanumeric Product Index

1200 Super S 1.17
Communications Service Monitor

2023A 2.2
9 kHz to 1.2 GHz Signal Generator

2023B 2.6
9 kHz to 2.05 GHz Signal Generator

2025 ..... 2.6
9 kHz to 2.51 GHz Signal Generator

2026 ..... 2.8
10 kHz to 2.4 GHz MultiSource Signal Generator

2026Q 2.8
CDMA Interferer MultiSource Signal Generator

2030 series 2.15
10 kHz to 5.4 GHz Signal Generator

2040 series 2.20
10 kHz to 5.4 GHz Low Noise Signal Generator

2050 series 2.25
10 kHz to 5.4 GHz Digital and Vector Signal Generator

2050T 2.29
Digital and Vector Signal Generator for TETRA

2310 ..... 2.44
TETRA Signal Analyzer

2388 ..... 6.8
1 GHz Active Probe

2390A series 6.1
Spectrum Analyzers, 9 kHz to 26.5 GHz

2398 ..... 6.6
9 kHz to 2.7 GHz Spectrum Analyzer

2450/51 ..... 7.2
Counter Power Meters, 20 & 46 GHz

2840A 4.2
2 Mbit/s Transmission Analyzer

2841 ..... 4.2
Digital Communications Analyzer

2850B/BS & 2851/S 4.9
Digital Analyzers to 8 Mbit/s

2852/S & 2853/S 4.20
Digital Analyzers to 34 Mbit/s

2854S/2855S 4.24
Digital Analyzers to 140 Mbit/s

285X Remote Software 4.25
Special Systems

2935 and PhoneTest 1.43
GSM 900/1800/1900 Radio Test Solution

2945A 1.10
Communications Service Monitor

2946A 3.2
Avionics Communications Service Monitor

2948 ..... 1.16
Low Phase-Noise Communications Service Monitor

2959 ..... 1.47
Advanced Multi-Mode Cellular Test Set

2965A 1.22
100 kHz to 1 GHz Radio Test Set

2966A 1.29
100 kHz to 1 GHz Radio Test Set (GSM)

2967 ..... 1.36
GSM 900/1800/1900 Radio Test Set

2968 ..... 1.54
TETRA Radio Test Set

3002 ..... 2.39
VXI Signal Generator

423/424 Netlink 4.30
Network Transmission Quality Tester

430 Netlink 4.28
Digital Line Test Set

4200 series 8.3
Advanced Manufacturing Test Systems

4800 series 8.9
Automatic Optical Inspection Systems

5200 series 8.11
Power Manufacturing Defects Analyzers

5300 series 8.13
Combinational Board Testers

6146 ..... 5.27
Pulse Modulator

6148 ..... 5.29
Pulse Generator and Modulator

6200B series 5.7
RF and Microwave Test Sets

6210 ..... 5.12
Reflection Analyzer

6230A/L series 5.24
Detectors, Return Loss Bridges and Autotesters

6240 series 5.26
Fault Locators

6250 series 5.16
Millimeter Wave Reflectometer

6800 series 5.2
RF and Microwave System Analyzers

6960B 7.4
RF Power Meter

6970 ..... 7.7
Portable RF Power Meter

6910, 6920 & 6930 ..... 7.9
Power Sensors

ATC-600A 3.4
Portable Transponder/DME Ramp Test Set

ATC-601 ..... 3.12
Mode S/A/C Transponder Ramp Test Set

ATC-1400A 3.20
Transponder/DME Test Set

COM-120B 1.6
Communications Service Monitor

CPM 20, 46 ..... 7.2
Counter Power Meter

FM/AM-500A 1.20
Communications Service Monitor

FM/AM-1600S/CSA 1.50
Cellular Protocol Analyzer

GPS-101 ..... 3.2
GPS Satellite Simulator

I-1402 ..... 3.25
Mode 4 Accessory Unit

IFF-701 ..... 3.14
IFF Transponder Test Set

IFR-1900 CSA 1.2
UWC-136 Digital PCS Radio Test Set

NAV-402AP 3.8
MKR/NAV/COMM Ramp & Bench Test Set

NAV-750C 3.18
Avionics Signal Generator

RD-301A 3.6
Weather Radar Test Set

S-1403DL 3.27
Mode S Accessory Unit

SI-1404 ..... 3.29
TCAS-201 & TCAS Coupler

T-1401 ..... 3.23
TACAN Accessory Unit

TCAS-201 & TCAS Coupler 3.4
TCAS Ramp Test Set

TS-4317-X 1.61
Frequency Agile Communications Test Set

WRX 7708 & DF 7708 ..... 3.34
Weather Radar Test Set

IFR Alphabetical Index

A

Accessories, Signal Generator 2.43
Active Diagnostic Probe and Card 8.19
Active Probe, 2388 . . . . . 6.3, 6.8
ADF Testing 3.19, 3.37
ADSL 4.25
Advanced Manufacturing Test System 8.3
Advanced Multi-Mode Cellular Test Set 1.47
AF Power Meter 1.10, 1.22, 1.29
AM/FM Radio Test Sets 1.22, 1.29
AM/FM Signal Generators 2.1
Amplitude Modulation - Generation . . 1.29, 2.15
Amplitude Modulation - Measurement 1.22, 1.29
AMPS Radio Test Sets . . . . . 1.10, 1.17 . . . . . 1.22, 1.29
Analog Channel Measurements 4.3
Analog In-Circuit Test (AIC) Facility 8.14
Analog Sampling Card 8.20
Analyzers, Digital 4.2, 4.8, 4.18, 4.22
Analyzers, Digital Communications 4.2, 4.8, 4.18, 4.22
Analyzers, Digital Transmission . . 4.8, 4.18, 4.22
Analyzers, Network - see Microwave Test Sets 5.2, 5.7
Analyzers, Reflection 5.12
Analyzers, Signal 2.44
Analyzers, Spectrum 6.1
AOI (Automatic Optical Inspection) 8.9
ASELP Vocoder 1.2
ATE (Automatic Test Equipment) . . . . . 8.1 - 8.32
ATE Data Analysis 9.2
ATE Fixtures 8.29
ATE Programs 8.29
ATE Software
- *i*-Base 9.2
- ISDN 8.24
- Programs and Fixtures 8.29
- Q-TEST 8.5
ATE Support Services 8.28
ATLAS 9.7
Audio Analysis, FFT 1.11
Audio Power Meters 1.10, 1.22
Automated Calibration System 9.11
Automatic Direction Finder Testing 3.18
Automatic Optical Inspection Systems 8.9
Automatic Test Equipment . . . . . 8.1 - 8.32
Autotesters (Return Loss Bridges) 5.24
Avionics Communications Service Monitor . . 3.36
Avionics Signal Generator 3.18

B

Band III (MPT 1327) Radio Test Set . . 1.10, 1.22
Bit Error Rate Test . . . . . 1.36, 1.43, 4.2 . . . . . 4.8, 4.18, 4.22
Bit Slip Detection 4.3, 4.5
Boundary Scan Testing . . . . . 8.8, 8.11 . . . . . 8.13, 8.17, 8.33
Bulk Call Generator - MPT 1327 . . . . . 9.13

C

CAD Conversion Software 8.27
Calibration Service 9.8
Calibration Systems 9.11
CAPG 8.7
CDMA Interferer MultiSource Generator 2.12
CDPD Modem Testing 1.48
Cellular Base Station Test Software . . . . . 1.2 . . . . . 1.6, 1.50
Cellular Protocol Analyzer 1.50
Cellular Radio Test Sets 1.1, 1.36, 1.43
Channel Associated Signaling . . . . 4.3, 4.4, 4.6, ... 4.10, 4.15, 4.18, 4.22
Combinational Board Testers
- 5300 series 8.13
- Active Diagnostic Probe 8.19
- Analog In-Circuit Test Facility 8.14
- Analog Sampling Card 8.20
- Boundary Scan Card 8.17
- Digital Functional 8.17
- Digital Multimeter 8.21
- Digital Test System 8.17
- Dual Voltage Source 8.19
- General Purpose Relay Card 8.23
- General Purpose Signal Routing Card . . 8.22
- Logic Analyzer 8.18
- Matrix Switch Card 8.25
- MIL-STD-1553 Bus 8.27
- Protocol Emulation Card 8.26
- Telephone Test Suite 8.23
- ISDN Test Suite 8.24
- ISDNU-2B1Q Interface Card 8.25
- Universal Counter Timer 8.22
- Universal In-Circuit Test Facility 8.15
- Waveform Synthesizer 8.20
ComLink 4.28
Communications Analyzer, Digital . . . . . 4.2, 4.8 . . . . . 4.18, 4.22
Communications Test Sets, Radio, Service Monitor 1.1
Computer Aided Program Generation (CAPG) . 8.7
Computer Aided Repair 9.3
Counter Power Meter 7.2
CPM 7.2
Customized Applications and Systems Group . 9.1

D

D-AMPS Radio Test Set 1.2, 1.47, 1.50
Data Interface Testing 4.2, 4.8, 4.18, 4.22
DCS . . . . . 1.7, 1.14, 1.16 . . . . . 1.26, 1.34, 1.41, 1.59
DECT Filter 2.43
Defense Test Solution 1.61
Demultiplex Monitoring . . . . . 4.19, 4.20 . . . . . 4.23, 4.24
Detectors, Microwave Test Set 5.24
Digital Analyzers . . . . . 4.8, 4.18 . . . . . 4.22, 4.2
Digital Cellular Test Set 1.43
Digital Communications Analyzer . . . . . 4.2, 4.8, ... 4.18, 4.22
Digital Functional 8.17
Digital Line Test Set - Netlink 430 . . . . . 4.31
Digital Multimeter 8.21
Digital PCS Radio Test 1.36, 1.43
Digital Power Meter 7.4
Digital Test System 8.17
Digital Transmission Analyzer . . . 4.8, 4.18, 4.22
Digital Vector Modulation 2.25, 2.29
Digital and Vector Signal Generator 2.25
Digital and Vector Signal Generator for TETRA 2.29
Distance to Fault Measurement 5.9
Distortion Measurement 1.10, 1.22, 1.29
DME Avionics 3.37
DME Bench/Ramp 3.10, 3.20
DME Test Set/Portable Transponder 3.20
DQPSK 1.3
xDSL Loop Prequalification 4.31
DTMF Signaling 4.10, 4.15
Dual Voltage Source 8.19

E

EDACS 1.6, 1.10, 1.11
Electronic Attenuator . . . . . 2.17, 2.22 . . . . . 2.25, 2.26, 2.29
EMC Signal Generator 1.15, 2.2
EMC Testing 9.10
E-TACS Radio Test Set 1.6, 1.10, 1.11

F

FABmaster 8.27
Fading 2.26, 2.28
Fast Pulse Modulator 2.3
Fault Location Head 5.26
Fault Locators 5.26
FFT - Audio Analysis . . . . . 1.22, 1.29 . . . . . 1.36, 1.54
Fixtures 8.29
Flight ID Test 3.13, 3.18
Frequency Agile Communications Test Set . . 1.61

Frequency Modulation - Generation 1.1, 2.1, 2.15, 3.39
Frequency Modulation - Measurement 1.10, 1.22, 1.29
FSK Modulation . . . . . 1.3, 1.70, 2.2, 2.8, 2.12 . . . . . 2.15, 2.20, 2.25, 2.30, 2.39
Functional Cluster Testing 8.4
Functional In-Circuit Test Mode 8.16

G

G.821 Measurements . . . . . 4.2, 4.5, 4.9 . . . . . 4.14, 4.18, 4.22
G.826 Measurements . . . . . 4.2, 4.5, 4.9 . . . . . 4.14, 4.18, 4.22
G.921 Measurements . . . 4.9, 4.14, 4.18, 4.22
G.962 Measurements . . . 4.9, 4.12, 4.18, 4.22
Gain Compression Application 5.22
GPIO Card 8.6
GPS 3.2
General Purpose Relay Card 8.23
General Purpose Signal Routing Card 8.22
GMSK Modulation - Generation . . . . . 1.29, 1.36 . . . . . 1.43, 2.15, 2.25, 2.33
GMSK Demodulation 1.29, 1.36, 1.43
GPIO Card 8.6
GPS Satellite Simulator 3.2
GSM PCN Modulation 2.17
GSM Testing . . . . . 1.24, 1.28, 1.29 . . . . . 1.36, 1.43, 1.54
Guided Measurements Application 5.20

H

HDSL 4.25
High Impedance Probe 6.8

I

i-Base Information Management System 9.2
ICT Plus 8.3
IFF (Identification Friend or Foe) - Bench/Ramp 3.14, 3.25, 3.29
IFF Transponder Test Set 3.14
ILS - Bench/Ramp 3.18, 3.36
ILS Monitor Testing 3.36
ILS Monitor Software 3.39
ILS Testing 3.36
In-Circuit Testing 8.3, 8.13
Information Management 9.2
Instrumentation Access Card 8.8
Intermodulation Testing 2.8
Internal Pulse Generator 2.37
IS-95/97A, 98 . . . . . 1.47, 2.12
IS 136 . . . . . 1.47
ISDN 4.25
ISDNU-2B1Q Interface Card 8.25
ISDN Test Suite 8.24
ISO 10012 Calibration (Features and Facilities) 9.8
IQ . . . . . 1.2, 1.29, 1.36, 1.47 . . . . . 1.50, 1.54, 2.25, 2.29

J

JDC Testing 1.25

L

LabWindows Drivers 1.43, 2.39
Logic Analyzer 8.18
Low Noise Signal Generators 2.20
Low Phase Noise Service Monitor 1.16
LTR Testing 1.6

M

M.2100 Measurements . . . . . 4.2, 4.5, 4.9 . . . . . 4.14, 4.18, 4.22
Manufacturing Defects Analyzer 8.11
Marker Beacons 3.18
Matrix Switch Card 8.25
MDA 8.11
Memory Card - PC Utilities 5.18
MIAMI 4.27
Microwave Accessories 5.31, 5.32
Microwave Power Meters 7.1
Microwave Power Sensors 7.9
Microwave System Analyzer 5.2
Microwave Test . . . . . 5.1 - 5.32
Microwave Test Set 5.7
MIL-STD-1553 Testing 8.27
Millimetric Wave Measurements 5.16
Millimeter Wave Reflectometer 5.16
Millimetric Network Analyzers 7.9
MIPlot Measurement Presentation Software . 2.46
MKR/NAV/COMM Ramp and Bench Test Set . . 3.8
MK12/Mode S IFF Accessory Unit 3.29
Mobile Radio Test Set 1.10, 1.22
Mode 4 Accessory Unit 3.25
Mode 4 - Bench/Ramp 3.14, 3.25, 3.29
Mode S Accessory Unit 3.27
Mode S - Bench/Ramp . . . . . 3.12, 3.14 . . . . . 3.27, 3.29
Mode S/A/C Transponder Ramp Test Set . . . 3.12
Monitoring Equipment, Data 4.2
Monitoring Equipment, Digital Transmission . . 4.2
MPT 1327 Testing 1.10, 1.29, 9.13
Multi-Mode Testing 1.47
MultiSource Signal Generator 2.8

N

NADC 2.25
NAMAS Calibration 9.8
N-AMPS Radio Test Sets . . 1.2, 1.47, 1.50, 1.61
Netlink 423/424 . . . . . 4.29
Netlink 430 . . . . . 4.31
Network Analyzers 5.2, 5.7, 5.12
Network Transmission Quality Testers 4.29
NMT Radio Test Set . . . . . 1.10, 1.22 . . . . . 1.29, 1.36

O

Octet Slip Detection . . . . . 4.3, 4.5 . . . . . 4.10, 4.14
Optical Inspection 8.9

P

π/4 DQPSK Modulation Generation 2.25
Paging/Pager Test Sets . . . . . 1.6, 1.10 . . . . . 1.17, 1.20
PCM Testing . . . . . 4.8 - 4.22
PCN/PCS Testing . . . . . 1.2, 1.36, 1.43 . . . . . 1.51, 2.12, 2.15, 2.33
PDC 2.25, 2.29
PhoneTest 1.29, 1.36, 1.43
PHP 2.25
PMR Test . . . . . 1.10, 1.22 . . . . . 1.29, 1.36, 1.54
POCSAG Decode . . . . . 1.10, 1.22 . . . . . 1.29, 1.36, 1.54
POCSAG Encode . . . . . 1.10, 1.22 . . . . . 1.29, 1.36, 1.54
Portable Power Meters . . . . . 7.1, 7.2 - 7.7
Portable Transponder/DME Test Set 3.10
Power Manufacturing Defects Analyzer 8.11
Power Meters . . . . . 7.1 - 7.7
Power Meter, AF . . . . . 1.10, 1.16, 1.22 . . . . . 1.29, 1.36, 1.47, 1.54
Power Meter, Handheld 7.7
Power Meters, RF and Microwave . . . . . 7.4 - 7.8
Power Sensors 7.9
Power Sensor Calibration System 9.11
Power Splitters and Dividers 5.31, 5.32
Probe, Active 6.3, 6.8
Production Test Services 8.29
Programs, Test 8.29
Propagation Delay Measurement . . 4.3, 4.5, 4.6 . . . . . 4.10, 4.15, 4.18, 4.22
Protocol Analyzer 1.2
Protocol Emulation Card 8.26
Pulse Generator and Modulator 5.27, 5.29
Pulse Modulation . . . . . 2.2 - 2.29

Q

QAM 2.25
Q Test II 8.5, 8.30

R

Rack Mounting Kits 2.43
Radar, Weather 3.3, 3.34

Radio Communications Avionics Test Instruments 3.18, 3.36
Radio Communications Test Instruments . . . 1.10 . . . . . 1.22, 1.29, 1.36, 1.54
Radio Personality Modules (RPMs) 1.63
Radio Test Sets . . . . . 1.1 - 1.72
Radio Test Set - AMPS, N-AMPS, D-AMPS . . . . . 1.2, 1.10, 1.17, 1.22 . . . . . 1.29, 1.47, 1.50, 1.61
Radio Test Set - Cellular 1.1
Radio Test Set - E-TACS, N-TACS, J-TACS 1.10, 1.29
Radio Test Set - NMT 450/900 NMT-F 1.1
Rayleigh Fading 2.25
Reflection Analyzer 5.12
Remote Applications Software 4.10
Remote Network Monitoring 4.27
Return Loss Bridges 5.24
RF & Microwave System Analyzers 5.2
RF and Microwave Test Sets 5.7
RF Profiles and Complex Sweep. 2.17, 2.35
RF Power Meters. 7.5, 7.7
RF Power Meter, Portable 7.7
RF Power Sensors 7.9
RF Profile and Complex Sweep. 2.35
Rician Fading 2.25

S

Scalar Analyzers 5.2
Scalar Detectors 5.24
SELCAL 3.18
Selective Calling Tone Generators . . . . . 2.15 - 2.33, 3.18
Selectivity Testing. 2.8
Sensor Calibration 9.12
Sensors for Power Meters 7.9
Service. 9.8
Signal Analyzer - TETRA 1.54, 2.44
Signal Generators . . . . . 2.1 - 2.43
Signal Generator - Accessories. 2.43
Signal Generator - Avionics 2.15, 3.18
- Digital Modulation 2.25
- EMC Testing 2.2, 9.10
- RF . . . . . 2.1 - 2.43
- Vector Modulation 2.25
- VXI. 2.39
SINAD Measurement . . . . . 2.2 - 2.6
Software
- ATE 9.2
- Instruments. 4.27
Software Programming System, Atlas 9.7
Software Programming System, TPG 9.6
Software - Radio Testing 9.6
Software - Remote Monitoring 4.27
Software - Test Area Management 9.2
Solutions (Turnkey Systems) 9.14
Spectrum Analyzers . . . . . 6.1 - 6.8
Squitter Test 3.13
SSB Testing 1.10, 3.36
Support - ATE 8.28, 8.29
Systems . . . . . 9.1 - 9.16

T

TACAN 3.23
TCAS 3.4
TACAN Accessory Unit. 3.23
TACS Cellular Radio Test Set . . 1.10, 1.16, 1.22 . . . . . 1.29, 1.36, 1.54
TCAS Coupler 3.5
TCAS Ramp Test Set. 3.4
Telecommunications Test Instruments . 4.1 - 4.31
Telephone Test Suite 8.23
Telephone Test Systems
Netlink 423/424 . . . . . 4.29
TEM Test Cell 2.42
Test Fixtures 8.28, 8.29
Test Heads - Distance to Fault 5.26
Test Programming 8.29
Test Systems. 9.1
TETRA Radio Test Set 1.54
TETRA Signal Analyzer. 2.44
TETRA Signal Generator 2.29
TETRA Testing. 1.54, 2.29, 2.44
TIA/EIA-553A Protocol Compliance Testing . . 1.50
TIA/EIA-136 Handoff Test Capability 1.50
TIA/EIA-136 Hyperband Handoff 1.2
TPG Software Programming 9.6
Transmission Analyzer, 2 Mbit/s 4.2
Transponder - Bench/Ramp . . . 3.10, 3.12, 3.20
TruView 8.16
Two/Three Tone Testing 2.28
Turnkey Systems 9.14

U

Universal Counter Timer 8.22
Universal In-Circuit Test Facility. 8.15
UWC-136 Digital PCS Radio Test Set 1.2

V

VCO Characterization 5.8
Vectorless Test 8.5
Vector Modulation 2.25
Vision Inspection Tools 8.10
VOR - Bench/Ramp. 3.8, 3.18, 3.36
VOR Testing 3.18, 3.36
VSELP Vocoder 1.2
VXI Signal Generator. 2.39

W

Wattmeters, RF and Microwave 7.4
Waveform Synthesizer. 8.20
Weather Radar Test Set 3.34, 3.6
Whisper Shout Monitor 3.4
Wideband FM, Generator 2.15, 2.20, 2.25
Wireless Test 1.1-1.72
Workshop Management Software 1.44

Wireless - Radio Test Sets

Since we introduced the industry's first test set in 1984, IFR has continued to focus on offering a wide selection of test sets for the Cellular, Professional Mobile Radio and Specialized Mobile Radio systems.

With solutions for analog systems and digital protocols including GSM and IS-136A, IFR offers a complete line of test solutions for the cellular industry, including our new 2935 with a complete service workshop logistics software solution.

IFR also provides industry exclusive solutions for the PMR and SMR markets with comprehensive test systems for TETRA, EDACS, LTR™ and other radio applications.

From fast and easy testing to detailed protocol analysis, IFR gives you the radio test solutions you need.

WIRELESS - RADIO TEST SETS

IFR-1900 CSA 1.2
UWC-136 Digital PCS Radio Test Set

COM-120B 1.6
Communications Service Monitor

2945A 1.10
Communications Service Monitor

2948 1.16
Low Phase-Noise Communications Service Monitor

1200 Super S 1.17
Communications Service Monitor

FM/AM-500A 1.20
Communications Service Monitor

2965A 1.22
100 kHz to 1 GHz Radio Test Set

2966A 1.29
100 kHz to 1 GHz Radio Test Set

2967 1.36
GSM 900/1800/1900 Radio Test Set

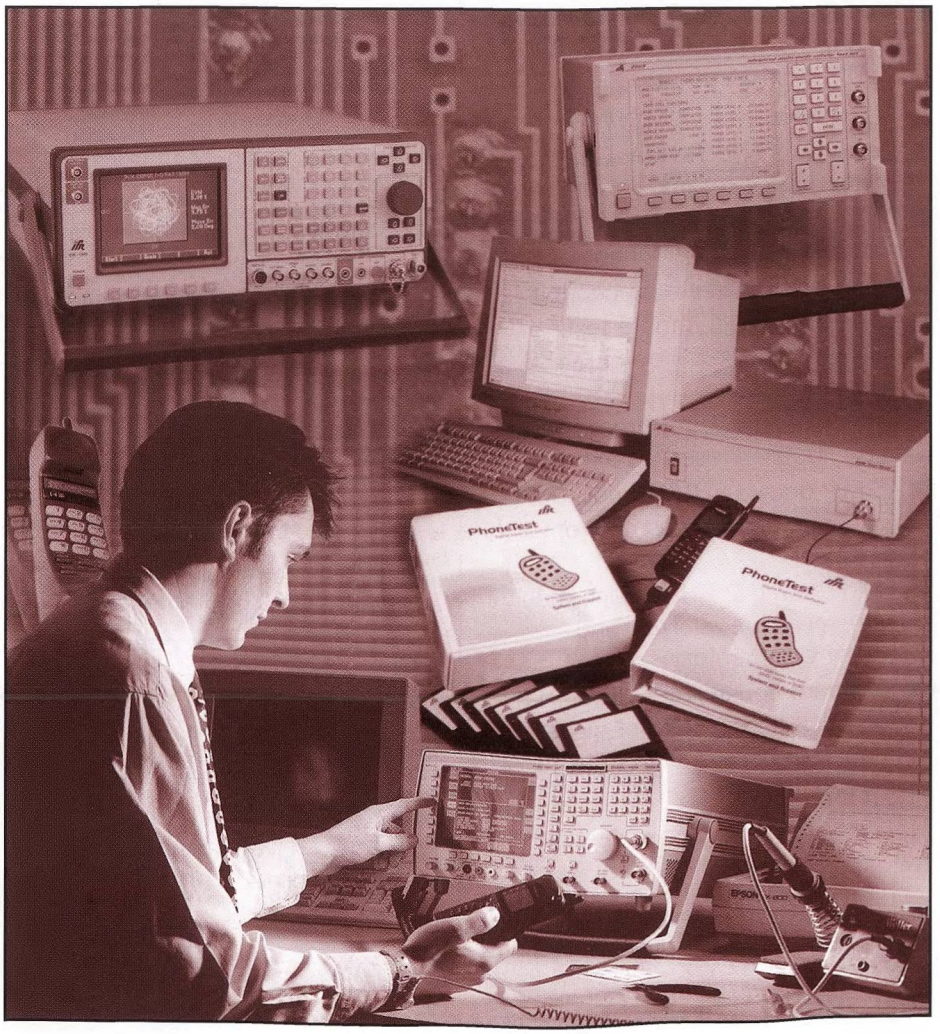
PhoneTest and the 2935 1.43
GSM 900/1800/1900 Radio Test Solution

2959 1.47
Advanced Multi-Mode Cellular Test Set

FM/AM-1600S/CSA 1.50
Cellular Protocol Analyzer

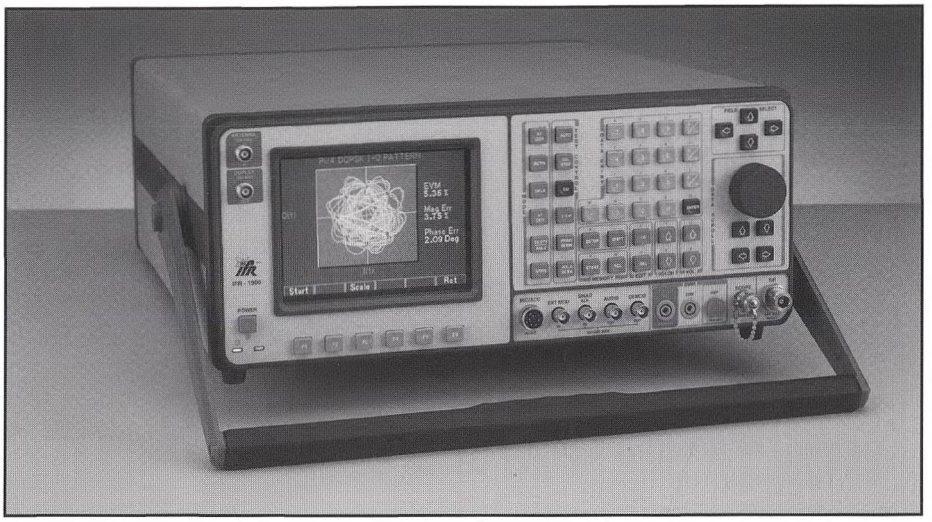
2968 1.54
TETRA Radio Test Set

TS-4317-X 1.61
Frequency Agile Communications Test Set



IFR-1900 CSA
UWC-136 Digital PCS Radio Test Set

Engineered for maximum performance, the IFR-1900 CSA is an all in one PCS solution for today's dual band/dual mode mobile and base station equipment



- The industry accepted simulator for TIA/EIA-136 conformance testing
- Tri-Band, 400/800 MHz and 1900 MHz PCS test capable
- Comprehensive TIA/EIA-136 conformance testing
- Analog and digital authentication compliance testing option
- TIA/EIA-136 hyperband handoff
- Fully automated remote testing ability with RS-232 or IEEE-488 (GPIB) interfaces
- Intuitive test set up screens for easy "Guided" user testing
- VSELP and ACELP vocoder functions allow verification of voice quality
- Full featured 2 GHz service monitor with spectrum analyzer and tracking generator
- Standard constellation IQ display for quick assessment of digital mobile or base station transmitter modulation

Fully Featured TIA/EIA-136 (TDMA) Test Solution

The IFR-1900 CSA provides you with the industry's only accepted test solution for TIA/EIA-136 analysis, including critical adjacent power measurements and power measurements down to -40 dBm, which allows the user to test the base station without taking it off-line.

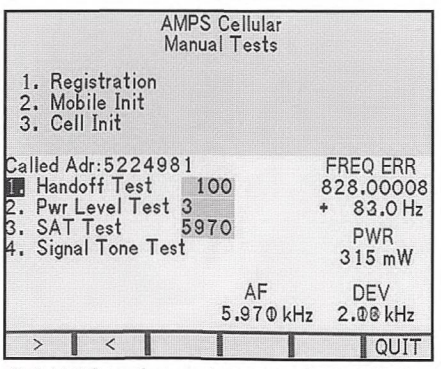
It is capable of performing the critical dual-mode analog/digital authentication and protocol compliance tests for TIA/EIA-136 dual mode mobiles.

As for flexibility, the IFR-1900 CSA provides the capability to perform both mobile and base station conformance testing. And with the VSELP and ACELP vocoder technology as standard features, the IFR-1900 CSA can handle today's latest technology.

The IFR-1900 CSA comes with a wide array of application software options. The AC1036 Protocol Conformance Test Software provides an excellent way to verify software conformance of TIA/EIA-136 mobiles. Other applications software supports automated tests for the most widely used base station applications.

AMPS Solutions

Engineered to be a true dual-mode test solution, the IFR-1900 CSA also incorporates AMPS and NAMPS mobile and base station compliance test features.



Full AMPS testing modes are available with the IFR-1900 CSA

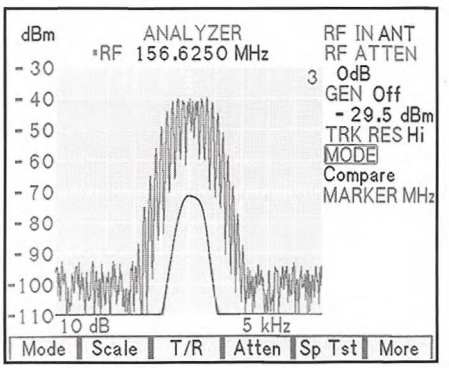
Automatic test routines and user defined print outs enhance manual mode testing for both mobiles and base stations.

Open control channel simulations, voice channel signaling, home/roam condition, home SID, SAT, DSAT, DST, DCC, SINAD reference points, RF power windows, and other AMPS/NAMPS functions and signaling routines allow complete AMPS and NAMPS system testing.

A Full Complement of Service Monitor Functions to 2 GHz.

The IFR-1900 CSA gives you full frequency domain analysis to 2 GHz with a fully featured spectrum analyzer and tracking generator built-in.

The IFR-1900 CSA also offers a full complement of standard service monitor features including a full span digitized oscilloscope to 1 MHz, DVM and SINAD functions, frequency and channel tables, selectable IF filters, and a wide variety of displays.



The IFR-1900 CSA gives you full featured service monitor functions

http://www.ifrinternational.com

In addition to the 2 GHz RF generator, the IFR-1900 CSA also provides full audio/data generator capabilities, full level control and measurement facilities and precision power control features for enhanced sensitivity and high accuracy testing needs.

Analog paging encoding/decoding, DTMF, tone coded squelch, digital squelch, AM modulation/demodulation along with two separate AF generators and cross band duplex gives added test versatility in a variety of wireless systems.

Software Options Make Complex Testing Simple

As with every IFR test set, you get the advantage of IFR applications engineering support.

Our comprehensive portfolio of application software options are designed to automate and expand the functionality of your instrument.

Plus, on-going software support means that you can easily upgrade your IFR-1900 CSA when test and service requirements change.

AC1009W - EasySpan™ is a Windows-based software utility which extracts spectrum analyzer and tracking generator traces from the IFR-1900 CSA.

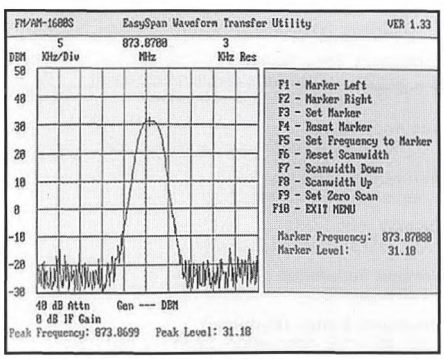
AC1017 - AutoCell-Series II is a comprehensive program for FCC compliance testing of Lucent Series II cell sites.

AC1019 - EasySweep™ is a swept measurement utility designed to test antennas and transmission lines.

AC1020D - AutoCell NTD provides automated testing of Northern Telecom cell sites.

AC1021 - CellScan™ cellular utility software simplifies combiner alignment, monitoring RF levels and base stations on DAMPS, NT400 or PCS cellular channel sets.

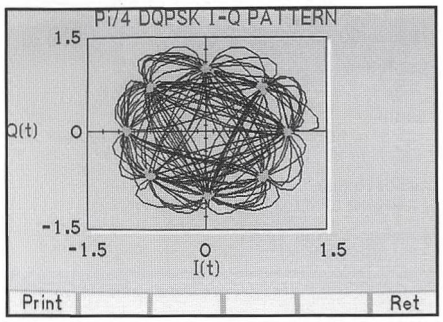
AC1027 - AutoCell-882/884 is an autotest program for performing acceptance tests on Ericsson 884/882/882D/882M/882DM base stations.



EasySpan Software

Dynamic IQ Constellation Display Simplifies Analysis

The IFR-1900 CSA provides you with a dynamic constellation display for precise RF modulation analysis of DQPSK digitally modulated waveforms from 10 MHz to 2010 MHz. This unique IFR-1900 CSA feature gives a near real time display for testing and troubleshooting, an ability that points out the cause of the trouble in digital radios.



IQ Constellation display allows for comprehensive digital modulation testing

Complex Functionality Made Easy

Even with its elaborate capabilities, the IFR-1900 CSA was developed to execute complex tests simply and with minimal operator training.

Using field-proven front panel and user man-machine interfaces, the IFR-1900 CSA gives you the performance and ease-of-use features that reduces your testing and training time.

Its test macro command programming language (TMAC) can be easily configured to perform automatic base station testing and remote terminal, single and multi-mode, single and multiband equipment. This powerful capability allows you to create and save simple "one button" test routines for future use. This flexibility means you can create and execute complex and repeatable routines no matter what your level of expertise.

A new color VGA display gives IFR-1900 CSA users vivid screen clarity. Extensive use of softkeys reduces your complex cellular / PCS parametric and protocol tests to fast, simple and manageable routines.

Specification

RF Signal Generator

(T/R) AND DUPLEX CONNECTOR

Frequency Range
10 MHz to 2010 MHz

Resolution
100 Hz

Accuracy
Same as Master Oscillator

Range
-127 dBm to + 10 dBm into 50 Ω
(T/R Connector: -30 dBm maximum with reverse power present)

Resolution
0.1 dB

Accuracy
± 1.5 dB (≥-110 dBm)

Duplex Connector Input Protection
Alarm sounds when level exceeds +20 dBm.

Modulation

EXTERNAL

Generator IF Output Frequency Range
88 MHz to 90 MHz

Level Range
-30 dBm to +25 dBm into 50 Ω

Residual FM
<10 Hz RMS

SSB Phase Noise
<-94 dBc/Hz (20 kHz Offset)

Residual AM
<0.3% RMS (50 Hz to 15 kHz BW)

Non-Harmonics
<-50 dBc

Nominal Input Frequency for Generator IF In
90 MHz

Input Level
-26 dBm to +28 dBm into 50 Ω

Signal Bandwidth
8.5 MHz

System Gain
28 dB ± 7dB, from GEN IF Input to T/R Ports

INTERNAL FM

Range
Off and ±100 Hz to ±100 kHz Dev.

Accuracy
± 5% (1 kHz to 20 kHz Dev, 1 kHz rate)
± 10% (1 kHz Dev and >20 kHz Dev, 1 kHz rate)

Resolution
100 Hz

Modulation Rate
1 kHz to 10 kHz - 5% accuracy

Waveforms
Sine, Square, Triangle

INTERNAL PHASE/QUADRATURE (IQ)

RF Ranges
10 MHz to 2010 MHz

IQ Error Vector Magnitude
5% from ideal DQPSK waveform (TIA/EIA-136)

IQ Origin Offset
<-30 dBc

AF Signal Generators

AF Generators #1 and #2

Range
10 Hz to 40 kHz

Resolution
0.1 Hz ≤2 kHz
1 Hz >2 kHz

Accuracy
±0.1%

Waveshapes
Sinewave, Square, Triangle, Ramp, Pulse

Audio Frequency Counter

Frequency Range
10 Hz to 200 kHz (in 4 decade ranges)

Accuracy
Same as Master Oscillator

Resolution
0.1 Hz (10 Hz to 2 kHz)
1 Hz (>2 kHz to 20 kHz)
10 Hz (>20 kHz to 40 kHz)

Input Waveform
Sine or Square

External Level
0.5 VRMS to 30 VRMS (SINAD/BER input)
0.1 VRMS to 3.5 VRMS (EXT MOD input)

IFR-1900 CSA

RF Counter

Frequency Range
10 MHz to 2010 MHz

Accuracy
Same as Master Oscillator

Resolution
1 Hz (fc <20 MHz)
10 Hz (fc >20 MHz)

Minimum Level
-60 dBm (ANT connector)

RF Frequency Error Meter

Frequency Digital Meter Range
0 Hz to ±150 kHz

Bar Graph Meter Range
0 to ±100 kHz (in 4 decade ranges)

Accuracy
Same as Master Oscillator ± LSD

Resolution
1 Hz (±1 Hz to ±10 kHz)
10 Hz (>±10 kHz to ±150 kHz)

Minimum Level
-60 dBm (ANT Input Port)

RF Power Meter

Frequency Range
100 MHz to 2010 MHz

Input Level
0.05 mW to 50 W RMS (<900 MHz, 1–2–5 sequence, 4 decade)
0.05 mW to 10 W RMS (>900 MHz, 1–2–5 sequence, 4 decade)

Resolution
1 %

Accuracy
±6% (>5 W and <50 W, at Typical Operational Ambient Temperature)

LOW LEVEL POWER METER

Frequency Range
Same as standard RF power meter

Input level
-40 dBm to -10 dBm

Accuracy
12% typical

Receiver

Frequency Range
10 MHz to 2010 MHz

Sensitivity
<-80 for 10 dB SINAD
(1 kHz rate, 6 kHz Dev, FM 2, ANT Input Port)

Demodulation Output Level
(FM): 5 Vp-p ±15 % (at full scale into 600 Ω)
(PM): 40 mVRMS ±15 % (5 Rad, into 600 Ω)
(AM): 1 VRMS ±15 % (80 % modulation, into 600 Ω)
(SSB): 1.15 VRMS ±15 % (Beat tone, into 600 Ω)

Receive IF Output Signal Frequency
88 MHz to 90 MHz

IF Bandwidth
8.5 MHz

FM Deviation Meter

Deviation Range
±100 Hz to ±100 kHz

Resolution
100 Hz (20 kHz ranges)
1 kHz (>20 kHz ranges)

Accuracy
±5 % ±2 counts + source residual FM
(300 kHz IF, <15 kHz rate)

Modulation Rate
100 Hz to 40 kHz

Carrier Range
100 MHz to 2010 MHz

Minimum Carrier Level
-60 dBm (ANT Input Port)

PM Deviation Meter

Deviation Range
0 Rad to 10 Rad (Peak)

Resolution
0.01 Rad (deviation ≤5 Rad)
0.1 Rad (deviation >5 Rad)

Carrier Range
100 MHz to 2010 MHz

Minimum Carrier Level
-60 dBm (ANT Input Port)

AM Modulation Meter

Modulation Range
1 % to 90 %

Resolution
1 %

Accuracy
±5 % of full scale ±1 count + source residual AM (30 % to 90 %)

Carrier Range
100 MHz to 2010 MHz

Minimum Carrier Level
-60 dBm (ANT Input Port)

Distortion Meter

Distortion Range
0.1 % to 20 %

Resolution
0.1 %

Accuracy
±0.5 % distortion ±1 count (1 % to 10 %)
±2 % distortion ±1 count (>10 %)

Signal Frequency
700 Hz to 1.4 kHz

Signal Level
0.1 VRMS to 30 VRMS (SINAD/BER input)

Error Vector Magnitude (EVM) Meter

Input Range
NT 400 Channels
Cellular 800 MHz Channels
PCS 1900 MHz Channels

Minimum Carrier Level
-60 dBm (ANT connector)

EVM Range
0 to 100 %

EVM Resolution
0.01 %

Meter Residual EVM
<2 % indication

Accuracy
± 3.0% indication, ± 1 LSD + meter residual EVM

SINAD Meter

Range
3 dB to 30 dB

Resolution
0.1 dB

Accuracy
±1 dB ±1 count (at 12 dB SINAD)

Signal Frequency
700 Hz to 1.4 kHz

Signal Level
0.1 VRMS to 30 VRMS (SINAD/BER input)

Digital Multimeter

VOLTMETER (DC/AC)

Ranges
200 mV to 200 V (full scale, decade sequence, 150 Ω, 600 Ω, 1 MΩ selectable)

Maximum Input
1000 VDC
500 VAC

Resolution
3.5 digit (maximum resolution 0.1 mV on 200 mV range)

Accuracy
±5% of full scale ± 1 count (AC, where ACV*kHz < 140)
±1% of full scale ± 1 count (DC)

Frequency
DC, 50 Hz to 20 kHz

Input Impedance
1 MΩ (±5%)
150 Ω (±5%)
600 Ω (±5%)

OHMMETER

Ranges
200 Ω to 20 MΩ (full scale, decade sequence)

Resolution
3.5 digit (maximum resolution 0.1 on 200 range)

Accuracy
±5% or 0.1 (±1 count)

CURRENT METER (DC/AC)

Ranges
20 mA to 2 A (full scale, decade sequence, 20 A maximum when using external shunt)

Resolution
3.5 digit (maximum resolution 0.01 mA on 20 mA range)

Accuracy
±5 % or 0.1 mA ±1 count

Oscilloscope

Vertical BW
1 MHz (-3 dB)

Input Ranges
1 mV / Div to 50 V / Div (1-2-5 sequence, 8 divisions)

Max Input Vertical
200 V Peak

Accuracy Vertical
±5% of full scale
±10% of full scale (1 mV and 2 mV ranges)

Resolution Vertical
Full Scale / 256

Coupling Vertical
AC, DC, GND

Horizontal Sweep Rate
1 μSec / Div to 100 msec / Div (1-2-5 sequence, 10 divisions)

Accuracy Horizontal
±1 % of Full Scale

Resolution Horizontal
Full Scale / 400

External Input Impedance Horizontal
1 MΩ (shunted by 27 pF nominal)

Internal Signal Routing
425 kHz IF
Demod Audio
Function Generator
SINAD/BER
RF Power
EXT MOD

Spectrum Analyzer

Range
10 MHz to 2010 MHz

Frequency Span Range
1 kHz/Div to 100 MHz/Div plus Zero Scan (10 divisions in a 1-2-5 sequence)

Accuracy
±5% of Span Width

Reference Accuracy
See Master Oscillator

Display
Log, 10 dB/Div and 2 dB/Div

Vertical Resolution
Full Scale/256

Displayed Range (Dynamic)
60 dB (0 dB Attenuation, Span <1 MHz/Div)

Bandwidth Switching Error
<2 dB (5 kHz/Div thru 1 MHz/Div)
<3 dB (<5 kHz/Div or >1 MHz/Div)

Overall Accuracy
± 4 dB (10 MHz to 400 MHz) (normalized)
± 5 dB (>400 MHz to 2010 MHz) (normalized)
± 2 dB Log Linearity

Input Attenuator
0 dB, 20 dB, 40 dB (User selectable, ANT Input Port)
40 dB, 60 dB, 80 dB, (User selectable Pwr <2 W, T/R Port)
60 dB, 80 dB, l00 dB, (User selectable, Pwr >2 W, T/R Port)

Bit Error Meter (BER)

Range
$1x10^{-1}$ to $1x10^{-5}$

Data Rates
75, 150, 300, 600, 1200, 2400, 4800 bps & 16 kbps

Data Pattern Size
100 to 100,000 bits

Data Pattern Type
Random, Fixed and User Defined

Input/Output (I/O)

IEEE 488.1-1987 Internally Assigned GPIB Addresses
System Control Processor (GPIB Address=4)
TDMA Control Processor (GPIB Address=5)

RS-232 (Asynchronous) SCSI-1 External Video Port Operation Mode
VGA Compliant

Frequency Reference Ports
BNC Input for External 10 MHz Sync
BNC Output of Internal 10 MHz Sync

Dedicated Printer Port
25-Pin D-Sub, Centronics Compatible

IQ Output Interface
BNC Connector

TDMA Timeslot Sync
BNC Connector

Master Oscillator

Frequency Standard
10 MHz (Nominal)

Temp Stability
±0.01 ppm (0 to 50°C)

General Characteristics

Dimensions
188 mm (7.4 in) H, 478 mm (18.8 in) W, 635 mm (25 in) D (with bail handle and front panel cover in place)

Weight
Less than 21.8 kg (48 lb)

Operating Temperature Range
0 to 50°C

POWER REQUIREMENTS

Line
105 - 130 to 210 - 260 VAC
50 to 60 Hz @ 200 W Maximum

DISPLAY

Type
Color, Active Matrix LCD

Size
96 mm (3.8 in) wide, 86 mm (3.4 in) high

Resolution
640 pixel x 480 pixels.

Versions & Accessories

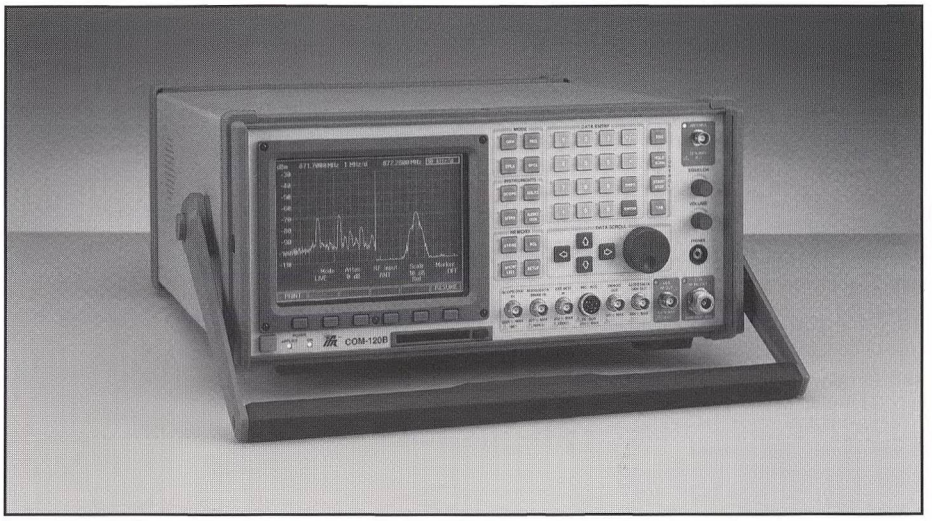
When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
1900	IFR-1900 CSA Service Monitor
1900-C	IFR-1900 CSA Service Monitor with Certificate of Calibration
	Accessories
AC510	Paging Encoder for Flex, GSC and NEC D3
AC1009W	EasySpan for Windows (Waveform Transfer)
AC1017	AutoCell-Series II (Lucent Series II)
AC1019	EasySweep (Swept Antenna Measurements)
AC1020D	AutoCell-NTD (Northern Telecom Cell Sites)
AC1021	CellScan
AC1027	AutoCell-882/884 (Ericsson)
AC1036	TIA/EIA-136 Conformance Software
AC1048	SSD Update & Authentication Test
AC1201	Telescoping Antenna
AC3403	TMAC Users Manual
AC4103	Return Loss Bridge Kit (5 MHz to 2 GHz) (Includes AC1019)
AC8645	Microphone
AC9153	Soft Padded Carrying Case

EasySpan, EasySweep, AutoCell and CellScan are copyrighted by IFR Systems, Inc.

COM-120B
Communications Service Monitor

The industry standard for fast, effective analog wireless testing, including high performance spectrum analysis, AMPS, EDACS and advanced paging test features



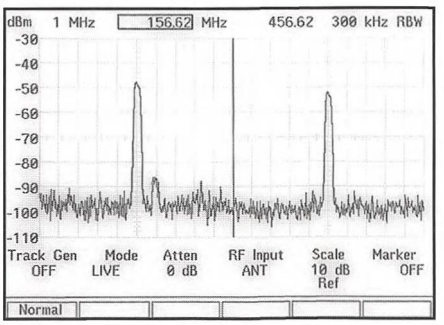
- Split Screen digitized full scan spectrum analyzer to 1 GHz
- EasyCom© software allows simplified testing of land mobile transceivers
- EasySpan© automated test software allows you to display and capture spectrum analyzer and tracking generator sweep information
- LIVE-REF and REF-LIVE comparisons for spectrum analyzer display
- Digitized full scan oscilloscope to 50 kHz
- Enhanced PCMCIA for easy data analysis
- Optional AutoCell-NT automated cellular base station test software
- High speed EDACS data capture capabilities with up to 50 user defined set-ups
- Full paging test for analog paging formats and advanced digital paging with the AC510 option
- Standard independent tracking generator
- 200 W power measurement capability
- RS-232 control interface with optional IEEE-488 (GPIB)

Fast Effective Wireless Test Solutions

The COM-120B has become an industry recognized standard in Communication Service Monitors. A tough, portable monitor with a full performance spectrum analyzer and digital oscilloscope, the COM-120B combines over 20 instruments into one unit, the versatile COM-120B offers a cost effective alternative to higher cost test sets.

Unique Split Screen Spectrum Analyzer

The COM-120B offers a split screen dual display spectrum analyzer. This feature allows you to view two signals or the same signal in two different ranges simultaneously. In addition, the spectrum analyzer can be viewed along with the RF Generator or RF Receiver screens giving you full control over testing details at one glance.



Split screen spectrum analyzer gives you more flexibility

RF Solutions

For RF testing professionals, the fully independent generator and receiver functions yield truer signal tracing, expanded analyzer capabilities and cross band duplex testing. In addition, the COM-120B boasts an impressive set of standard features:

- Digitized oscilloscope
- RF and Auxiliary RF Generator
- 2 µV receiver sensitivity
- Frequency Selective RF Counter
- RF Frequency Error Meter
- FM Deviation Meter
- ΦM Deviation Meter
- AF Frequency Counter
- AM Modulation Meter
- RF Power Meter
- RF Level Meter
- Distortion Meter
- SINAD Meter with 0 - 55 dB range
- LIVE-REF and REF-LIVE on the Spectrum Analyzer and Oscilloscope, Average, peak hold and min hold can be displayed independently
- The FM and ΦM Deviation Meters allow toggling of the deviation meter from the standard mode to the ± peak mode. The measurement shows the + and - peak deviation as two separate readings

EDACS and LTR Testing

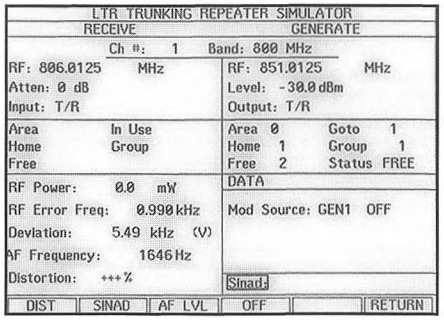
The EDACS™ option provides a comprehensive system test for both repeaters and terminals.

The EDACS™ option also incorporates:

- High speed data capture which reads EDACS data as soon as the COM-120B's DSP decodes valid EDACS messages.
- Individual Call System All-Call decodes a dual message on the inbound control channel.
- Support for Narrow-band (900) MHz testing.
- User definable frequencies as channels.
- Expanded storage capability that allows users to store and recall up to 50 EDACS™ system test set-ups.

http://www.ifrinternational.com

The CLEARCHANNEL LTR™ trunking option allows the COM-120B to be configured to simulate LTR repeater systems. The test set can perform system encode/decode functions as well as Home and Next repeater access procedures.



Clear Channel LTR Menu

Full Paging Support

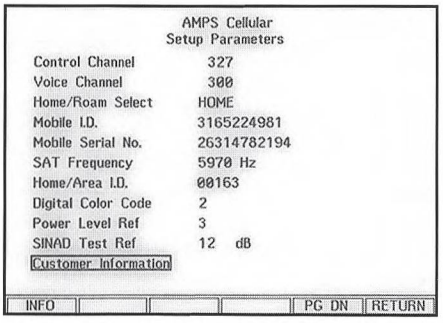
The standard COM-120B performs encode/decode of 2-tone and sequential tone testing, as well as tone squelch, DCS and DTMF. The flexibility of the COM-120B is enhanced with optional analog/digital signaling. This feature allows you to test the following formats:

CCIR	CCIRH	CCIRH4
EEA	EIA	NATEL
ZVEI	DZVEI	DDZVEI
EURO	5/6 TONE	POCSAG

Adding the AC510 option enables the COM-120B to encode advanced digital paging formats including Flex™, Golay Sequential Code (GSC) and NEC D3.

Analog Cellular Solutions

The COM-120B may be configured with an optional AMPS Mobile Station testing feature which is designed to verify proper operation of AMPS handsets and mobiles. Flexible testing includes both automatic and manual test functions.



Analog AMPS Capabilities

Complex Testing Made Simple

Even with its impressive list of testing capabilities, the COM-120B retains the simplicity that has earned the respect of thousands of dedicated users. A modem capability turns the COM-120B into a remote controlled instrument. Tests can now be initiated remotely by simply plugging in a modem.

For more specialized testing, the COM-120B programmable test function may be used to create custom test applications. Using the COM-120B's TMAC programming language, complex tests can be reduced to simple "one-touch" test procedures.

And with its intuitive internal/external data file storage and retrieval system, complex testing is simple and efficient. This system allows users to create user-defined tests and customized results logs. It also gives you the flexibility to store data internally or download test results to a PC.

RS-232 or IEEE-488 (GPIB) Remote Testing Ability

Fully automated or remote testing abilities in a stand alone or multiple instrument environment can be realized with the standard RS-232 interface or with the IEEE-488 (Option 13) interface.

Power Tests from 2 mW to 200 Watts

The COM-120B provides low level measurements with high power protection for measuring off air signals as well as direct base station power measurements up to 200 Watts. The antenna input is protected to 10 Watts with a built in alarm to notify you if you are in an overload condition.

Software Options Simplify Testing

For those requiring automated test capability, several applications software packages are available:

EasyCom-B (AC1022)
Simplifies routine performance testing of land mobile transceivers.

AutoCell - NT (AC1037)
Provides automated testing and calibration of Northern Telecom, Novatel and GE analog cellular base stations.

EasySpan (AC1009W)
Can store, display and manipulate spectrum analyzer and tracking generator sweep information to a PC running windows.

All IFR software can be down loaded using the PCMCIA memory card or through the RS-232 interface using a PC controller. The COM-120B is compatible with popular accessories from other manufacturers including the Optoelectronics Super Scout and the STI 9100 series mobile signal analysis and data acquisition system.

Specification

RF Signal Generator

Frequency Range
250 kHz to 999.9999 MHz

Resolution
100 Hz

Accuracy
Same as Master Oscillator

Output Level

(T/R and AUX Connectors)

Range (T/R)
-130 to -20 dBm (Simplex mode)
-130 to -40 dBm (Duplex mode)

Range (AUX)
-130 to -13 dBm

Resolution
0.1 dB

Accuracy
± 2 dB (>-90.1 dBm, <400 MHz)
± 2.5 dB otherwise

VSWR
<1.15:1 (0.25 to ≤100 MHz)
<1.23:1 (100 to ≤400 MHz)
<1.38:1 (400 MHz to 1 GHz)

Spectral Purity

Residual FM
<20 Hz RMS (0.3 to 3 kHz BW)

Residual AM
<0.5% RMS (0.3 to 3 kHz BW)

Harmonics
<-26 dBc

Non-Harmonics
<-50 dBc (below 1 GHz)
<-40 dBc (above 1 GHz)

Input Protection

(T/R)
50 W CW continuous
100 W CW (90 sec - 3 min cycle)
150 W CW (30 sec - 3 min cycle)
200 W CW (15 sec - 3 min cycle)

(AUX)
Up to 0.25 W

Frequency Modulation

RF Frequency Range
250 kHz to 999.9999 MHz

Deviation Range
100 Hz to 100 kHz

Deviation Resolution
10 Hz (0.01 kHz to 2.55 kHz)
50 Hz (2.60 kHz to 12.75 kHz)
100 Hz (12.8 kHz to 25.5 kHz)
500 Hz (26.0 kHz to 100.0 kHz)

Rate
10 Hz to 20 kHz (FSK rates up to 40 kbps)

Accuracy
±5% + residual FM (1 kHz rate, GEN1, GEN2, EXT MOD)
±10% + residual FM + resolution (DATA GEN)
±15% + residual FM + resolution (DTMF GEN)

Distortion
<2% (1 kHz sine wave, 10 kHz deviation, 0.3 to 3 kHz BW)

EXT MOD Sensitivity
2 kHz/Vpk ±10% (FM Narrow)
10 kHz/Vpk ±10% (FM Wide)

Amplitude Modulation

RF Frequency Range
250 kHz to 999.9999 MHz

AM Depth Range
30% to 90%

Resolution
1 %

Rate
100 kHz to 10 kHz

Accuracy
±5% + residual AM + resolution (1 kHz rate, RF Level <0 dBm)
±15% + residual AM + resolution (RF Level <0 dBm)

Distortion
<2% (30% to 90% modulation, 1 kHz rate, 0.3 to 3 kHz BW)

EXT MOD Sensitivity
9% to 11% per Vpk

Phase Modulation

RF Frequency Range
250 kHz to 999.9999 MHz

Modulation Range
0.1 to 10 radians peak

Resolution
0.1 radian (2.6 to 10.0 rad)
0.01 radian (below 2.55 rad)

Rate
100 Hz to 6 kHz

Accuracy
±5% + residual PM + resolution (1 kHz rate)
±15% + residual PM + resolution (DTMF GEN)

EXT MOD Sensitivity
2 rad/Vpk ±10%

Audio Data Generators

AF GENERATOR #1

Frequency Range
5 Hz to 20 kHz (sinewave only)
5 Hz to 10 kHz (other waveshapes)

COM-120B

Frequency Resolution
0.1 Hz

Frequency Accuracy
Same as timebase ±0.1 Hz

Output Range (High Lvl)
0.01 Vpk to 2.5 Vpk (into 150 Ω)

Output Resolution (High Lvl)
0.01 Vpk

Output Accuracy (High Lvl)
±3% full range ±5 mVpk (≤10 kHz, ≥0.03 Vpk)
±7% full range ±5 mVpk (>10 kHz, ≥0.03 Vpk)

Output Range (Low Lvl)
1 mVpk to 250 mVpk (into 150 Ω)

Output Resolution (Low Lvl)
1 mV

Output Accuracy (Low Lvl)
±4% full range ±0.25 mVpk (≤10 kHz, .03 Vpk < level ≥ 1 mVpk)
±7% full range ±0.25 mVpk (>10 kHz, 0.03 Vpk < level ≥1 mVpk)

THD
<0.7% (1 kHz sinewave, 2.5 Vpk, 150 Ω load)
<1% sinewave (all other frequencies/levels)

Waveshapes
Sine, Ramp, Square, Triangle

AF GENERATOR #2

Frequency Range
1 kHz (sinewave)

Frequency Accuracy
±0.2 Hz

Output Range (High Lvl)
0.01 Vpk to 2.5 Vpk (into 150 Ω)

Output Resolution (High Lvl)
0.01 Vpk

Output Accuracy (High Lvl)
±3% full range ±5 mVpk (≥ 0.03 Vpk)

Output Range (Low Lvl)
1 mVpk to 250 mVpk (into 150 Ω)

Output Resolution (Low Lvl)
1 mV

Output Accuracy (Low Lvl)
±4% full range ±0.25 mVpk
(0.03 Vpk < level ≥1 mVpk)

THD
0.7% (2.50 V peak, into 150 Ω)

DTMF Generator

Output Range (High Lvl)
0.01 Vpk to 2.5 Vpk (into 150 Ω)

Output Resolution (High Lvl)
0.01 Vpk

Output Accuracy (High Lvl)
±10% full range ±5 mVpk (≥30 mV)

Output Range (Low Lvl)
0.1 mVpk to 25 mVpk (into 150 Ω)

Output Resolution (Low Lvl)
0.1 mV

Output Accuracy (Low Lvl)
±10% full range ±0.25 mVpk (1 mV to 30 mV)

Modes
Continuous, single shot

Digits
16 (0-9, *, #, A, B, C, D)

Mark/Space Timing
25 to 999 msec

Mark/Space Timing Resolution
1 msec

Mark/Space Timing Accuracy
±20%

Receiver

Range
250 kHz to 999.9999 MHz

Resolution
100 Hz

Tunable Range
Tunable from 0 Hz to 1.0 GHz
(characteristics below 250 kHz are not specified)

Sensitivity
2 µV (10 dB SINAD, >2 MHz, 1 kHz tone, 3.3 kHz deviation, 15 kHz IF BW, C-Message weighted filter, 10 kHz FM deviation meter range, 15 to 35°C
<2.5 µV otherwise

Antenna Input Protection
10 W CW (5 sec with alarm)

Selectivity
300 kHz
15 kHz

Adjacent Channel Rejection

IF Bandwidth	*Selectivity*
(3 dB)	>30 dB Down
300 kHz	±485 kHz
15 kHz	±15 kHz

Demodulation Output (<50 Ω)

FM:	0.20 Vpk/kHz ±10% (10 kHz range) 0.10 Vpk/kHz ±10% (20 kHz range) 0.04 Vpk/kHz ±10% (50 kHz range) 0.02 Vpk/kHz ±10% (100 kHz range)
AM:	1.13 ±0.06 V RMS (80% modulation)
ΦM:	0.2 Vpk/rad ±10%

Selective RF Counter

Frequency Range
250 kHz to 999.9999 MHz (The received frequency must be within the IF bandpass of the COM-120B)

Tunable Range
100 Hz to 999.9999 MHz (characteristics below 250 kHz are not specified)

Resolution
1 Hz

Accuracy
Same as Master Oscillator ±2 Hz

RF Level
0 to +53 dBm (T/R connector)
-60 to 0 dBm (ANT connector)

RF Frequency Error

Meter Range
0 Hz to 100 kHz

Meter Accuracy
Same as Master Oscillator ±2 counts

Meter Resolution
1 Hz (10 sec gate time)
10 Hz (1 sec gate time)

RF Frequency Range
250 kHz to 999.999999 MHz (The received frequency must be within the IF bandpass of the COM-120B)

RF Level
0 to +53 dBm (T/R connector)
-60 to 0 dBm (ANT connector)

AF Frequency Counter

Frequency Range
10 Hz to 20 kHz

Accuracy
Same as Master Oscillator ± 1 count

Resolution
0.1 Hz (10 sec gate time, 10 Hz to 500 Hz)
1 Hz (1 sec gate time, 500 Hz to 20 kHz)
0.1 Hz, (10 sec gate time)

Input Signal Level
SCOPE/DMV Input:
90 mVp-p (50 mV range, any waveform)

AUDIO/DATA Input
450 mVp-p (any waveform)

Frequency Modulation Meter

Ranges
10 kHz, 20 kHz, 50 kHz, 100 kHz full scale

Resolution
10 Hz (10 kHz range)
100 Hz (20, 50, and 100 kHz Ranges)

Accuracy
±5% full scale ± 50 Hz ± 1 digit + source residual FM (300 kHz IF BW, 1 kHz tone, 5 kHz deviation, C-Message weighted filter)

Modulation Rate
0 to 20 kHz

Carrier Range
250 kHz to 999.9999 MHz (The received frequency must be within the IF bandpass)

Carrier Level
0 to +53 dBm (T/R connector)
-60 to 0 dBm (ANT connector)

ΦM Meter

Ranges
1 rad, 2 rad, 5 rad, 10 rad peak full scale

Resolution
0.01 rad (1 and 2 radian scales)
0.1 rad (5 and 10 radian scales)

Accuracy
±5% of full scale ±0.1 rad ±1 digit + source residual PM (300 kHz IF BW, 1.0 kHz tone, 1.0 rad deviation, C-Message weighted)

Modulation Rate
100 Hz to 6 kHz

Carrier Range
250 kHz to 999.9999 MHz (The received frequency must be within the IF bandpass)

Carrier Level
0 to +53 dBm (T/R connector)
-60 to 0 dBm (ANT connector)

AM Modulation Meter

Range
1% to 100%

Resolution
0.1%

Accuracy
±5% of full scale ±1 digit +source residual AM (300 kHz IF BW, 1 kHz tone, 50% AM depth, C-Message weighted filter)

Modulation Rate
50 Hz to 10 kHz

Carrier Range
250 kHz to 999.9999 MHz (The received frequency must be within the IF bandpass of the COM-120B)

Carrier Level
0 to +53 dBm (T/R connector)
-60 to 0 dBm (ANT connector)

AGC Attack Time
50 msec maximum

RF Power Meter

Meter Ranges
2 mW to 200 W in a 1-2-5 sequence

Resolution
1 % of full scale or 0.1 mW whichever is greater

Accuracy
±10% ±0.1 mW ±1 digit (>200 mW, 15 to 36°C)
±15% ±0.1 mW ±1 digit (<200 mW below 15°C and above 35°C)

Frequency Range
1.5 MHz to 999.9999 MHz

RF Level Range
2 mW to 200 W average power

Usable Level
0.2 mW to 200 W average power (characteristics below 2 mW not specified)

Operating Conditions
50 Watts CW continuous (50°C)
100 Watts CW (90 sec/3 min, 50°C)
150 Watts CW (30 sec/3 min, 50°C)
200 Watts CW (15 sec/3 min, 50°C)

VSWR
1.15:1 (0.25 to 100 MHz)
1.23:1 (100 to 400 MHz)
1.38:1 (400 MHz to 999.9999 MHz)

Alarms
Audible and visual (if applied power exceeds 200 W in the 200 W range or the COM-120B's power term module temperature exceeds 105°C)

Receive Level Meter

Range
-101 to -30 dBm (15 kHz IF BW)
-80 to -30 dBm (300 kHz IF BW)

Accuracy
±3 dB

Frequency Range
250 kHz to 999.9999 MHz (The received frequency must be within the IF bandpass of the COM-120B)

Distortion Meter

Range
1 % to 20%

Resolution
0.1 %

Accuracy
±0.5% distortion ±1 digit (1 to 10%)
±2% distortion ±1 digit (>10% to 20%)

Signal Frequency
1 kHz sine wave

Signal Level
0.02 to 200 VRMS (SCOPE/DVM input)
0.15 to 15 VRMS (AUDIO/DATA IN)

SINAD Meter

Range
3 to 30 dB

Resolution
0.1 dB

Accuracy
±1 dB ±1 digit (at 12 dB SINAD)

Signal Frequency
1 kHz sine wave

Signal Level
0.03 to 200 VRMS (SCOPE/DVM input)
0.15 to 15 VRMS (AUDIO/DATA IN)

Digital Voltmeter

Ranges
50 mV to 200 V in a 1-2-5 sequence

Range (DC)
10 mV to 200 VDC (SCOPE/DVM input)

Range (AC)
10 mV to 200 V RMS (SCOPE/DVM input)
150 mV to 15 V RMS (AUDIO/DATA IN)

Resolution
3 ½ digit

Accuracy
±5% full scale ±5 mV ±1 digit (SCOPE/DVM input)
±7% full scale ±5 mV ±1 digit (AUDIO/DATA IN)

Frequency
DC, 50 Hz to 20 kHz

Input Impedance
1 MΩ, unbalanced (SCOPE/DVM/SINAD IN)
100 kΩ, unbalanced (AUDIO/DATA IN)

Oscilloscope

Bandwidth (3 dB)
50 kHz

VERTICAL

Ranges
10 mV to 50 V per division (1-2-5 sequence)

Max Input
200 Vpk

Accuracy
5% full scale

Resolution
1 % full scale, 256 data points, 8 major divisions

Coupling
DC, AC and GND

HORIZONTAL

Ranges
100 µs to 200 ms per division (1-2-5 sequence)

Accuracy
1 % full scale

Resolution
1 % full scale, 500 data points, 10 major divisions

Input Impedance
1 MΩ, unbalanced (nominal)

Spectrum Analyzer

Center Frequency
250 kHz to 999.9999 MHz

Tunable Range
100 Hz to 999.9999 MHz (characteristics below 250 kHz are not specified)

Resolution
100 Hz

FREQUENCY SPAN

Ranges
1 kHz to 100 MHz per division in a 1-2-5 sequency and zero span

Accuracy
±5% of span width

Operational Modes
Normal, Split Screen

Frequency Span Modes

Scan Width	*RBW*
100 MHz/div	3 MHz
50 MHz	3 MHz
20 MHz	3 MHz
10 MHz	3 MHz
5 MHz	300 kHz
2 MHz	300 kHz
1 MHz	300 kHz
500 kHz	30 kHz
200 kHz	30 kHz
100 kHz	30 kHz
50 kHz	30 kHz
20 kHz	3 kHz
10 kHz	3 kHz
5 kHz	3 kHz
2 kHz	300 Hz
1 kHz	300 Hz
0 kHz	30 kHz

LEVEL

Display
Log, 2 and 10 dB per division

Vertical Resolution
1 dB

Dynamic Range
60 dB

Bandwidth Switching Error
<3 dB

Log Linearity
±2 dB (referenced to -40 dBm, 15 to 35°C)
±3 dB (referenced to - 40 dBm, 0 to 15°C and 35 to 50°C)

Input Attenuator
0, 30 dB (ANT connector)

RS-232C

Operations Mode
Off, PC (input/output)

Baud Rate
100, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400

Stop Bits
1,2

Parity
Odd, Even, None

Handshake
None, Xon/Xoff, CTS/RTS

Master Oscillator

TCXO

Frequency
10 MHz

Uncertainty
±0.1 ppm

Temperature Stability
±0.2 ppm (0 to 50°C)

Ageing Rate
±0.5 ppm/year

Power Requirements

Line Voltage
90 to 135 VAC (50 to 400 Hz)
200 to 265 VAC (50 to 60 Hz)

DC Input
12 to 30 VDC

Power Consumption
AC 180 W maximum
AC 110 W typical
DC 150 W maximum
DC 90 W typical

General Characteristics

Operating Temperatures
0 to 50°C

Dimensions
400 mm (15.75 in) W, 190 mm (7.5 in) H, 429 mm (16.875 in) D (without bail handle and front panel cover)
440 mm (17.32 in) W, 190 mm (7.5 in) H, 537 mm (21.125 in) D (with bail handle and front panel cover)

Weight
17.3 kg (38.5 lb) (without options, lid, accessories)

Versions and Accessories

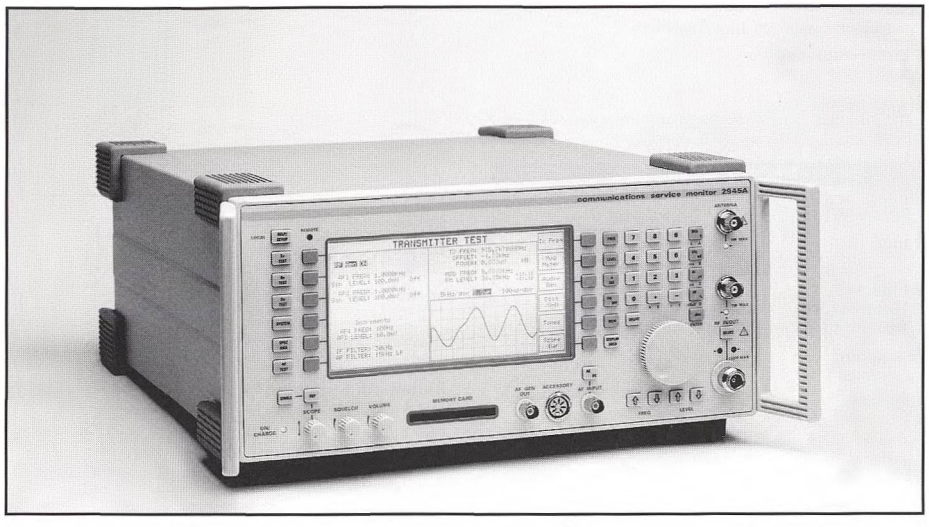
When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
120B-3	COM-120B Service monitor; 30 kHz IF Filter
120B-3-C	120B-3 with Certificate of Calibration
120B-3T	120B-3, 0.01 ppm OCXO time base
120B-3T-C	120B-3, 0.01 ppm OCXO time base with Certificate of Calibration
120B-8	COM-120B, SSB Receive filter
120B-8-C	120B-8 with Certificate of Calibration
120B-8T	120-B-8 with 0.01 ppm OCXO time base
120B-8T-C	120B-8 with 0.01 ppm OCXO time base with Certificate of Calibration
	Accessories
AC 510	Paging encoder
AC0600	Maintenance manual
AC1009W	EasySpan for Windows (Waveform Transfer Software
AC1022	EasyCom-B
AC1023	Applications library
AC1025	EasySpan (rep AC3012)
AC1037	Autocell-NT (req AC9160)
AC1201	Telescopic antenna
AC3001	Internal rechargeable battery
AC3007	Data generator/BER meter
AC3009	RCC Signaling
AC3011	Digital/Analog Sampling
AC3012	Tracking generator
AC3013	IEEE-488
AC3014	CLEAR CHANNEL LTR
AC3015	AMPS Mobile station test (req AC9160)
AC3016	EDACS
AC4101	Return loss bridge (5 MHz to 1 GHz)
AC8645	Microphone
AC9161	MPT-1327 Trunking
AC9162	7.5 kHz IF Filter
AC9925	Soft padded carrying case

CLEARCHANNEL LTR® is a registered trademark of Transcrypt International, Inc.
EDACS® is a registered trademark of Ericsson, Inc.
Flex® is a registered trademark of Motorola, Inc.
Windows® is a registered trademark of Microsoft Corporation.
EasyCom-ΦM, EasySweep and EasyScan are copyrighted by IFR Systems, Inc.

2945A
Communications Service Monitor

A compact, lightweight and rugged instrument that allows laboratory standard measurements to be conducted in the field



- Rugged lightweight package
- Full span spectrum analyzer with 'live' look and listen
- Tracking generator with full offset tracking
- Accurate power measurement to 150 W
- 5 W protection on all RF ports as standard
- Superfast LCD with rapid refresh rate for easy monitoring and real time adjustment
- 50 kHz DSO (Digital Storage Oscilloscope) with anti-aliasing
- Transient and Harmonic analysis

The 2945A Communications Service Monitor is the lightest, most rugged service monitor available with a full performance spectrum analyzer as standard. For field work the 2945A provides an excellent combination of instruments for all types of maintenance work. In the workshop, it provides all of the performance you would expect for exacting measurements.

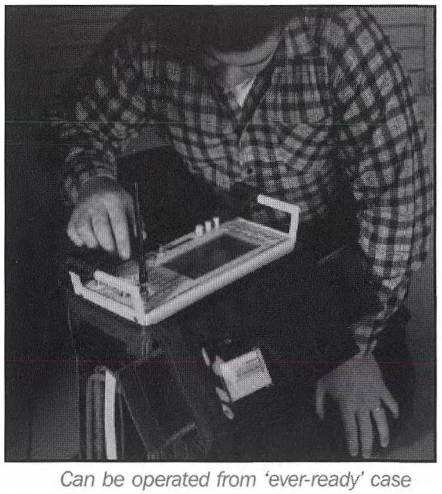
Field Operation

At under 12 kg (25 lb), the 2945A lightens the load to remote sites. The shape of the 2945A is ideal for carrying. The side handle ensures that the instrument is clear of the stairs when ascending buildings and the depth is suitable for the 2945A to be operated comfortably when it is placed on the floor.

An optional bail arm is also available. This option allows a stowage cover to be fitted over the front panel for storage of adapters and further protection to the instrument's front panel. Full operation is possible from the protective "ever-ready" case so that your instrument is protected from transit damage.

Battery - carry a spare

The battery fits neatly into the "ever-ready" case and is easily replaced with a spare when discharged. There is no memory effect associated with the battery, even when partially discharged.



Can be operated from 'ever-ready' case

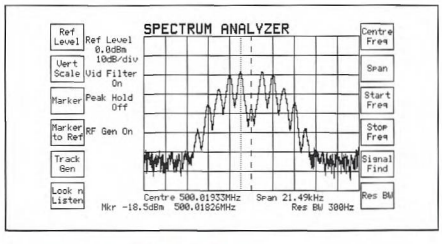
Fast Warm Up - fast results

The standard TCXO allows results to be made reliably within a minute of switch on. Where even better stability is required, an optional OCXO is available.

Stored settings may be recalled from internal memory or from a memory card, allowing fast and straightforward setting up.

Fast Full Performance Spectrum Analyzer - provided as standard

The spectrum analyzer provides spans from 100 Hz per division to full span and also has a fully adjustable reference level. Speed is comparable with analog analyzers, allowing real time adjustments over a full 80 dB dynamic range. With the tracking generator provided as standard, duplexers and filters can be aligned quickly and easily. An offset facility provides testing of equipment with frequency translation. Channel stepping can be performed by defining an increment and then using the FREQ ⇧⇩ keys. This is particularly useful when testing multi-channel systems.



Live Look and Listen

This feature puts the 2945A above all its peers with the ability to examine signals on the screen and demodulate them simultaneously. Intermittent interference can be isolated quickly and the signals then easily identified. The trace can be saved to memory card along with the time and date, providing factual evidence that can be recalled later. This feature is

particularly useful when looking for rogue transmissions, especially on busy base station sites.

From 2 µV to 150 Watts

The 2945A will measure the power of low level signals such as those encountered when monitoring off-air signals or those found when probing a circuit. 150 Watts measurement is provided without the need for external attenuators, so high power base stations can be measured directly. Measurement accuracy of better than 10% is guaranteed all the way down to 5 mW on the N-Type connector, allowing cellular radios to be qualified at low power levels.

Accurate RF Signals

The signal generator provides coverage from 400 kHz to 1.05 GHz with +5 dBm output (+7 dBm overrange) and fast switching speed. Level accuracy is ±2 dB at all levels above -127 dBm.

Duplex - provided as standard

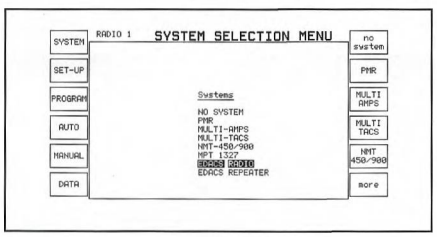
Full duplex operation is provided by the 2945A. This allows testing of duplex radios as well as simultaneous testing of repeater transmit and receive paths. There are no restrictions to the duplex offset.

Cellular and Trunking - built in

AMPS, TACS and NMT analog cellular standards are available internally, with all country variants provided in each package. MPT 1327/1343 trunking system and variants of it are also available.

A new trunking capability has been added with the introduction of EDACS™ Radio and Repeater test capability.

Remote control of the inbuilt tests is provided, so that measurements can be started and results logged automatically.



Network Simulation

The 2945A simulates the signaling protocol that the radio would see from the real network. This allows calls to be set up and handled enabling receiver and transmitter parametric measurements to be made.

Remote Control - RS-232 or GPIB

Remote control is provided with an RS-232 interface as standard. An IEEE-488.2 interface (Option 5) can be fitted where other instruments are required to operate in a system with the 2945A.

Printing Made Easy

With the parallel printer port interface, screen dumps, automatic test results or previously stored results may be sent to any parallel printer. These facilities are available as standard using the serial RS-232 interface.

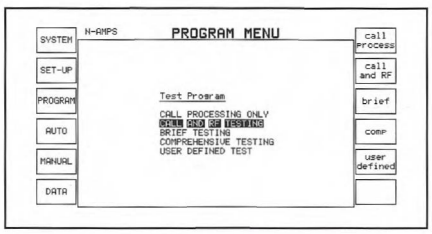
A screen capture facility is available so any screen displayed on the 2945A Communications Service Monitor can be saved direct to a PC, via the serial port, as a bit map file.

Autorun - internal control

With the (optional) Analog Systems Card fitted, automatic testing without an external controller is possible. Custom tests may be written and run by the operator. Four programmable relay contacts are provided with the optional parallel printer interface to allow remote control of radios or test fixtures from built-in automatic tests.

Custom Programs

Users may program the instrument to suit their own specific needs. This is possible either by configuring any of the four built-in programs or by using the MI-BASIC interpreter to produce a customized test program that can be executed internally, without an external controller.



Memory Card - with real time clock

The Memory Card Drive meets the PCMCIA standard format for PC cards. The 2945A provides a DOS based filing system that allows transfer of information to a PC fitted with a memory card slot.

Test setups, test results, screen dumps, spectrum analyzer co-ordinates and test sequences can all be stored on the memory card, allowing information to be easily stored and retrieved when required.

Reliability

The 2945A features high integration with a rugged chassis design to maximize mechanical protection.

Audio Analysis

A comprehensive range of filters is provided as standard, including band pass, lowpass and high pass. Optional filters are available for psophometric weighting of audio signals and demodulation of signals in a simulated radio channel bandwidth.

The direct measurement of CTCSS is possible with the 300 Hz LP filter, even with speech present.

Two comprehensive audio generators are provided as standard for internal modulation or audio sources for transmitter stimulus.

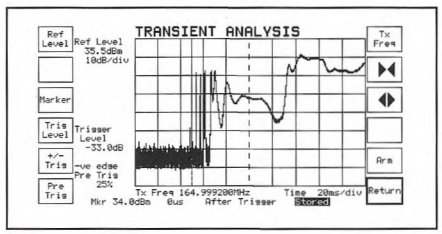
External DC coupled FM is provided.

Comprehensive Oscilloscope

Analysis of audio signals, whether from the demodulated signal or the audio input direct, can be viewed for further inspection. The oscilloscope can either be combined with the measurement screen in the Tx, Rx or AF test modes or 'zoomed' to a full screen display. Different levels of persistence can be selected to allow short or long term effects to be captured.

Transient Analysis

The ability to capture transients on the rising or falling edge of a waveform provides a valuable tool for fault finding radios and radio systems. The user has full control of the trigger level and input attenuation as well as the timebase and five fixed trigger points, making this feature simple and flexible to operate.



Harmonic Analysis

An automatic harmonic analysis function is included in the 2945A. This complements the fast spectrum analyzer and allows a rapid check that the transmitter is not producing any large harmonics.

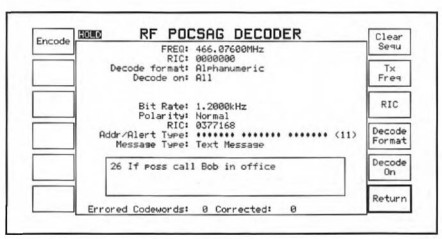
Tones Generation and Decoding

The tones menus now include full remote control so that radio workshops can further automate their tasks. These and other improvements are in response to user feedback and allow better control of the tones from the top level screens.

POCSAG Decode - built in option

Off-air decoding of POCSAG signals is provided as an option.

This allows tone, numeric and alphanumeric signals to be displayed. Signals with bit rates of up to 4800 bits/s can be automatically detected making the 2945A an ideal surveillance tool. The 2945A can be set to detect all messages, a user selectable RIC (just like a Pager), or a fixed message string.



Specification

Certain characteristics are shown as typical. These provide additional information for applying the instrument, but are unwarranted.

RF Signal Generator

FREQUENCY

Frequency Range
400 kHz to 1.05 GHz

Resolution
10 Hz

2945A

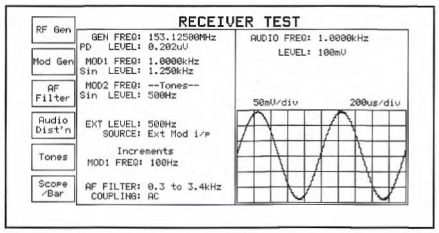
Indication
10 digit display

Setting
Keyboard entry, delta increment/decrement function and rotary control

Accuracy
As frequency standard

OUTPUT LEVEL

Output Level Range
Rx Test:
N-Type socket: -141 dBm to -21 dBm
BNC socket: -115 dBm to +5 dBm
(overrange to +7dBm)



Resolution
0.1 dB

Indication
4 digits plus sign (dBm, dBµV, µV, mV PD/EMF).

Accuracy
±2 dB for levels above -127 dBm on N-Type socket up to 1 GHz

Reverse Power Protection
N-Type: 50 W 10 minutes, normal operation
150 W for 1 minute at 20°C
Overload indicated by audible and visual warning
BNC: 5 W Overload indicated by audible and visual warning

Output Impedance
Nominally 50 Ω

VSWR

N-Type
Better than 1.2:1 up to 500 MHz
Better than 1.35:1 up to 1.05 GHz

BNC
Better than 2.2:1 up to 1.05 GHz

SPECTRAL PURITY
(If you require even better spectral purity than that specified here, please consider the 2948)

Residual FM
Less than 15 Hz RMS (0.3 to 3.4 kHz) up to 500 MHz
Less than 20 Hz RMS (0.3 to 3.4 kHz) up to 1.0 GHz (with OCXO)

Harmonics
Better than –20 dBc

Spurious Signals
Better than –30 dBc (±10 kHz to 1.5 MHz offset from carrier frequency or over range 600 to 700 MHz)
Better than –40 dBc from 400 kHz to 1 GHz

SSB Phase Noise (20 kHz offset)
Better than -95 dBc/Hz up to 1 GHz

RF Carrier Leakage
Less than 0.5 µV PD generated in a 50 Ω load by a 2 turn loop 25 mm from the case. Output level less than –40 dBm into a sealed 50 Ω load.

AMPLITUDE MODULATION - INTERNAL

Frequency Range
400 kHz to 1.05 GHz

AM Depth Range
0 to 99%

Resolution
1%

Indication
2 digits

Setting
Keyboard entry, delta increment / decrement function and rotary control

Accuracy
For carrier frequencies from 1.5 MHz to 400 MHz
± 7% ± 1digit for modulation frequency of 1 kHz.
± 10% ± 1 digit for modulation frequencies from 50 Hz to 5 kHz.
± 15% ±1 digit for modulation frequencies from 50 Hz to 15 kHz.

Distortion
Less than 2% at 1 kHz for 30% AM, CCITT weighted

Modulation Frequency
20 Hz to 20 kHz

AMPLITUDE MODULATION - EXTERNAL

Input Impedance
Nominally 10 kΩ in parallel with 40 pF

Frequency Range
As internal AM

Modulation Frequency Range
As internal AM

Sensitivity
1 V RMS for 0 to 100% AM

FREQUENCY MODULATION - INTERNAL

Frequency Range
400 kHz to 1.05 GHz

Maximum Deviation
0 to 75 kHz

Indication
3 digits

Setting
Keyboard entry, delta increment/decrement function and rotary control

Accuracy (1)
±5% ± 10 Hz at 1 kHz modulating frequency
±10% at modulating frequencies from 50 Hz to 15 kHz

Distortion
Less than 1% at 1 kHz for deviation of 5 kHz, CCITT weighted

Modulation Frequency Range
20 Hz to 25 kHz

Resolution
25 Hz

Pre-emphasis
750 µs selectable

FREQUENCY MODULATION - EXTERNAL

Input Impedance
Nominally 10 kΩ in parallel with 40 pF

Frequency Range
As internal FM

Modulation Frequency Range
DC to 100 kHz

Pre-emphasis
750 µs selectable

Sensitivity
1 Volt RMS for 0 to 75 kHz deviation

MICROPHONE INPUT

Input Level
2 mV to 200 mV (AGC levelled)

Input Impedance
Nominally 150 Ω

Press To Talk (PTT)
When using the optional microphone in Tx Test mode, the PTT will switch instrument to Rx Test

Audio Voltmeter

Input Impedance
Nominally 1 MΩ in parallel with 40 pF

Frequency Range
DC and 20 Hz to 50 kHz
AC only 20 Hz to 50 kHz

Level Ranges
0 to 100 mV to 0 to 100 V RMS in a 1, 3, 10 sequence.
Digital readout also in mW (user selectable)

Resolution
1 mV or 1% of reading

Indication
3 digits and bar-chart

Accuracy
±3% ±3 mV ±1 digit

Audio Frequency Meter

Frequency Range
20 Hz to 20 kHz

Resolution
0.1 Hz, less than 10 kHz
1 Hz, at 10 kHz and above

Indication
5 digits

Accuracy
As frequency standard ± 1 digit ± resolution

Sensitivity
50 mV

Audio SINAD Meter

Frequency
1 kHz

Range
0 to 18 dB and 0 to 50 dB

Resolution
0.1 dB

Indication
3 digits and bar-charts

Accuracy
±1 dB

Sensitivity
50 mV (100 mV for 40 dB SINAD) reading suppressed if audio voltage is less than 5 mV

Audio Distortion Meter

Frequency
1 kHz

Range
0 to 10%, 0 to 30% and 0 to 100%

Resolution
0.1% distortion

Indication
3 digits and bar-charts

Accuracy
±5% of reading ± 0.5% distortion

Sensitivity
50 mV (100 mV for 1% distortion) reading suppressed if audio voltage is less than 5 mV

Audio S/N Meter

Range
0 to 30 dB and 0 to 100 dB

Resolution
0.1 dB

Indication
3 digits and bar-chart

Accuracy
±1 dB

Sensitivity
50 mV (100 mV for 40 dB S/N) reading suppressed if audio voltage is less than 5 mV

Audio Oscilloscope

Operating Modes
Single with digital storage on screen or repetitive sweep

Frequency Range
DC to 50 kHz, 3 Hz to 50 kHz AC coupled

Voltage Range
10 mV to 20 V per division in a 1, 2, 5 sequence

Voltage Accuracy
±5% of full scale

FM Ranges
±75, 30, 15, 6, 3 and 1.5 kHz deviation full scale, ±10% accuracy

AM Ranges
20, 10 and 5% per division, ±10% accuracy

Timebase
50 µs/div to 5 s/div in a 1, 2, 5 sequence

Graticule
10 Horizontal by 6 Vertical divisions

Special features
Built in anti-aliasing circuitry and variable decode trigger level

Audio Bar-Charts

Bar-chart Displays
AF Voltage, SINAD, Distortion, S/N

Vertical Resolution
2% of full scale

Ranging
Autoranging, range hold or manual selection
1, 2, 5, sequence with hysteresis

Audio and Modulation Filters
300 Hz, 3 kHz, 15 kHz Lowpass
300 Hz to 3.4 kHz Bandpass
300 Hz Highpass
750 μs de-emphasis
50 kHz Lowpass (No filters applied)

Audio Analyzer General Features
Tones Mode

RF Frequency Meter

Frequency Range
100 kHz to 1.05 GHz (manual tune)
10 MHz to 1 GHz (autotune)

Resolution
1 Hz or 10 Hz, selectable

Indication
Up to 10 digits

Accuracy
As frequency standard ± resolution

Acquisition Time
Less than 1 second (manual tune)
Typically 3 seconds (autotune)

Sensitivity
Autotuned: 5 mW (N-Type)
0.05 mW (Antenna port)
Manual Tuned: –34 dBm (N-Type)
–60 dBm (Antenna port)

VSWR
N-Type: Better than 1.2:1 up to 500 MHz
Better than 1.25:1 up to 1.05 GHz
BNC: Better than 3:1 up to 1.05 GHz

RF Power Meter (broadband)

Frequency Range
200 kHz to 1.05 GHz

Dynamic Range
5 mW to 150 W (N-Type)
0.05 mW to 250 mW (Antenna port)

Indication Units
Watts, dBm or dBW

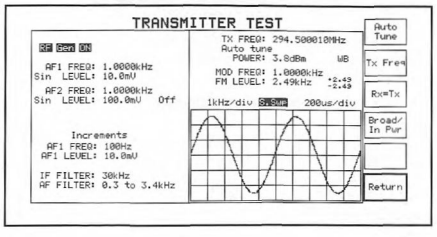
Indication
3 digits or bar-chart

Resolution
0.1 dB max, typically 1%

Accuracy (N-Type)
±10% ± resolution up to 1 GHz

Maximum Continuous Rating
N-Type: 50 W at 20°C
Antenna port: 1 W

Intermittent Rating
N-Type: 150 W for limited periods, typically 1 minute at 20°C. Overload indicated by audible and visual warning.



Harmonic and Transient Analysis

HARMONIC MEASUREMENT
Displays 1st to 5th harmonic of the selected carrier

Maximum Harmonic Frequency
1.05 GHz

Dynamic Range
0 to –60 dBc

TRANSIENT POWER ANALYSIS
Displays power profile against time

Frequency Range
1 to 1050 MHz

Dynamic Range
60 dB below spectrum analyzer reference level

Scale (power)
10 dB/div

Scale (time)
50 μs/division to 5 s/div.

Trigger Level
Adjustable over full dynamic range +ve or –ve trigger selection

Pre-trigger
0, 25, 50, 75 or 100% of displayed period

Modulation Meter

Sensitivity
Autotuned: 5 mW (N-Type)
0.05 mW (Antenna port)
Manual Tuned: –34 dBm (N-Type)
–60 dBm (Antenna port)

Audio & Modulation Filters
300 Hz, 3 kHz, 15 kHz Lowpass
300 Hz to 3.4 kHz Bandpass
300 Hz Highpass
750 μs de-emphasis
50 kHz Lowpass (No filters applied)

AMPLITUDE MODULATION

Frequency Range
100 kHz to 1.05 GHz

Modulation Frequency Range
10 Hz to 15 kHz

AM Depth Range
0 to 99% (manually tuned)
0 to 90% below 100 MHz
0 to 80% from 100 to 400 MHz

Resolution
1% AM

Indication
2 digits and bar-chart

Accuracy (1)
±5% ±1 digit at 1 kHz
±8.5% ±1 digit from 50 Hz to 10 kHz

Demodulation Distortion (1)
Less than 2%, at 1 kHz and 30% AM, (CCITT weighted)

Residual AM
Less than 1% (300 Hz to 3.4 kHz)

FREQUENCY MODULATION

Frequency Range
100 kHz to 1.05 GHz

Modulation Frequency Range
10 Hz to 15 kHz

Deviation Range
0 to 75 kHz

Resolution
10 Hz below 2 kHz deviation,
1% above 2 kHz deviation

Indication
3 digits and bar-chart

Accuracy (1)
±5% ±1 digit at 1 kHz modulation frequency
±7.5% ±1 digit for modulation frequencies 50 Hz to 10 kHz

Demodulation Distortion
Less than 2% at 1 kHz and 5 kHz FM, (CCITT weighted)

Residual FM
Less than 30 Hz (300 Hz to 3.4 kHz)

Demodulation Output Socket
200 mV peak to peak ±10% per 1 kHz deviation

RF Spectrum Analyzer

Frequency Range
100 kHz to 1.0 GHz

Spans
1 kHz/division to 100 MHz/division in a 1, 2, 5 sequence or continuously variable
Start - stop facility allows selection of infinitely variable span width

Resolution Bandwidth
300 Hz, 3, 30, 300 kHz, 3 MHz

Reference Level (top of screen)
–50 dBm to +52 dBm 0.7 mV to 71 V

On Screen Dynamic Range
80 dB

On Screen Linearity
Typically ±2 dB ±1 resolution (10 dB/div) >10 dB above noise floor

Vertical Resolution
0.1 dB on 2 dB/division
0.5 dB on 10 dB/division

Level Flatness
±1 dB ± resolution over 50 MHz span

Intermodulation Distortion
Better than 70 dB for two signals at –30 dBm into first mixer

Sweep Speeds
10 ms/div to 200 ms/div in a 1, 2, 5 sequence (optimum sweep speed and bandwidth selected according to span or user selectable)

Span	*Resolution Bandwidth*	*Update (Sweeps/sec)*
10 kHz	300 Hz	5
100 kHz	3 kHz	9
1 MHz	30 kHz	9
10 MHz	300 kHz	9
100 MHz	300 kHz	5
1000 MHz	3 MHz	5

Marker Indication
Level and frequency or delta marker from centre line of screen
Single marker for frequency and level display
Marker to centre frequency
Δ marker

Features
Simultaneous 'Look and Listen' spans 100 kHz, 200 kHz, 500 kHz, 1 MHz
Start/stop frequency entry

Tracking Generator Offset
0 to 999 MHz

Sensitivity
2 μV

Audio Generators

FREQUENCY

Frequency Range
10 Hz to 25 kHz (sine or square)

Setting
Keyboard entry, delta increment / decrement function and rotary control

Indication
5 digits

Resolution
0.1 Hz below 3.25 kHz
1 Hz above 3.25 kHz

Accuracy
0.01 Hz below 180 Hz, 0.1 Hz above 180 Hz.

LEVEL

Level Range
0.1 mV to 4V RMS

Setting
Keyboard entry, delta increment / decrement function and rotary control

Indication
4 digits

2945A

Resolution
0.1 mV below 409 mV
1 mV above 409 mV

Accuracy
± 5% + resolution 50 Hz to 15 kHz

Output Impedance
Nominally 5 Ω (minimum load 25 Ω)

Distortion
Less than 0.5% at 1 kHz
Less than 1% from 50 Hz to 15 kHz

Signaling Encoder / Decoder
Sequential tones functions including revert
User defined tones
Encodes and decodes up to 40 tones
CCIR, ZVEI, DZVEI, EEA, EIA or user defined
Any of the tones may be extended
Continuous, burst and single step modes available
Up to two frequency plans may be defined and stored within the 2945A for sequential tones
Any of the standard tone frequency plans may be copied to user defined and modified
Tone length 20 ms to 1 s
Standard tone frequencies may be selected from a menu
Generation and decoding of DTMF tones
Generation and decoding of DCS (Digitally Coded Squelch)
Generation of POCSAG code CCIR No.1 Rec 584
Bit rates from 400 to 4800 bit/s. Inversion available

AUDIO MONITOR
Demodulated signals and audio signals may be monitored via the internal loudspeaker and the accessory socket output on the front panel

Cellular and Trunking

Test Modes
Auto test/manual test

Auto Test Programs
Call processing only
Call and RF testing
Brief testing
Comprehensive testing

Parametric Auto Test Routines

AF Frequency	AF Level
FM Deviation	Mod frequency
Rx Distortion	Rx Expansion
Rx Sensitivity	Rx SINAD
Rx S/N	Tx Compression
Tx Distortion	Tx Frequency
Tx Level	Tx Power Level
Tx Limiting	Tx Mod Level
Tx Noise	Tx SINAD
Tx S/N	

Signaling Auto Test Routines
Registration/Roaming Update
Place Call
Page Mobile
Clear from Land
Clear from Mobile
Handoff
Hook Flash
DTMF Decode
Data Performance
PTT On
PTT Off
SAT Deviation
SAT Frequency
ST Duration
ST Frequency
ST Deviation
DSAT Deviation

Frequency Standard

INTERNAL FREQUENCY STANDARD (TCXO)

Frequency
10 MHz

Temperature Stability
Better than 0.5 ppm, 0 to 50°C

Ageing Rate
Better than 1 ppm per year

Warm up
1 minute to specified accuracy

EXTERNAL FREQUENCY STANDARD INPUT

Frequency
1, 2, 5 and 10 MHz

Input Level
Greater than 1 V peak to peak

Input Impedance
Nominally 1 kΩ

General

Keyboard and Display
Logical colour coded keyboard with bright high resolution fast LCD

Display Size
160 x 85 mm

RS-232C
RS-232C interface is provided for printing and remote instrument control

Connector
9 way female 'D' Type

POWER REQUIREMENTS

AC Supply Voltage
100 V to 240 V (±10%)

AC Supply Frequency
45 Hz to 440 Hz

Maximum AC Power
190 VA

DC Supply Voltage
11 to 32 V

Maximum DC Power
100 W

Charge Output
13.8 V at 6 A max to charge a 12 V sealed lead acid battery

ElectroMagnetic Compatibility
Conforms with the protection requirements of Council directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2, 3, 4
EN60555-2	IEC 555-2

Safety
Complies with IEC 1010-1 , BS EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.
Approved to UL3111-1.

ENVIRONMENTAL

Rated Range of Use
0 to 50°C and up to 95% relative humidity at 40°C

Storage and Transport

Temperature
–40°C to +71°C

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential)

DIMENSIONS AND WEIGHT

Height
178 mm (7 in)

Width
380 mm (15 in)

Depth
457 mm (18 in)
(including handle, feet and covers)

Weight
Less than 11.4 kg, (<25 lb)

Options and Accessories

600 Ω MATCHING UNIT (OPTION 1)
Switchable 600 Ω balanced audio input and output
Switchable 20 dB attenuator on AF generator output

ANALOG SYSTEMS CARD (OPTION 2)
This option provides automatic testing for cellular, trunked and FM radios and a BASIC Interpreter for customized tests

HIGH STABILITY INTERNAL FREQUENCY (OCXO) STANDARD (OPTION 3)

Frequency
10 MHz

Temperature Stability
Better than 0.05 ppm, 5 to 55°C

Ageing Rate
Better than 0.1 ppm, per year, after 1 month continuous use

Warm-up Time
Less than 10 minutes to within 0.2 ppm at 20°C

PARALLEL INTERFACE (OPTION 4)
Allows direct connection of a parallel printer
Additionally provides four software programmable output lines

Printer Port

Connector
25 way female D type

Printers Supported
75, 100, 150 dots per inch laser printers, FX 80, FX 100 Epson format

Accessory Port

Connector
9 way female D type

Outputs
4 independently programmable output lines, each one configurable as a logic line or as a relay contact closure. +5V supply available

GPIB (OPTION 5)

Capability
For printing, remote instrument control or for programming of user defined test sequences.
Complies with the following subsets defined IEEE-488:-
SH1, AH1, T6, L4, SR1, RL1, DT0, EI, DC1

MEMORY CARD DRIVE AND REAL TIME CLOCK (OPTION 6)
The memory card facility allows the storage of results , set-ups screen dumps and user programs with SRAM cards. Meets PCMCIA 2 standard. Allows the current date and time to be stored with results to the memory card and/or printed with a screen dump.

SSB DEMODULATOR (OPTION 8)
The SSB demodulator allows signals to be demodulated either via the internal loudspeaker or via the accessory socket. Provides demodulation of SSB signals (upper and lower sideband).

Frequency Range
400 kHz to 1 GHz

AF Demodulation Range
10 Hz to 15 kHz

Distortion
Typically less than 3% at 1 kHz (300 to 3.4 kHz)

Detection Range
2 μV to 150 W

Features
Automatic detection of USB or LSB. BFO can be used for tuning of carrier for AM and FM radios.

NMT CELLULAR SOFTWARE (OPTION 10)

NMT 450	NMT 900
Benelux	NMTF
Austria	Spain
Malaysia	Indonesia
Saudi 1	Saudi 2
Thailand	Oman
Tunisia	Hungary
Poland	Russia
Czech	Bulgaria
Slovenia	Turkey
USER DEFINED NMT	

AMPS CELLULAR SOFTWARE (OPTION 11)
USER DEFINED AMPS

TACS CELLULAR SOFTWARE (OPTION 12)

E-TACS	TACS 2
C-TACS I	C-TACS II
J-TACS	N-TACS
USER DEFINED TACS	

MPT 1327 TRUNKING SOFTWARE (OPTION 13)

BAND III	JRC
UK WATER	HONG KONG
AUTONET	AMT
MADEIRA	NL-TRAXIS
NZ MPT1327	PH-INDO
USER DEFINED MPT	

PMRTEST SOFTWARE (OPTION 14)
USER DEFINED PMR for FM radios

http://www.ifrinternational.com

EDACS™ RADIO TEST SOFTWARE (OPTION 15)
Provides Auto/Manual test capability for EDACS™ radios. Up to 4 user defined variants can be created and stored, each with up to 24 spot channel frequencies.
Performs bit error rate tests to check performance of receiver and transmitter.

EDACS™ REPEATER TEST SOFTWARE (OPTION 16)
Provides Auto/Manual test capability for EDACS™ repeaters. Up to four user defined variants can be created and stored, each with up to 24 spot channel frequencies. A data logging facility is also available to continuously decode and display data messages from the repeater under test.

EDACS is an Ericsson GE registered trademark. IFR Ltd is an EDACS trunking licensee.

DEMODULATION FILTERS (OPTION 21)
Provides a range of high selectivity channel filters in Spectrum Analyzer Look and Listen mode. Shape factor approximates to ETSI requirements.

Bandwidths
5 kHz, 12.5 kHz, 25 kHz, 50 kHz and 300 kHz

POCSAG DECODE (OPTION 22)
Allows off-air decoding of POCSAG messages. Can decode a message as it is received, or decoding can be triggered from a user selectable RIC code or fixed message pattern.

Bit Rate
Automatically decodes any standard bit rate up to 4800 bits/s. Numeric or alphanumeric decoding is provided.
Number of received errors is displayed.

CCITT FILTER (OPTION 23)
Allows a CCITT filter to be inserted into either the demodulated audio path or the audio input path.

CMESS FILTER (OPTION 24)
Allows a CMESS filter to be inserted into either the demodulated audio path or the audio input path.

BAIL ARM/FRONT COVER (OPTION 30)
Provides a bail arm carrying handle and front panel cover and storage area. The bail arm will also provide additional viewing angles when mounted on a bench.

BATTERY PACK

Type
12 V Sealed lead-acid
Connector XLR Type

Capacity
7 AH (30 minutes operation)

Weight
3 kg (6.6 lb)

Charge time from instrument
16 hours

Notes
(1) At low modulation levels the residual AM/FM may become significant.

Versions and Accessories

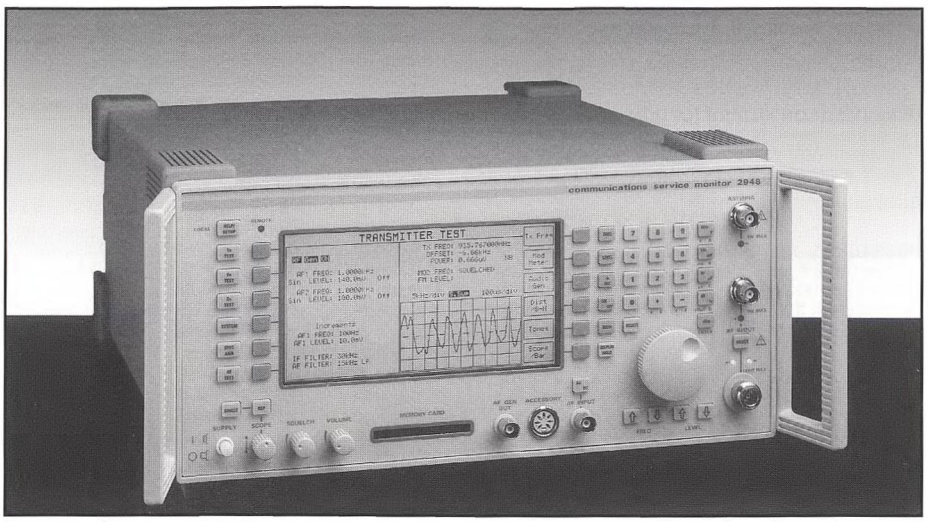
When ordering please quote the full ordering number information.

Ordering numbers	*Versions*
2945A	Communications Service Monitor
2946A	Avionics Service Monitor
2948	Low Phase-Noise Communications Service Monitor
	Options
Option 1	600 Ω Matching Unit
Option 2	Analog Systems Card
Option 3	High Stability OCXO
Option 4	Parallel Interface †
Option 5	GPIB Interface †
Option 6	Memory Card Drive with real time clock
Option 8	SSB Demodulator
	Note : Option 2 required when ordering any of the following options 10 to 16
Option 10	NMT Cellular
Option 11	AMPS Cellular
Option 12	TACS Cellular
Option 13	MPT 1327 trunking
Option 14	PMRTEST
Option 15	EDACS™ Radio Test
Option 16	EDACS™ Repeater Test
Option 21	Demodulation Filters
Option 22	POCSAG Decode
Option 23	CCITT Filter ††
Option 24	CMESS Filter ††
Option 30	Bail Arm and Front Panel Stowage cover
	Supplied Accessories
	AC Supply lead
	DC Supply lead
	Operating Manual
	Optional Accessories
44991/145	Microphone with PTT
59000/189	Memory Card (128k)
43113/021	Battery Pack for 2945A‡
46662/571	'Ever-Ready' Case
46662/616	'Ever-Ready' Case for use with Option 30
54112/163	Hard Transit Case
54431/023	20 dB AF Attenuator (BNC)
46884/728	Rack Mounting Kit
54421/001	BNC Telescopic Antenna
46884/650	Serial port to PC control cable (9 way)
46884/649	Serial port to PC control cable (25 way)
46884/648	RS-232 Printer cable (25 way)
54421/016	Fit Fast Installation Tester (70-1000 MHz) with Adapter
59999/170	RF Directional Bridge
54421/002	(1 to 50 MHz) RF Directional Power Head
54421/003	(25 to 1000 MHz) RF Directional Power Head
54432/012	(50 to 1000 MHz) Wideband Amplifier
46880/079	Service Manual

† Options 4 and 5 cannot be fitted together.
†† Options 23 and 24 cannot be fitted together.
‡ Battery Pack for previous model 2945 is still available under code 43113/018

2948
Low Phase-Noise Communications Service Monitor

All the benefits of the 2945A plus low phase noise signal generation, for the most demanding receiver testing requirements



- Low phase noise signal generator
- High stability reference oscillator (OCXO) as standard
- Accurate power measurement to 150 W
- Transient and harmonic analysis
- Fast response high resolution bar charts for peaking and nulling
- Tracking generator with full offset tracking
- Full span spectrum analyzer with 'live' look and listen
- Rugged, lightweight package

The 2948 is a second generation product utilizing the functionality of its well established predecessors, which includes a rugged housing, yet still retains the label of the lightest service monitor on the market today. Careful selection of the available test functions, combined with a comprehensive range of analog radio systems test solutions, gives this product an unparalleled appeal.

Low Phase-Noise Signal Generator

The 2948 differs from its 2945A cousin with the inclusion of a low phase noise signal source as standard. The provision of this enhanced capability enables the user to perform accurate measurement of noise characteristics on FM receivers and is especially beneficial when making accurate measurements on narrow band receivers. The performance of the 2948 Radio Test Set enables signal-to-noise measurements of better than 46 dB to be made on receivers with 12.5 kHz channel spacing.

Field Operation

DC operation plus the rugged lightweight construction makes the 2948 ideal for field use, especially when housed in the made to measure protective 'ever-ready' case. The built-in Live Look and Listen feature adds to the appeal for field use applications with its ability to examine signals on screen with an audible simultaneous demodulation capability. Intermittent interference and rogue transmissions can be quickly isolated, identified and saved to memory card for future analysis, should it be required - providing an invaluable tool for site survey requirements.

Specification

The 2948 includes all of the capabilities of the 2945A. **The following specifications therefore contain only those capabilities and specifications which are incremental relative to the 2945A.**

RF Signal Generator

SPECTRAL PURITY

Residual FM
Less than 6 Hz RMS (0.3 to 3.4 kHz) up to 500 MHz
Less than 12 Hz RMS (0.3 to 3.4 kHz) up to 1.05 GHz

Harmonics
Better than -25 dBc

Spurious Signals
Better than -50 dBc

SSB Phase Noise (20 kHz offset)
Better than -112 dBc/Hz up to 500 MHz
Better than -108 dBc/Hz up to 1 GHz

RF Carrier Leakage
Less than 0.5 µV PD generated in a 50 Ω load by a 2 turn loop 25 mm from the case. Output level less than -40 dBm into a sealed 50 Ω load.

AMPLITUDE MODULATION - INTERNAL

Accuracy
For carrier frequencies from 1.5 MHz to 1 GHz
±5% at 50% for modulation frequency of 1 kHz.

For carrier frequencies from 1.5 MHz to 400 MHz
±7% ±1 digit for modulation frequency of 1 kHz.
±10% ±1 digit for modulation frequencies from 50 Hz to 5 kHz.
±15% ±1 digit for modulation frequencies from 50 Hz to 15 kHz.

FREQUENCY MODULATION - EXTERNAL

Accuracy (1)
±7% ± 10 Hz at 1 kHz modulating frequency.
±10% at modulating frequencies from 50 Hz to 15 kHz.

Distortion
Less than 1% at 1 kHz for deviation of 5 kHz, CCITT weighted

Audio Voltmeter

Accuracy AC
±3% ±3 mV ±1 digit

Accuracy DC
±1% +50 mV up to 40 V

Audio Distortion Meter

Accuracy
±1 dB of reading ± 0.5% distortion

RF Power Meter (Broadband)

Maximum Continuous Rating
N-Type: 50 W at 20°C
BNC output: 5 W
Antenna port: 1 W

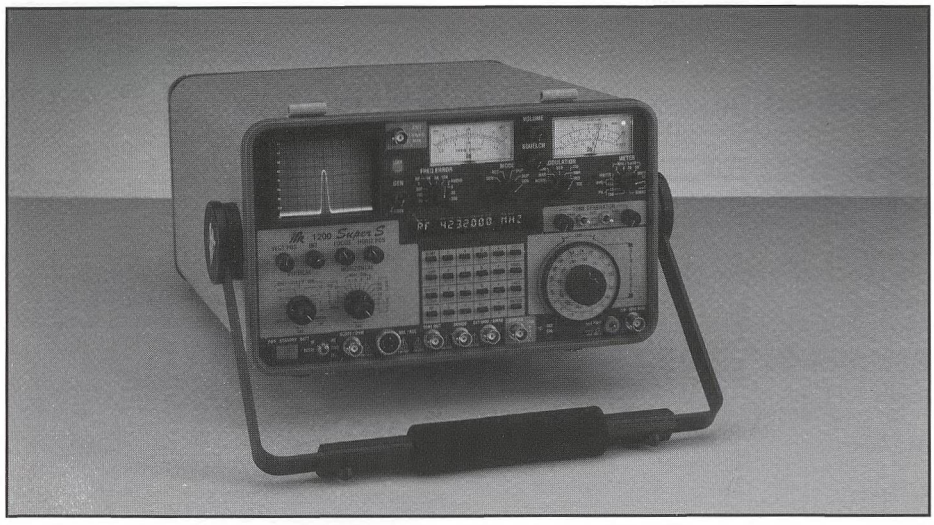
Versions and Accessories

See 2945A for general specification, ordering numbers, options and accessories

(1) At low modulation levels the residual AM/FM may become significant.

1200 Super S
Communications Service Monitor

A cost effective alternative for analog cellular, SSB, paging and mobile radio testing



- Analog meter and VFD (Vacuum Fluorescent Display) offer high visibility in all lighting conditions
- Convenient service analyzer with duplex and simplex connectors
- Standard internal spectrum analyzer to 1 GHz
- Built-in 1 MHz oscilloscope
- Optional AMPS/TACS mobile testing
- Comprehensive testing of analog and advanced digital paging with the AC510 option

RF Solutions

Designed for land mobile professionals with demanding RF testing requirements, the 1200 Super S has a sensitive 2 µV triple conversion receiver capable of monitoring AM, FM and SSB carriers within the low band, VHF, UHF and high band ranges.

Depending on your specific needs, the 1200 Super S also gives you the choice of receiving straight "off the air" or through a direct connection to a T/R port.

Recognized for its versatility, the 1200 Super S supports DCS, DTMF, MTS, IMTS and pulsed audio signaling formats.

The 1200 Super S also meets RF measurement needs for:-

- RF frequency error
- RF power
- Audio frequency error
- CTCSS frequency
- CTCSS modulation

In duplex mode the 1200 Super S is capable of simultaneously generating and receiving frequency offsets in 2.5 kHz steps. The duplex feature can be configured to operate in three modes:-

- Testing using separate transmit and receive ports
- Testing using one common transmit/receive port
- "Off-the-air" duplex testing

With standard features like a 1000 MHz spectrum analyzer and built-in 1 MHz oscilloscope, the 1200 Super S virtually eliminates the need for costly additional equipment purchases. An optional tracking generator makes cable testing simple.

Paging Solutions

The versatility of the 1200 Super S also allows comprehensive testing of the most popular paging protocols, including encode/decode or 2-tone sequential, 5/6 Tone testing and a European Signaling option.

For those involved with advanced paging protocol systems, the AC510 option supports the following paging standards:

- FLEX
- POCSAG
- Golay Sequential Code (GSC)
- NEC D3

Trunking Solutions

With the CLEARCHANNEL LTR® trunking option, the 1200 Super S is an ideal platform for testing LTR mobiles, portables and repeaters. For basic repeater testing, the 1200 Super S allows you to perform extensive receiver and transmitter tests. For more in-depth analysis, the LTR test option emulates the repeater system and allows testing of home repeater access and next repeater access, including Handshake and Hand-off operation.

In addition, with 760 trunking channels, an internal tracking generator and user friendly LTR programming screens, the 1200 Super S is designed to give you the greatest control and flexibility possible.

Cellular Solutions

The 1200 Super S can also be ordered with an AMPS mobile terminal test option. With it you can choose the manual mode to perform either a cell or mobile initiated call. In either mode, the instrument measures transmitter power, frequency levels, frequency error, SAT frequencies and deviation. Switch to the automatic mode and the 1200 Super S gives you all the measurements found in the manual mode, plus SAT and ST deviations.

The 1200 Super S also supports TACS / ETACS mobile station testing. And for maximum performance, the channel mode allows users to manually input cellular system channels.

Complex Functionality That's Simple to Use

From the user interface to functions and displays, the 1200 Super S allows technicians of any skill level to fully utilize its vast testing resources.

- Intuitive user interface makes complex testing simple and efficient.
- CTCSS encode/decode feature makes it easy to work with sub-audible tones.

1200 Super S

- A standard RS-232 port allows remote testing.
- Internal memory allows storage of up to 99 RF frequencies.

From programming automatic test sequences to executing standard measurements, the operating system of the 1200 Super S provides a high level of testing. Yet the 1200 Super S is so user-friendly, you'll spend less time setting up tests and more time testing.

Specification

RF Signal Generator

Frequency Range
250 kHz to 999.9999 MHz

Resolution
100 Hz

Accuracy
Same as Master Oscillator

Output (T/R)

Range
-127 to -20 dBm

Resolution
10 dB steps with 11 dB vernier

Accuracy
2.5 dB
3.0 dB @ -20 dB attenuator setting

Spectral Purity Harmonics
-30 dBc

Spectral Purity Nonharmonics
-55 dBc

IF Image
≤-35 dB

Residual FM
<100 Hz (RMS, 0.3 to 3 kHz BW)

Input Protection
150 W

Duplex Generator

Frequency Range
0 to ±49.9975 MHz from receive frequency

Resolution
2.5 kHz

Accuracy
See Master Oscillator

Duplex Output Level
-40 dBm (Low), -15 dBm (High) into 50 Ω

Input Protection
0.25 W

T/R Port
-85 dBm ±10 dB fixed level

Modulation

Internal Frequency Modulation Range
0 to 50 kHz (1 kHz tone)

FM Rate
10 Hz to 30 kHz (Internal)
2 Hz to 30 kHz (External) (DC when in variable generate)

FM Accuracy
±5% of reading, ±3% of full scale (1 kHz tone)

FM Distortion
<1 % (to 20 kHz deviation)

EXT MOD Sensitivity
0.1 VRMS/kHz (- 0% + 30%)

Amplitude Modulation Range
0 to 90%

AM Rate
10 Hz to 10 kHz (30% maximum modulation above 5 kHz)

AM Accuracy
±5% of reading, ±3% of full scale (1 kHz tone)

AM Distortion
<10% (to 60% modulation)

EXT MOD sensitivity
0.01 VRMS (0% to +30%)

Audio Generators

Generator #1 Frequency Range
1 kHz

#1 Accuracy
Same as Master Oscillator

#1 Output Range
0 to 2.5 V (RMS, into 150 Ω)

#1 Distortion
<0.5%

#1 Waveshape
Sine

Audio Generator #2 Frequency Range:
10 Hz to 30 kHz

#2 Resolution
0.1 Hz

#2 Accuracy
±0.01%

#2 Output Range
0 to 2.5 V (RMS, into 150 Ω)

#2 Distortion (at 2.5 VRMS)
<2% (10 Hz to 100 Hz) < 0.7% (100 Hz to 30 kHz)

#2 Waveshapes
Sine, Square, Ramp, Triangle, TTL

Receiver

Frequency Range
100 kHz to 999.9999 MHz

Resolution
100 Hz

Sensitivity
2 µV typical (1 MHz to 1000 MHz, FM narrow)

Antenna Input Protection
0.25 W

Selectivity

Mode	*Rx BW*	*AF BW*
FM WIDE	200 kHz	80 kHz
FM MID	200 kHz	8 kHz
FM NAR	15 kHz	8 kHz
SSB	6 kHz	8 kHz
AM NAR	6 kHz	8 kHz
AM NORM	15 kHz	8 kHz

Adjacent Channel Rejection

Rx BW	*BW >40 dB Down*
200 kHz	±300 kHz
15 kHz	±27 kHz
6 kHz	±12 kHz

Demodulation Output

AM Output Level
5 mV RMS/%

FM Output Level
60 mV RMS/1 kHz

Impedance
600 Ω

RF Frequency Error Meter

Meter Range
± 30 Hz to ± 10 kHz (full scale, 1-3-10 sequence)

Meter Accuracy
± Master Oscillator, +3% of full scale

AF Frequency Error Meter

Frequency Range
10 Hz to 12 kHz

Meter Range
±3 Hz to ±300 Hz (full scale, decade sequence)

Meter Accuracy
±0.01%, ±3% of full scale

FM Deviation Meter

Meter Range
2 kHz to 60 kHz (full scale, 2-6-20 sequence)

Meter Accuracy
±5% of reading, ±3% of full scale (1 kHz tone)

AM Modulation Meter

Meter Range
60% and 200% full scale

Meter Accuracy
±5% of reading, ±3% of full scale (1 kHz tone)

RF Power Meter

Input Level Ranges
0 to 15 W and 0 to 150 W (peak or average responding)

Accuracy
±7% of reading, ±3% of full scale (1 to 600 MHz)
±20% of reading, ±3% of full scale (600 to 1000 MHz)

Operating Conditions
50 W continuous
>50 W to 150 W (1 min on, 5 min off)

Distortion Meter

Range
0 to 20 % at 1 kHz

Accuracy
±1 % (at 10% distortion)

Signal Frequency
1 kHz

Input Level
0.25 to 2 VRMS

Input Impedance
10 kΩ nominal

SINAD Meter

Range
3 to 20 dB at 1 kHz

Accuracy
±1 dB (at 12 dB SINAD)

Signal Frequency
1 kHz

Input Level
0.25 to 2 VRMS

Input Impedance
10 kΩ nominal

Spectrum Analyzer

Level Display
10 dB/div

Dynamic Range
70 dB

Log Linearity
±2 dB (-90 to -30 dBm)

Frequency Span Modes

Scan Width	*RBW*
1 MHz/div	30 kHz
500 kHz/div	30 kHz
200 kHz/div	30 kHz
100 kHz/ div	30 kHz
50 kHz/div	30 kHz
20 kHz/div	3 kHz
10 kHz/div	3 kHz
5 kHz/div	3 kHz
2 kHz/div	300 Hz
1 kHz/div	300 Hz

Oscilloscope

Bandwidth (3 dB)
DC to 1 MHz

Input Ranges
10 mV/div to 10 V/div (decade sequence)

Horizontal Sweep Rate
10 msec/div to 10 µsec/div (decade sequence)

Digital Voltmeter

AC VOLTS

Voltage Range
0 to 100 VRMS

Accuracy
10% ± 2 counts

Frequency Range
45 Hz to 10 kHz

DC VOLTS

Voltage Range
0 to 100 V

Accuracy
10% ± 2 counts

Master Oscillator

TCXO

Temperature Stability
±0.2 ppm (0 to 50°C)

Ageing
±0.5 ppm/year

Power Requirements

Line Voltage
105 to 130 VAC
210 to 260 VAC

Frequency
50 to 400 Hz

Power Consumption
60 W typical

DC Input
12 to 30 VDC

General Characteristics

Dimensions
332 mm (13.06 in) wide, 185 mm (7.3 in) high, 445 mm (17.5 in) deep

Weight
17.2 kg (38 lb) without options

0.05 ppm OCXO (Premium)

Stability
0.05 ppm/year (0 to 50°C)

Generate Amplifier (Premium)

Gain
30 dB (±2 dB) typical, 250 kHz to 1000 kHz

Test Set Output with Analyzer Installed
Variable to +10 dBm, FM and CW
Variable to +4 dBm, AM

Tracking Generator (Premium)

Frequency Range
1 to 999.9999 MHz

Output Level

Track High	-5 dBm (+3/-5 dB)
Track Mid	-15 dBm (±7 dB)
Track Low	-40 dBm (+5/-10 dB)

Flatness
±1 dB over center 30% of display
±5 dB over remaining display

Tracking Span
10 kHz to 10 MHz

Output Impedance
50 Ω (nominal)

Spurious
Harmonic and non harmonic are <5 dBc, <10 dB typical
Image (RF + 180 MHz) 0 dB typical

Dynamic Range
70 dB

Tracking Range
200 Hz to 1.0 kHz

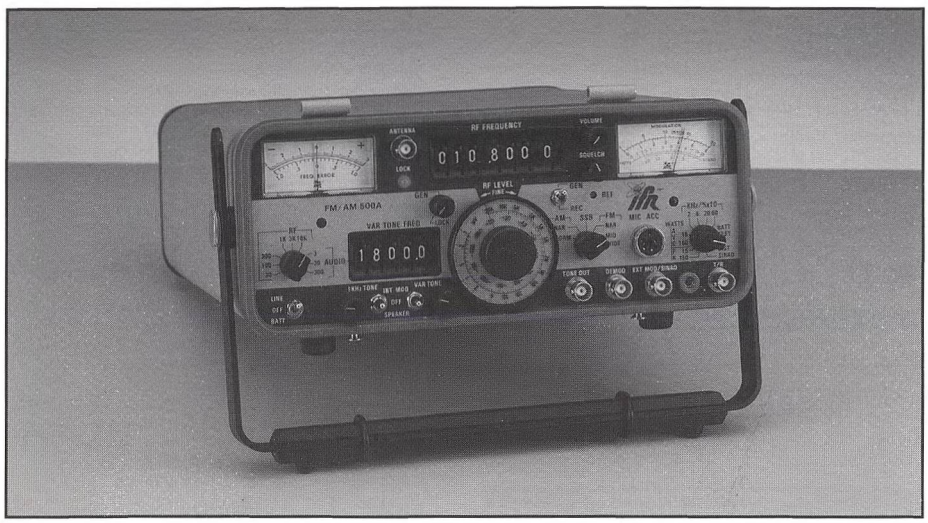
Versions and Accessories

When ordering please quote the full order number information

Ordering Numbers	*Versions*
1200SS-110	1200 Super S, 110 VAC
1200SS-110-C	1200 Super S, 110 VAC with Certificate of Calibration
1200SS-220	1200 Super S, 220 VAC operation
1200SS-220-C	1200 Super S, 220 VAC with Certificate of Calibration
1200SSP-110	1200 Super S Premium (0.05 ppm OCXO time base, tone signaling, tracking generator) 110 VAC operation
1200SSP-110-C	1200 Super S Premium, 110 VAC, Cert. Cal
1200SSP-220	1200 Super S Premium, 220 VAC operation
1200SSP-220-C	1200 Super S Premium, 220 VAC with Certificate of Calibration
	Accessories
AC0002	Soft padded carrying case
AC0450	AMPS/ETACS mobile station test (not avail. with AC0488)
AC0488	IEEE-488 (in lieu of RS-232) (not avail. with 1200SSP or AC0450)
AC0489	CLEAR CHANNEL LTR
AC510	Paging encoder
AC1201	Telescopic antenna
AC1205	Microphone
AC2200	Maintenance manual
AC2201	Rack mounting kit
AC4101	Return loss bridge 5 MHz to 1 GHz (req. 1200 Super S Premium)
AC5249	Generate Amplifier +30 dBm

FM/AM-500A
Communications Service Monitor

A low cost, proven service monitor for a variety of wireless communications test requirements



- FM and AM Signal Generator
- 2 µV receiver for AM, FM and SSB
- Analog meters offer high visibility in all lighting conditions
- Paging test for analog paging formats and advanced digital paging with the AC510 option
- 0.2 ppm TCXO

Proven Performance

The FM/AM-500A is a communications service monitor that gives you the performance, field portability and durability you need in a value-priced and compact package.

Since its introduction, the FM/AM-500A has earned a loyal following among wireless testing professionals. It is an incredibly rugged and field-proven communication test set.

With proven performance, the FM/AM-500A is the perfect test solution for a wide range of wireless communication test requirements.

Typical applications include FM/AM testing, conventional two-way radio test, SSB testing and basic communication systems performance tests.

Standard Features

- FM and AM Signal Generator
- 2 µV receiver for AM, FM and SSB
- 10 Hz to 9999.9 Hz variable audio generator and audio frequency error meter
- 1 kHz audio generator
- Frequency error meter with 1 Hz resolution
- Peak/Average watt meter
- Deviation measurement to 60 kHz
- SINAD/Distortion Meter
- 0.2 ppm TCXO
- Microphone input
- Audio demodulator output

Specification

RF Signal Generator

Frequency Range
250 kHz to 999.9999 MHz

Resolution
100 Hz

Variable Generate
Continuous tuning ±10 kHz from selected frequency

Residual FM
<100 Hz peak RMS

RF Output Power
-127 dBm to -20 dBm (10 dB steps with 11 dB range continuous vernier)

RF Output Accuracy
±3 dB

Output Impedance
50 Ω Nominal

EXTERNAL MODULATION

Frequency Response

FM	2 Hz to 30 kHz (DC when in variable generate)
AM	10 Hz to 10 kHz (30% maximum modulation above 5 kHz)

Modulation Sensitivity

FM	0.08 VRMS/kHz ±30% of reading
AM	0.01 VRMS/%

Distortion (1 kHz tone)

FM	<1% to 20 kHz deviation
AM	<10% to 60% modulation

Input Impedance
Greater than 10 kΩ

Audio Generator

Operating Modes

Internal	Modulation/Tone Out level controlled by 1 kHz or variable control
Speaker	Tone applied directly to speaker with volume controlled by 1 kHz or variable control.
External + Internal	External modulation input is summed directly with tones and applied to modulator

Tone Accuracy

Fixed	Same as master oscillator
Variable	±0.01%

Tone Distortion (@ 2.5 VRMS Output)

Fixed	<0.5%
Variable	±0.5% @ 1 kHz, <1.5% 10 Hz to 9999.9 Hz

Tone Output Level
0 to 2.5 VRMS into 150 Ω load

Frequency Range
10 Hz to 9999.9 Hz in 0.1 Hz increments

Generate Amplifier

Gain
30 dB ±2 dB typical, 100 kHz to 1000 MHz

Test Set Output with Amplifier Installed
Variable to +10 dBm, FM and CW
Variable to +4 dBm, AM (nominal)

Power Meter

Range
0 to 15 and 0 to 150 W peak or average responding

Accuracy

1 to 600 MHz	±7% reading ±3% full scale
600 to 1000 MHz	±20% reading ±3% full scale

Input Power
25 W continuous
150 W - 1 minute on, 5 minutes off

Receiver Monitor

Frequency Range
100 kHz to 999.9999 MHz in 100 Hz increments

Sensitivity
2 µV (1 MHz to 1000 MHz, FM Narrow)

Demodulation Output Impedance
600 Ω

Frequency Error Meter

RF Accuracy
±Master Oscillator, ±3% of full scale

RF Ranges
±10 kHz, ±3 kHz, ±1 kHz, ±300 Hz, ±100 Hz, ±30 Hz full scale

Audio Counter Ranges
±300 Hz, ±30 Hz, ±3 Hz full scale

Audio Counter Accuracy
±0.01%, ±6% of full scale

Modulation Meter

Type
Maximum of positive or negative peak (AM and FM)

FM Deviation Accuracy
±5% of reading, ±3% of full scale

AM% Modulation Accuracy
±5% of reading ±3% of full scale

SINAD Distortion Meter

SINAD Range
3 to 20 dB @ 1 kHz

Accuracy
±1 dB at 12 dB SINAD

Input Level
0.25 VRMS to 2 VRMS
(10 VRMS maximum SINAD)

Impedance
10 kΩ nominal

Distortion Range
0 to 20% at 1 kHz

General Characteristics

Dimensions
292 mm (11.5 in) wide, 124 mm (4.9 in) high, 363 mm (14.3 in) deep

Weight
9.9 kg (22 lb) with battery

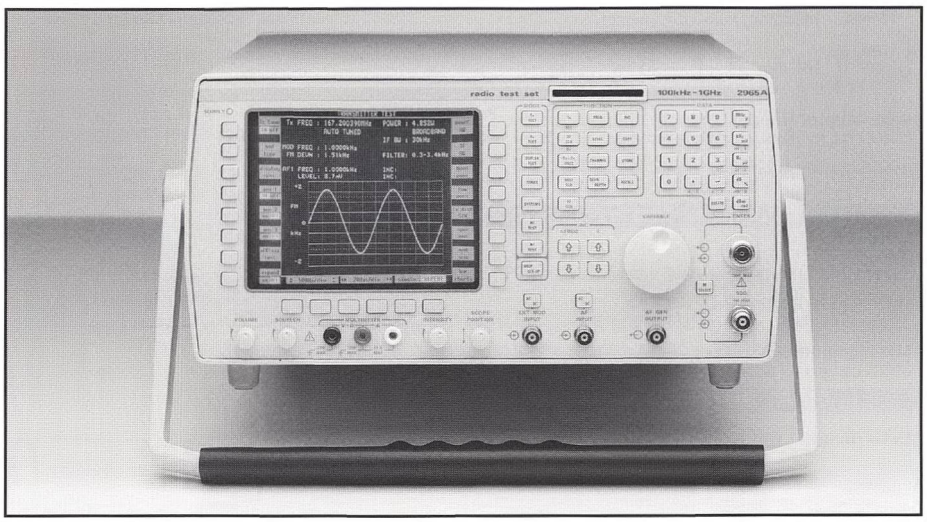
Versions and Accessories

When ordering please quote the full order number information

Ordering Numbers	*Versions*
500A-110	FM/AM-500A, 110 VAC operation
500A-110-C	FM/AM-500A, 110 VAC, with Certificate of Calibration
500A-220	FM/AM-500A, 220 VAC operation
500A-220-C	FM/AM-500A, 220 VAC operation, with Certificate of Calibration
500A-T-110	FM/AM-500A, 110 VAC, with 0.05 ppm OCXO time base
500A-T-110-C	FM/AM-500A-T-110, with Certificate of Calibration
500A-T-220	FM/AM-500A, 220 VAC, 0.05 ppm OCXO timebase
500A-T-220-C	FM/AM-500A-T-220, with Certificate of Calibration
	Accessories
AC0005	Soft Padded Carrying Case
AC510	Paging Encoder
AC1201	Telescopic Antenna
AC1205	Microphone
AC5201	Maintenance Manual
AC5249	Generate Amplifier +30 dB gain

2965A
100 kHz to 1 GHz Radio Test Set

A high performance and comprehensive radio test set that provides fast tests for increased throughput



- Fast and accurate radio testing
- High performance, full span spectrum analyzer
- Tracking generator with variable level and offset tracking
- FFT analyzer for audio and modulation signals
- 500 kHz digital storage oscilloscope
- Variable Frequency SINAD/Distortion
- Accurate broadband power meter from 1 mW to 150 W
- Selective power meter with 2 µV sensitivity

The 2965A Radio Test Set builds on the benchmark performance of its 2955 series predecessors by offering superior speed and ease of use. Its benefits include competitive pricing and performance, well proven ergonomics and broad range of applications and options. It boasts many features that are not found in test sets selling for much higher prices. The design allows high speed of operation and accuracy of measurements, resulting in higher throughput and the application of tighter test limits.

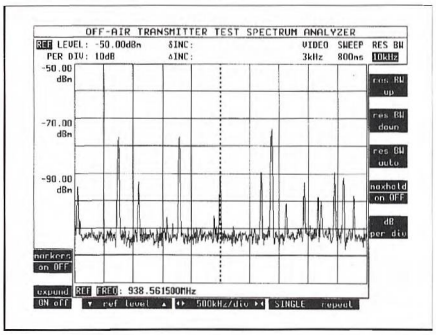
Standard Features

The 2965A Radio Test Set follows the philosophy of offering a complete package with many of the features as standard. Among the standard features of the 2965A Radio Test Set are full span spectrum analyzer, tracking generator, broadband power meter, 500 kHz oscilloscope and a PC compatible memory card with internal autorun capability.

The 2965A Radio Test Set includes RF and LF high performance spectrum analyzers with features that are normally only found on dedicated high performance spectrum analyzers.

RF Spectrum Analysis

The RF spectrum analyzer allows fast high resolution analysis of signals applied to either of the RF inputs over a wide dynamic range including off-air signals. Facilities include flexible frequency level settings, steerable markers for absolute or relative measurement of level or frequency and control of the resolution bandwidth.



The update rate is remarkable for this type of product, allowing real-time measurements on off-air signals.

The tracking generator provides a convenient method of alignment for filters and sub-modules whilst the offset generator facilitates mixer testing.

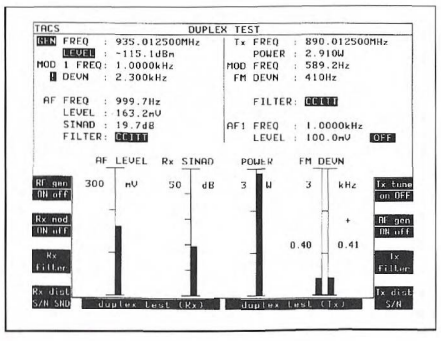
LF Spectrum Analysis

The FFT analyzer allows analysis of audio signals demodulated from RF or via the audio input. Interference and intermodulation products can be analyzed and distortion observed at a range of frequencies. An automatic sweep facility to 20 kHz complements the manual facilities of the FFT.

Comprehensive Audio and Modulation Sources

Three LF generators are provided for audio stimulus along with three modulation sources - enabling the most complex signaling to be generated without the need for external oscillators. These sources can be combined to produce a single audio or modulation source to 100 kHz.

Major signaling protocols are included as standard to reduce the need for external encoders and decoders. User definable tones may be stored in non-volatile memory so that non-standard tone systems can easily be emulated.



Large Bright Display

The 2965A Radio Test Set is designed for intuitive operation. The large, bright, high resolution screen with its 22

associated soft keys has significant benefits for automated as well as manual testing. From switch on, the 2965A Radio Test Set welcomes the user with features that make radio testing simple, fast and accurate.

Selective Test Modes for Specific Tests

The 2965A Radio Test Set allows a wide range of radio testing.

The DUPLEX mode shows both transmit and receive paths so that any interaction can be observed. If one path needs closer examination, it may be selected without disturbing the other path.

The RF test mode is for testing repeaters, mixers and RF systems including SSB measurements. This mode also gives access to the tracking generator which can be configured to allow RF to IF and IF to RF conversions, doubler and ÷2 analysis. Likewise the AF Test mode provides audio testing when the RF is not required giving access to an audio sweep facility.

Comprehensive Cellular Testing

Testing of cellular and trunked radio is required at many stages in the life-cycle of a radio. For applications ranging from factory production through to repair and customer assurance, the test requirements vary considerably. Simple checks through to a full performance test of all the important radio parameters are required. The 2965A Radio Test Set meets all these demands and is flexible yet easy to operate.

The 2965A Radio Test Set provides 'cell site simulation'. This generates the signaling protocol that the radio would see from the real network. It is then possible to place and receive calls. This activates the receiver and transmitter, so that normal parametric measurements can be made. The signaling may also be verified, permitting faults and errors to be traced before releasing a phone on to the network.

All system options allow 'system definition' so that future changes and new country variants can be defined by the user. This flexibility ensures that the 2965A Radio Test Set can develop with a rapidly expanding market.

Built-in Automatic Tests

There are four built-in test programs, ranging from simple call processing to comprehensive performance testing. Each of the tests may be run in a variety of ways to suit individual requirements. The 2965A Radio Test Set can offer a solution for every application using internally run programs.

Manual Test Mode

A manual testing mode is included, allowing tests to be repeated or varied to identify faults.

Data Displays

Data displays show the messages being sent to and from the radio under test. Corrupted messages are indicated on the display and the screen can be easily downloaded to a printer whenever the need arises.

Programming

The control capabilities and Autorun facilities of the 2965A Radio Test Set benefit users who are automating testing in an attempt to reduce failures. Programs can be written in an interpreted form of BASIC by the user and stored inside the instrument. Additional programs can be downloaded via the RS-232 into the user defined area allowing custom programs to be run. Speed is important in all aspects of testing particularly in automatic control. The 2965A Radio Test Set allows multi-tasking for parallel measurements to be made, further enhancing its speed.

Test Program Generation made easy

GPIB Edit and Runtime Software is a PC based test programming and test executive environment for developers of automatic test applications. It runs under Windows and allows the 2965A Radio Test Set to be programmed using high-level language commands. While providing simple access to its powerful facilities the software offers experienced designers the speed and efficiency benefits of a high-level programming environment. The 2965A Radio Test Set GPIB software driver implements all the control functions. Commands are provided for low level access to the 2965A Radio Test Set as well as the main test modes and measurements. The driver allows remote control of transmitter and receiver testing, off air signaling and general purpose RF and AF testing.

Size and Weight

Not only does the 2965A Radio Test Set pack the performance you would normally see on a bench full of instruments, it weighs in at under 18 kg (39.5 lb) so it is portable when the need arises.

Results Storage

Results may be stored in a number of ways. They may be transferred to the PC compatible memory card or sent via the RS-232 or parallel interface to a printer. The memory card meets the PCMCIA 2 standard for standardization of memory card formats.

Utilities Disk

A collection of PC software utilities is available to aid users in programming the 2965A Radio Test Set.

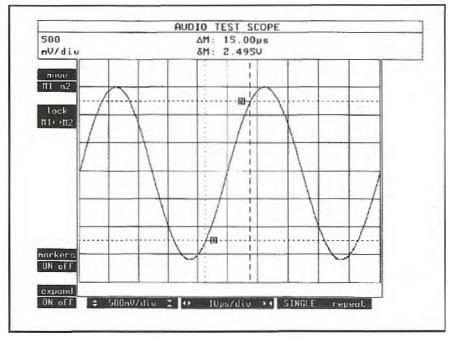
A screen capture facility is available so any screen displayed on the 2965A Radio Test Set can be saved direct to a PC, via the serial port, as a bit map file. These screens can then be imported into documents or retained on a database.

A GPIB command transfer program is also available for use with a suitably equipped PC – this program allows single command transfer, file transfer into internal memory and running of remote control programs.

APPLICATIONS

Base Stations

Many base stations are situated with other transmitters meaning that it is very important to control the problems of out of band radiation and intermodulation products. Most are multi-channel and operate in full duplex, which requires the use of combiners, duplexers and filters. The quality spectrum analyzer with tracking generator will greatly facilitate base station testing. The sensitivity of the receiver also allows remote monitoring and field strength measurements to be taken. The 2965A Radio Test Set is light enough and small enough to be easily carried on-site.

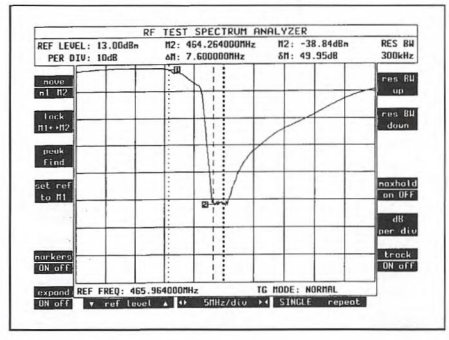


Antenna feeder forward and reverse power, and VSWR measurements can be made using the 2955 Directional Power Head accessories which are compatible with 2965A Radio Test Set.

The software to interface with the Directional Power Head is supplied as standard within the 2965A Radio Test Set.

Comprehensive audio waveform generation and analysis facilities are included for use with modems, speech processors, filters and tone encoders.

The inclusion of a 500 kHz DSO (Digital Storage Oscilloscope) allows audio and demodulated signals to be analyzed, including sequential tones. The multimeter function completes the picture.



Production

Modern production facilities for mobile radio equipment fall into two classes – fully automated and fully de-skilled. In the case of fully de-skilled processes remote control is of primary importance. The use of IEEE-488.2 commands and syntax, multi-tasking and high speeds make the 2965A Radio Test Set ideal. The ease of use of the Autorun capability, the small footprint and the low capital outlay per work station make it ideally suited to this application.

User calibration allows the instrument to be optimized for the operating environmental conditions, i.e. in an equipment rack or on the bench. Once run,

it will not be necessary to re-run the user calibration unless the operating or ambient temperature changes by more than 5°C.

Quality Assurance

With escalating exports of mobile radio equipment around the world, the need for acceptance testing and quality audits away from the production environment is increasing. It is essential in these situations that the tests be performed with equipment comparable to that used in production. It is often the case, however, that these remote centres are poorly funded and therefore the price/performance of the instrument is a key issue. The 2965A Radio Test Set provides a cost effective solution to meet these needs.

Research and Development

The 2965A Radio Test Set with its spectrum analyzer and high performance signal generator is ideal for use in research and development laboratories. The 2965A provides a complete solution for laboratory needs yet with flexibility to allow field testing and fault location to be easily achieved.

Surveillance

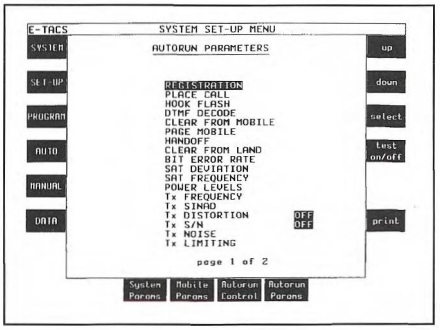
The needs for this market are growing. The basic tools of this trade are a spectrum analyzer and receiver. The 2965A Radio Test Set combines both these requirements.

Military

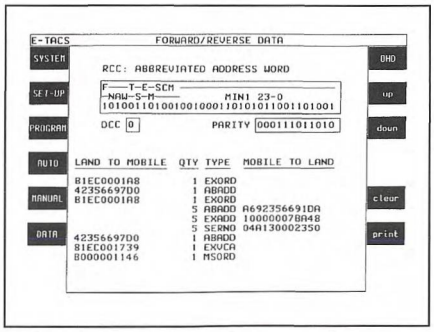
The capabilities of the 2965A Radio Test Set allow a wide range of military AM, FM and SSB radio equipment to be tested, including systems using tone signaling. High power handling capability (up to 150 W) saves the need for external power attenuators when testing vehicle radios.

Analog Cellular

2965A Radio Test Set has optional software for major analog systems which retain the ease of use and comprehensive test capability of the 2960 series.



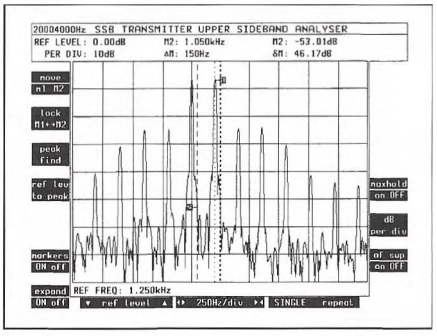
The data display mode allows the sequence of signaling on both the forward and reverse channels to be viewed on the same screen.



A GSM upgrade path is available for the 2965A Radio Test Set allowing effective testing of digital GSM systems.

SSB Option

The SSB option allows the demodulation of SSB transmissions with CW, upper and lower sideband analysis capabilities. The displayed frequency is always the carrier frequency, calculated from the mode (e.g. CW, upper SB and lower SB) and the audio generator frequency. Analysis capabilities include carrier and alternate sideband suppression to 50 dBc and audio analysis via the FFT. Two fully variable audio generators are available to perform two tone measurements.



Specification

Certain characteristics are shown as typical. These provide additional information for use in applying the instrument but they are unwarranted.
(Applies to version 7.00 and above)

RF Signal Generator

FREQUENCY

Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Resolution
1 Hz

Indication
10 digit display

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
As frequency standard

OUTPUT LEVEL

Range
One-port Dx:
N-Type socket: –135 dBm to –40 dBm
TNC socket: –115 dBm to –20 dBm

Rx Test and two port Dx modes:
N-Type socket: –135 dBm to –7 dBm
(–17 dBm with AM)
TNC socket: –115 dBm to +13 dBm
(+3 dBm with AM)

Resolution
0.1 dB

Indication
4 digits plus sign (dBm, dBμV, μV, mV PD/EMF)

Accuracy
N-Type socket:
±1 dB up to 575 MHz,
±1.5 dB up to 1 GHz for levels above –120 dBm
±1.2 dB 575 MHz to 1 GHz over the temperature range 15 to 35°C.

Carrier On/Off
Keyboard operation, reduces signal generator output to less than –120 dBm

Reverse Power Protection
N-Type socket: With instrument switched on 150 W. Overload indicated by visual and audible warning.

TNC socket: Protection up to 10 W. Reset available on removal of RF power. Excess power indicated by visual and audible warnings.

Output Impedance
50 Ω nominal

VSWR
N-Type socket: better than 1.2 up to 500 MHz; better than 1.3 up to 1 GHz (typically 1.2).
TNC socket: typically 1.3 at 900 MHz.

SPECTRAL PURITY

Residual FM (CCITT weighted)
Less than 6 Hz RMS up to 575 MHz
Less than 12 Hz RMS up to 1 GHz
Residual AM (CCITT weighted)
Less than 0.05% RMS

Harmonics
Better than –30 dBc for levels up to +7 dBm (TNC)
Better than –30 dBc for levels up to –13 dBm (N-Type)

Spurious Signals
Better than –45 dBc for carrier frequencies from 100 kHz to 36 MHz;
Better than –50 dBc for carrier frequencies above 36 MHz

SSB Phase Noise (20 kHz offset)
Better than –114 dBc/Hz up to 575 MHz;
Better than –108 dBc/Hz up to 1 GHz.

RF Carrier Leakage
Less than 0.5 μV PD generated at the carrier frequency in a 50 Ω load by a 2 turn loop 25 mm or more from the case with output level set to below –60 dBm and terminated in a sealed 50 Ω load.

AMPLITUDE MODULATION – INTERNAL

Frequency Range
100 kHz to 400 MHz, useable to 1.15 GHz

AM Depth Range
0 to 99%

Resolution
0.1%

Indication
3 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy[1] (up to 85% AM)
±4% of setting ±1 digit for modulation frequency 1 kHz
±6% of setting ±1 digit for modulation frequencies from 30 Hz to 10 kHz
±8% of setting ±1 digit for modulation frequencies from 10 kHz to 20 kHz

Distortion
Less than 1% at 1 kHz for modulation depths up to 30%, CCITT weighted
Less than 2% for modulation frequencies from 100 Hz to 20 kHz and depths up to 85%

Modulation Frequency
Range: 20 Hz to 15 kHz for carrier frequencies up to 36 MHz; 20 Hz to 20 kHz for carrier frequencies up to 400 MHz.
Resolution: 0.1 Hz below 10 kHz; 1 Hz below 20 kHz.

AMPLITUDE MODULATION – EXTERNAL

Input impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal AM

Modulation Frequency Range
As internal AM with AC or DC coupling

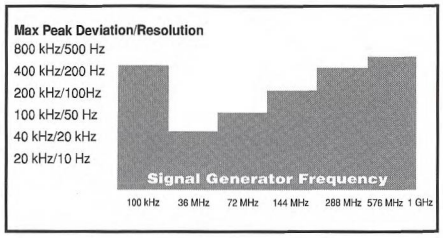
Accuracy
As internal ±2%

Input Sensitivity
1 V RMS for indicated modulation depth

FREQUENCY MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Maximum Deviation



Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control.

Accuracy[1]
±3% ±1 digit at 1 kHz over the range 15 to 35°C (0.1% per °C outside this range)
Typically ±3% ±1 digit for modulation frequencies from 20 Hz to 5 kHz
Typically ±7% ±1 digit for modulation frequencies from 5 kHz to 20 kHz
Typically ±10% ±1 digit for modulation frequencies from 20 kHz to 75 kHz

Distortion[1]
Less than 0.5% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 kHz to 800 kHz).
Less than 1% for modulation frequencies from 50 Hz to 20 kHz (for deviation 1 kHz to 800 kHz).

Modulation Frequency Range[6]
20 Hz to 20 kHz Mod generators 1, 2, 3 or
20 Hz to 100 kHz Mod generator 4

Resolution
0.1 Hz

FREQUENCY MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal FM

Modulation Frequency Range
DC to 100 kHz (DC coupled)
10 Hz to 100 kHz (AC coupled)

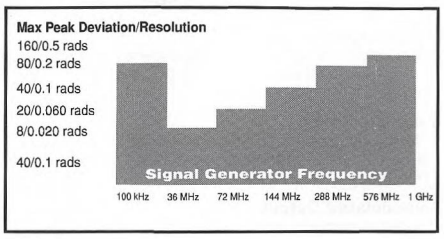
Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2% for frequencies up to 20 kHz

PHASE MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable to 1.15 GHz

Maximum Deviation



Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
±5% ±1 digit for modulation frequencies from 250 Hz to 3.4 kHz, over the range 15 to 35°C (0.1% per °C outside this range)

Distortion [1]
Less than 1% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 rad to 160 rads)

Modulation Frequency
Range: 250 Hz to 5 kHz

Resolution
0.1 Hz

PHASE MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal phase modulation

Modulation Frequency Range
250 Hz to 5 kHz

Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2%

INTERNAL MODULATION AND AUDIO SOURCES

Up to 6 tone sources can be assigned as 3 modulation generators and 3 audio tone generators

Modulation Modes
Internal generators may be assigned to AM, FM, ΦM

Audio Voltmeter

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
DC and 20 Hz to 500 kHz
AC only 20 Hz to 500 kHz
Polarized DC less than 10 Hz

Level Ranges
0 to 10, 0 to 30, 0 to 100, 0 to 300 mV, 0 to 1, 0 to 3, 0 to 10, 0 to 30 V RMS reading (autoranging or fixed)

Level Indication
4 digits and barchart with peak hold

Level Accuracy (DC Coupled)[3] [5]
±2% of reading ±1 mV ± resolution, DC and 100 Hz to 20 kHz
±4% of reading ±1 mV ± resolution, 40 Hz to 100 kHz

Level Accuracy (AC Coupled)[3]
±2% of reading ±1 mV, ± resolution 150 Hz to 20 kHz
±4% of reading ±1 mV, ± resolution 100 Hz to 100 kHz

Residual Noise
100 µV RMS CCITT weighted

Audio Frequency Meter

Range
10 Hz to 500 kHz

Resolution
0.1 Hz from 10 Hz to 5 kHz
1 Hz from 5 kHz to 50 kHz
10 Hz from 50 kHz to 500 kHz

Indication
6 digits

Accuracy
As frequency standard ±1 digit ± resolution

Sensitivity
On barchart greater than 25% FSD (DC coupled)

Audio SINAD Meter

Frequency
1 kHz default. User selectable up to 20 kHz

SINAD Range
5 to 50 dB

Resolution
0.1 dB for readings less than 20 dB
0.2 dB for readings less than 25 dB

Indication
3 digits and barchart with peak hold

Accuracy (bandpass filter selected)
±0.5 dB ± resolution

Sensitivity
100 mV for 46 dB SINAD

Audio Distortion Meter

Frequency
1 kHz default. User selectable up to 20 kHz

Distortion Range
0 to 100%

Resolution
0.1% distortion for readings greater than 1%
0.2% distortion for readings less than 1%

Indication
3 digits and barchart with peak hold.

Accuracy
±5% of reading ± resolution (Bandpass filter selected)

Sensitivity
100 mV for 0.5% distortion

Audio S/N Meter

S/N Range
0 to 100 dB

Resolution
0.1 dB for readings less than 50 dB
0.2 dB for readings less than 70 dB

Indication
3 digits and barchart with peak hold

Accuracy
±0.5 dB ± resolution

Sensitivity
2 V for 60 dB, 200 mV for 40 dB

Audio Oscilloscope

Operating Modes
Single or Repetitive sweep

Frequency Range
DC to 500 kHz
10 Hz to 500 kHz (AC coupled)

Glitch Catching
1 µs minimum

Voltage Ranges
2 mV/div to 20 V/div in a 1, 2, 5 sequence

Voltage Accuracy
±5% of full scale

Timebase
5 µs/div to 10 s/div in a 1, 2, 5 sequence

Timebase Accuracy
As frequency standard

Trigger Mode
Auto trigger

Marker Indication
Level: M1-M2, M2-M1
Time: M1-M2, M2-M1

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Audio FFT Analyzer

Span Widths
50 Hz to 50 kHz in a 5, 10, 25 sequence.
Above 40 kHz signals are attenuated by 80 dB/octave

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Level Reference (top of screen)
10 mV to 20 V, in a 1, 2, 5 sequence

Level Accuracy
±0.3 dB 100 Hz to 15 kHz; typically ±1 dB 40 Hz to 40 kHz

2965A

Vertical Scaling
1, 2, 5, 10 dB/div

Dynamic Range
60 dB

Max Hold Facility

Audio Sweep facility
DC to 20 kHz

Marker Indication
Level: M1, M2, M1-M2
Frequency: M1, M2, M1-M2

Audio Barcharts

Displays: AF voltage, SINAD, Distortion, S/N.
Vertical Resolution: 1% of full scale
Ranging: Autoranging, range hold or manual selection (up/down), 1, 3, 10 sequence with hysteresis
With peak hold facility

Audio and Modulation Filters

300 Hz Lowpass (±0.1 dB less than 150 Hz, ±0.2 dB, 150-200 Hz relative to 100 Hz).
300 Hz to 3.4 kHz Bandpass (±0.4 dB, 400 to 2100 Hz relative to 1 kHz).
5 kHz Lowpass (±0.3 dB at <3 kHz relative to 1 kHz)
20 kHz Lowpass ±0.3 dB at <12 kHz, typically –0.9 dB at <15 kHz and –3 dB at 20 kHz relative to 1 kHz
CCITT Psophometric
C-MESSAGE
See also under Environmental/User Calibration

Multimeter

Input Terminals
3 x 4 mm, 'Volt/Ohm', 'Current' and 'Common'

Maximum Input Voltage
375 V with respect to instrument chassis

VOLTMETER

Voltage Range
0 to 300 V, 0 to 30 V, 0 to 3 V, 0 to 300 mV, Terminals, 'Volt/Ohm' and 'Common', maximum crest factor 3:1 at range full scale

Frequency Range
Polarized DC or 40 Hz to 1 kHz

Input Impedance
Nominally 6 MΩ in parallel with 100 pF

Resolution
0.1% of FSD

Accuracy [5]
±3% of reading ±1 mV ±1 digit
See also under Environmental/User Calibration

Indication
4 digits and barchart with peak hold

AMMETER

Current Range
0 to 1 A and 0 to 10 A

Frequency Range
Polarized DC or 40 Hz to 1 kHz

Resolution
1 mA below 1 A; 10 mA below 10 A

Accuracy
±5% of reading ±1 mA ±1 digit

Indication
4 digits and barchart with peak hold

RESISTANCE METER

Resistance Ranges
100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ

Resolution
1 Ω below 1 kΩ or 3 digits

Accuracy [5]
±5% of reading ±1 Ω ±1 digit
Continuity Test continuous tone if reading is less than 10 Ω

Indication
4 digits and bar chart with peak hold

RF Frequency Meter

Range
100 kHz to 1 GHz

Resolution
1 Hz or 10 Hz selectable

Indication
Up to 10 digits

Accuracy
As Frequency Standard ±2 Hz ± resolution

Dynamic Range (Auto tuned)
As RF Power Meter (broadband)

Frequency Range (Auto tuned)
10 MHz to 999.9 MHz

Sensitivity
Manual tuned: –100 dBm (TNC) dependent on receiver bandwidth in off air test mode

Offset Frequency Range
±1 MHz dependent on receiver bandwidth

RF Power Meter (Broadband)

Frequency Range
100 kHz to 1 GHz

Dynamic Range (Auto tuned)
10 mW to 150 W (N-Type), 100 µW to 0.5 W (TNC)

Power Reading
True mean power

Indication Units
Watts

Resolution
Better than 1%

Indication
3 digits and barchart with peak hold

Accuracy[5]
100 kHz to 500 MHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type).
±10% (0.4 dB), 20 mW to 150 W (N-Type).
±12% (0.5 dB), 200 µW to 50 mW (TNC).

500 MHz to 1 GHz:
±12% (0.5 dB), 20 mW to 150 W (N-Type).
±15% (0.6 dB), 200 µW to 50 mW (TNC).
100 kHz to 1 GHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type) +10% (0.4 dB).
1 mW to 50 mW (TNC) for ambient temperatures in the range 15 to 35°C.
See also under Environmental/User Calibration

Maximum Safe Continuous Rating
N-Type: 50 W
TNC: 0.5 W; overload protected to 10 W

Intermittent Rating
N-Type: 150 W for limited periods, typically two minutes at 20°C. Typical off to on ratio is 6:1. Overload indicated by audible and visual warning

RF Power Meter (Selective)

Frequency Range
100 kHz to 1 GHz

IF Bandwidth
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Dynamic Range (Manual tuned)
0 dBm to +50 dBm (110 kHz IF bandwidth) (N-Type
–90 dBm to +20 dBm (110 kHz IF bandwidth) (TNC)

Power Reading
Average

Indication Units
dBm

Resolution
0.1 dB

Indication
3 digits + barchart with peak hold

Accuracy [5]
Typically ±2.5 dB N-Type & TNC
See also under Environmental/User Calibration

RF Spectrum Analyzer

Frequency
Range: 100 kHz to 1 GHz, useable from 30 kHz to 1.05 GHz

Spans
500 Hz/div to 100 MHz/div, in a 1, 2, 5 sequence

Resolution Bandwidth
300 Hz to 300 kHz in a 1, 3, 10 sequence and 3 MHz (automatically selected according to span and manually selectable).
Video bandwidth – fixed at 3 kHz

Filter Shape
Nominally 3 dB/60 dB, 1:11 (300 Hz to 30 kHz bandwidth)

Reference Level (top of screen)
–100 dBm to +70 dBm

On Screen Dynamic Range
80 dB

Vertical Resolution
0.5 dB on 10 dB/div, 0.05 dB on 1 dB/div

Level Accuracy [5]
Typically ±2.5 dB
See also under Environmental/User Calibration

Intermodulation Distortion
Less than 80 dB for 2 signals on screen at reference level

Sweep Speeds
Optimum sweep speed selected according to span and resolution bandwidth

Modes
Single sweep and continuous

Graticule
10 horizontal by 8 vertical divisions

Expanded Mode
Can be made to occupy full screen for high definition

Markers
M1 and M2

Indication
Level: M1, M2, M1-M2
Frequency: M1, M2, M1-M2

TRACKING GENERATOR
Available in RF TEST mode

Frequency Range
100 kHz to 1 GHz

Level Range
–135 dBm to +13 dBm

Offset Tracking
Allows testing of mixers, IFs, fundamental and 2nd harmonic analysis (up, down, x2, ÷2)

Modulation Analyzer

Dynamic Range (Auto tuned)
As RF Power Meter (Broadband)

Sensitivity (Manual tuned)
N-Type –30 dBm (110 kHz IF bandwidth)
TNC –50 dBm (110 kHz IF bandwidth)
TNC (off-air test mode) –101 dBm (2 µV 10 dB SINAD in 30 kHz IF bandwidth and CCITT weighting)

Demodulation
Accuracy maintained on signals greater than –60 dBm

Receiver Bandwidths
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Demodulation Filters
As audio analyzer plus 5 kHz lowpass (+0.3 dB at less than 3.4 kHz relative to 1 kHz)

Audio Output
Available in to an internal loudspeaker, demodulated output or accessory socket for external loudspeaker or headphones.

Switching Speed
Nominally less than 1 ms channel to channel up to 50 MHz apart, settling to within 1 kHz of final frequency

Demodulated Output
Nominal output impedance less than 10 Ω. Output voltage is range dependent (2 V peak at top of range).

http://www.ifrinternational.com

Squelch
A manual squelch control is provided with a variable threshold

AMPLITUDE MODULATION

Frequency Range
100 kHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

AM Depth Range
0 to 99.9%

Resolution
0.1% AM

Indication
3 digits and barchart with peak hold

Accuracy (up to 85% AM)[1] [5]
±% of reading, ±1% AM, 250 Hz to 5 kHz.
Typically ±5% of reading, ±1% AM, 50 Hz to 15 kHz.

Demodulation Distortion[1]
Less than 1% at 1 kHz, CCITT weighted

Residual AM
Less than 0.1% AM, CCITT weighted

FREQUENCY MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

Deviation Range
0 to 100 kHz

Resolution
10 Hz below 10 kHz deviation; 100 Hz below 100 kHz deviation

Indication
3 digits and barchart with peak hold

Accuracy [1] [3] [5]
±3% ± resolution for modulation frequency of 1 kHz
±5% ± resolution for modulation frequencies from 100 Hz to 15 kHz

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted

Residual FM
Less than 25 Hz RMS CCITT weighted

PHASE MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
250 Hz to 5 kHz

Deviation Range
0 to 20 rads

Resolution
0.01 rads

Indication
3 digits and barchart with peak hold

Accuracy [1] [3] [5]
±5% ± resolution

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted

Audio Generators

See section on modulation generators for interaction of audio and modulation generators.

FREQUENCY

Range[6]
1 Hz to 20 kHz AF Gens 1, 2 & 3 or
1 Hz to 100 kHz AF Gen 4

Setting
Keyboard entry, delta increment/decrement function and rotary control

Indication
6 digits

Resolution
0.1 Hz

Accuracy
As frequency standard

LEVEL

Range
0.1 mV to 5 V RMS (maximum AF output 7 V peak, all generators combined)

Setting
Keyboard entry, delta increment/decrement function and rotary control

Indication
4 digits

Resolution
0.1 mV

Accuracy
±3% ±1 digit, 250 Hz to 5 kHz
±5% ±1 digit, 10 Hz to 20 kHz
±10% ±1 digit, 20 kHz to 75 kHz

Output Impedance
Nominally 5 Ω

Protection
Maximum applied voltage 50 V

SIGNAL PURITY

Distortion[2]
Less than 0.5% at 1 kHz measured in a 30 kHz bandwidth
Less than 1% from 20 Hz to 20 kHz measured in an 80 kHz bandwidth
Typically 0.1% for levels greater than 100 mV

Residual Noise
Less than 50 µV RMS (CCITT weighted)

DC Offset
Less than 10 mV

Signaling Encoder/Decoder

Sequential tones functions
Encodes and decodes up to 40 tones.
CCIR, ZVEI, DZVEI, EEA, EIA or user defined.
Any of the tones may be extended.
Continuous, burst and single step modes available.

User defined tones
Up to three frequency plans may be defined and stored within the 2965 for sequential tones.
Any of the standard tone frequency plans may be copied to user defined and modified.
Tone length 10 ms to 1 s.
Extended tone length 100 ms to 10 s.

CTCSS tones mode
Standard tone frequencies may be selected from a menu

DTMF Encoder/Decode
Generation and decode of DTMF tones, displaying Hi/Lo frequencies, frequency error, timing information and twist.

DCS Encode/Decode
Generation and decoding of digitally coded squelch

POCSAG generator
Generation of POCSAG code CCIR No.1 Rec 584. Bit rates from 400 to 9600 bit/s

Audio Monitor

Audio and demodulation signals and audio signals may be monitored via the internal loudspeaker or via the accessory socket output or BNC socket on the rear panel

SSB Option

SSB Tx

Frequency, Range and meter accuracy	– as RF frequency
Power, level and meter accuracy	– as Broadband power
Detection Range	– 100 µV to 150 W
AF Demod range	– 10 Hz to 5 kHz
Demod distortion	– <2% @ 1 kHz, CCITT weighted
Carrier and Alternate s/band suppression	– Better than –50 dBc
Sideband/CW Analyzer	– max 5 kHz full span frequency range
Spectrum Analyzer	– as RF spectrum analyzer
Audio Generator	– two – as audio generator
Sideband Selection	– LSB, USB, CW

SSB Rx

Sideband Generator	– as RF Gen (AM mode)
Offset measurement	– to 0.1 Hz resolution
SINAD	– as SINAD meter
Distortion	– as Distortion meter

Note: No audio is available in SSB option

General Features

INTERFACES

Keyboard and Display
Logical color coded keyboard with bright high resolution CRT

GPIB
Full control of all major instrument functions via the GPIB interface
Flexibility is further enhanced by IFR's implementation of IEEE-488.2.

Capability
Complies with the following subsets as defined in IEEE-488.1-1978:- SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, E1.

Serial
Serial interface is provided for connection of RS-232 for instrument remote control. 9 Way socket. Control language is based on IEEE P1174.

Parallel Printer
Connector 25 way female D-Type. Provision made for graphics screen dump. A selection of printer drivers are included.

Accessory Socket
Allows the connection of various optional accessories.
With suitable adapters is compatible with most 2955 series accessories.

Memory Card
Meets PCMCIA2/JEIDA – 4 standard. The memory card facility allows the storage of results and set ups.

Video Output
Color, compatible with most VGA monitors.
15 way Sub Miniature D Type.

Frequency Standard

Internal Frequency Standard Output

Frequency
10 MHz

Level
Nominally 2 V pk-pk

Output Impedance
Nominally 50 Ω

Temperature Stability
Better than 5 in 10^8, 5 to 50°C

Ageing Rate
Better than 1 in 10^7 per year, after 1 month continuous use

Warm Up Time
Less than 10 minutes to within 2 in 10^7 at 20°C

External Frequency Standard Input

Frequencies
1, 2, 5 and 10 MHz

Level
From 1 V pk-pk to 5 V pk-pk

Input Impedance
Nominally 1 MΩ in parallel with 40 pF

Power Requirements

AC supply

Voltage
88 V to 132 V and 188 V to 265 V

Supply frequency
45 Hz to 65 Hz

Power
Nominally 135 W, 260 W maximum, for future options

Electromagnetic Compatibility

Conforms with the protection requirements of Council directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR11
EN50082-1	IEC 801-2, 3, 4
EN60555-2	IEC 555-2

Safety

Complies with IEC 1010-1, BS EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Environmental

Rated Range Of Use
0 to 50°C and up to 95% relative humidity at 40°C.

User Calibration

User calibrations are provided to maintain high accuracy for any ambient temperature (e.g. in ATE racks or in field measurements). Having allowed the instrument to stabilize, running the user calibrations optimizes the performance at that temperature.
A change in temperature of 5°C from the calibration temperature affects readings as below. These figures are provided as a guide to typical performance.
Typical variations are as follows for a 5°C change in temperature.

Power Meter:	Broadband	2%
	Selective	0.5 dB
Spectrum Analyzer Level		0.5 dB
Audio Analyzer & Modulation Filters		
	Audio Voltage	0.4%
	Demod depth & deviation	0.4%
Multimeter:	Voltage	0.5%
	Current	0.5%

STORAGE AND TRANSPORT

Temperature
−40 to +70°C

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential)

Internal Test Software

OPTION 10 NMT CELLULAR SOFTWARE

NMT450	NMT900
Benelux	NMTF
Austria	Spain
Malaysia	Indonesia
Saudi 1	Saudi 2
Thailand	Oman
Tunisia	Hungary
Poland	Russia
Czech	Bulgaria
Slovenia	Turkey

USER DEFINED NMT

OPTION 11 AMPS CELLULAR SOFTWARE

E-AMPS	N-AMPS

USER DEFINED AMPS

OPTION 12 TACS CELLULAR SOFTWARE

E-TACS	TACS-2
C-TACS I	C-TACS II
J-TACS	N-TACS

USER DEFINED TACS

OPTION 13 MPT1327 TRUNKING SOFTWARE

Band III	JRC
UK Water	Hong Kong
Autonet	AMT
Madeira	NL-TRAXYS
NZ MPT1327	PH-INDO

USER DEFINED MPT

OPTION 14 PMRTEST SOFTWARE
USER DEFINED PMR for FM radios

General Features (Systems)

Test Modes
Auto Test/Manual Test

Auto Test Programs
Call Processing Only
Call and RF Testing
Brief Testing
Comprehensive Testing
User Defined Test

Parametric Auto Test Routines

AF Frequency	AF Level
FM Deviation	Mod Frequency
Rx Distortion	Rx Expansion
Rx Sensitivity	Rx SINAD
Rx S/N	Tx Compression
Tx Distortion	Tx Frequency
Tx Level	Tx Power Level
Tx Limiting	Tx Mod Level
Tx Noise	Tx SINAD
Tx S/N	SAT Deviation
SAT Frequency	ST Duration
ST Frequency	ST Deviation
Data Deviation	DSAT Deviation

Signaling Auto Test Routines
Registration/Roaming Update
Place Call
Clear From Mobile
Page Mobile
Handoff
Clear From Land
Hook Flash
DTMF Decode
Data Performance
PTT On
PTT Off

Auto Test Pause Modes
Pause Manual Only
Pause On Failure
Pause Always

DIMENSIONS AND WEIGHT
Excluding handle, feet and covers.

Height	*Width*	*Depth*
177 mm (6.9 in)	370 mm (14.5 in)	540 mm (21.2 in)

Including handle, feet and covers.

Height	*Width*	*Depth*
203 mm (7.9 in)	420 mm (16.5 in)	600 mm (23.6 in)

Weight
Less than 18 kg (39.5 lb)

NOTES
(1) At low modulation levels the residual AM/FM may become significant.
(2) At low audio levels the residual noise may become significant.
(3) Audio and Modulation filter passband errors not included.
(4) Typical performance figures are non-warranted.
(5) Refer to USER CALIBRATION section.
(6) Either 3 modulation plus 3 audio generators up to 20 kHz or 1 modulation or 1 audio generator to 100 kHz.

Versions and Accessories

When ordering please quote full ordering number information

Ordering numbers	*Versions*
2965A	Radio Test Set
	Options
Option 01	French Language Version
Option 02	Spanish Language Version
Option 03	German Language Version
Option 09	SSB receiver option
Option 10	NMT Cellular Radio option*
Option 11	AMPS Cellular Radio option (including N-AMPS)*
Option 12	TACS Cellular Radio option (including N-TACS)*
Option 13	MPT 1327/MPT 1343 Trunked Radio option*
Option 14	PMRTEST for FM

* Specify which analog cellular option (options 10 to 14) is required at time of ordering

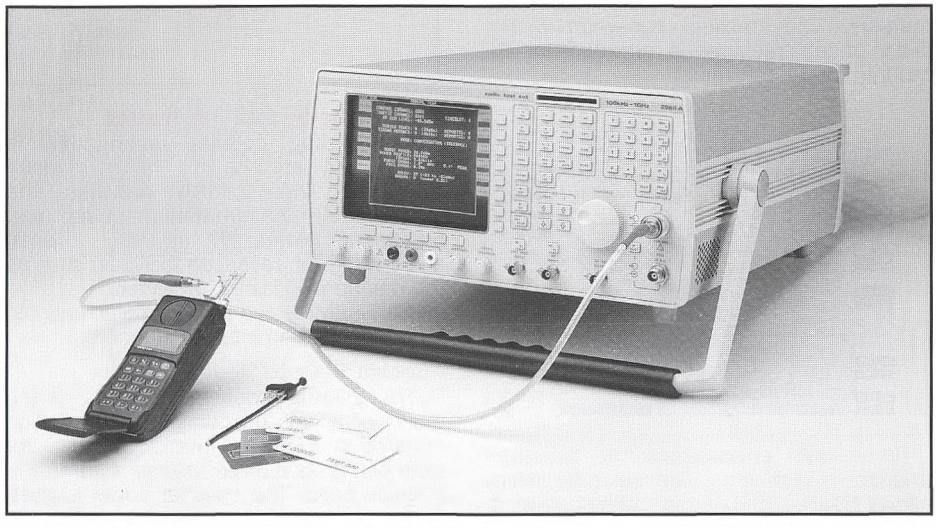
Contact your local sales outlet for details of availability of options

Option 21	GSM Hardware and Software Upgrade, P-GSM, E-GSM, User Defined GSM
	Supplied with
	AC Supply lead
	Operating Manual
	Multimeter Lead Kit (Two 4 mm leads to test points)
	Accessories
54421/001	BNC Telescopic antenna
54431/023	20 dB AF attenuator (BNC)
54112/158	Hard Transit Case
54112/157	Soft Carrying Case
54127/310	Rack Mounting Kit
59000/189	Memory Card (128 k)
54411/052	Impedance Matching Unit (requires 46884/645 Accessory socket adapter)
46884/645	Accessory socket adapter (for use with 2955 accessories)
46884/646	Accessory Socket 'Y' adapter
46884/560	Parallel Printer Interface Cable
46884/649	Serial port to PC Cable 25 way
46884/650	Serial port to PC Cable 9 way
43129/189	GPIB Cable
43130/596	Coaxial cable N-Type(m) to TNC(m) (double screened)
54311/095	Coaxial cable N-Type(m) to N-Type(m) (1 metre)
54311/071	TNC(m) to BNC(f) adapter
54311/092	N-Type(m) to BNC(f) adapter
52388/900	1 GHz Active Probe
54441/012	Power supply for probe 52388/900
B27033	GPIB Edit and Runtime Software, Single User, Dongled.
B27071	2965A Radio Test Set GPIB Software Driver
46880/056	Service manual
Option 21	GSM Hardware and Software Upgrade Note that this option is only available as a retrospective upgrade. To order a complete Radio Test Set, with GSM capability, see 2966A.
	Service Support
W2	Two year warranty
W3	Three year warranty

Contact your local sales outlet for availability of these and other service plans

2966A series
100 kHz to 1 GHz Radio Test Set

A high performance GSM 900 and analog radio tester that provides fast test speeds and very accurate measurements. This product can be used in conjunction with PhoneTest Software



- Full suite of GSM measurements
- Power profile and phase profile plots for normal and access bursts
- Full range of BER measurements for receiver testing
- Phase 2 frequency plan (E-GSM) and power levels supported
- High performance full span spectrum analyzer
- 500 kHz digital storage oscilloscope
- Accurate frequency counter
- Comprehensive LF generation and analysis

The 2966A Radio Test Set performs all of the measurements and supports protocol functions required in a GSM service or production environment. It also supports all of the international analog cellular standards (TACS, AMPS and NMT) and the main worldwide trunking format (MPT 1327).

Unlike 'GSM Only' testers, the 2966A includes a host of standard RF instruments, such as spectrum analyzer and CW frequency counter, as well as audio sources, an audio analyzer and a digital multimeter. These are invaluable for radio alignment and detailed fault finding. Performance is uncompromised and test speeds are significantly greater than previous generation equipment.

Based on ETSI's GSM11.10 specifications, the 2966A's functionality has been designed to test all of the essential RF, audio and DC parameters of a GSM radio quickly and easily. The world proven IFR user interface has been extended to allow access to these GSM specific functions.

Standard Features

The 2966A follows the IFR philosophy of offering a complete package with the essential features as standard and not as additional costly options.

Extensive GSM Functionality

The 2966A emulates a GSM base station allowing radios to be tested as if they were on a real system, without user knowledge of manufacturer specific test modes. Network simulation is especially useful when checking for configurational problems.

Transmitter testing provides transmitter power, peak and RMS phase error, frequency error and timing error, all measured as specified in GSM11.10. Graphical displays, with fast update rates, show power profile and phase profile against the relevant GSM masks, for both shortened and normal bursts, to aid radio alignment

Receiver testing covers all classes of BER, RBER and FER readings and automatic sensitivity measurement is also provided.

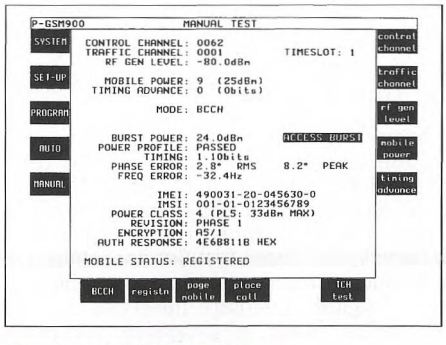
The 2966A covers the phase two frequency plan (E-GSM) and supports the lower power levels (PL16-PL19).

Advanced GSM Measurements

The 2966A performs advanced GSM measurements for detailed fault diagnosis and production environments. For radios that refuse to register or go into conversation, analysis of access (RACH) bursts is essential. All transmitter measurements are automatically triggered on these bursts to help the user to isolate a problem.

An advanced Mobile Tuning Range Test Capability is also available. With this facility (Option 22) the BCCH (Broadcast Control Channel) frequency and data rate can be varied in controlled steps, enabling mobiles with poor reference oscillators to be identified in Manual and Automatic modes of operation.

For complete versatility, the 2966A can be used to transmit or receive at any frequency within the 10 MHz to 1 GHz band and radios can be tested in test modes, without signaling and synchronization.



Display of Mobile Reports

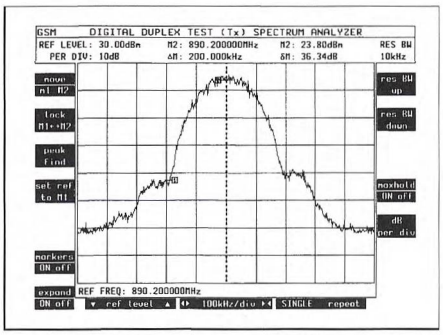
The 2966A reports equipment and subscriber details during registration and call placement. The IMSI and IMEI are displayed, as are power-class, revision (Phase 1 or Phase 2), and encryption capability (A5/1 or A5/2), frequency and short message service capabilities.

During conversation the test set continuously displays the mobile's reported

power level, timing advance, RXLEV and RXQUAL.

Spectrum Analysis

The RF spectrum analyzer allows fast, high resolution analysis of signals applied either directly to the RF ports or off-air via an antenna. It carries many features only usually found on standalone analyzers such as full span, selectable resolution bandwidth filters and two steerable markers. The tracking generator facility (with offset tracking) is provided for RF module characterization.



In a GSM environment the spectrum analyzer is invaluable. The max hold facility allows TDMA (GSM) signals to be analyzed. The analyzer also allows IQ modulator alignment (required on some popular GSM phones) and IFs and LOs to be inspected.

Manual and Automatic Operation

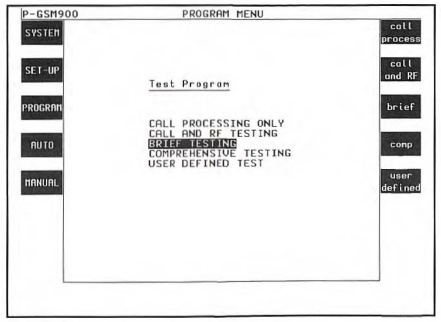
The 2966A user interface offers ready access to many sophisticated functions. The instrument extends the original test set interface established by the 2955.

The large bright, high resolution screen and the 22 associated softkeys on the front panel have significant benefits in terms of user comfort, and hence efficiency.

For automatic testing, the 2966A includes four built-in test programs ranging from simple call processing to comprehensive performance testing. These test programs are easy to configure – individual tests can be turned on and off, limits changed and averaging periods optimized. For complete flexibility, the 2966A can be programmed through MI-BASIC.

PhoneTest

The 2966A can be enhanced by using PhoneTest, which is a PC based solution running on Windows 95 or Windows NT, for GSM testing. PhoneTest brings a new dimension to Radio Test Set applications by introducing more than just the ability to test digital cellular handsets. The PhoneTest suite of programs comprises four component parts, a control driver package, PhoneTest-Repair, PhoneTest-Manager and PhoneTest-Exchange, providing a complete service workshop logistics solution.



Proven Analog Cellular Testing

For analog cellular testing IFR is established as the de facto industry standard. The 2966A provides the fundamental measurements required (e.g. broadband power, FM deviation, SINAD) and a range of advanced facilities, such as the unique 40 kHz FFT analyzer.

TACS, AMPS and NMT come as options. Most country variants are standard.

Concise Easy to Read Printouts

The 2966A produces printouts at the touch of a key, providing the information required in a concise form. 'Brief Test', for example, gives a three channel summary in a single page. The pass/fail count is given at the bottom of the page so good radios can be verified quickly and bad ones can be identified.

2966A printouts also include the instrument serial number, time/date stamping, company name and user name for quality control. Printouts can be stored to a standard PCMCIA2 memory card.

Test Program Generation Made Easy

The internal MI-BASIC controller allows users to write programs using the internal automatic test routines and the standard instrument functions and measurements. Conventional BASIC functions are supported such as mathematical operations, branching and looping.

Programs can be written using a standard PC text editor and downloaded, via RS-232, to the test set. The program then remains in the instrument even after switch off.

Size and Weight

Not only does the 2966A pack the performance you would normally expect to see on a bench full of instruments, it weighs in at under 19.5 kg (43 lb), so it is portable too.

APPLICATIONS

Production

For the production environment the 2966A option can be controlled fully over GPIB or RS-232. These interfaces come as standard. Versatility is paramount; all of the internal test sequences can be modified easily by the user – particular tests can be selected/deselected, parameters and limits can be adjusted to suit.

For more involved testing the unit is fully programmable via the internal MI-BASIC interpreter, allowing the user to write custom test programs. Via this programming language the user has access to all the internal tests and more: RS-232 read/write can be used to control a radio in test modes and read or write calibration data; four logic controls on the rear of the instrument can be used to drive mechanical actuators.

Alignment

Most modern cellular phones, whether analog or digital, contain few if any mechanical trimmers – most calibration, or 'phasing', is carried out electrically via the keypad or a local PC.

For calibration, the 2966A option shows all the fundamental measurements on the screen at the same time. Rapid update rates simplify alignment. Calibrating the radio for power, frequency and modulation accuracy is straight-forward using the instruments bar charts and graphical displays.

MI-BASIC provides full access to the RS-232 port and all measurement functions, making the standard instrument suitable for closed-loop alignment applications.

Service

In the field, many faults are simple connector, antenna or battery problems. These can, more often than not, be identified visually. To locate more complex faults, those that result from component or solder joint failure, sophisticated test tools are required. The 2966A option allows phones to be tested in test modes. Under manual mode the instrument behaves as a signal generator and, at the same time, a 'free-running' receiver. No synchronization between the uplink and downlink is required.

Standard features, such as the spectrum analyzer, oscilloscope, multimeter and the unique FFT audio analyzer aid rapid fault diagnosis. Such features are not available on GSM specific test sets.

Go/No Go Testing

Go/No Go testing is essential to maintain quality in production, distribution and service. In this application, test speed and ease-of-use are key; the 2966A delivers on both counts.

Specification

Certain characteristics are shown as typical. These provide additional information for use in applying the instrument but they are unwarranted.
(Applies to version 7.00 and above)

RF Signal Generator

FREQUENCY

Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Resolution
1 Hz

Indication
10 digit display

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
As frequency standard

OUTPUT LEVEL

Range
One-port Dx modes:
N-Type socket: –135 dBm to –45 dBm (GMSK)
(–40 dBm with FM/PM/AM).
TNC socket: –135 dBm to –25 dBm (GMSK)
(–115 dBm to –20 dBm with FM/PM/AM).
Rx Test and two-port Dx modes:
N-Type socket: –135 dBm to –35 dBm (GMSK)
(–10 dBm with FM/PM)
(–20 dBm with AM).
TNC socket: –135 dBm to –15 dBm (GMSK)
(–115 dBm to +10 dBm with FM/PM)
(–115 dBm to 0 dBm with AM).

Resolution
0.1 dB

Indication
4 digits plus sign (dBm, dB µV, µV, mV PD/EMF)

Accuracy
N-Type socket:
±1 dB (GMSK) over the temperature range 15 to 35°C
Otherwise
±1.2 dB up to 575 MHz for levels above –120 dBm
±1.75 dB up to 1 GHz for levels above –120 dBm.
±1.3 dB up to 1 GHz over the temperature range 15 to 35°C.

Carrier On/Off
Keyboard operation, reduces signal generator output to less than –120 dBm

Reverse Power Protection
N-Type socket: With instrument switched on 150 W. Overload indicated by visual and audible warning.
TNC socket: Protection up to 10 W. Reset available on removal of RF power. Excess power indicated by visual and audible warnings.

Output Impedance
50 Ω nominal

VSWR
N-Type socket: better than 1.2 up to 500 MHz; better than 1.3 up to 1 GHz (typically 1.2).
TNC socket: typically 1.3 at 900 MHz

SPECTRAL PURITY

Residual FM (CCITT weighted)
Less than 6 Hz RMS up to 575 MHz
Less than 12 Hz RMS up to 1 GHz

Residual AM (CCITT weighted)
Less than 0.05% RMS

Harmonics
Better than –30 dBc for levels up to +7 dBm (TNC).
Better than –30 dBc for levels up to –13 dBm (N-Type)

Spurious Signals
Better than –45 dBc for carrier frequencies from 100 kHz to 36 MHz;
Better than –50 dBc for carrier frequencies above 36 MHz

SSB Phase Noise (20 kHz offset)
Better than –114 dBc/Hz up to 575 MHz;
Better than –108 dBc/Hz up to 1 GHz.

RF Carrier Leakage
Less than 0.5 µV PD generated at the carrier frequency in a 50 Ω load by a 2 turn loop 25 mm or more from the case with output level set to below –60 dBm and terminated in a sealed 50 Ω load.

GMSK MODULATION – INTERNAL

Frequency Range
10 MHz to 1 GHz, useable to 1.15 GHz

Bt
0.3

Phase Error
<1° RMS
<4° peak

AMPLITUDE MODULATION – INTERNAL

Frequency Range
100 kHz to 400 MHz, useable to 1.15 GHz

AM Depth Range
0 to 99%

Resolution
0.1%

Indication
3 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy [1] (up to 85% AM)
±4% of setting ±1 digit for modulation frequency 1 kHz
±6% of setting ±1 digit for modulation frequencies from 30 Hz to 10 kHz
±8% of setting ±1 digit for modulation frequencies from 10 kHz to 20 kHz

Distortion
Less than 1% at 1 kHz for modulation depths up to 30%, CCITT weighted
Less than 2% for modulation frequencies from 100 Hz to 20 kHz and depths up to 85%

Modulation Frequency
Range: 20 Hz to 15 kHz for carrier frequencies up to 36 MHz; 20 Hz to 20 kHz for carrier frequencies up to 400 MHz
Resolution: 0.1 Hz below 10 kHz; 1 Hz below 20 kHz

AMPLITUDE MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal AM

Modulation Frequency Range
As internal AM with AC or DC coupling

Accuracy
As internal ±2%

Input Sensitivity
1 VRMS for indicated modulation depth

FREQUENCY MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy[1]
±3% ±1 digit at 1 kHz over the range 15 to 35°C (0.1% per °C outside this range)
Typically ±3% ±1 digit for modulation frequencies from 20 Hz to 5 kHz
Typically ±7% ±1 digit for modulation frequencies from 5 kHz to 20 kHz
Typically ±10% ±1 digit for modulation frequencies from 20 kHz to 75 kHz

Distortion[1]
Less than 0.5% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 kHz to 800 kHz).
Less than 1% for modulation frequencies from 50 Hz to 20 kHz (for deviation 1 kHz to 800 kHz).

Modulation Frequency Range[6]
20 Hz to 20 kHz Mod generators 1, 2, 3 or
20 Hz to 100 kHz Mod generator 4

Resolution
0.1 Hz

FREQUENCY MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal FM

Modulation Frequency Range
DC to 100 kHz (DC coupled)
10 Hz to 100 kHz (AC coupled)

Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2% for frequencies up to 20 kHz

PHASE MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable to 1.15 GHz

Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
±5% ±1 digit for modulation frequencies from 250 Hz to 3.4 kHz, over the range 15 to 35°C (0.1% per °C outside this range)

Distortion[1]
Less than 1% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 rad to 160 rads)

Modulation Frequency
Range: 250 Hz to 5 kHz

Resolution
0.1 Hz

PHASE MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal phase modulation

Modulation Frequency Range
250 Hz to 5 kHz

Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal +2%

INTERNAL MODULATION AND AUDIO SOURCES
Up to 6 tone sources can be assigned as 3 modulation generators and 3 audio tone generators.

Modulation Modes
Internal generators may be assigned to AM, FM, ΦM

BER Meter

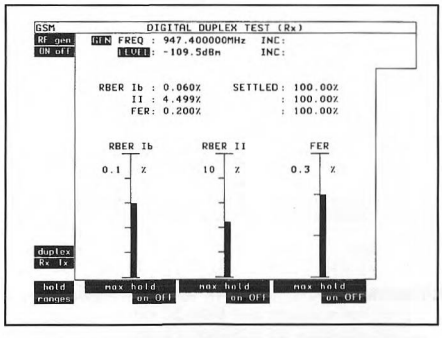
Types
BER Class I
BER Class II
RBER Class Ib
RBER Class II
FER

Range
0 to 99%

Resolution
0.001%

Indication
4 digits and bar chart with peak hold

Features
Adjustable Sample Size
Duration Indication
% Settled Indication



Audio Voltmeter

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
DC and 20 Hz to 500 kHz
AC only 20 Hz to 500 kHz
Polarized DC less than 10 Hz

Level Ranges
0 to 10, 0 to 30, 0 to 100, 0 to 300 mV, 0 to 1, 0 to 3, 0 to 10, 0 to 30 V RMS reading (autoranging or fixed)

2966A

Level Indication
4 digits and barchart with peak hold

Level Accuracy (DC Coupled)[3] [5]
±2% of reading ±1 mV ± resolution, DC and 100 Hz to 20 kHz
±4% of reading ±1 mV ± resolution, 40 Hz to 100 kHz

Level Accuracy (AC Coupled)[3]
±2% of reading ±1 mV, ± resolution 150 Hz to 20 kHz
±4% of reading ±1 mV, ± resolution 100 Hz to 100 kHz

Residual Noise
100 µV RMS CCITT weighted

Audio Frequency Meter

Range
10 Hz to 500 kHz

Resolution
0.1 Hz from 10 Hz to 5 kHz
1 Hz from 5 kHz to 50 kHz
10 Hz from 50 kHz to 500 kHz

Indication
6 digits

Accuracy
As frequency standard ±1 digit ± resolution

Sensitivity
On barchart greater than 25% FSD (DC coupled)

Audio SINAD Meter

Frequency
1 kHz default. User selectable up to 20 kHz

SINAD Range
5 to 50 dB

Resolution
0.1 dB for readings less than 20 dB
0.2 dB for readings less than 25 dB

Indication
3 digits and barchart with peak hold

Accuracy (bandpass filter selected)
±0.5 dB ± resolution

Sensitivity
100 mV for 46 dB SINAD

Audio Distortion Meter

Frequency
1 kHz default. User selectable up to 20 kHz

Distortion Range
0 to 30%

Resolution
0.1% distortion for readings greater than 1%
0.2% distortion for readings less than 1%

Indication
3 digits and bar chart with peak hold

Accuracy
±5% of reading ± resolution (Bandpass filter selected)

Sensitivity
100 mV for 0.5% distortion

Audio S/N Meter

S/N Range
0 to 100 dB

Resolution
0.1 dB for readings less than 50 dB
0.2 dB for readings less than 70 dB

Indication
3 digits and bar chart with peak hold

Accuracy
±0.5 dB ± resolution

Sensitivity
2 V for 60 dB, 200 mV for 40 dB

Audio Oscilloscope

Operating Modes
Single or Repetitive sweep

Frequency Range
DC to 500 kHz
10 Hz to 500 kHz (AC coupled)

Glitch Catching
1 µs minimum

Voltage Ranges
2 mV/div to 20 V/div in a 1, 2, 5 sequence

Voltage Accuracy
±5% of full scale

Timebase
5 µs/div to 10 s/div in a 1, 2, 5 sequence

Timebase Accuracy
As frequency standard

Trigger Mode
Auto trigger

Marker Indication
Level: M1-M2, M2-M1
Time: M1-M2, M2-M1

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Audio FFT Analyzer

Span Widths
50 Hz to 50 kHz in a 5, 10, 25 sequence
Above 40 kHz signals are attenuated by 80 dB/octave

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Level Reference (top of screen)
10 mV to 20 V, in a 1, 2, 5 sequence

Level Accuracy
±0.3 dB 100 Hz to 15 kHz; typically ±1 dB 40 Hz to 40 kHz

Vertical Scaling
1, 2, 5, 10 dB/div

Dynamic Range
60 dB

Max hold facility

Audio Sweep facility
DC to 20 kHz

Marker Indication
Level: M1, M2, M1-M2
Frequency: M1, M2, M1-M2

Audio Bar Charts

Displays: AF voltage, SINAD, Distortion, S/N.
Vertical Resolution: 1% of full scale.
Ranging: Autoranging, range hold or manual selection
(up/down), 1, 3, 10 sequence with hysteresis.
With peak hold facility.

Audio and Modulation Filters

300 Hz Lowpass (±0.1 dB less than 150 Hz, ±0.2 dB, 150 to 200 Hz relative to 100 Hz).
300 Hz to 3.4 kHz Bandpass (±0.4 dB, 400 to 2100 Hz relative to 1 kHz).
5 kHz Lowpass (±0.3 dB at <3 kHz relative to 1 kHz).
20 kHz Lowpass ±0.3 dB at <12 kHz, typically –0.9 dB at <15 kHz and –3 dB at 20 kHz relative to 1 kHz
CCITT Psophometric
C-MESSAGE
See also under Environmental/User Calibration

Multimeter

Input Terminals
3 x 4 mm, 'Volt/ohm', 'Current' and 'Common'

Maximum Input Voltage
375 V with respect to instrument chassis

VOLTMETER

Voltage Range
0 to 300 V, 0 to 30 V, 0 to 3 V, 0 to 300 mV, Terminals, 'Volt/Ohm' and 'Common', maximum crest factor 3:1 at range full scale

Frequency Range
Polarized DC or 40 Hz to 1 kHz

Input Impedance
Nominally 6 MΩ in parallel with 100 pF

Resolution
0.1% of FSD

Accuracy[5]
±3% of reading ±1 mV ±1 digit
See also under Environmental/User Calibration

Indication
4 digits and bar chart with peak hold

AMMETER

Current Range
0 to 1 A and 0 to 10 A

Frequency Range
Polarized DC or 40 Hz to 1 kHz

Resolution
1 mA below 1 A; 10 mA below 10 A

Accuracy
±5% of reading ±1 mA ±1 digit

Indication
4 digits and bar chart with peak hold

RESISTANCE METER

Resistance Ranges
100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ

Resolution
1 Ω below 1 kΩ or 3 digits

Accuracy[5]
±5% of reading ±1 Ω ±1 digit
Continuity Test continuous tone if reading is less than 10 Ω

Indication
4 digits and bar chart with peak hold

RF Frequency Error Meter (Burst)

Frequency Range
10 MHz to 1 GHz

Frequency Error Range
±5 kHz

Burst Type
Normal/Access

Resolution
0.1 Hz

Indication
3 digits and bar chart with peak hold

Accuracy
±15 Hz

RF Frequency Meter

Range
100 kHz to 1 GHz

Resolution
1 Hz or 10 Hz selectable

Indication
Up to 10 digits

Accuracy
As Frequency Standard ±2 Hz ± resolution

Dynamic Range (Auto tuned)
As RF Power Meter (broadband)

Frequency Range (Auto tuned)
10 MHz to 999.9 MHz

Sensitivity
Manual tuned: –100 dBm (TNC) dependent on receiver bandwidth in off air test mode

Offset Frequency Range
±1 MHz dependent on receiver bandwidth

RF Power Meter (Burst)

Frequency Range
10 MHz to 1 GHz

Dynamic Range
0 dBm to +47 dBm

Power Profile Dynamic Range
44 dB

Power Reading
Average power over useful part of burst

http://www.ifrinternational.com

Burst Type
Normal/Access

Indication Units
dBm

Resolution
0.1 dB

Indication
3 digits and bar chart with peak hold
Power profile against GSM11.10 template
Normal/Access
Full burst
Useful Part
Ramps

Accuracy
±0.6 dB for temperatures in the range 15 to 35°C
See also under Environmental/User Calibration

RF Power Meter (Broadband)

Frequency Range
100 kHz to 1 GHz

Dynamic Range (Auto tuned)
10 mW to 150 W (N-Type), 100 µW to 0.5 W (TNC)

Power Reading
True mean power

Indication Units
Watts

Resolution
Better than 1%

Indication
3 digits and barchart with peak hold

Accuracy[5]
100 kHz to 500 MHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type)
±10% (0.4 dB), 20 mW to 150 W (N-Type)
±12% (0.5 dB), 200 µW to 50 mW (TNC)
500 MHz to 1 GHz:
±12% (0.5 dB), 20 mW to 150 W (N-Type)
±15% (0.6 dB), 200 µW to 50 mW (TNC)
100 kHz to 1 GHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type)
+10% (0.4 dB) 1 mW to 50 mW (TNC)
For ambient temperatures in the range 15 to 35°C.
See also under Environmental/User Calibration

Maximum Safe Continuous Rating
N-Type: 50 W
TNC: 0.5 W; overload protected to 10 W

Intermittent Rating
N-Type: 150 W for limited periods, typically 2 minutes at 20°C. Typical off to on ratio is 6:1. Overload indicated by audible and visual warning.

RF Power Meter (Selective)

Frequency Range
100 kHz to 1 GHz

IF Bandwidth
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Dynamic Range (Manually tuned)
0 dBm to +50 dBm (110 kHz IF bandwidth) (N-Type)
–90 dBm to +20 dBm (110 kHz IF bandwidth) (TNC)

Power Reading
Average

Indication Units
dBm

Resolution
0.1 dB

Indication
3 digits + barchart with peak hold

Accuracy[5]
Typically ±2.5 dB N-Type & TNC.
See also under Environmental/User Calibration

RF Spectrum Analyzer

Frequency
Range: 100 kHz to 1 GHz, useable from 30 kHz to 1.05 GHz

Spans
500 Hz/div to 100 MHz/div, in a 1, 2, 5 sequence

Resolution Bandwidth
300 Hz to 300 kHz in a 1, 3, 10 sequence and 3 MHz (automatically selected according to span and manually selectable)
Video bandwidth – fixed at 3 kHz.

Filter Shape
Nominally 3 dB/60 dB, 1:11 (300 Hz to 30 kHz bandwidth)

Reference Level (top of screen)
–100 dBm to +70 dBm

On Screen Dynamic Range
80 dB

Vertical Resolution
0.5 dB on 10 dB/div, 0.05 dB on 1 dB/div

Level Accuracy [5]
Typically ±2.5 dB
See also under Environmental/User Calibration

Intermodulation Distortion
Less than 80 dB for 2 signals on screen at reference level

Sweep Speeds
Optimum sweep speed selected according to span and resolution bandwidth

Modes
Single sweep and continuous

Graticule
10 horizontal by 8 vertical divisions

Expanded Mode
Can be made to occupy full screen for high definition

Markers
M1 and M2

Indication
Level: M1, M2, M1-M2.
Frequency: M1, M2, M1-M2

TRACKING GENERATOR
Available in RF TEST mode

Frequency Range
100 kHz to 1 GHz

Level Range
–135 dBm to +10 dBm

Offset Tracking
Allows testing of mixers, IFs, fundamental and 2nd harmonic analysis (up, down, x2, ÷2)

Modulation Analyzer

Dynamic Range (Auto tuned)
As RF Power Meter (Broadband)

Sensitivity (Manual tuned)
N-Type –30 dBm (110 kHz IF bandwidth)
TNC –50 dBm (110 kHz IF bandwidth)
TNC (off-air test mode) –101 dBm (2 µV 10 dB SINAD in 30 kHz IF bandwidth and CCITT weighting)

Demodulation
Accuracy maintained on signals greater than –60 dBm

Receiver Bandwidths
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Demodulation Filters
As audio analyzer plus 5 kHz lowpass (±0.3 dB at less than 3.4 kHz relative to 1 kHz)

Audio Output
Available in to an internal loudspeaker, demodulated output or accessory socket for external loudspeaker or headphones

Switching Speed
Nominally less than 1 ms channel to channel up to 50 MHz apart, settling to within 1 kHz of final frequency

Demodulated Output
Nominal output impedance less than 10 Ω. Output voltage is range dependent (2 V peak at top of range)

Squelch
A manual squelch control is provided with a variable threshold

GMSK MODULATION

Frequency Range
10 MHz to 1 GHz

Phase Error Range
10° RMS
±30° peak

Burst Type
Normal/Access

Resolution
0.1°

Indication
3 digits and bar chart with peak hold
Phase profile

Accuracy
Better than 0.3° RMS at 5°
Better than 4° peak

AMPLITUDE MODULATION

Frequency Range
100 kHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

AM Depth Range
0 to 99.9%

Resolution
0.1% AM

Indication
3 digits and bar chart with peak hold

Accuracy (up to 85% AM)[1] [5]
±3% of reading, ±1% AM, 250 Hz to 5 kHz
Typically ±5% of reading, ±1% AM, 50 Hz to 15 kHz

Demodulation Distortion[1]
Less than 1% at 1 kHz, CCITT weighted

Residual AM
Less than 0.1% AM, CCITT weighted

FREQUENCY MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

Deviation Range
0 to 100 kHz

Resolution
10 Hz below 10 kHz deviation; 100 Hz below 100 kHz deviation

Indication
3 digits and bar chart with peak hold

Accuracy[1] [3] [5]
±3% ± resolution for modulation frequency of 1 kHz
±5% ± resolution for modulation frequencies from 100 Hz to 15 kHz

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted

Residual FM
Less than 25 Hz RMS CCITT weighted

PHASE MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
250 Hz to 5 kHz

Deviation Range
0 to 20 rads

Resolution
0.01 rads

Indication
3 digits and bar chart with peak hold

Accuracy[1] [3] [5]
±5% ± resolution

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted

Burst Timing Meter

Burst Type
Normal/Access

Range
–128 to +127 bits

Resolution
0.01 bits

Indication
5 digits

Accuracy
±0.1 bits

Audio Generators

See section on modulation generators for interaction of audio and modulation generators

FREQUENCY

Range[6]
1 Hz to 20 kHz AF Gens 1, 2 & 3 or
1 Hz to 100 kHz AF Gen 4

Setting
Keyboard entry, delta increment/decrement function and rotary control

Indication
6 digits

Resolution
0.1 Hz

Accuracy
As frequency standard

LEVEL

Range
0.1 mV to 5 V RMS (maximum AF output 7 V peak, all generators combined)

Setting
Keyboard entry, delta increment/decrement function and rotary control

Indication
4 digits

Resolution
0.1 mV

Accuracy
±3% ±1 digit, 250 Hz to 5 kHz
±5% ±1 digit, 10 Hz to 20 kHz
±10% ± 1 digit, 20 kHz to 75 kHz

Output Impedance
Nominally 5 Ω

Protection
Maximum applied voltage 50 V

SIGNAL PURITY

Distortion[2]
Less than 0.5% at 1 kHz measured in a 30 kHz bandwidth
Less than 1% from 20 Hz to 20 kHz measured in an 80 kHz bandwidth
Typically 0.1% for levels greater than 100 mV.

Residual Noise
Less than 50 µV RMS (CCITT weighted)

DC Offset
Less than 10 mV

Signaling Encoder/Decoder

Sequential tones functions
Encodes and decodes up to 40 tones
CCIR, ZVEI, DZVEI, EEA, EIA or user defined
Any of the tones may be extended
Continuous, burst and single step modes available

User defined tones
Up to three frequency plans may be defined and stored within the 2966A for sequential tones
Any of the standard tone frequency plans may be copied to user defined and modified
Tone length 10 ms to 1 s
Extended tone length 100 ms to 10 s

CTCSS tones mode
Standard tone frequencies may be selected from a menu

DTMF Encoder/Decode
Generation and decode of DTMF tones, displaying Hi/Lo frequencies, frequency error, timing information and twist

DCS Encode/Decode
Generation and decoding of digitally coded squelch

POCSAG generator
Generation of POCSAG code CCIR No.1
Rec 584. Bit rates from 400 to 9600 bit/s

Audio Monitor

Audio and demodulation signals may be monitored via the internal loudspeaker or via the accessory socket output or BNC socket on the rear panel.

SSB Option

SSB Tx

Frequency, range and meter accuracy	– as RF frequency
Power, level and meter accuracy	– as Broadband power
Detection Range	– 100 µV to 150 W
AF Demod range	– 10 Hz to 5 kHz
Demod distortion	– <2% @ 1 kHz CCITT weighted
Carrier and Alternate s/band suppression	– Better than –50 dBc
Sideband/CW Analyzer	– max 5 kHz full span frequency range
Spectrum Analyzer	– as RF spectrum analyzer
Audio Generator	– two – as audio generator
Sideband Selection	– LSB, USB, CW

SSB Rx

Sideband Generator	– as RF Gen (AM mode)
Offset measurement	– to 0.1 Hz resolution
SINAD	– as SINAD meter
Distortion	– as Distortion meter

Note: No audio is available in SSB option.

General Features

INTERFACES
Keyboard and Display
Logical color coded keyboard with bright high resolution CRT.

GPIB
Full control of all major instrument functions via the GPIB interface.
Flexibility is further enhanced by IFR's implementation of IEEE-488.2.

Capability
Complies with the following subsets as defined in IEEE-488.1-1978:- SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, E1.

Serial
Serial interface is provided for connection of RS-232 for instrument remote control. 9 Way socket. Control language is based on IEEE P1174.

Parallel
Connector 25 way female D-Type. Provision made for graphics screen dump. A selection of printer drivers are included.

Accessory Socket
Allows the connection of various optional accessories.
With suitable adapters is compatible with most 2955 series accessories.

Memory Card
Meets PCMCIA2/JEIDA – 4 standard. The memory card facility allows the storage of results and set ups.

Video Output
Color, compatible with most VGA monitors.
15 way Sub Miniature D Type.

Frequency Standard

Internal Frequency Standard Output

Frequencies
10 MHz and 13 MHz

Level
Nominally 2 V pk-pk

Output Impedance
Nominally 50 Ω

Temperature Stability
Better than 5 in 10^8, 5 to 50°C

Ageing Rate
Better than 1 in 10^7 per year, after 1 month continuous use

Warm Up Time
Less than 10 minutes to within 2 in 10^7 at 20°C

External Frequency Standard Input

Frequencies
1, 2, 5, 10 and 13 MHz

Level
Greater than 2 V pk-pk, less than 5 V pk-pk

Input Impedance
Nominally 1 MΩ in parallel with 40 pF

Power Requirements

AC supply

Voltage
88 V to 132 V and 188 V to 265 V

Supply frequency
45 Hz to 65 Hz

Power
Nominally 135 W, 260 W maximum, for future options

Electromagnetic Compatibility

Conforms with the protection requirements of Council directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2, 3, 4
EN60555-2	IEC 555-2

Safety

Complies with IEC1010-1, BS EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Environmental

Rated Range Of Use
0 to 50°C and up to 95% relative humidity at 40°C

User Calibration

User calibrations are provided to maintain high accuracy for any ambient temperature (e.g. in ATE racks or in field measurements). Having allowed the instrument to stabilize, running the user calibrations optimizes the performance at that temperature.
A change in temperature of 5°C from the calibration temperature affects readings as below. These figures are provided as a guide to typical performance.
Typical variations are as follows for a 5°C change in temperature.

Power Meter:	Burst	0.5 dB
	Broadband	2%
	Selective	0.5 dB
Spectrum Analyzer Level		0.5 dB
Audio Analyzer & Modulation Filters		
	Audio Voltage	0.4%
	Demod depth & deviation	0.4%
Multimeter:	Voltage	0.5%
	Current	0.5%

STORAGE AND TRANSPORT

Temperature
–40 to +70°C

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential)

Internal Test Software

OPTION 10 NMT CELLULAR SOFTWARE

NMT450	NMT900
Benelux	NMTF
Austria	Spain
Malaysia	Indonesia
Saudi 1	Saudi 2
Thailand	Oman
Tunisia	Hungary
Poland	Russia
Czech	Bulgaria
Slovenia	Turkey

USER DEFINED NMT

OPTION 11 AMPS CELLULAR SOFTWARE

E-AMPS	N-AMPS

USER DEFINED AMPS

OPTION 12 TACS CELLULAR SOFTWARE

E-TACS	TACS-2
C-TACS I	C-TACS II
J-TACS	N-TACS

USER DEFINED TACS

http://www.ifrinternational.com

OPTION 13 MPT 1327 TRUNKING SOFTWARE

Band III	JRC
UK Water	Hong Kong
Autonet	AMT
Madeira	NL-TRAXYS
NZ MPT1327	PH-INDO
USER DEFINED MPT	

OPTION 14 PMRTEST SOFTWARE
USER DEFINED PMR for FM radios

General Features (Systems)

Test Modes
Manual Test/Auto Test

Auto Test Programs
Call Processing Only
Call and RF Testing
Brief Testing
Comprehensive Testing
User Defined Test
Digital Parametric Auto Test Routines
Tx Timing
Tx Power Level
Tx Power Profile
Tx Frequency Error
Tx RMS Phase Error
Tx Peak Phase Error
Rx BER Class I
Rx BER Class II
Rx RBER Class Ib
Rx RBER Class II
Rx Frame Erasure
Rx Sensitivity
Rx RSSI Report

Analog Parametric Auto Test Routines

AF Frequency	AF Level
FM Deviation	Mod Frequency
Rx Distortion	Rx Expansion
Rx Sensitivity	Rx SINAD
Rx S/N	Tx Compression
Tx Distortion	Tx Frequency
Tx Level	Tx Power Level
Tx Limiting	Tx Mod Level
Tx Noise	Tx SINAD
Tx S/N	SAT Deviation
SAT Frequency	ST Duration
ST Frequency	ST Deviation
Data Deviation	DSAT Deviation

Signaling Auto Test Routines
Registration / Roaming Update
Place Call
Clear From Mobile
Page Mobile
Handoff
Clear From Land
Speech Quality
Hook Flash
DTMF Decode
Data Performance
PTT On
PTT Off

Auto Test Pause Modes
Pause Manual Only
Pause On Failure
Pause Always

DIMENSIONS AND WEIGHT
Excluding handle, feet and covers.

Height	*Width*	*Depth*
177 mm (6.9 in)	370 mm (14.5 in)	540 mm (21.2 in)

Including handle, feet and covers

Height	*Width*	*Depth*
203 mm (7.9 in)	420 mm (16.5 in)	600 mm (23.6 in)

Weight
Less than 19.5 kg (42.9 lb)

NOTES
(1) At low modulation levels the residual AM/FM may become significant.
(2) At low audio levels the residual noise may become significant.
(3) Audio and Modulation filter passband errors not included.
(4) Typical performance figures are non-warranted.
(5) Refer to USER CALIBRATION section.
(6) Either 3 modulation plus 3 audio generators up to 20 kHz or 1 modulation or 1 audio generator to 100 kHz.

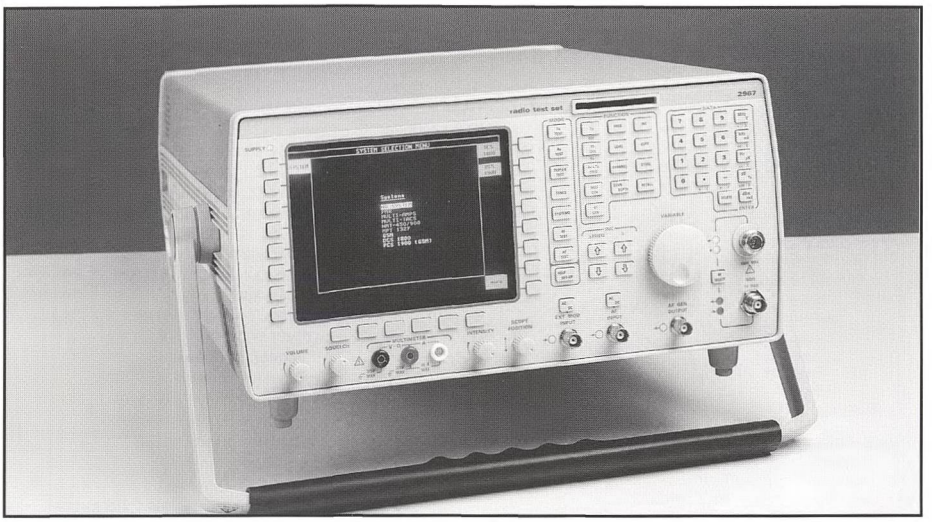
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2966A	Radio Test Set
	Options
Option 01	French Language Version
Option 02	Spanish Language Version
Option 03	German Language Version
Option 09	SSB receiver option
Option 10	NMT Cellular Radio option
Option 11	AMPS Cellular Radio option (including N-AMPS)
Option 12	TACS Cellular Radio option (including N-TACS)
Option 13	MPT 1327/MPT 1343 Trunked Radio option
Option 14	PMRTEST for AM/FM/ΦM radios
Option 22	Mobile Tuning Range Test
Contact your local sales outlet for details of availability of options	
	Supplied with
	AC Supply lead
	Operating Manual
	Multimeter Lead Kit (Two 4 mm leads to test points)
	PhoneTest Options
81506	PhoneTest Software for 2966A
81510	PhoneTest bundle includes 81506/81507/81508/81509
81507	PhoneTest-Repair
81508	PhoneTest-Manager
81509	PhoneTest-Exchange
81504	PhoneTest and enabled options, site licence software upgrade
81505	PhoneLib
	Accessories
54421/001	BNC Telescopic antenna
54431/023	20 dB AF attenuator (BNC)
54112/158	Hard Transit Case
54112/157	Soft Carrying Case
54127/310	Rack Mounting Kit
59000/189	Memory Card (128 K)
54411/052	600 Ω interface and 20 dB AF attenuator (requires 46884/645 Accessory socket adapter)
46884/645	Accessory socket adapter (for use with 2955 accessories)
46884/646	Accessory Socket 'Y' adapter
46884/560	Parallel Printer Interface Cable
46884/649	Serial port to PC Cable (25 way)
46884/650	Serial port to PC cable (9 way)
54212/001	GSM Phase 2 Plug/In TEST SIM
54212/002	GSM Phase 2 Full Size TEST SIM
46884/650	Serial port to PC Cable (9 way)
43129/189	GPIB Cable
43130/596	Coaxial cable N-Type(m) to TNC(m) (double screened)
54311/095	Coaxial cable N-Type(m) to N-Type(m) (1 metre)
54311/071	TNC(m) to BNC (f) adapter
54311/092	N-Type(m) to BNC(f) adapter
52388/900	1 GHz Active Probe
54441/012	Power supply for probe 52388/900
B27033	Edit and Runtime Software, Single user, dongled
B27071	GPIB Software Driver
	Service Support
W2	Two year warranty
W3	Three year warranty
Contact your local sales outlet for availability of these and other service plans	

2967
GSM 900/1800/1900 Radio Test Set

High Performance GSM 900/1800/1900 and analog test solution with digital test incorporating Dual Band functionality. This product can be used in conjunction with PhoneTest software



- Supports GSM 900/1800/1900 (GSM) and Phase 2 GSM measurements
- Available with PhoneTest software suite
- Power and phase profile plots for normal and access bursts to aid diagnostics
- Full range of BER/RBER/FER measurements for receiver testing
- Dual band functionality
- Manual, GO/NO GO and fully programmable testing
- Supports AMPS, TACS, NMT and MPT 1327 trunking
- Full range of analog instrumentation

The 2967 Radio Test Set supports all the protocols required to perform measurements on GSM 900/1800/1900 MHz systems. In addition, it supports analog cellular standards TACS, AMPS, NMT and the world-wide trunking systems based on MPT 1327.

Based on ETSI GSM11.10 recommendations, the 2967 tests all the essential RF, audio and DC parameters quickly and easily in both Service and Production environments.

Unlike GSM only radio test sets, the 2967 includes a host of RF instrumentation and analog/digital facilities which are invaluable for performing diagnostics, radio alignment and parametric tests.

High-speed testing is ensured by use of pre-programmed test sequences, fully user configurable for depth of test, running on a multi-processor test platform. Further speed enhancements are obtained by performing simultaneous TX or RX measurements over a specified number of bursts using remote control commands.

GSM 900 Phase two testing is fully supported in the 2967.

Extensive GSM Functionality

The 2967 emulates a GSM 900/1800/1900 base station allowing mobiles to be tested in the same way that they operate on a real system without user knowledge of manufacturer specific test modes. Network simulation is especially useful when checking for configuration problems on mobiles. Transmitter tests measure power, peak and RMS phase error, frequency error and timing error, all as specified in GSM11.10. Graphical displays, with fast update rates, show power profile and phase profile against the relevant GSM masks, for both shortened and normal bursts, to aid radio alignment. Receiver testing covers all classes of BER, RBER and FER readings, and automatic sensitivity measurement is also provided.

New system features have been added to test additional terminal facilities, IMSI detach, Cell Barring and Minimum RF level for Access.

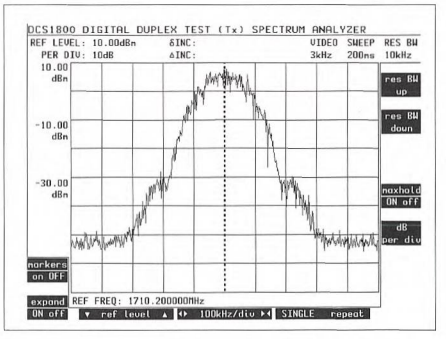
The 2967 covers the Phase 2 frequency plan (E-GSM) and supports the lower power levels (PL16-PL19).

Dual Band Functionality

Multi-band capability has been added to the test functions of the 2967, allowing full testing of multi-band mobiles in manual test, autorun and remote, including PhoneTest applications. Registration and calls to and from the mobile can be tested in the GSM 900 and 1800/1900 bands with handoff carried out from band to band.

Spectrum Analysis

The inbuilt RF spectrum analyzer allows fast, high resolution analysis of signals applied either directly to the RF ports or off-air via an antenna. It carries many features



only usually found on stand-alone analyzers, such as full span, selectable resolution bandwidth filters and two steerable markers. The tracking generator facility (with offset tracking) is provided for RF module characterization. With a useable frequency range of 100 kHz to 1 GHz and 1.3 GHz to 2.2 GHz, the spectrum analyzer supports IQ modulator alignment and the testing of internal local oscillators and IF systems. IQ alignment tests are recommended on most popular GSM terminals.

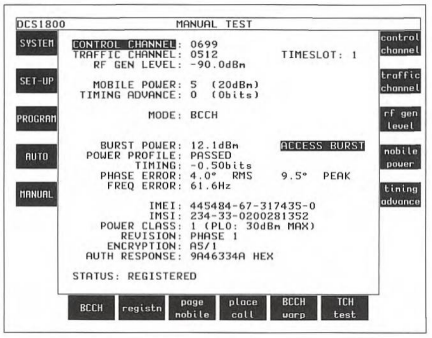
Advanced GSM Measurements

The 2967 performs advanced GSM

measurements for detailed fault diagnosis in production and advanced service centre environments. For radios that refuse to register or go into conversation, the 2967's capability to analyze the access (RACH) bursts is invaluable. All transmitter measurements are automatically triggered on these bursts to help the user isolate problems.

An advanced Mobile Tuning Range Test Capability (Warping) is also available. With this facility (Option 22) the BCCH (Broadcast Control Channel) frequency and data rate can be varied in controlled steps, enabling mobiles with poor reference oscillators to be identified in Manual and Automatic modes of operation.

For complete versatility, the 2967 can be used to transmit or receive at any frequency within the 10 MHz to 1 GHz band, 1.709 to 1.991 GHz Rx and 1.709 to 1.991 GHz Tx frequencies and radios can be tested in test modes, without signaling and synchronization.



Display of Mobile Reports

The 2967 reports equipment and subscriber details during registration and call placement. The IMSI and IMEI are displayed, as are power-class, revision (Phase 1 or Phase 2), and encryption capability (A5/1 or A5/2), frequency and short message service capabilities.

The 2967 produces print outs at the touch of a key, providing the terminal information and test results in a concise form. 'Brief Test', for example, gives a three channel summary in a single page. The pass/fail count is given at the bottom of the page so good radios can be verified quickly and bad ones can be identified.

The 2967 print-outs also include the instrument serial number as well as time/date stamping, and can also be annotated with the Company name and User name for quality control. Printouts can be stored to a standard PCMCIA2 memory card.

Manual and Automatic Operation

The 2967 User Interface offers ready access to many sophisticated functions. The instrument extends the original test set interface established by the 2955 into the world of digital communications.

The large bright, high resolution screen and the 22 associated softkeys on the front panel have significant benefits in terms of user comfort, and hence efficiency in Manual test modes.

For automatic testing, the 2967 includes four built-in test programs ranging from simple call processing to comprehensive performance testing. These test programs are easy to configure – individual tests can be turned on and off, limits changed and averaging periods optimized. For complete flexibility, the 2967 can be programmed through MI-BASIC.

PhoneTest

The 2967 can be enhanced by using PhoneTest, which is a PC based solution running on Windows 95 or Windows NT, for GSM 900/1800/1900 testing. PhoneTest brings a new dimension to Radio Test Set applications by introducing more than just the ability to test digital cellular handsets. The PhoneTest suite of programs comprises four component parts, a control driver package, PhoneTest-Repair, PhoneTest-Manager and PhoneTest-Exchange, providing a complete service workshop logistics solution.

Proven Analog Cellular Testing

For analog cellular testing IFR is established as the de facto industry standard. The 2967 provides the fundamental measurements required (e.g. broadband power, FM deviation, SINAD) and a range of advanced diagnostic facilities, such as the unique 40 kHz FFT analyzer and 500 kHz oscilloscope.

TACS, AMPS and NMT come as options which support most country variants.

Test Program Generation Made Easy

The internal MI-BASIC controller allows users to write programs using the internal automatic test routines and the standard instrument functions and measurements. Conventional BASIC functions are supported such as mathematical operations, branching and looping.

Programs can be written using a standard PC text editor and downloaded, via RS-232, to the test set. The program then remains in the instrument even after switch off. A program loaded into the instrument can be copied onto a memory card and then transferred quickly and easily to another unit.

APPLICATIONS

Production

For the production environment the 2967 option can be controlled fully over GPIB or RS-232. These interfaces come as standard. Versatility is paramount; all of the internal test sequences can be modified easily by the user – particular tests can be selected/deselected, parameters and limits can be adjusted to suit.

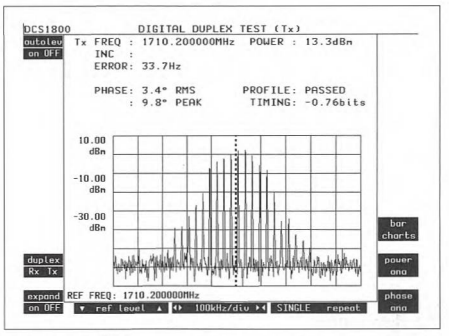
For GSM 900/1800/1900, commands are available to perform and read back the results of either all the TX tests or all the RX tests simultaneously giving a significant time saving.

For more involved testing the unit is fully programmable via the internal MI-BASIC interpreter, allowing the user to write custom test programs. Via this programming language the user has access to all of the internal tests and more: RS-232 read/write can be used to control a radio in test modes and read or write calibration data; four logic controls on the rear of the instrument can be used to drive mechanical actuators. Programs downloaded into the instrument can be copied onto the memory card then quickly and easily transferred to other units.

Alignment

Most modern cellular phones, whether analog or digital, contain few if any mechanical trimmers – most calibration, or 'phasing', is carried out electrically via the keypad or a local PC.

For calibration, the 2967 shows all of the fundamental measurements on the screen at the same time. Rapid update rates simplify alignment. Calibrating the radio for power, frequency and modulation accuracy is straight-forward using the instrument's bar charts and graphical displays.



MI-BASIC provides full access to the RS-232 port and all measurement functions, making the standard instrument suitable for closed-loop alignment applications.

Service

In the field, many faults are simple connector, antenna or battery problems. These can often be identified visually. To locate more complex faults, e.g. unable to register, those that result from component or solder joint failure, sophisticated test tools are required. The 2967 TCH mode allows phones to be tested in test modes. Under Manual mode the instrument behaves as a signal generator and, at the same time, a 'free-running' receiver. No synchronization between the uplink and downlink is required.

Standard features, not available on GSM specific test sets, such as the spectrum analyzer, oscilloscope, multimeter and the unique FFT audio analyzer aid rapid fault diagnosis.

Go/No Go Testing

Go/No Go testing is essential to maintain quality in production, distribution and service. In this application, test speed and ease-of-use are key; the 2967 delivers on both counts.

Specification

Certain characteristics are shown as typical. These provide additional information for use in applying the instrument but they are unwarranted.
(Applies to version 7.00 and above)

RF Signal Generator

DIGITAL SIGNAL GENERATOR

FREQUENCY

Range
800 MHz to 1 GHz
1709 MHz to 1991 MHz

Resolution
1 Hz to 1 GHz
2 Hz to 1991 MHz

Indication
10 digit display

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
As frequency standard

OUTPUT LEVEL

Range
One-port Dx modes:
N-Type socket: –135 dBm to –45 dBm
TNC socket: –135 dBm to –25 dBm
Two-port Dx modes:
N-Type socket: –135 dBm to –35 dBm
TNC socket: –135 dBm to –15 dBm

Resolution
0.1 dB

Indication
4 digits plus sign (dBm, dB µV, µV, mV PD/EMF)

Accuracy
N-Type socket single port duplex
±1.5 dB
±1.0 dB over the temperature range 15 to 35°C

Sub Harmonics
1709 to 1991 MHz <-40dBc

GMSK MODULATION – INTERNAL

Frequency Range
800 MHz to 1 GHz, useable to 1.15 GHz
1.805 to 1.88 GHz (GSM 1800)
1.930 to 1.99 GHz (GSM 1900)

Bt
0.3

Phase Error (in useful part of burst)
<1° RMS
<4° peak

BER Meter

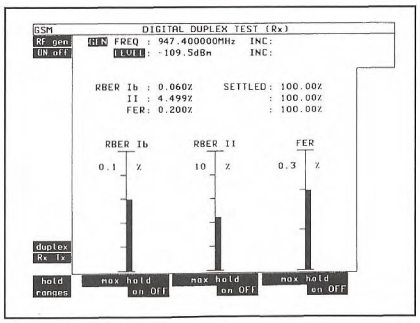
Types
BER Class I
BER Class II
RBER Class Ib
RBER Class II
FER

Range
0 to 99%

Resolution
0.001%

Indication
4 digits and bar chart with peak hold

Features
Adjustable Sample Size
Duration Indication
% Settled Indication



RF Power Meter (Burst)

Frequency Range
800 MHz to 1 GHz
1.709 GHz to 1.991 GHz

Dynamic Range
0 dBm to +47 dBm

Power Profile Dynamic Range
44 dB

Power Reading
Average power over useful part of burst

Burst Type
Normal/Access

Indication Units
dBm

Resolution
0.1 dB

Indication
3 digits and bar chart with peak hold
Power profile against GSM11.10 template
Normal/Access bursts
Full burst
Useful Part
Ramps

Accuracy
±0.6 dB for temperatures in the range 15 to 35°C
See also under Environmental/User Calibration

GMSK MODULATION

Frequency Range
800 MHz to 1 GHz
1709 MHz to 1991 MHz

Phase Error Range
10° RMS
±30° peak

Burst Type
Normal/Access

Resolution
0.1°

Indication
3 digits and bar chart with peak hold
Phase profile

Accuracy
Better than 0.3° RMS at 5°
Better than 4° peak

Burst Timing Meter

Burst Type
Normal/Access

Range
–128 to +127 bits

Resolution
0.01 bits

Indication
5 digits

Accuracy
±0.1 bits

General Features (Systems)

Test Modes
Manual Test/Auto Test

Auto Test Programs
Call Processing Only
Call and RF Testing
Brief Testing
Comprehensive Testing
User Defined Test
Digital Parametric Auto Test Routines
Tx Timing
Tx Power Level
Tx Power Profile
Tx Frequency Error
Tx RMS Phase Error
Tx Peak Phase Error
Rx BER Class I
Rx BER Class II
Rx RBER Class Ib
Rx RBER Class II
Rx Frame Erasure
Rx Sensitivity
Rx RSSI Report
Dual band handoff

Analog Signal Generator

FREQUENCY

Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Resolution
1 Hz

Indication
10 digit display

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
As frequency standard

OUTPUT LEVEL

Range
One-port Dx modes:
N-Type socket: –135 dBm to –40 dBm
TNC socket: –115 dBm to –20 dBm
Rx Test and two-port Dx modes:
N-Type socket: –135 dBm to –10 dBm
(–20 dBm with AM)
TNC socket: –115 dBm to + 10 dBm
(0 dBm with AM)

Resolution
0.1 dB

Indication
4 digits plus sign (dBm, dB µV, µV, mV PD/EMF)

Accuracy
N-Type socket:
±1.2 dB up to 575 MHz for levels above –120 dBm
±1.75 dB up to 1 GHz for levels above –120 dBm
±1.3 dB up to 1 GHz over the temperature range 15 to 35°C

Analog and Digital

Carrier On/Off
Keyboard operation, reduces signal generator output to less than –120 dBm

Reverse Power Protection
N-Type socket: With instrument switched on 150 W. Overload indicated by visual and audible warning.
TNC socket: Protection up to 10 W. Reset available on removal of RF power. Excess power indicated by visual and audible warnings.

Output Impedance
50 Ω nominal

VSWR
N-Type socket:
better than 1.2 up to 500 MHz;
better than 1.3 up to 1 GHz (typically 1.2),
better than 1.4 up to 1991 MHz (typically 1.3)
TNC socket: typically 1.3 at 900 MHz,
typically <1.5 at 1991 MHz

SPECTRAL PURITY

Residual FM (CCITT weighted)
Less than 6 Hz RMS up to 575 MHz
Less than 12 Hz RMS up to 1 GHz
Less than 24 Hz RMS up to 1991 MHz

Residual AM (CCITT weighted)
Less than 0.05% RMS

Harmonics
Better than –30 dBc for levels up to +4 dBm (TNC)
Better than –30 dBc for levels up to –16 dBm
(N-Type)

Spurious Signals
Better than –45 dBc for carrier frequencies from 100 kHz to 36 MHz;
Better than –50 dBc for carrier frequencies 36 MHz to 1 GHz.

SSB Phase Noise (20 kHz offset)
Better than –114 dBc/Hz up to 575 MHz
Better than –108 dBc/Hz up to 1 GHz.
Better than –102 dBc/Hz up to 1991 MHz

RF Carrier Leakage
Less than <0.5 µV PD generated at the carrier frequency, up to 1 GHz, across a 50 Ω load by a 2-turn 25 mm loop, 25 mm from the surface of the instrument with the output level at <-60 dBm and terminated in a 50 Ω sealed load.

Less than <1.0 µV PD generated at the carrier frequency, from 1 GHz to 2 GHz, across a 50 Ω load by a 2-turn 25 mm loop, 25 mm from the surface of the instrument with the output level at <-60 dBm and terminated in a 50 Ω sealed load.

AMPLITUDE MODULATION – INTERNAL

Frequency Range
100 kHz to 400 MHz, useable to 1.15 GHz

AM Depth Range
0 to 99%

Resolution
0.1%

Indication
3 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy[1] (up to 85% AM)
±4% of setting ±1 digit for modulation frequency 1 kHz.
±6% of setting ±1 digit for modulation frequencies from 30 Hz to 10 kHz.
±8% of setting ±1 digit for modulation frequencies from 10 kHz to 20 kHz.

Distortion
Less than 1% at 1 kHz for modulation depths up to 30%, CCITT weighted.
Less than 2% for modulation frequencies from 100 Hz to 20 kHz and depths up to 85%.

Modulation Frequency
Range: 20 Hz to 15 kHz for carrier frequencies up to 36 MHz; 20 Hz to 20 kHz for carrier frequencies up to 400 MHz.
Resolution: 0.1 Hz below 10 kHz; 1 Hz below 20 kHz.

AMPLITUDE MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal AM

Modulation Frequency Range
As internal AM with AC or DC coupling

Accuracy
As internal ±2%

Input Sensitivity
1 VRMS for indicated modulation depth

FREQUENCY MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy [1]
±3% ±1 digit at 1 kHz over the range 15 to 35°C (0.1% per °C outside this range)
Typically ±3% ±1 digit for modulation frequencies from 20 Hz to 5 kHz.
Typically ±7% ±1 digit for modulation frequencies from 5 kHz to 20 kHz.
Typically ±10% ±1 digit for modulation frequencies from 20 kHz to 75 kHz.

Distortion[1]
Less than 0.5% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 kHz to 800 kHz).
Less than 1% for modulation frequencies from 50 Hz to 20 kHz (for deviation 1 kHz to 800 kHz).

Modulation Frequency Range[6]
20 Hz to 20 kHz Mod generators 1, 2, 3 or
20 Hz to 100 kHz Mod generator 4

Resolution
0.1 Hz

FREQUENCY MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal FM

Modulation Frequency Range
DC to 100 kHz (DC coupled)
10 Hz to 100 kHz (AC coupled)

Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2% for frequencies up to 20 kHz

PHASE MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable to 1.15 GHz

Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
±5% ±1 digit for modulation frequencies from 250 Hz to 3.4 kHz, over the range 15 to 35°C (0.1% per °C outside this range)

Distortion[1]
Less than 1% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 rad to 160 rads).

Modulation Frequency
Range: 250 Hz to 5 kHz

Resolution
0.1 Hz

PHASE MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal phase modulation

Modulation Frequency Range
250 Hz to 5 kHz

Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2%

INTERNAL MODULATION AND AUDIO SOURCES
Up to 6 tone sources can be assigned as 3 modulation generators and 3 audio tone generators.

Modulation Modes
Internal generators may be assigned to AM, FM, ΦM.

Audio Voltmeter

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
DC and 20 Hz to 500 kHz
AC only 20 Hz to 500 kHz
Polarized DC less than 10 Hz

Level Ranges and Resolution

0-10, 0-30, 0-100 mV,	resolution 0.1 mV
0-300 mV,	resolution 0.3 mV
0-1 V	resolution 1 mV
0-3 V	resolution 3 mV
0-10 V	resolution 10 mV
0-30 V	resolution 30 mV

All RMS reading, autoranging or fixed

Level Indication
4 digits and barchart with peak hold

Level Accuracy (DC Coupled)[3] [5]
+2% of reading +1 mV + resolution, DC and 100 Hz to 20 kHz.
+4% of reading +1 mV + resolution, 40 Hz to 100 kHz.

Level Accuracy (AC Coupled)[3]
±2% of reading ±1 mV, ± resolution 150 Hz to 20 kHz.
±4% of reading ±1 mV, ± resolution 100 Hz to 100 kHz.

Residual Noise
100 µV RMS CCITT weighted

Audio Frequency Meter

Range
10 Hz to 500 kHz

Resolution
0.1 Hz from 10 Hz to 5 kHz
1 Hz from 5 kHz to 50 kHz
10 Hz from 50 kHz to 500 kHz

Indication
6 digits

Accuracy
As frequency standard ±1 digit ± resolution

Sensitivity
On barchart greater than 25% FSD (DC coupled)

Audio SINAD Meter

Frequency
1 kHz default. User selectable up to 20 kHz

SINAD Range
5 to 50 dB

Resolution
0.1 dB for readings less than 20 dB
0.2 dB for readings less than 25 dB

Indication
3 digits and barchart with peak hold

Accuracy (Bandpass filter selected)
±0.5 dB ± resolution

Sensitivity
100 mV for 46 dB SINAD

Audio Distortion Meter

Frequency
1 kHz default. User selectable up to 20 kHz

Distortion Range
0 to 30%

Resolution
0.1% distortion for readings greater than 1%
0.2% distortion for readings less than 1%

Indication
3 digits and bar chart with peak hold

Accuracy
±5% of reading ± resolution (bandpass filter selected)

Sensitivity
100 mV for 0.5% distortion

Audio S/N Meter

S/N Range
0 to 100 dB

Resolution
0.1 dB for readings less than 50 dB
0.2 dB for readings less than 70 dB

Indication
3 digits and bar chart with peak hold

Accuracy
±0.5 dB ± resolution

Sensitivity
2 V for 60 dB, 200 mV for 40 dB

Audio Oscilloscope

Operating Modes
Single or Repetitive sweep

Frequency Range
DC to 500 kHz
10 Hz to 500 kHz (AC coupled)

Glitch Catching
1 µs minimum

Voltage Ranges
2 mV/div to 20 V/div in a 1, 2, 5 sequence

Voltage Accuracy
±5% of full scale

Timebase
5 µs/div to 10 s/div in a 1, 2, 5 sequence

Timebase Accuracy
As frequency standard

Trigger Mode
Auto trigger

Marker Indication
Level: M1, M2, δM
Time: M1, M2, ΔM

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Audio FFT Analyzer

Span Widths
50 Hz to 50 kHz in a 5, 10, 25 sequence
Above 40 kHz signals are attenuated by 80 dB/octave

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Level Reference (top of screen)
10 mV to 20 V, in a 1, 2, 5 sequence

Level Accuracy
±0.3 dB 100 Hz to 15 kHz; typically ±1 dB 40 Hz to 40 kHz

Vertical Scaling
1, 2, 5, 10 dB/div

Dynamic Range
60 dB

Max hold facility

Audio Sweep facility
DC to 20 kHz

Marker Indication
Level: M1, M2, δM
Frequency: M1, M2, ΔM

Audio Bar Charts

Displays: AF voltage, SINAD, Distortion, S/N.
Vertical Resolution: 1% of full scale.
Ranging: Autoranging, range hold or manual selection (up/down), 1, 3, 10 sequence with hysteresis.
With peak hold facility.

Audio and Modulation Filters

300 Hz Lowpass (±0.1 dB less than 150 Hz, ±0.2 dB, 150-200 Hz relative to 100 Hz).
300 Hz to 3.4 kHz Bandpass (±0.4 dB, 400 to 2100 Hz relative to 1 kHz).
5 kHz Lowpass (±0.3 dB at <3 kHz relative to 1 kHz).
20 kHz Lowpass ±0.3 dB at <12 kHz, typically –0.9 dB at <15 kHz and –3 dB at 20 kHz relative to 1 kHz.
CCITT Psophometric
C-MESSAGE
See also under Environmental/User Calibration

Multimeter

Input Terminals
3 x 4 mm, 'Volt/Ohm', 'Current' and 'Common'

Maximum Input Voltage
375 V with respect to instrument chassis

VOLTMETER

Voltage Range
0 to 300 V, 0 to 30 V, 0 to 3 V, 0 to 300 mV, Terminals, 'Volt/Ohm' and 'Common', maximum crest factor 3:1 at range full scale

Frequency Range
Polarized DC or 40 Hz to 1 kHz

Input Impedance
Nominally 6 MΩ in parallel with 100 pF

Resolution
0.1% of FSD

Accuracy (5)
±3% of reading ±1 mV ±1 digit
See also under Environmental/User Calibration

Indication
4 digits and bar chart with peak hold

AMMETER

Current Range
0 to 1 A and 0 to 10 A

Frequency Range
Polarized DC or 40 Hz to 1 kHz

Resolution
1 mA below 1 A; 10 mA below 10 A

Accuracy
±5% of reading ±1 mA ±1 digit

Indication
4 digits and bar chart with peak hold

RESISTANCE METER

Resistance Ranges
100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ

Resolution
1 Ω below 1 kΩ or 3 digits

Accuracy(5)
±5% of reading ±1 Ω ±1 digit

Continuity Test
Continuous tone if reading is less than 10 Ω

Indication
4 digits and bar chart with peak hold

RF Frequency Error Meter

Frequency Range
800 MHz to 1 GHz
1.709 GHz to 1.991 GHz

Frequency Error Range
±5 kHz

Burst Type
Normal/Access

Resolution
0.1 Hz.

Indication
3 digits and bar chart with peak hold

Accuracy
±30 Hz

RF Frequency Meter

Range
100 kHz to 1 GHz

Resolution
1 Hz or 10 Hz selectable

Indication
Up to 10 digits

Accuracy
As Frequency Standard ±2 Hz ± resolution

Dynamic Range (Auto tuned)
As RF Power Meter (broadband)

Frequency Range (Auto tuned)
10 MHz to 999.9 MHz

Sensitivity
Manual tuned: –100 dBm (TNC) dependent on receiver bandwidth in off air test mode

Offset Frequency Range
±1 MHz dependent on receiver bandwidth

RF Power Meter (Broadband)

Frequency Range
100 kHz to 1 GHz

Dynamic Range (Auto tuned)
10 mW to 150 W (N-Type), 100 µW to 0.5 W (TNC)

Power Reading
True mean power

Indication Units
Watts

Resolution
Better than 1%

Indication
3 digits and barchart with peak hold

Accuracy(5)
100 kHz to 500 MHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type)
±10% (0.4 dB), 20 mW to 150 W (N-Type)
±12% (0.5 dB), 200 µW to 50 mW (TNC)
500 MHz to 1 GHz:
±12% (0.5 dB), 20 mW to 150 W (N-Type)
±15% (0.6 dB), 200 µW to 50 mW (TNC)
100 kHz to 1 GHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type)
±10% (0.4 dB) 1 mW to 50 mW (TNC)
For ambient temperatures in the range 15 to 35°C.
See also under Environmental/User Calibration

Maximum Safe Continuous Rating
N-Type: 50 W
TNC: 0.5 W; overload protected to 10 W

Intermittent Rating
N-Type: 150 W for limited periods, typically 2 minutes at 20°C. Typical off to on ratio is 6:1.
Overload indicated by audible and visual warning

RF Power Meter (Selective)

Frequency Range
100 kHz to 1 GHz

IF Bandwidth
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Dynamic Range (Manually tune)
0 dBm to +50 dBm (110 kHz IF bandwidth) (N-Type)
–90 dBm to +20 dBm (110 kHz IF bandwidth) (TNC)

Power Reading
Average

Indication Units
dBm

Resolution
0.1 dB

Indication
3 digits + barchart with peak hold

Accuracy(5)
Typically ±2.5 dB N-Type and TNC
See also under Environmental/User Calibration

RF Spectrum Analyzer

Frequency
Range: 100 kHz to 1 GHz, useable from 30 kHz to 1.05 GHz
1.71 GHz to 1.991 GHz, useable from 1.3 GHz to 2.2 GHz

Spans
500 Hz/div to 100 MHz/div, in a 1, 2, 5 sequence up to 1 GHz
1 MHz/div max, 1.7 GHz to 1.99 GHz
50 kHz/div max 1.3 GHz to 2.2 GHz

Resolution Bandwidth
300 Hz to 300 kHz in a 1, 3, 10 sequence and 3 MHz (automatically selected according to span and manually selectable).
Video bandwidth, auto selection 100 Hz, 1 kHz and 3 kHz.

Filter Shape
Nominally 3 dB/60 dB, 1:11 (300 Hz to 30 kHz bandwidth)

Reference Level (top of screen)
–100 dBm to +70 dBm

On Screen Dynamic Range
80 dB

Vertical Resolution
0.5 dB on 10 dB/div, 0.05 dB on 1 dB/div

Level Accuracy(5)
Typically ±2.5 dB
See also under Environmental/User Calibration

Sweep Speeds
Optimum sweep speed selected according to span and resolution bandwidth

Modes
Single sweep and continuous

Graticule
10 horizontal by 8 vertical divisions

Expanded Mode
Can be made to occupy full screen for high definition

Markers
M1 and M2

Indication
Level: M1, M2, δM
Frequency: M1, M2, ΔM

TRACKING GENERATOR
Available in RF TEST mode

Frequency Range
100 kHz to 1 GHz

Level Range
–135 dBm to +10 dBm

Offset Tracking
Allows testing of mixers, IFs, fundamental and 2nd harmonic analysis (up, down, x2, ÷2)

Modulation Analyzer

Dynamic Range (Auto tuned)
As RF Power Meter (Broadband)

Sensitivity (Manual tuned)
N-Type –30 dBm (110 kHz IF bandwidth).
TNC –50 dBm (110 kHz IF bandwidth).
TNC (off-air test mode) –101 dBm (2 µV 10 dB SINAD in 30 kHz IF bandwidth and CCITT weighting).

Demodulation
Accuracy maintained on signals greater than –60 dBm

Receiver Bandwidths
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz.

Demodulation Filters
As audio analyzer plus 5 kHz lowpass (±0.3 dB at less than 3.4 kHz relative to 1 kHz)

Audio Output
Available in to an internal loudspeaker, demodulated output or accessory socket for external loudspeaker or headphones.

Demodulated Output
Nominal output impedance less than 10 Ω. Output voltage is range dependent (2 V peak at top of range)

Switching Speed
Nominally less than 1 ms channel to channel up to 50 MHz apart, settling to within 1 kHz of final frequency

Squelch
A manual squelch control is provided with a variable threshold.

AMPLITUDE MODULATION

Frequency Range
100 kHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

AM Depth Range
0 to 99.9%

Resolution
0.1% AM

Indication
3 digits and bar chart with peak hold.

Accuracy (up to 85% AM)[1][5]
±3% of reading, ±1% AM, 250 Hz to 5 kHz.
Typically ±5% of reading, ±1% AM, 50 Hz to 15 kHz.

Demodulation Distortion[1]
Less than 1% at 1 kHz, CCITT weighted

Residual AM
Less than 0.1% AM, CCITT weighted

FREQUENCY MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz
20 Hz to 100 kHz when Option 08 fitted

Deviation Range
0 to 100 kHz

Resolution
10 Hz below 10 kHz deviation; 100 Hz below 100 kHz deviation

Indication
3 digits and bar chart with peak hold.

Accuracy[1] [3] [5]
±3% ± resolution for modulation frequency of 1 kHz.
±5% ± resolution for modulation frequencies from 100 Hz to 15 kHz.
±10% ± resolution for modulation frequency 15 kHz to 100 kHz opt 8 only.

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted.

Residual FM
Less than 25 Hz RMS CCITT weighted.

PHASE MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
250 Hz to 5 kHz

Deviation Range
0 to 20 rads

Resolution
0.01 rads

Indication
3 digits and bar chart with peak hold.

Accuracy[1] [3] [5]
±5% ± resolution, 2 to 20 rads

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted.

Audio Generators

See section on modulation generators for interaction of audio and modulation generators

FREQUENCY

Range[6]
1 Hz to 20 kHz AF Gens 1, 2 and 3 or
1 Hz to 100 kHz AF Gen 4

Setting
Keyboard entry, delta increment/decrement function and rotary control.

Indication
6 digits

Resolution
0.1 Hz

Accuracy
As frequency standard

LEVEL

Range
0.1 mV to 5 V RMS (maximum AF output 7 V peak, all generators combined)

Setting
Keyboard entry, delta increment/decrement function and rotary control

Indication
4 digits

Resolution
0.1 mV

Accuracy
±3% ±1 digit, 250 Hz to 5 kHz
±5% ±1 digit, 10 Hz to 20 kHz
±10% ±1 digit, 20 kHz to 75 kHz

Output Impedance
Nominally 5 Ω

Protection
Maximum applied voltage 50 V

SIGNAL PURITY

Distortion[2]
Less than 0.5% at 1 kHz measured in a 30 kHz bandwidth
Less than 1% from 20 Hz to 20 kHz measured in an 80 kHz bandwidth
Typically 0.1% for levels greater than 100 mV

Residual Noise
Less than 50 µV RMS (CCITT weighted)

DC Offset
Less than 10 mV

Signaling Encoder/Decoder

Sequential tones functions
Encodes and decodes up to 40 tones.
CCIR, ZVEI, DZVEI, EEA, EIA or user defined.
Any of the tones may be extended.
Continuous, burst and single step modes available.

User defined tones
Up to three frequency plans may be defined and stored within the 2967 for sequential tones.
Any of the standard tone frequency plans may be copied to user defined and modified.
Tone length 10 ms to 1 s.
Extended tone length 100 ms to 10 s.

CTCSS tones mode
Standard tone frequencies may be selected from a menu

DTMF Encoder/Decode
Generation and decode of DTMF tones, displaying Hi/Lo frequencies, frequency error, timing information and twist

DCS Encode/Decode
Generation and decoding of digitally coded squelch

POCSAG generator
Generation of POCSAG code CCIR No.1 Rec 584. Bit rates from 400 to 9600 bit/s

Audio Monitor

Audio and demodulation signals may be monitored via the internal loudspeaker or via the accessory socket output or BNC socket on the rear panel.

SSB Option

SSB Tx

Frequency, range and meter accuracy	– as RF frequency
Power, level and meter accuracy	– as Broadband power
Detection Range	– 100 µV to 150 W
AF Demod range	– 10 Hz to 5 kHz
Demod distortion	– <2% @ 1 kHz CCITT weighted
Carrier and Alternate s/band suppression	– Better than –50 dBc
Sideband/CW Analyzer	– max 5 kHz full span frequency range
Spectrum Analyzer	– as RF spectrum analyzer
Audio Generator	– two – as audio generator
Sideband Selection	– LSB, USB, CW

SSB Rx

Sideband Generator	– as RF Gen (AM mode)
Offset measurement	– to 0.1 Hz resolution
SINAD	– as SINAD meter
Distortion	– as Distortion meter

Note: No audio is available in SSB option.

General Features

INTERFACES
Keyboard and Display
Logical color coded keyboard with bright high resolution CRT

GPIB
Full control of all major instrument functions via the GPIB interface.
Flexibility is further enhanced by IFR Ltd's implementation of IEEE-488.2.

Capability
Complies with the following subsets as defined in IEEE-488.1-1978:- SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, E1.

Serial
Serial interface is provided for connection of RS-232 for instrument remote control. 9 Way socket.

Parallel
Connector 25 way female D-Type. Provision made for graphics screen dump. A selection of printer drivers are included.

Accessory Socket
Allows the connection of various optional accessories.
With suitable adapters is compatible with most 2955 series accessories.

Memory Card
Meets PCMCIA2/JEIDA – 4 standard. The memory card facility allows the storage of results, set ups and MI-BASIC programs.

Video Output
Color, compatible with most VGA monitors.
15 way Sub Miniature D Type.

Frequency Standard

Internal Frequency Standard Output

Frequencies
10 MHz and 13 MHz

Level
Nominally 2 V pk-pk

Output Impedance
Nominally 50 Ω

Temperature Stability
Better than 5 in 10^8, 5 to 50°C.

Ageing Rate
Better than 1 in 10^7 per year, after 1 month continuous use

Warm Up Time
Less than 10 minutes to within 2 in 10^7 at 20°C

External Frequency Standard Input

Frequencies
1, 2, 5, 10 and 13 MHz

Level
Greater than 2 V pk-pk, less than 5 Vpk-pk

Input Impedance
Nominally 100 Ω

Power Requirements

AC supply

Voltage
88 V to 132 V and 188 V to 265 V

Supply frequency
45 Hz to 65 Hz

Power
Nominally 135 W, 260 W maximum, for future options

Electromagnetic Compatibility

Conforms with the protection requirements of Council directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2, 3, 4
EN60555-2	IEC 555-2

Safety

Complies with IEC1010-1, BS EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Environmental

Rated Range Of Use
0 to 50°C and up to 95% relative humidity at 40°C.

User Calibration

User calibrations are provided to maintain high accuracy for any ambient temperature (e.g. in ATE racks or in field measurements). Having allowed the instrument to stabilize, running the user calibrations optimizes the performance at that temperature.
A change in temperature of 5°C from the calibration temperature affects readings as below. These figures are provided as a guide to typical performance.
Typical variations are as follows for a 5°C change in temperature.

Power Meter:	Burst	0.5 dB
	Broadband	2%
	Selective	0.5 dB
Spectrum Analyzer Level		0.5 dB
Audio Analyzer & Modulation Filters		
Audio Voltage		0.4%
Demod depth & deviation		0.4%
Multimeter:	Voltage	0.5%
	Current	0.5%

STORAGE AND TRANSPORT

Temperature
–40 to +70°C

Altitude
Up to 2500 m (pressurised freight at 27 kPa differential)

Internal Test Software

OPTION 10 NMT CELLULAR SOFTWARE

NMT450	NMT900
Benelux	NMTF
Austria	Spain
Malaysia	Indonesia
Saudi 1	Saudi 2
Thailand	Oman
Tunisia	Hungary
Poland	Russia
Czech	Bulgaria
Slovenia	Turkey

USER DEFINED NMT

OPTION 11 AMPS CELLULAR SOFTWARE

E-AMPS	N-AMPS

USER DEFINED AMPS

OPTION 12 TACS CELLULAR SOFTWARE

E-TACS	TACS-2
C-TACS I	C-TACS II
J-TACS	N-TACS

USER DEFINED TACS

OPTION 13 MPT 1327 TRUNKING SOFTWARE

Band III	JRC
UK Water	Hong Kong
Autonet	AMT
Madeira	NL-TRAXYS
NZ MPT1327	PH-INDO

USER DEFINED MPT

OPTION 14 PMRTEST SOFTWARE
USER DEFINED PMR for FM radios

Analog Parametric Auto Test Routines

AF Frequency	AF Level
FM Deviation	Mod Frequency
Rx Distortion	Rx Expansion
Rx Sensitivity	Rx SINAD
Rx S/N	Tx Compression
Tx Distortion	Tx Frequency
Tx Level	Tx Power Level
Tx Limiting	Tx Mod Level
Tx Noise	Tx SINAD
Tx S/N	SAT Deviation
SAT Frequency	ST Duration
ST Frequency	ST Deviation
Data Deviation	DSAT Deviation

Signalling Auto Test Routines
Registration / Roaming Update
Place Call
Clear From Mobile
Page Mobile
Handoff
Clear From Land
Speech Quality
Hook Flash
DTMF Decode
Data Performance
PTT On
PTT Off

Auto Test Pause Modes
Pause Manual Only
Pause On Failure
Pause Always

DIMENSIONS AND WEIGHT
Excluding handle, feet and covers.

Height	*Width*	*Depth*
177 mm (6.9 in)	370 mm (14.5 in)	540 mm (21.2 in)

Including handle, feet and covers.

Height	*Width*	*Depth*
203 mm (7.9 in)	420 mm (16.5 in)	600 mm (23.6 in)

Weight
Less than 20.5 kg (45.1 lb)

NOTES
(1) At low modulation levels the residual AM/FM may become significant.
(2) At low audio levels the residual noise may become significant.
(3) Audio and Modulation filter passband errors not included.
(4) Typical performance figures are non-warranted.
(5) Refer to USER CALIBRATION section.
(6) Either 3 modulation plus 3 audio generators up to 20 kHz or 1 modulation or 1 audio generator to 100 kHz.

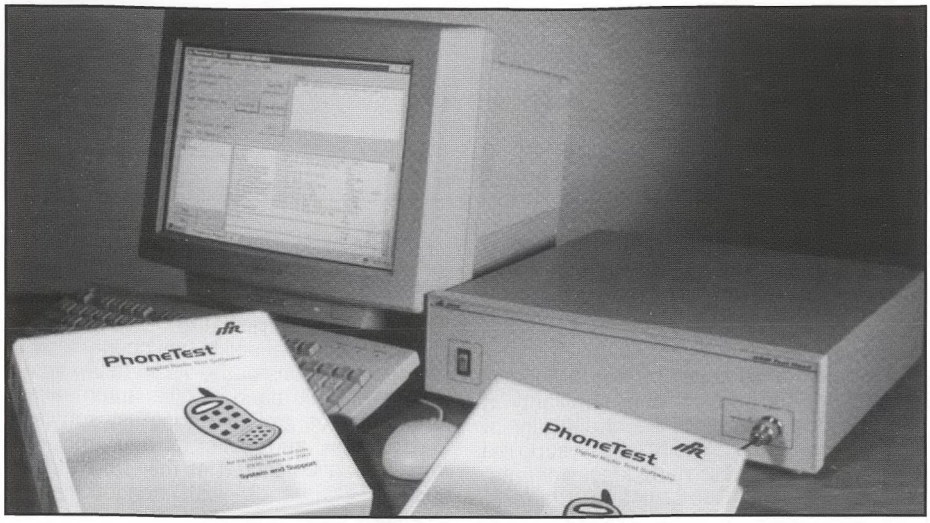
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2967	Radio Test Set
	Options
Option 01	French Language Version
Option 02	Spanish Language Version
Option 03	German Language Version
Option 08	Wideband FM deviation
Option 09	SSB receiver option
Option 10	NMT Cellular Radio option
Option 11	AMPS Cellular Radio option (including N-AMPS)
Option 12	TACS Cellular Radio option (including N-TACS)
Option 13	MPT 1327/MPT 1343 Trunked Radio option
Option 14	PMRTEST for FM radios.
Option 16	GSM 1800
Option 17	GSM 1900
Option 21	GSM 900
Option 22	Mobile Tuning Range Test
Contact your local Sales Outlet for details of availability of options	
	Supplied with
	AC Supply lead
	Operating Manual
	Multimeter Lead Kit (Two 4 mm leads to test points)
	PhoneTest Options
81506	PhoneTest for 2967
81510	PhoneTest Bundle includes - 81506/81507/81508/81509
81507	PhoneTest-Repair
81508	PhoneTest-Manager
81509	PhoneTest-Exchange
81504	PhoneTest and enabled options, site licence software upgrade
81505	PhoneLib
	Accessories
54421/001	BNC Telescopic antenna
54431/023	20 dB AF attenuator (BNC)
54112/158	Hard Transit Case
54112/157	Soft Carrying Case
54127/310	Rack Mounting Kit
59000/189	Memory Card (128 K)
54411/052	600 Ω interface and 20dB AF attenuator (requires 46884/645 Accessory socket adapter)
46884/645	Accessory socket adapter (for use with 2955 accessories)
46884/646	Accessory Socket 'Y' adapter
46884/560	Parallel Printer Interface Cable
46884/649	Serial port to PC Cable (25 way)
46884/650	Serial port to PC Cable (9 way)
43129/189	GPIB Cable
43130/596	Coaxial cable N-Type(m) to TNC(m) (double screened)
54311/095	Coaxial cable N-Type(m) to N-Type(m) (1 metre)
54212/001	GSM Phase 2 Plug-In TEST SIM
54212/002	GSM Phase 2 Full Size TEST SIM
54311/071	TNC(m) to BNC(f) adapter
54311/092	N-Type(m) to BNC(f) adapter
52388/900	1 GHz Active Probe
54441/012	Power supply for probe 52388/900
B27033	Edit and Runtime Software, Single User, Dongled
B27071	GPIB Software Driver
	Service Support
W2	Two year warranty
W3	Three year warranty
Contact your local Sales Outlet for availability of these and other service plans	

PhoneTest and the 2935 GSM 900/1800/1900 Radio Test Solution

A low cost GSM 900/1800/1900 test head, used in conjunction with the PhoneTest software suite incorporating Dual Band functionality



- A low cost PC controlled test system for GSM 900/1800/1900 mobiles
- Available in five languages
- PC control through a familiar Windows interface
- High throughput with rapid auto test sequences
- Simple test script language for custom program generation
- Reduced labor costs from a paperless service and analysis facility
- Improved repair efficiency with optional PhoneTest-Repair and PhoneTest-Manager
- Interface to existing databases via PhoneTest-Exchange
- Rapid terminal transmitter and receiver alignment capability

PhoneTest is a complete PC based digital test solution for GSM 900 / 1800 / 1900 MHz digital cellular handsets.

The measurement system comprises a single desktop unit, the 2935 Test Head, which is controlled by a separate PC running a Windows 95 minimum or Windows NT based application program. The ideal would be to utilize an existing PC that is currently used to run the manufacturers test and alignment software.

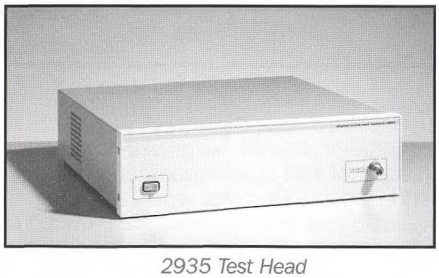
For ordering purposes the 2935 comes complete with the PhoneTest software in all language variants and an RS-232 interconnect cable.

The Test Head requires minimum interfacing. The only facilities on its front panel are the power ON / OFF switch and the RF connection to the terminal under test, whilst on the rear are two RS-232 connections. One of the RS-232 connections provides the interface to the PC for control, the second provides a power-up diagnostic facility to test the integrity of the Test Head-PC link and cable connection.

RS-232 control eliminates the need for an expensive GPIB module for control whilst retaining high speed operation.

Small Footprint, More Space

The measurement Test Head is housed in a small compact unit which can easily sit between the monitor and body of a desk mounted PC or concealed away under or above the workbench. By using the display and keyboard of a PC, the Test Head does not need to be regularly accessed freeing up valuable workspace in today's cluttered workshop environments.



2935 Test Head

GSM Measurements

The Test Head provides the necessary signaling protocols to simulate a base station which allows a GSM terminal to be put into conversation mode and parametric measurements performed on it. Standard transmitter and receiver measurements such as TX power, profile, frequency and phase error along with RX BER, RBER and FER are available. The E-GSM, GSM 1800 and GSM 1900 frequency and power levels are fully supported.

Test Head measurement capabilities are:-

Transmitter
- Power
- Power Profile to 45 dB (ramps, full, useful part)
- Frequency
- Phase, RMS and Peak
- Timing Advance.

Receiver
- BER I and II
- RBER Ib and II
- FER
- RX Lev
- RXQual

Protocol
- Registration
- Page Mobile
- Place Call
- Cleardown
- Handoff
- Dual Band Handoff

Additionally in Manual Mode there is the ability to provide an "unsynchronized" Traffic Channel Test Mode. This provides Tx

power measurement capability and an on Channel CW RF source for terminal alignment without protocol information.

Burst Profile

A burst profile can be measured in Manual Mode with display of either the full burst, the ramp up and down or the useful part of the burst containing the data bits.

Phase Profile

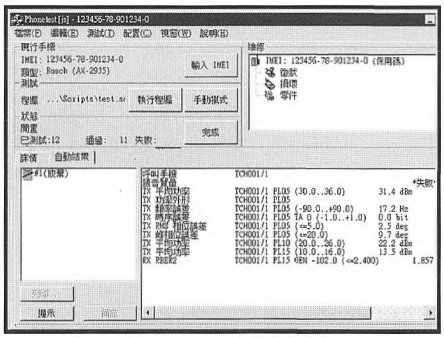
A peak phase profile display is available in manual mode, which through marker functions can be analyzed against timing or data bits

PhoneTest Application Software

The Test Head is designed to make terminal measurements according to ETS 300 607-1 Specification. These measurements are controlled from the PC interface by the PhoneTest Application software in the Windows environment. This software is supplied with the Test Head on disk.

Language Variants

A major advantage of the Windows Application software is the familiarity it offers to the user and the availability of language variants. PhoneTest is supplied with four selectable language variants, English, French, German and Chinese, both traditional and simplified. This enables the technician to work in his own language allowing lower labor costs to be employed.

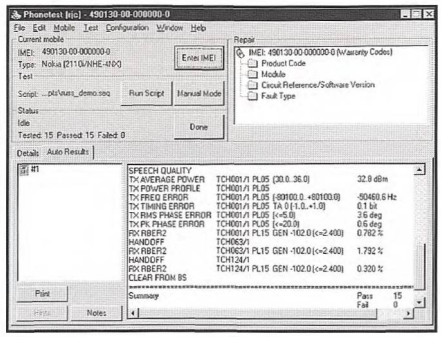


Chinese language version

Auto Test

The Auto Test procedures are stored in the controlling PC as simple script files. PhoneTest is delivered with a number of generic test scripts for each of the three GSM systems available. Scripts can be written for Go/NoGo automated test sequences for fast and efficient mobile checks. Alternatively, more comprehensive tests can be generated using the script wizard and stored for future use. For example registration, call placement and full parametric tests for transmission and receiver verification can be selected during script generation.

Running a script file or Auto sequence is similar to opening a file in Windows 95. Simply select the FILE pull-down and load or generate a test script as required. With the script loaded, select Run Script and observe the prompts on the PC screen. A results window is generated on the PC giving a PASS/FAIL indication on completion. The results can be viewed on the screen showing the tests performed and their results compared against the programmed limits.



AutoTest

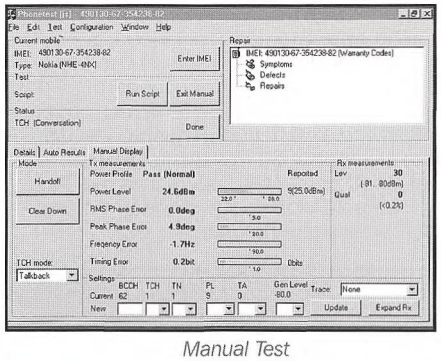
Results can be sent directly to a printer or to the optional PhoneTest-Manager software package.

Dual Band Functionality

Multi-band capability has been added to the test functions of the 2935, allowing full testing of multi-band mobiles automatically under the control of PhoneTest software. Registration and calls to and from the mobile can be tested in the GSM 900 or 1800/1900 bands, with handoff carried out from band to band.

Manual Test

Manual mode offers the user the ability to perform individual measurements as required or intervene and investigate a particular parameter from an Auto Sequence failure. The operator can view both Tx and Rx measurements on the PC screen in bar chart and digital forms. Valid measurements are displayed on a green bar chart while measurements which are outside of limits are displayed in red with an accompanying yellow and black warning triangle. This gives the benefit of speedy visual decisions on measurement results. Control of call set up including call origination, termination and handoff selection is available.

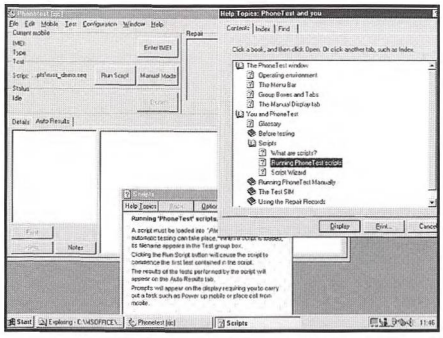


Manual Test

Customized Test Routines

A Script Wizard is provided for rapid creation of fast customized automatic test sequences. On line error reporting is available and HELP facilities are provided to aid program creation. Commands are simple, logical and Scripts can be generated without any specialist software knowledge.

Once created any further editing that is required can be carried out manually using a DOS or Windows text editor. A number of generic test Scripts are provided as templates from which to generate Custom Scripts.



On line pull down help

Help is always at hand to guide the user. Simply select the Help pull-down and select the relevant topic in the familiar way.

PC Requirements

The recommended minimum requirement for the PC to control the 2935 Test Head is a 66 MHz, 486 type PC with 16 MByte of RAM and running Windows 95 or Windows NT with a spare RS-232 connection. An RS-232 interconnecting lead is provided with the 2935 and the PhoneTest application software; all you need to provide is the PC and the User. The application will run on PCs of a lower standard running Windows 95 but the speed of operation will be reduced accordingly. For users with a desktop PC which has a single RS-232 port used for mouse operation, an additional serial card can be provided as a plug in module (see accessory list).

Low Cost of Ownership

With the PhoneTest application resident on the controlling PC, upgrades can be achieved quickly and easily at the user's premises. If the upgrade option (81504) is purchased any system enhancements will be automatically sent to the user.

A modular exchange program has been implemented with this product allowing fast fast repair turn around times.

Workshop Management Software

A range of "workshop management" software packages are available to use alongside PhoneTest.

PhoneTest-Repair

This software option provides the capability for quickly and efficiently generating repair and fault information to accompany the actual repair. Fault symptoms, defects, repair codes and parts used can be entered and added to warranty claims forms or saved to be recalled later from the optional PhoneTest-Manager.

PhoneTest-Manager

PhoneTest-Manager is a test area management software package that provides facilities for archiving and retrieval of test results, repair histories and

workshop throughput and performance analysis. This software is invaluable for reducing tiresome paperwork tasks which divert skilled engineers from their primary functions. Increased efficiency, repair hints on-line, specific terminal type failure modes and more consistent reporting of failures are the major benefits of PhoneTest-Manager.

PhoneTest-Exchange

This option uses ODBC-32 (Open Database Communication) drivers for interfacing to an existing or new Management Information System with PhoneTest.

An example may be the reading in of job information e.g. customer's reported problem, name, etc. from the Goods-In entry procedure at the front desk through to the technician effecting the repair.

Many Service Centres will already be running their own database for accounting purposes and may want to link in the terminal test and repair data. PhoneTest-Exchange provides this link.

PhoneLib

PhoneLib provides a programming interface for customized Windows 95 and NT applications. A DLL interface is available for Visual C / BASIC programming and a VXI Plug and Play driver is available for development environments such as LabWindows.

2935 Specification

Certain characteristics are shown as typical. These provide additional information for use in applying the instrument but they are unwarranted.

Digital Signal Generator

FREQUENCY

Range
GSM 900 Band 925 MHz to 960 MHz
GSM 1800 Band 1805 MHz to 1880 MHz
GSM 1900 Band 1930 MHz to 1990 MHz

Accuracy
As frequency standard

OUTPUT LEVEL

Range
–120 dBm to –40 dBm

Resolution
0.1 dB

Accuracy
Better than ±1.5 dB for generator levels <–52 dBm
Typically better than ±1.5 dB for generator levels ≥–52 dBm

OUTPUT IMPEDANCE
Nominally 50 Ω

VSWR
Better than 1.5:1

REVERSE POWER PROTECTION
10 W max

SPECTRAL PURITY

Harmonics
Typically better than –20 dBc

RF Carrier Leakage
Less than <1.0 µV PD generated at the carrier frequency across a 50 Ω load by a 2-turn 25 mm loop, 25 mm from the surface of the instrument with the output terminated in a 50 Ω sealed load

GMSK MODULATION - INTERNAL
GMSK, Bt 0.3

Phase Error
Typically <1.2° RMS
Typically <4° Peak

RF Receiver

FREQUENCY RANGE
GSM 900 Band 880 to 915 MHz
GSM 1800 Band 1710 to 1785 MHz
GSM 1900 Band 1850 to 1910 MHz

FREQUENCY ERROR METER

Burst type
Normal/Access

Frequency Error Range
±5 kHz

Resolution
0.5 Hz

Accuracy
As per frequency standard ±2 Hz ± resolution

TDMA POWER METER

Dynamic Range
–15 dBm to +40 dBm

VSWR
Better than 1.5:1

Power Reading
Average power over useful part of burst

Indication Units
dBm

Resolution
0.1 dB

Accuracy
Better than ±1.5 dB for $P_{in} \geq -2$ dBm
typically better than ±1.5 dB for $P_{in} < -2$ dBm

Input Power
10 W max

GMSK MODULATION METER

Burst Type
Normal/Access

Phase Error Range
10° RMS
±30° peak

Resolution
0.1°

Indication
2 digits and barchart

Phase Error Accuracy
Better than 1° RMS
Better than 4° peak

BURST TIMING METER

Burst type
Normal/Access

Range
–128 to +127 bits

Resolution
0.1 bits

Timing Accuracy
±0.1 bits

BER METER

Types
BER Class I
BER Class II
RBER Class Ib
RBER Class II
FER
Range 0 to 99%
Resolution 0.001%
Adjustable sample size.
Duration and % settled indication

Trace Displays

Following traces are available all with two marker operation

POWER PROFILE

Range
45 dB for $P_{in} > -10$ dBm

Burst Type
Normal/Access

Display
Full Burst or
Leading and Trailing ramp or
Useful Part

PHASE PROFILE
Range ±25°

Frequency Standard

Internal Frequency Standard
10 MHz

Temperature Stability
Better than 5 in 10^8, 0°C to 50°C

Ageing Rate
Better than 1 in 10^7 per year, after 1 month continuous use.

Warm Up Time
Less than 10 minutes to within 2 in 10^7

External Frequency Standard Input

Frequency
1, 2, 5 or 10 MHz

Input Level
Greater than 1 V peak to peak

Input Impedance
Nominally 1 kΩ

Supported Features

Controllable Parameters
BCCH ARFCN;
TCH ARFCN;TCH TN;
BCC; MCC; MNC; LAC;
TSC; IMSI-DETACH;
MIN LEVEL FOR ACCESS;
MS POWER; MS TIMING ADVANCE;
AUTHENTICATION CHALLENGE;
AUTHENTICATION RESPONSE;
RF GENERATOR LEVEL
MEASUREMENT AND PROTOCOL TIMEOUT PERIODS;
BER/RBER MEASUREMENT SAMPLES
POWER, FREQUENCY ERROR AND PHASE ERROR MEASUREMENT SAMPLES

TX MEASUREMENTS
POWER LEVEL
POWER PROFILE
RMS PHASE ERROR
PEAK PHASE ERROR
FREQUENCY ERROR
TIMING ADVANCE

RX MEASUREMENTS
BER I; BER II; BER Ib;
RBER II; FER,
RX LEV & RX QUAL

PROTOCOL FUNCTIONS
MS and BS Originated Call
MS and BS Originated Clear Down
Registration
Authentication
De-registration
Handoff
Dual Band handoff

RS-232 Interface

2 ports (one a test port)

Baud Rate
2,400 to 38,400 (autoranging)

Connector
9 way male "D" type

POWER REQUIREMENTS

AC supply

Voltage
100 V to 240 V (±10%)

Supply frequency
45 Hz to 63 Hz

Max AC Power
80 VA

Electromagnetic Compatibility

Conforms with the protection requirements of the EEC Council directive 89/336/EEC.
Complies with the limits specified in the following standards:
EN55011 Class B CISPR 11
EN50082-1 IEC 61000-4-2,3,4

2935 & PhoneTest

Safety

Complies with IEC/EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.

Environmental

Rated Range Of Use
15 to 35°C and up to 95% relative humidity at 35°C.

Storage and Transport.
Temperature -40 to +70°C

Altitude
Up to 2500 m (pressurised freight at 27 kPa differential)

Dimensions and Weight

Height	Width	Depth
120 mm	415 mm	400 mm

Weight
Less than 12 kg (<25 lb)

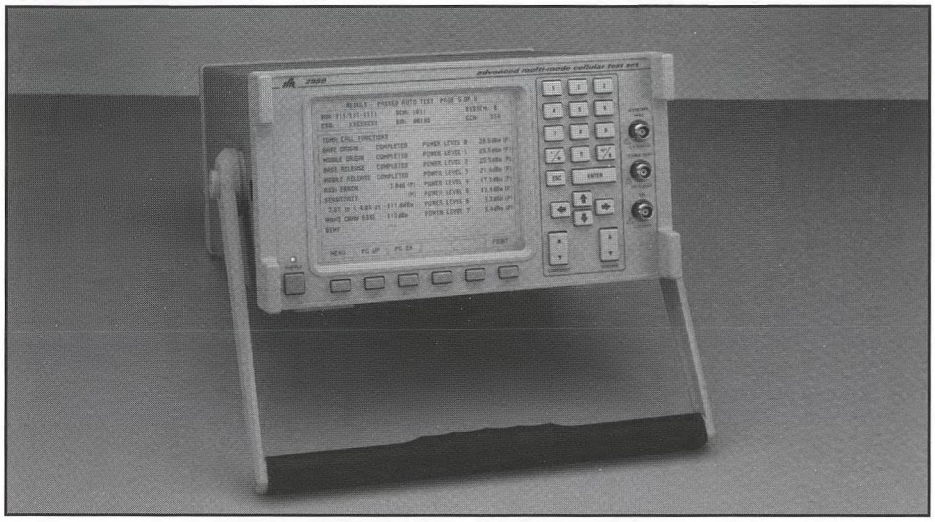
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2935	GSM 900/1800/1900 Radio Test Solution including 2935 Test Head PhoneTest Software and Getting Started Manual Serial RS-232 Cable Assembly Mains Supply Cord Supplied with the following language variants: English, French, German and Chinese. Also evaluation copies of 81501, 81502 & 81503.
	Software Options
81500	PhoneTest Bundle includes 81501/81502/81503
81501	PhoneTest-Repair
81502	PhoneTest-Manager
81503	PhoneTest-Exchange
81504	Software upgrade for 81501/2/3 (currently enabled options only)
81505	PhoneLib
	Optional Accessories
54212/001	GSM Phase 2 Plug-In Test SIM
54212/002	GSM Phase 2 Full Size Test SIM
46884/650	Serial Cable 9 way F to 9 way F

2959
Advanced Multi-Mode Cellular Test Set

Full IS-136A cellular phone testing with ACELP and VSELP vocoder in an affordable package



- Low cost and highly accurate with a full set of troubleshooting features for AMPS, NAMPS and TDMA (IS-136A) cellular handset testing
- Supports VSELP and ACELP vocoder testing
- Constellation display of a phone's digital modulation for IQ analysis of $\pi/4$ DQPSK
- Plot transmit and receive performance over the handset's operating frequency range
- Manual and automatic test modes supported with print out routines
- Built-in antenna and cable loss tester
- CDPD cellular modem test capable, including GMSK modulation and burst power
- Spanish and English instrument personalities with supporting documentation

Cellular Phone Tester

IFR's global leadership in AMPS and TDMA (IS-136A) testing is well known. The sophisticated signaling analysis, voice codecs, and the precise RF power measurement capabilities of IFR's advanced production and laboratory instruments are available now in a portable, low cost and full-featured cellular phone test set, including CDPD modem test capability.

The 2959 allows you to perform tests manually or automatically on AMPS, NAMPS and TDMA (IS-136A) phones as well as on CDPD wireless modems. You have complete control over the entire testing process, including which tests are performed in automatic sequences and the pass/fail tolerances for each test.

Multi-Mode Testing

Multi-Mode phones can be tested in the modes disclosed to the 2959 during the Registration procedure, or individual aspects of the different modes can be tested explicitly in the manual procedures. All types of cross-mode handoffs are supported. Tests can vary from quick and simple confidence checks to comprehensive tests that disclose the causes of troublesome handset misbehavior. A rich collection of graphic displays assists in the quick and efficient identification of problems.

Users can set up and store up to 10 test configurations in the 2959, while retaining factory default set up for quick tests or operator training.

Since the 2959 has the ability to recover confidential ESNs (Electronic Serial Numbers) from handsets, special features are included in the instrument's software to protect this information.

Analog AMPS Testing

Analog testing is simple and straight forward. Connect the phone to the 2959's RF test connector and begin. You can perform simple functional tests over the air interface with an antenna attached to the 2959's RF port or make accurate measurements through a test cable. An audio connector allows access to both sides of the phone's audio: transmit and receive. The user has control over:

- System assignment (A or B) System ID (SID), channel definitions, and all pass/fail criteria
- Registration, handoffs, release orders, page responses, audit orders, hook flash, and disconnects
- MO (Mobile Originated) and MT (Mobile Terminated) calls
- SAT and ST frequency error and deviation
- ST duration
- Receiver sensitivity in either 12 dB or 20 dB SINAD
- Forward and Reverse voice modulation
- DTMF tests of the handset
- RF frequency error
- All eight of the phone's RF power levels
- Plots of transmitter and receiver performance over all the phone's operating channels

Analog NAMPS Testing

NAMPS phones are set up and tested exactly the same way as AMPS phones. In addition to registration and call control functions common to all the 2959's test modes, you have access to and control over specialized NAMPS test features.

- Which sub-channel on which to perform tests and handoffs - upper, lower or middle.
- All seven DSAT and DST data words and their frequency deviations.
- The presence and absence of DSAT

and DST data at the proper times.

Digital TDMA (IS-136A) Testing

To simplify testing, digital phone tests mirror analog test procedures with alterations only to account for the different digital measurements and enhanced features available with modern TDMA (IS-136A) handsets. Set up and testing of IS-136A handsets can be fully automatic for all modes available in the handset, or it can be manual and interactive for diagnostic analysis. In addition to the normal registration and call control functions the 2959 provides control over specialized TDMA (IS-136A) test features.

- All eleven RF power levels
- TDMA-specific call control such as time slot changes
- DTMF signaling from the handset
- RMS EVM (Error Vector Magnitude), phase error, droop, and I/Q origin offset (Carrier leak)
- RMS EVM over the first 10 symbols
- Voice loopback tests or actual voice checks with built-in VSELP and ACELP codecs including the energy (r0) variable of the VSELP codec
- BER verification of the phone's receiver
- MAHO RSSI (Mobile Assisted Handoff-Receive Signal Strength Indication) on the alternate channel at -75, -85 and -95 dBm
- Full-featured Constellation display of the transmitter's modulation

CDPD Modem Testing

CDPD (Cellular Digital Packet Data) is a separate packet radio service deployed on many AMPS cellular networks. The 2959's CDPD test mode simulates the functions of Mobile Data Base Stations (MDBS) and Mobile Data Intermediate Systems (MD-IS), which provides the stimulus and response necessary to test mobile-end systems
(M-ES) often called CDPD wireless modems.

Though some handsets may have CDPD modems built in, they always operate separately from the phone, and are tested as autonomous devices. The external modems have an RF connector for their antennas, and a data connector for a laptop's serial connector. Modems can be integrated into laptops, cellular phones or PDAs (Personal Digital Assistants). Testing can be as simple as connecting the external modem to a laptop loaded with the appropriate software to communicate with the CDPD modem, connect the 2959's RF test port to the modem's antenna connector, and then running a simple automatic test such as a Ping. Modems integrated into other devices do not require an auxiliary laptop connection for proper testing.

Not only do CDPD modems require traditional radio testing associated with cellular phones, the 2959 must be able to simulate the CDPD base station and the supporting network. This requires test analysis of the 19,200 baud GMSK RF carrier from the modem; protocol checks of the CDPD messages and associated compression, encryption, and authentication algorithms. As in cellular handset testing, you have control over specialized functions for CDPD tests:

- RF power and frequency
- Frequency stability and modulation indexes
- Receiver sensitivity
- Verification of CDPD protocol functions.
- GMSK (Gaussian Minimum Shift Keying) eye pattern
- Graphic burst analysis for relative on/off switching level confirmation and spectrum plot over the assigned channel.

Specification

RF Signal Generator

FREQUENCY

Range
869.01 to 893 (Mobile Station Rx frequency range)

Resolution
10 kHz

Accuracy
Same as Timebase

INTERNAL FM MODULATION

AMPS Test Tone Frequency
1 kHz

AMPS Data
Manchester encoded

NAMPS Test Tone Frequency
1 kHz

NAMPS DSAT/DST
codes 0 through 6

EXTERNAL FM MODULATION INPUT

Impedance
2 kΩ nominal

Sensitivity
100 Hz/mV peak, ±30% at 1 kHz

Frequency Range
300 Hz to 3 kHz

π/4 DQPSK MODULATION
RMS Error Vector magnitude (EVM)
As defined by EIA/TIA-627

CDPD GMSK MODULATION

Data Rate
19.2 kbps, ±1 bps

Deviation
4.8 kHz peak, ±240 Hz

B.T. Product
0.5

RF OUTPUT (T/R CONNECTOR)

Level Range
-40 to -127 dBm

Level Resolution
0.1 dB

Level Accuracy
±1.5 dB

Receiver

FREQUENCY

Range
824.01 to 848.97 MHz (Mobile Station Tx Frequency Range)

Resolution
10 kHz

INPUT POWER

Maximum Input
5 W maximum (continuous into T/R Connector)

SENSITIVITY

FM Audio
-90 dBm, 12 dB SINAD

Meter Functions

RF POWER

Frequency Range
824.01 to 848.97 MHz

Power Range
0.05 mW to 4 W

Accuracy (Reading <3 mW)
±20%, ±1 digit

Accuracy (Reading ≥3 mW)
±15%, ±1 digit

T/R Port VSWR
<1.5:1

RF FREQUENCY ERROR

Range
±10 kHz

Resolution (N/AMPS, TDMA)
1 Hz

Resolution (CDPD)
10 Hz

Accuracy
Same as timebase, ±2 Hz

ANTENNA VSWR MEASUREMENT

Range
1.20:1 to 4.00:1

Resolution
0.01

AF COUNTER

SAT Range (AMPS)
5,950 Hz to 6,050 Hz

ST Range (AMPS)
9,950 Hz to 10,050 Hz

Resolution
1 Hz

Accuracy
±1 Hz, ±1 digit

FREQUENCY DEVIATION

	Minimum		*Maximum*
SAT Range (AMPS)	±1 kHz	to	±3 kHz
ST Range	±7 kHz	to	±9 kHz
DSAT/DST Range	±0.5 kHz	to	±0.9 kHz
AMPS Voice Range	±1 kHz	to	±14 kHz
NAMPS Voice Range	±1 kHz	to	±4 kHz

For CDPD GMSK
±4.8 kHz (with any valid CDPD Data)

Deviation Resolution
0.01 kHz

Deviation Accuracy
±5%, ±1 digit

SINAD

Range
3 to 40 dB

Resolution
0.1 dB

Accuracy
±1 dB at 12 dB SINAD

Test Frequency
1 kHz

CABLE LOSS MEASUREMENT

Cable Loss Range
0.0 to 20.0 dB

Cable Loss Resolution
0.1 dB

Cable Loss Accuracy
±0.5 dB (0 to 3 dB reading)

π/4 DQPSK
(EVM)

EVM Range
0% to 23% RMS

EVM Resolution
0.01%

EVM Error
<1.7% RMS

Timebase

INTERNAL TIMEBASE

Frequency
10 MHz nominal

Uncertainty
±0.1 ppm

Temperature Stability
±0.1 ppm

Ageing Rate
±0.1 ppm/year

EXTERNAL TIMEBASE

Level
0.25 to 6.0 V p-p

Frequency
10 MHz

Impedance
1 kΩ nominal

Power Requirements

AC INPUT

Source Voltage
100 to 240 VAC

Source Frequency
47 Hz to 63 Hz

Power Consumption
<75 W

DC INPUT

Source Voltage
11.5 to 15 VDC

Power Consumption
<75 W

Physical Characteristics

DIMENSIONS AND WEIGHT

Outside Dimensions (H x W x D)
164.9 mm x 303.6 mm x 381.5 mm
6.43 in x 11.84 in x 14.88 in

Weight
11.8 kg (26 lb) (not including lid or lid contents)

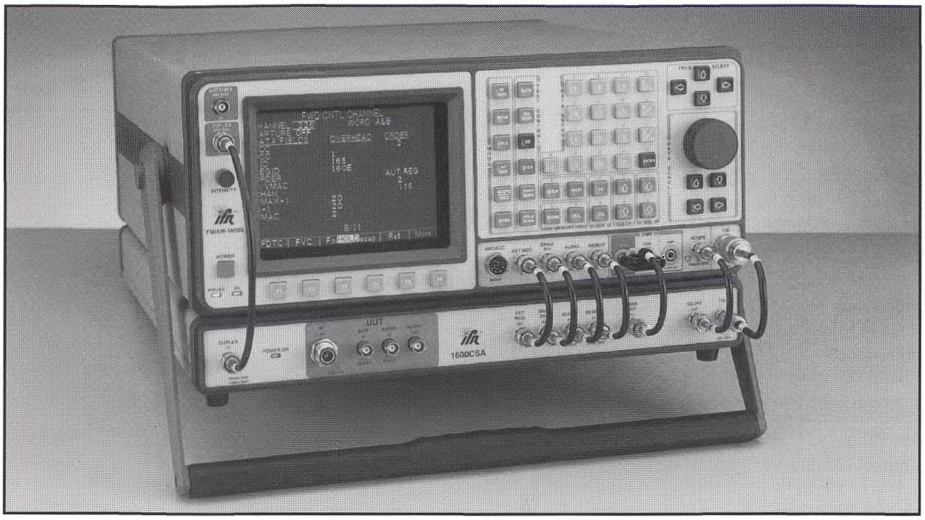
Versions and Accessories

When ordering please quote the full ordering information

Ordering Numbers	*Versions*
2959	Advanced Multi-Mode Cellular Test Set
2959-C	Advanced Multi-Mode Cellular Test Set with Certificate of Calibration
	Accessories
AC6001	Printer
AC6002	Service Cart
AC6003	RF Cable Set
AC6004	Audio Adapter

FM/AM-1600S/CSA
Cellular Protocol Analyzer

Ideal for conformance and protocol testing of UWC-136 base stations and terminals.



- Industry accepted protocol analyzer for TIA/EIA-136 conformance testing
- Dual-Band, 400/800 MHz cellular
- TIA/EIA 553A protocol compliance testing
- Analog/digital authentication compliance testing option
- TIA/EIA-136 handoff test capability
- Fully automated remote testing ability with RS-232 or IEEE-488 (GPIB) interfaces
- Intuitive test set up screens for easy "Guided" user testing
- Full featured 1 GHz service monitor with a full range spectrum analyzer and tracking generator
- Easy to read color display simplifies analysis of complex protocols

Full Featured TIA/EIA-136 Test Solution

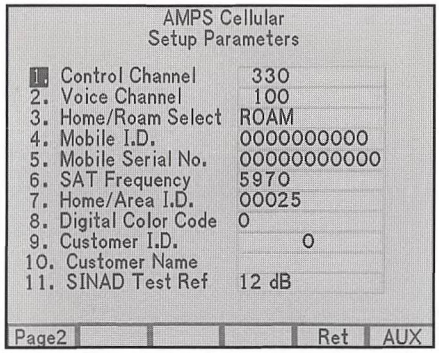
The FM/AM-1600S/CSA provides you with the industry's only fully approved test solution for TIA/EIA 553A analysis. The FM/AM-1600S/CSA is accepted for confirming the proper operation of the critical dual mode analog/digital authentication procedure. It also offers a complete suite of tools for comprehensive signaling protocol compliance testing of TIA/EIA-136 dual mode TDMA/DAMPS phones on all the world's cellular frequency assignments below 1 GHz.

The FM/AM-1600S/CSA provides both base station and mobile phone conformance test capabilities.

The AC1036 conformance test option verifies and thoroughly documents that your handset's signaling software conforms to current TIA/EIA-136 series specifications.

AMPS Solutions

Engineered to be a flexible test solution, the FM/AM-1600S/CSA also incorporates AMPS and NAMPS mobile terminal and base station signaling compliance test features as well as standard radio measurements.



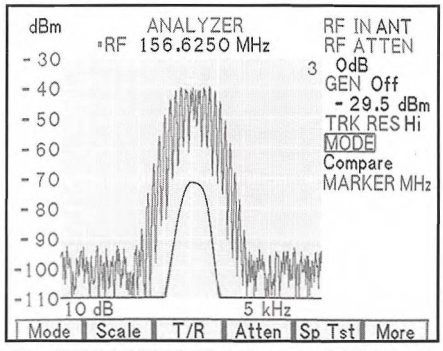
Full AMPS testing modes are available with the FM/AM-1600S/CSA

As a true dual mode solution, the FM/AM-1600S/CSA incorporates AMPS and NAMPS mobile terminal tests as a standard feature. Optional base station testing routines, unique to the type of infrastructure under test, automate cell site testing chores so that maximum network quality is easily maintained. Automatic test routines and user defined print outs enhance manual mode testing for both mobiles and base sites.

Comprehensive control channel simulations, voice channel signaling, home/roam condition, SID assignments, SAT, DSAT, DST, DCC, SINAD reference points, RF power windows, and other helpful functions and signaling manipulation tools let you test analog AMPS/NAMPS systems and radios as thoroughly as you need to.

A Full Complement of Radio Test Set Functions to 1 GHz.

The FM/AM-1600S/CSA gives you full frequency domain analysis to 1 GHz with a fully featured spectrum analyzer and tracking generator.



The FM/AM-1600S/CSA gives you full featured service monitor functions.

The FM/AM-1600S/CSA also offers a full complement of traditional service monitor features including a full scan digitized oscilloscope to 1 MHz, a DVM, SINAD meter and functions, frequency and channel tables, selectable IF filters, and a wide variety of displays.

http://www.ifrinternational.com

In addition to the full coverage 1 GHz RF generator, the FM/AM-1600S/CSA also gives you full audio/data generator capabilities, full level control and measurement facilities of modulation, and precision power meter features for enhanced sensitivity and high accuracy testing needs.

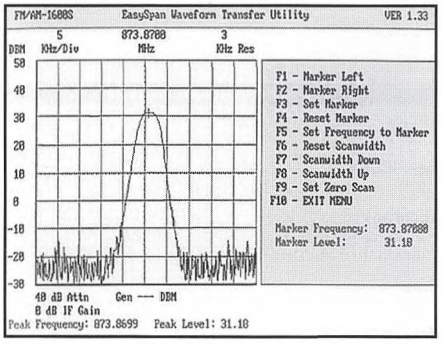
Analog paging encoding/decoding, DTMF, tone coded squelch, digital squelch, AM modulation/demodulation with two separate AF generators and a cross band duplex feature gives you added test versatility in a variety of public and private wireless systems.

Software Options Make Complex Testing Simple

As with every IFR test set, you get the advantage of IFR applications engineering support.

Our comprehensive portfolio of application software options is designed to automate and expand the functionality of your instrument.

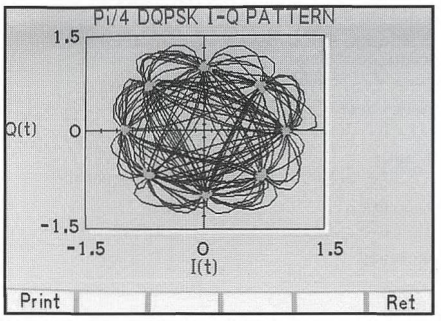
Plus, on-going software support means that you can easily upgrade your FM/AM-1600S/CSA when standards definitions or test and service requirements change.



- AC1009W - EasySpan is a Windows-based software utility which extracts spectrum analyzer and tracking generator traces from the IFR FM/AM-1600S/CSA to a PC for further off-line analysis.
- AC1011 - Simultaneously analyzes the signal strength or channel activity of up to three voice channel groups or 100 frequencies.
- AC1012 - AutoCell 882 is a comprehensive test package for Ericsson model 882 base station transceivers.
- AC1017 - AutoCell-Series II is a comprehensive program for FCC compliance testing of Lucent Series II cell sites.
- AC1018 - Provides automated testing and calibration of Motorola HD-II/LD cell sites.
- AC1019 - EasySweep is a swept measurement utility designed to test antennas and transmission lines.
- AC1020D - AutoCell NT and AutoCell NTD provides automated testing of Northern Telecom cell sites.

Dynamic IQ Constellation Display Simplifies Analysis

The FM/AM-1600S/CSA provides you with a dynamic, high speed constellation display for precise RF modulation analysis of $\pi/4$ DQPSK digitally modulated waveforms from 10 MHz to 1 GHz. This unique FM/AM-1600S/CSA feature gives a near-real time display of digital modulation characteristics that points out the cause of the trouble in digital radios.



IQ Constellation display allows for comprehensive digital modulation testing

Complex Functionality Made Easy

Even with its elaborate capabilities, the FM/AM-1600S/CSA was developed to execute complex tests simply and with minimal operator training.

Using field-proven front panel and user man-machine interfaces, the FM/AM-1600S/CSA gives you the performance and ease-of-use features that significantly reduce your testing and training time.

Its test macro command programming language (TMAC) can be easily configured to perform complex automatic tests on base stations and terminals (including single and multi-mode as well as single and multi-band radios), and baseband equipment. This powerful capability allows you to create and save simple "one button" test routines for future use. This flexibility means you can create and execute complex and repeatable routines no matter what your level of expertise.

A color display gives FM/AM-1600S/CSA users vivid screen clarity. Extensive use of softkeys reduces your complex cellular and PCS parametric and protocol tests to fast, simple and manageable routines.

Specification

RF Signal Generator

(T/R & DUPLEX CONNECTORS)

Frequency Range
400 kHz to 999.9999 MHz

Resolution
100 Hz

Accuracy
Same as Master Oscillator

Output Level Range (T/R)
-137 dBm to 0 dBm into 50 Ω
(-40 dBm maximum with reverse power present)

Duplex Level Range
-120 dBm to + 7 dBm or into 50 Ω

Duplex Resolution
0.1 dB

Level Accuracy (T/R)
±1.5 dB (level ≥-110 dBm)
±2.5 dB (levels from <-110 dBm to -127 dBm)

Duplex Level Accuracy
±1.5 dB (level ≥-100 dBm)
±2.5 dB (levels from <-100 dBm to -120 dBm)

VSWR (T/R)
<1.35:1 typical

Duplex VSWR
<1.38:1

INPUT PROTECTION

(T/R)
See RF Power Meter

(DUPLEX)
65 W (15 seconds with alarm)

SPECTRAL PURITY

Harmonics
<-26 dBc

Non-Harmonics
<-50 dBc

Residual FM
<10 Hz (RMS, 0.3 kHz to 3 kHz BW)

Residual AM
<0.05% (RMS, 0.3 kHz to 3 kHz BW)

SSB Phase Noise
<-90 dBc/Hz (25 kHz offset)
<-85 dBc/Hz (25 kHz offset, f_c ≥930 MHz)
<-80 dBc/Hz (25 kHz offset, f_c <1 MHz)

Modulation

Internal FM Range
Off, 100 Hz to 100 kHz Dev

Accuracy
±5% (1 kHz to 25 kHz Dev, 1 kHz rate)
±7% (<1 kHz Dev and >25 kHz Dev, 1 kHz rate)

Resolution
100 Hz (≤ 25 kHz Dev)
500 Hz (>25 kHz Dev)

Rate
Off, 30 Hz to 40 kHz
(≤ 20 kbs digital)

Waveforms
Sine, Square, Triangle, Ramp and Pulse

Distortion
<1 % (1 kHz rate, 0.3 kHz to 3 kHz BW, 1 kHz to 25 kHz deviation)

INTERNAL AM RF GENERATOR

Range
500 kHz to 999.9999 MHz

Internal AM Range
Off, 1% to 90%

Accuracy
±5% of setting (30% to 90% modulation, 1 kHz sinewave)
±10% of setting (30% to 90% modulation, 1 kHz sinewave f_c < 1 MHz)

Resolution
1 %

Rate
100 Hz to 10 kHz

Waveforms
Sine, Square, Triangle, Ramp and Pulse

Distortion
<1% (30% to 70% modulation, 1 kHz sinewave, f_c >1 MHz, 0.3 kHz to 3 kHz BW)

Internal Phase Modulation Range
Off, 0.1 to 10 Radians

Accuracy
±10% (at 1 kHz rate, > 0.3 Rad)

Resolution
0.1 Radians

Rate
Off, 30 Hz to 6 kHz

FM/AM-1600/CSA

Waveforms
Sine, Square, Triangle, Ramp and Pulse

Distortion
<2% (1 kHz rate, 0.3 kHz to 3 kHz BW, ≥0.5 Rad)

External
External inputs with the same characteristics as the internal modulation sources are supported.
A 10 Vp-p injection level is required to obtain indicated setting ±10%.

Synthesizer Switching Speed Settling Time
1.5 ms (within 1 kHz of desired frequency, 1 MHz ≤f_c <100 MHz, 25 kHz steps)
2.5 ms (within 1 kHz of desired frequency, 400 kHz ≤f_c ≤999.9999 MHz, 100 Hz steps)

AF Signal Generators

AF GENERATORS #1 AND #2

Frequency Range
10 Hz to 40 kHz

Frequency Resolution
0.1 Hz (≤2 kHz), 1 Hz (>2 kHz)

Frequency Accuracy
±0.1%

Level Range
0.5 mV RMS to 2.5 VRMS (into 150 Ω)
Up to 3 VRMS (into 600 Ω)

Level Resolution
0.1 mV RMS (10 mVRMS to 200 mVRMS)
0.8 mV RMS (> 200 mVRMS)

Level Accuracy
±0.1 mV or < 3% (≤10 kHz, into 150 Ω)
±5% (10 kHz to 25 kHz, into 150 Ω)

SPECTRAL PURITY

THD
<0.25% (sinewave, 10 Hz to 1.1 kHz, >100 mV RMS)
<1% (sinewave, 1.1 kHz to 35 kHz, >100 mV RMS)

Waveshape
Sinewave, Square, Triangle, Ramp and Pulse

Audio Frequency Counter

Range
10 Hz to 40 kHz (in 4 decade ranges)

Accuracy
Same as Master Oscillator

Resolution
0.1 Hz (10 Hz to ≤2 kHz)
1 Hz (>2 kHz to ≤20 kHz)
10 Hz (>20 kHz to 40 kHz)

Input Waveform
Sine or Square

External Level
0.5 VRMS to 30 VRMS (SINAD/BER input)
0.1 VRMS to 3.5 VRMS (EXT MOD input)

Impedance
1 MΩ (SINAD/BER input)
100 kΩ (EXT MOD input)

Signal Selections
Demod Audio
SINAD/BER
AF Generators
RF Power
External Audio

RF Counter

RF COUNTER

Frequency Range
250,000 Hz to 999,999,990 Hz

Accuracy
Same as Master Oscillator

Resolution
1 Hz (f_c <20 MHz)
10 Hz (f_c ≥20 MHz)

Level
-10 dBm to +50 dBm (T/R connector)
-80 dBm to +10 dBm (ANT connector)

RF Frequency Error Meter

Digital Meter Range
0 Hz to ± 150 kHz

Bar Graph Meter Range
0 to ±100 kHz (in 4 decade ranges)

Accuracy
Same as Master Oscillator

Resolution
1 Hz (±1 Hz to ≤ ±10 kHz)
10 Hz (> ±10 kHz to ±150 kHz)

Level
-10 dBm to +50 dBm (T/R connector)
-80 dBm to +10 dBm (ANT connector)

RF Power Meter

Frequency Range
1.5 MHz to 1 GHz

Input Level
0.2 mW to 200 W

Ranges
20 mW to 200 W full scale (1-2-5 sequence)

Resolution
0.1 mW

Accuracy
±10% ±2 counts

VSWR
<1.15:1 (0.25 MHz ≤ f_c ≤100 MHz)
<1.23:1 (100 MHz <f_c ≤400 MHz)
<1.38:1 (400 MHz <f_c ≤999.9999 MHz)

Receiver

Frequency Range
400 kHz to 999.9999 MHz

Sensitivity
≤2 µV for 10 dB SINAD
(1 kHz rate, 6 kHz Dev, FM 1)

	RX IF Selectivity Bandwidth	*AF Mode Bandwidth*
FM 4	300 kHz	100 kHz
FM 3	300 kHz	20 kHz
FM 2	30 kHz	10 kHz
FM 1	30 kHz	3 kHz
AM 1	2.9 kHz	3 kHz
AM 2	30 kHz	10 kHz
USB	2.9 kHz	3 kHz
LSB	2.9 kHz	3 kHz
PM	30 kHz	3 kHz

Adjacent Channel Rejection

RX IF Bandwidth	*>30 dB Down*
300 kHz	±485 kHz maximum
30 kHz	±52 kHz maximum
2.9 kHz	±2.5 kHz maximum

DEMODULATION OUTPUT

Output Level (FM)
5 Vp-p ±10% (at full scale, into 600 Ω)

(PM)
40 mV RMS ±10% (5 Rad, into 600 Ω)

(AM)
1 VRMS ±10%
(80% modulation, into 600 Ω)

(SSB)
1. 15 VRMS ±10% (Beat tone, into 600 Ω)

DISTORTION + NOISE

(FM)
<2% (1 kHz rate, >1 kHz Dev, 0.3 kHz to 3 kHz BW)

(AM)
<2% (1 kHz rate, 30% to 90% modulation, 0.3 kHz to 3 kHz BW)

Impedance
<1 Ω

ANT Input Protection
≤65 W for 15 sec with alarm

FM Deviation Meter

Range
±100 kHz (± peak in 6 ranges)

Resolution
50 Hz (≤20 kHz ranges)
1 kHz(>20 kHz ranges)

Accuracy
±4% ±2 counts + source residual (300 kHz IF, <15 kHz rate)
±7% ±2 counts + source residual (300 kHz IF, ≥15 kHz rate)
±7% ± 2 counts + source residual (30 kHz IF)

Rate
100 Hz to 40 kHz

Carrier Range
400 kHz to 999.9999 MHz

Carrier Level
-10 dBm to +50 dBm (T/R connector)
-70 dBm to +10 dBm (ANT connector)

PM Deviation Meter

Range
0 Rad to 10 Rad (Peak)

Resolution
0.01 Rad (≤5 Rad)
0.1 Rad (>5 Rad)

Accuracy
±3% full scale ±1 count + source residual

Rate
300 Hz to 4 kHz

Carrier Range
400 kHz to 999.9999 MHz

Carrier Level
-10 dBm to +50 dBm (T/R connector)
-80 dBm to +10 dBm (ANT connector)

AM Modulation Meter

Range:
1% to 100%

Resolution
1 %

Accuracy
±5% of full scale ±1 count + source residual (30% to 90%)

Rate
100 Hz to 10 kHz

Carrier Range
400 kHz to 999.9999 MHz

Carrier Level
-10 dBm to +50 dBm (T/R connector)
-80 dBm to +10 dBm (ANT connector)

Distortion Meter

Distortion Range
0.1 % to 20 %

Resolution
0.1 %

Accuracy
±0.5 % distortion ±1 count (1 % to 10 %)
±2 % distortion ±1 count (>1 % to 20 %)

SINAD Meter

Signal Frequency
600 Hz to 1.4 kHz

Range
3 dB to 30 dB

Resolution
0.1 dB

Accuracy
±1 dB ±1 count (@12 dB SINAD)

Signal Level
0.1 VRMS to 30 VRMS (SINAD/BER input)

Error Vector Magnitude (EVM) Meter

Input Range
NT 400 Channels
Cellular 800 MHz Channels

http://www.ifrinternational.com

Minimum Carrier Level
-60 dBm (ANT connector)

EVM Range
0 to 100 %

EVM Resolution
0.01 %

Meter Residual EVM
<2 % indication

Accuracy
±3.0% indication, ±1 LSD + meter residual EVM

Digital Multimeter

VOLTMETER (DC/AC)

Ranges
200 mV to 2000 V (full scale, decade sequence, 1 MΩ)

Maximum Input (DC)
1000 VDC
500 VAC

Resolution
3.5 digit (maximum resolution 0.1 mV on 200 mV range)

Accuracy
±5% of full scale ± 1 count (AC, where ACV/kHz <140)
±1% of full scale ± 1 count (DC)

Frequency
DC, 50 Hz to 20 kHz

Input Impedance
1 MΩ (±5%)
150 Ω (±5%)
600 Ω (±5%)

OHMMETER

Ranges

200 Ω to 20 MΩ (full scale, decade sequence)

Resolution
3.5 digit (maximum resolution 0.1 on 200 Ω range)

Accuracy
±5% or 0.1 Ω (±1 count)

Current Meter (DC/AC)

Ranges
20 mA to 2 A (full scale, decade sequence, 20 A maximum when using external shunt)

Resolution
3.5 digit (maximum resolution 0.01 mA on 20 mA range)

Accuracy
±5 % or 0.1 mA ±1 count

Oscilloscope

Vertical BW
1 MHz (-3 dB)

Input Ranges
1 mV/Div to 50 V/Div (1-2-5 sequence, 8 divisions)

Max Input
200 V Peak

Accuracy
±5% of full scale
±10% of full scale (1 mV and 2 mV ranges)

Resolution
1 % of full scale/256 datapoints, 8 divisions

Coupling
AC, DC, GND

Horizontal Sweep Rate
1 μSec /Div to 100 mSec/Div (1-2-5 sequence, 10 divisions)

Accuracy
±1 % of full scale

Resolution
1 % of full scale/400 datapoints per sweep

External Input Impedance
1 MΩ (shunted by 27 pF nominal)

Internal Signal Routing
425 kHz IF
Demod Audio
Function Generator
SINAD/BER
RF Power
EXT MOD

Spectrum Analyzer

Range
400 kHz to 999.9999 MHz

Frequency Span Range
1 kHz/Div to 100 MHz/Div plus Zero Scan (10 divisions in a 1-2-5 sequence)

Accuracy
±5% of span width + timebase accuracy

Display
Log 10 dB/Div and 2 dB/Div

Vertical Resolution
Full scale/1 dB full scale

Displayed Range (Dynamic)
60 dB (0 dB attenuation, span <1 MHz/Div)
70 dB (0 dB attenuation, 1 kHz/Div, Ant connector)

Bandwidth Switching Error
<2 dB (5 kHz/Div thru 1 MHz/Div)
<3 dB (<5 kHz/Div or >1 MHz/Div)

Overall Accuracy
±4 dB (10 MHz to 400 MHz) (normalized)
±5 dB (>400 MHz to 2010 MHz) (normalized)
±2 dB Log Linearity

Input Attenuator
0 dB, 20 dB, 40 dB (User selectable, ANT Input Port)
40 dB, 60 dB, 80 dB, (User selectable Pwr ≤2 W, T/R Port)
60 dB, 80 dB, I00 dB, (User selectable, Pwr >2 W, T/R)

Bit Error Meter (BER)

Range
1 x 10^{-1} to 1 x 10^{-5}

Data Rates
75, 150, 300, 600, 1200, 2400, 4800 bps and 16 kbps

Data Pattern Size
100 to 100,000 bits

Data Pattern Type
Random, Fixed and User Defined

Input/Output (I/O)

IEEE 488.1-1987 Internally Assigned GPIB Addresses
System Control Processor (GPIB Address=4)
TDMA Control Processor (GPIB Address=5)

RS-232 (Asynchronous) SCSI-1 External Video Port Operation Mode
EGA Compliant

Frequency Reference Ports
BNC Input for External 10 MHz Sync
BNC Output of Internal 10 MHz Sync

IQ Output Interface
BNC Connector

TDMA Timeslot Sync
BNC Connector

Master Oscillator

Frequency Standard
10 MHz (Nominal)

Temp Stability
±0.01 ppm (0 to 50°C)

Ageing
±0.1 ppm per year

General Characteristics

Dimensions
477 mm (18.8 in) wide, 187 mm (7.4 in) high, 635 mm (25 in) deep (with bail handle and front panel cover in place, without CSA)

Weight
21.8 kg (48 lb) without CSA
(60 lb) with CSA

Operating Temperature Range
0 to 50°C

Power Requirements

Line
85 - 135 to 180 - 260 VAC
50 to 400 Hz @ 200 W Maximum
170 W Typical

Display

Type
Color, CRT 70° deflection, inline

Size
172 mm (6.8 in) diagonal, 142 mm (5.6 in) wide, 132 mm (5.2 in) high

Resolution
640 pixel x 350 pixels.

Versions and Accessories

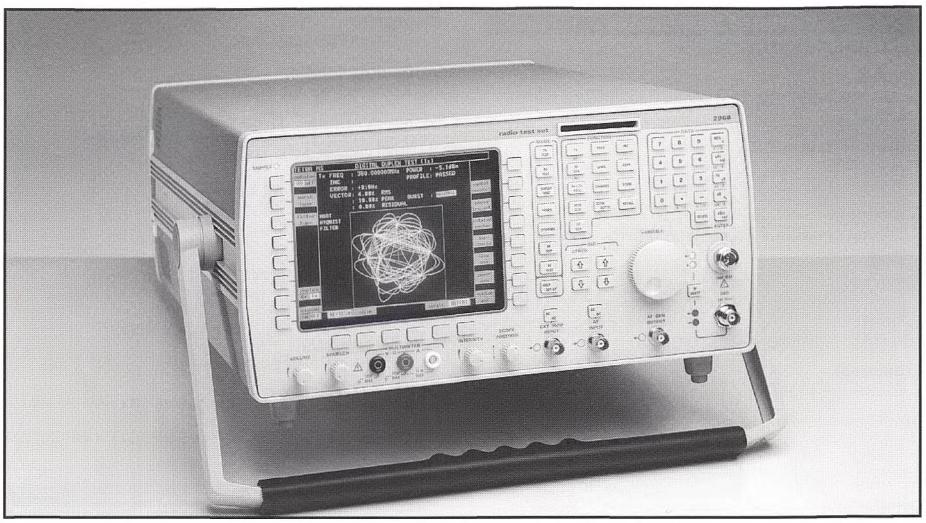
When ordering please quote the full ordering number information

Ordering Numbers	*Versions*
1600S	FM/AM-1600S Service Monitor
1600S-C	FM/AM-1600S Service Monitor with Certificate of Calibration
CSA4	CSA4 (IS-54, GPIB, UWC-136, TDMA, 400 & 800 MHz)
CSA4-C	CSA4 (IS-54, GPIB, UWC-136, TDMA, 400 & 800 MHz) with Certificate of Calibration
1600SNAMPS	FM/AM-1600S/CSA, NAMPS
1600SCSA4	CSA4 System (includes 1600S Service Monitor CSA4 with IS-54, GPIB, UWC-136, TDMA, 400 & 800 MHz) with Certificate of Calibration
1600SCSA4-C	CSA4 Systems (includes 1600S Service Monitor and CSA4 with IS-54, GPIB, UWC-136, TDMA, 400 & 800 MHz) with Certificate of Calibration
	Accessories
AC0300	TMAC User Manual
AC510	Paging Encoder
AC1009	EasySpan for DOS (Waveform Transfer Software)
AC1009W	EasySpan for Windows (Transfer Software)
AC1010	Easy-Com-FM (Land Mobile Test Software)
AC1011	EasyScan (Spectral Usage Software)(req. AC9157)
AC1012	AutoCell-882 (Ericsson 882 Test Software)(req. AC9157)
AC1017	AutoCell Series II (Lucent Series II Test)(req. AC9157)
AC1018	AutoCell-Motorola (Motorola LD & HD Test)(req. 1600SNAMPS and AC9157)
AC1019	EasySweep (Swept Antenna Measurements)(req. AC9157)
AC1020D	AutoCell-NTD (NT/Novatel/GE/NTTRU)(req. AC9157)
AC1021	CellScan Cellular Bar Graph RF Level Meter (req. AC9157)
AC1036	UWC-136 Conformance Software (req. CSA4)
AC1048	SSD Update & Authentication Test (req. CSA4)
AC1201	Telescopic Antenna
AC4101	Return Loss Bridge (5 MHz to 1 GHz)
AC4102	Return Loss Bridge Kit (5 MHz to 1 GHz) (includes AC1019)
AC4103	Return Loss Bridge Kit (5 MHz to 2 GHz) (includes AC1019)
AC8600	Maintenance Manual
AC8645	Microphone
AC9153	Carrying Case
AC9154	NT400 System Test (req. CSA4)
AC9155	AMPS Cellular System Analyzer
AC9156	AMPS Mobile Station Test
AC9157	2.5 MB Flle System
AC9158	Rubidium Time Base

EasyCom-FM, EasySweep, EasySpan, CellScan, AutoCell and EasyScan are copyrighted by IFR Systems, Inc.

2968
TETRA Radio Test Set

The 2968 TETRA Radio Test Set for comprehensive mobile and base station testing



- Call processing for simplex and duplex operation
- On-channel TETRA transmitter measurements for manufacturing and installation
- T1 test signal generator supports conformance tests
- Comprehensive TETRA modulation analysis with constellation and phase trajectory analysis
- Uplink test signal for base receiver testing
- Base station control channel simulation to provide effective network simulation
- Error vector analysis

The 2968 is the world's leading TETRA radio test set, addressing the testing needs of TETRA terminals and base stations.

The 2968 TETRA radio test set performs the on-channel transmitter measurements required in a TETRA production environment. Burst and continuous power measurements, vector modulation accuracy and frequency error are supported. Receiver measurements are supported by generation of the T1 test signals. The 2968 is also capable of supporting the main world-wide trunking format (MPT 1327), GSM digital cellular and all of the international analog cellular standards (TACS, AMPS and NMT).

Based on the methods specified in the ETSI TETRA specifications, the 2968 has been designed to test all of the key RF, audio and DC parameters of a TETRA radio quickly and easily.

TETRA Functionality

The development of the 2968 has been phased to provide increasing TETRA functionality as the TETRA market moves from manufacture and installation through to maintenance and service.

The 2968 is capable of emulating the environments of the TETRA mobile, base station and direct mode terminal, providing a one instrument test solution for the TETRA air interface. To satisfy the wide range of future applications, the 2968 covers the frequency range of 10 MHz to 1 GHz.

The latest enhancements for the 2968 enable testing of base station receivers and mobile station call processing functions.

Ongoing development will add further functions to the current 2968 by field upgrades.

TETRA Measurements

The 2968 provides the capability to make a range of essential measurements on an active TETRA transmitter.

Transmitter measurements on mobiles, base stations and direct mode TETRA terminals can be made via the intuitive user interface. Measurements include transmitter power, both burst and continuous, and burst profiles for all major burst types. Modulation accuracy, for both peak and RMS vector error, can also be measured. Constellation and phase trajectory displays provide a graphical indication of vector error. Demodulated data is also available for display and is selectable by burst type.

The 2968's signal generator provides T1 test signals, defined in ETS 300 394-1, for performing receiver and transmitter tests on mobiles which implement a T1 test mode. The 2968 can generate a Main Control CHannel (MCCH) or Traffic CHannel (TCH) to support manufacturer-specific test modes.

For base station receiver testing, the 2968 synchronizes to the multiframe timing of the downlink signal generated by a TETRA Base Station, and transmits an uplink T1 type 7 (TCH/7.2) test signal to the base station receiver. This new feature provides the signal required to enable the base station to measure its own receiver Bit Error Rate, without the need of a separate signal generator or an external synchronization signal.

For mobile station testing the 2968 supports call processing performed by TETRA radios from a variety of manufacturers. The call processing functions include registration, de-registration, individual and group call set up, mobile-originated and mobile-terminated call set up, plus audio loopback (talk-back) for simplex and duplex radios. Applications for call processing include production final test, screening prior to installation, and maintenance testing. The general functionality of a radio can be tested quickly and easily before use on a live system.

The enhanced 2968 also includes:-

- Burst timing meter for measurement of mobile station timing alignment.
- Slot selection to enable transmitter measurements to be made on a particular time slot.
- Bit Error Rate (BER) meter for measuring mobile station receiver

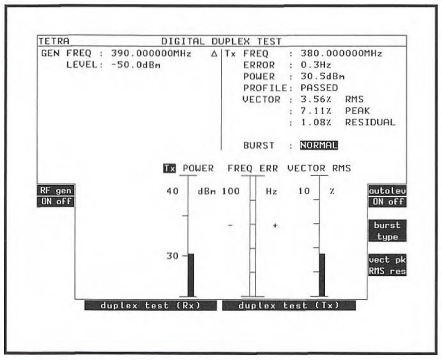
performance with a downlink T1 type 1 (TCH/7.2) signal, using T1 Loopback.
- Enhanced data displays providing decoded logical channel data in addition to demodulated burst data.
- Standard TETRA channel numbering plans for 380, 410, 450 and 870 MHz bands + user definable channels
- Flexible duplex offset + channel spacing
- The T1 test signal enables transmitter frequency error to be measured and also exercises the TETRA link control to adjust transmitter power.

Operation

Single or dual port duplex test modes of operation are available, configurable for high power or high sensitivity measurements.

The full range of TETRA features is available under manual or remote operation. The high resolution display and 22 associated softkeys enable selection of all the major test modes. The Duplex screen displays both the stimulus to the radio receiver and the response from the transmitter, softkeys allowing selection of the display format for the results. Alternatively the display can be confined to one signal path only, either Rx or Tx.

In Rx test mode the receiver under test can be stimulated using a T1 test signal, control channel or traffic channel whose level and frequency can be varied. The Tx test mode provides measurements of all the major on-channel parameters. Selection of the measurement type such as burst power profile, spectrum analyzer or vector diagram produces the appropriate display whilst maintaining all the other measurement parameters on screen. The measurement displays can be expanded to occupy the full screen when more detailed analysis is required.



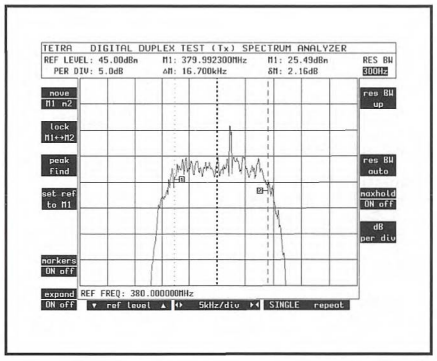
REMOTE Operation

The 2968 provides remote control of all the major functions. Control can be exercised by either GPIB or RS-232.

STANDARD FEATURES

The 2968 follows the IFR philosophy of offering a comprehensive package with all the essential features for testing in the radio environment, including:-

- Full span Spectrum Analyzer for signal tracking and alignment.
- Tracking Generator with variable level and offset tracking for gain and loss measurement, including mixer stages.
- Single port and two port Duplex test modes enabling measurement before or after the duplexer/combiner.
- FFT analyzer for audio analysis giving rapid display update with narrow resolution bandwidths.
- Variable frequency SINAD and distortion measurement for customized applications.
- Range of selectable Audio filters for versatile audio characterization.
- Comprehensive audio generators, with up to six sources enabling complex signaling to be generated without additional oscillators.
- Broad band and selective power meters to enable measurement of total transmitted power or power in a specific channel.
- Built-in multimeter, on the bench when you need it.



Spectrum Analysis

The RF spectrum analyzer allows analysis of signals applied either directly to the RF ports or off-air via an antenna.

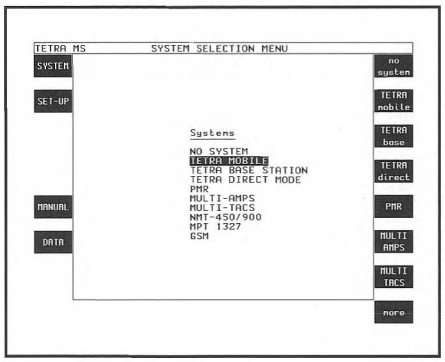
It carries many features usually found only on stand alone analyzers such as full span, selectable resolution bandwidth filters and two steerable markers.

In a TETRA environment the spectrum analyzer max hold facility allows TDMA signals to be displayed. For alignment of IQ mixers, carrier leakage and image rejection can be displayed. For RF module characterization and radio alignment a tracking generator facility is provided. Additionally the tracking generator can be programmed with a fixed frequency offset to characterize frequency converter stages, and ×2 or ÷2 frequency ranges for doubler or divider stages.

Optional Systems

In addition to TETRA the 2968 may also be equipped with analog trunking, analog cellular and digital cellular systems. This allows the current analog system users to be prepared for the introduction of digital systems. The following systems are available:

- MPT 1327/MPT 1343 Trunked Radio
- PMR Test for AM/FM/ΦM radios.
- NMT Cellular Radio
- AMPS Cellular Radio (inc. N-AMPS)
- TACS Cellular radio (inc. N-TACS)
- GSM Digital Cellular (900 MHz)



For analog trunking and cellular testing IFR is established as the industry standard. The 2968 provides the fundamental measurements required (e.g. broadband power, FM deviation, SINAD) and a range of advanced facilities, such as the unique 40 kHz FFT analyzer.

Concise easy to read printouts

The 2968 produces printouts at the touch of a key. This enables measurement results to be added to test reports and service notes.

Additionally, for analog systems and GSM, printouts can be stored on PCMCIA2 memory card.

Size and Weight

Not only does the 2968 have the performance you would normally expect to see on a bench full of instruments, it also weighs under 19.5 kg (43 lb), so it is portable too.

Specification

Certain characteristics are shown as typical. These provide additional information for use in applying the instrument but they are unwarranted.

TETRA Signal Generator

FREQUENCY

Range
10 MHz to 1 GHz, useable to 1.15 GHz

Resolution
1 Hz

Indication
4 digit display (channel number) in SYSTEMS mode
10 digit display (Hz) in Duplex mode

Setting
SYSTEMS mode: Channel number and frequency plan.
Other modes: Keyboard entry (Hz), delta increment/decrement function and rotary variable control.

Accuracy
As frequency standard

OUTPUT LEVEL

Range
One-port Dx modes:
N-Type socket: -135 dBm to -50 dBm

TNC socket: -135 dBm to -30 dBm
Rx Test and two-port Dx modes:
N-Type socket: -135 dBm to -40 dBm
TNC socket: -135 dBm to -20 dBm

Resolution
0.1 dB

Indication
4 digits plus sign (dBm)

Accuracy
N-Type socket:
±1 dB (TETRA modulation) over the temperature range 15 to 35°C.
Otherwise
±1.2 dB up to 575 MHz
±1.75 dB up to 1 GHz for levels above –120 dBm.
±1.3 dB up to 1 GHz over the temperature range 15 to 35°C.

Carrier On/Off
Keyboard operation, reduces signal generator output to less than -120 dBm

Reverse Power Protection
N-Type socket: With instrument switched on 150 W. Overload indicated by visual and audible warning.
TNC socket: Protection up to 10 W. Reset available on removal of RF power. Excess power indicated by visual and audible warnings.

Output Impedance
50 Ω nominal

VSWR
N-Type socket: better than 1.2 up to 500 MHz; better than 1.3 up to 1 GHz (typically 1.2).
TNC socket: typically 1.3 at 900 MHz.

RF Carrier Leakage
Less than 0.5 µV PD generated at the carrier frequency in a 50 Ω load by a 2 turn loop 25 mm or more from the case with output level set to below -60 dBm and terminated in a sealed 50 Ω load.

TETRA Modulation

Frequency Range
10 MHz to 1 GHz, useable to 1.15 GHz

Modulation Rate
18 k symbols/sec

Modulation Filter
Root Nyquist, α =0.35

Vector Error
<3% RMS
<6% peak

Residual Carrier Power
<-35 dBc

Data
T1 test signals (in accordance with ETS 300 394-1)
T1 type 1 (TCH/7.2 downlink)
T1 type 2 (SCH/F downlink)
T1 type 4 (TCH/2.4 downlink)
T1 type 7 (TCH/7.2 uplink)

Control Channel (MCCH)
Traffic Channel (TCH)

TETRA Transmitter Measurements

Frequency Range
10 MHz to 1 GHz

Dynamic Range
0 dBm to +52 dBm

Burst Types Measured - Base Station Test
NDB - Normal Down Link (cont.) using TS1 or TS2
SB - Synchronization Burst (cont.)
NDB - Normal Down Link (discont.) using TS1 or TS2
SB - Synchronization Burst (discont.)

Burst Types Measured - Direct Mode Mobile Test
DNB - Direct mode Normal Burst using TS1 or TS2
DSB - Direct mode Synchronization Burst
DSB - Direct mode Synchronization Burst (cont.)

Burst Types Measured - Mobile Test
CB - Control Burst (Half Slot discont.)
NUB - Normal Uplink Burst (discont.) TS1 or TS2
NUB - Normal Uplink Burst (cont.) TS1 or TS2

RF RELATIVE FREQUENCY ERROR METER
Mobiles test mode only

Frequency Error Range
±500 Hz

Burst Types Measured
CB, NUB (discont.), NUB (cont.)

Resolution
10 Hz

Indication
3 digits and bar chart with peak hold

Accuracy
±15 Hz

RF ABSOLUTE FREQUENCY ERROR METER
Base Station and Direct Mode test modes only

Frequency Range
10 MHz to 1 GHz

Dynamic Range
0 dBm to +52 dBm

Frequency Error Range
±500 Hz

Resolution
0.1 Hz

Indication
3 digits and bar chart with peak hold

Accuracy
±15 Hz + frequency standard accuracy

TETRA RF POWER METER

Power Measurement
Average power during one burst
Measured at the symbol points
Measured through TETRA filter
(Root Nyquist α = 0.35)
Averaged over n bursts
(selectable between n = 1 to n = 250)

Indication Units
dBm

Resolution
0.1 dB

Indication
3 digits and bar chart with peak hold

Accuracy
±0.6 dB for temperatures in the range 15 to 35°C
See also under Environmental/User Calibration

TETRA MODULATION ANALYZER

Modulation Error Range
20% RMS Vector error
40% Peak Vector error
20% Residual Carrier

Resolution
0.25%

Indication
4 digits and bar chart with peak hold
Vector Error profile

Accuracy
±0.5% at 10% error

Graphical Displays

RF POWER PROFILE

Vertical Scale
10 dB/div or 3 dB/div

Burst Type (Selectable)
BS, MS and DM-MS (Discontinuous only).

Power Measurement
Measured through TETRA filter
Referenced (0 dB) to average power

Power Profile Dynamic Range:
50 dB

Indication
Power profile against TETRA template

Display
Complete Burst
Ramp Up/Ramp Down

Time Spans
300 symbol periods for NUB, DNB, DSB, NDB, SB.
150 symbol periods for CB
Ramp Up/Ramp Down 2 × 25 symbol periods

Accuracy
±0.6 dB at symbol points for levels greater than -10 dB

CONSTELLATION DIAGRAM
Amplitude and phase at the symbol point
Measured over all symbols of the burst
($SN_0 \sim SN_{max}$)
Measured through TETRA filter

Display Features
Normal/Expanded

Display Mode
Single/Continuous
Refresh/Persistence/Accumulate

PHASE TRAJECTORY DIAGRAM
Amplitude and phase continuously
Measured over all symbols of the burst
($SN_0 \sim SN_{max}$)
Measured through TETRA filter

Display Features
Normal/Expanded

Display Mode
Single/Continuous
Refresh/Accumulate

RF Analog Signal Generator

Frequency Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Resolution
1 Hz

Indication
4 digit display (channel number) in SYSTEMS mode
10 digit display (Hz) in Duplex mode

Setting
SYSTEMS mode: Channel number and frequency plan.
Other modes: Keyboard entry (Hz), delta increment/decrement function and rotary variable control.

Accuracy
As frequency standard

OUTPUT LEVEL

Range
One-port Dx modes:
N-Type socket: -135 dBm -40 dBm.
TNC socket: -115 dBm -20 dBm.

Rx Test and two-port Dx modes:
N-Type socket: -135 dBm -10 dBm (-20 dBm with AM).
TNC socket: -115 dBm +10 dBm (0 dBm with AM).

Resolution
0.1 dB

Indication
4 digits plus sign (dBm, dBµV, µV, mV PD/EMF)

Accuracy
N-Type socket:
±1.2 dB up to 575 MHz
±1.75 dB up to 1 GHz for levels above -120 dBm
±1.3 dB up to 1 GHz over the temperature range 15 to 35°C

Carrier On/Off
Keyboard operation, reduces signal generator output to less than -120 dBm

Reverse Power Protection
N-Type socket: With instrument switched on 150 W. Overload indicated by visual and audible warning.
TNC socket: Protection up to 10 W. Reset available on removal of RF power. Excess power indicated by visual and audible warnings.

Output Impedance
50 Ω nominal

VSWR
N-Type socket: better than 1.2 up to 500 MHz; better than 1.3 up to 1 GHz (typically 1.2).
TNC socket: typically 1.3 at 900 MHz.

SPECTRAL PURITY

Residual FM (CCITT weighted)
Less than 6 Hz RMS up to 575 MHz
Less than 12 Hz RMS up to 1 GHz

Residual AM (CCITT weighted)
Less than 0.05% RMS

Harmonics
Better than -30 dBc for levels up to +7 dBm (TNC)

Better than -30 dBc for levels up to -13 dBm (N-Type).

Spurious signals
Better than -45 dBc for carrier frequencies from 100 kHz to 36 MHz;
Better than -50 dBc for carrier frequencies above 36 MHz.

SSB Phase Noise (20 kHz offset)
Better than -114 dBc/Hz up to 575 MHz
Better than -108 dBc/Hz up to 1 GHz

RF Carrier Leakage
Less than 0.5 µV PD generated at the carrier frequency in a 50 Ω load by a 2 turn loop 25 mm or more from the case with output level set to below -60 dBm and terminated in a sealed 50 Ω load.

AMPLITUDE MODULATION – INTERNAL

Frequency Range
100 kHz to 400 MHz, useable to 1.15 GHz

AM Depth Range
0 to 99%

Resolution
0.1%

Indication
3 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy[1] (up to 85% AM)
±4% of setting ±1 digit for modulation frequency 1 kHz.
±6% of setting ±1 digit for modulation frequencies from 30 Hz to 10 kHz.
±8% of setting ±1 digit for modulation frequencies from 10 kHz to 20 kHz.

Distortion
Less than 1% at 1 kHz for modulation depths up to 30%, CCITT weighted.
Less than 2% for modulation frequencies from 100 Hz to 20 kHz and depths up to 85%.

Modulation Frequency
Range: 20 Hz to 15 kHz for carrier frequencies up to 36 MHz; 20 Hz to 20 kHz for carrier frequencies up to 400 MHz.
Resolution: 0.1 Hz below 10 kHz; 1 Hz below 20 kHz.

AMPLITUDE MODULATION – EXTERNAL

Input impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal AM

Modulation Frequency Range
As internal AM with AC or DC coupling.

Accuracy
As internal ±2%

Input Sensitivity
1 VRMS for indicated modulation depth

FREQUENCY MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy [1]
±3% ±1 digit at 1 kHz over the range 15 to 35°C (0.1% per °C outside this range).
Typically ±3% ±1 digit for modulation frequencies from 20 Hz to 5 kHz.
Typically ±7% ±1 digit for modulation frequencies from 5 kHz to 20 kHz.
Typically ±10% ±1 digit for modulation frequencies from 20 kHz to 75 kHz.

Distortion [1]
Less than 0.5% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 kHz to 800 kHz).
Less than 1% for modulation frequencies from 50 Hz to 20 kHz (for deviation 1 kHz to 800 kHz).
Modulation Frequency Range[6]
20 Hz to 20 kHz Mod generators 1, 2, 3 or 20 Hz to 100 kHz Mod generator 4.

Resolution
0.1 Hz

FREQUENCY MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal FM

Modulation Frequency Range
DC to 100 kHz (DC coupled)
10 Hz to 100 kHz (AC coupled)

Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2% for frequencies up to 20 kHz

PHASE MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable to 1.15 GHz

Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control.

Accuracy
±5% ±1 digit for modulation frequencies from 250 Hz to 3.4 kHz, over the range 15 to 35°C (0.1% per °C outside this range).

Distortion[1]
Less than 1% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 rad to 160 rads).

Modulation Frequency
Range 250 Hz to 5 kHz

Resolution
0.1 Hz

PHASE MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal phase modulation

Modulation Frequency Range
250 Hz to 5 kHz

Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2%

INTERNAL MODULATION AND AUDIO SOURCES
Up to 6 tone sources can be assigned as 3 modulation generators and 3 audio tone generators.

Modulation Modes
Internal generators may be assigned to AM, FM, ΦM

Audio Voltmeter

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
DC and 20 Hz to 500 kHz
AC only 20 Hz to 500 kHz
Polarized DC less than 10 Hz

Level Ranges
0 to 10, 0 to 30, 0 to 100, 0 to 300 mV, 0 to 1, 0 to 3, 0 to 10, 0 to 30 V RMS reading (autoranging or fixed)

Level Indication
4 digits and barchart with peak hold

Level Accuracy (DC Coupled)[3] [5]
±2% of reading ±1 mV ± resolution, DC and 100 Hz to 20 kHz
±4% of reading ±1 mV ±resolution, 40 Hz to 100 kHz

Level Accuracy (AC Coupled)[3]
±2% of reading ±1 mV, ± resolution 150 Hz to 20 kHz
±4% of reading ±1 mV, ± resolution 100 Hz to 100 kHz

Residual Noise
100 µV RMS CCITT weighted

Audio Frequency Meter

Range
10 Hz to 500 kHz

Resolution
0.1 Hz from 10 Hz to 5 kHz
1 Hz from 5 kHz to 50 kHz
10 Hz from 50 kHz to 500 kHz

Indication
6 digits

Accuracy
As frequency standard ±1 digit ± resolution

Sensitivity
On barchart greater than 25% FSD (DC coupled)

Audio SINAD Meter

Frequency
1 kHz default. User selectable up to 20 kHz

SINAD Range
5 to 50 dB

Resolution
0.1 dB for readings less than 20 dB
0.2 dB for readings less than 25 dB

Indication
3 digits and barchart with peak hold

Accuracy (bandpass filter selected)
±0.5 dB ± resolution

Sensitivity
100 mV for 46 dB SINAD

Audio Distortion Meter

Frequency
1 kHz default. User selectable up to 20 kHz

Distortion Range
0 to 100%

Resolution
0.1% distortion for readings greater than 1%
0.2% distortion for readings less than 1%

Indication
3 digits and bar chart with peak hold

Accuracy
±5% of reading ± resolution (bandpass filter selected)

Sensitivity
100 mV for 0.5% distortion

Audio S/N Meter

S/N Range
0 to 100 dB

Resolution
0.1 dB for readings less than 50 dB
0.2 dB for readings less than 70 dB

Indication
3 digits and bar chart with peak hold

Accuracy
±0.5 dB ± resolution

Sensitivity
2 V for 60 dB, 200 mV for 40 dB

Audio Oscilloscope

Operating Modes
Single or Repetitive sweep

Frequency Range
DC to 500 kHz
10 Hz to 500 kHz (AC coupled)

Glitch Catching
1 µs minimum

Voltage Ranges
2 mV/div to 20 V/div in a 1, 2, 5 sequence

Voltage Accuracy
±5% of full scale

Timebase
5 µs/div to 10 s/div in a 1, 2, 5 sequence

Timebase Accuracy
As frequency standard

Trigger Mode
Auto trigger

Marker Indication
Level: M1-M2, M2-M1
Time: M1-M2, M2-M1

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Audio FFT Analyzer

Span Widths
50 Hz to 50 kHz in a 5, 10, 25 sequence
Above 40 kHz signals are attenuated by 80 dB/octave.

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Level Reference (top of screen)
10 mV to 20 V, in a 1, 2, 5 sequence

Level Accuracy
±0.3 dB 100 Hz to 15 kHz; typically ±1 dB 40 Hz to 40 kHz

Vertical Scaling
1, 2, 5, 10 dB/div

Dynamic Range
60 dB

Max hold facility

Audio Sweep facility
DC to 20 kHz

Marker Indication
Level: M1, M2, M1-M2
Frequency: M1, M2, M1-M2

Audio Bar Charts

Displays: AF voltage, SINAD, Distortion, S/N.
Vertical Resolution: 1% of full scale.
Ranging: Autoranging, range hold or manual selection (up/down), 1, 3, 10 sequence with hysteresis.
With peak hold facility.

Audio and Modulation Filters

300 Hz Lowpass (±0.1 dB less than 150 Hz, ±0.2 dB, 150-200 Hz relative to 100 Hz).
300 Hz to 3.4 kHz Bandpass (±0.4 dB, 400-2100 Hz relative to 1 kHz).
5 kHz Lowpass (±0.3 dB at <3 kHz relative to 1 kHz).
20 kHz Lowpass ±0.3 dB at <12 kHz, typically -0.9 dB at <15 kHz and -3 dB at 20 kHz relative to 1 kHz.
CCITT Psophometric.
C-MESSAGE.
See also under Environmental/User Calibration

RF Frequency Meter

Range
100 kHz to 1 GHz

Resolution
1 Hz or 10 Hz selectable

Indication
Up to 10 digits

Accuracy
As Frequency Standard ±2 Hz ± resolution

Dynamic Range (Auto tuned)
As RF Power Meter (broadband)

Frequency Range (Auto tuned)
10 MHz to 999.9 MHz

Sensitivity
Manual tuned: -100 dBm (TNC) dependent on receiver bandwidth in off air test mode

Offset Frequency Range
±1 MHz dependent on receiver bandwidth

RF Power Meter (Broadband)

Frequency Range
100 kHz to 1 GHz

Dynamic Range (Auto tuned)
10 mW to 150 W (N-Type), 100 µW to 0.5 W (TNC)

Power Reading
True mean power

Indication Units
Watts

Resolution
Better than 1%

Indication
3 digits and barchart with peak hold

Accuracy[5]
100 kHz to 500 MHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type).
±10% (0.4 dB), 20 mW to 150 W (N-Type).
±12% (0.5 dB), 200 µW to 50 mW (TNC).
500 MHz to 1 GHz:
±12% (0.5 dB), 20 mW to 150 W (N-Type).
±15% (0.6 dB), 200 µW to 50 mW (TNC).
100 kHz to 1 GHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type) ±10% (0.4 dB)
1 mW to 50 mW (TNC) for ambient temperatures in the range 15°C to 35°C.
See also under Environmental/User Calibration

Maximum Safe Continuous Rating
N-Type: 50 W.
TNC: 0.5 W; overload protected to 10 W

Intermittent Rating
N-Type: 150 W for limited periods, typically 2 minutes at 20°C. Typical off to on ratio is 6:1.
Overload indicated by audible and visual warning.

RF Power Meter (Selective)

Frequency Range
100 kHz to 1 GHz

IF Bandwidth
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Dynamic Range (Manually tuned)
0 dBm to +50 dBm (110 kHz IF bandwidth) (N-Type)
-90 dBm to +20 dBm (110 kHz IF bandwidth) (TNC)

Power Reading
Average

Indication Units
dBm

Resolution
0.1 dB

Indication
3 digits + barchart with peak hold

Accuracy [5]
Typically ±2.5 dB N-Type & TNC.
See also under Environmental/User Calibration

RF Spectrum Analyzer

Frequency Range:
100 kHz to 1 GHz, useable from 30 kHz to 1.05 GHz.

Spans
500 Hz/div to 100 MHz/div, in a 1, 2, 5 sequence

Resolution Bandwidth
300 Hz to 300 kHz in a 1, 3, 10 sequence and 3 MHz (automatically selected according to span and manually selectable).
Video bandwidth – fixed at 3 kHz

Filter Shape
Nominally 3 dB/60 dB, 1:11 (300 Hz to 30 kHz bandwidth)

Reference Level (top of screen)
-100 dBm to +70 dBm

On Screen Dynamic Range
80 dB

Vertical Resolution
0.5 dB on 10 dB/div, 0.05 dB on 1 dB/div

Level Accuracy[5]
Typically ±2.5 dB
See also under Environmental-User Calibration

Intermodulation Distortion
Less than 80 dB for 2 signals on screen at reference level

Phase Noise
Typically -70 dBc / Hz at ±100 Hz from signal
Typically -75 dBc / Hz at ±1 kHz from signal
Typically -75 dBc / Hz at ±10 kHz from signal
Typically -85 dBc / Hz at ±20 kHz from signal
Typically -100 dBc / Hz at ±100 kHz from signal

Sweep Speeds
Optimum sweep speed selected according to span and resolution bandwidth

Modes
Single sweep and continuous

Graticule
10 horizontal by 8 vertical divisions

Display Features
Normal/Expanded

Markers
M1 and M2

Indication
Level: M1, M2, M1-M2
Frequency: M1, M2, M1-M2

TRACKING GENERATOR
Available in RF TEST mode

Frequency Range
100 kHz to 1 GHz

Level Range
-135 dBm to +13 dBm

Offset Tracking
Allows testing of mixers, IFs, fundamental and 2nd harmonic analysis (up, down, ×2, ÷2)

Modulation Analyzer

Dynamic Range (Auto tuned)
As RF Power Meter (Broadband)

Sensitivity (Manual tuned)
N-Type -30 dBm (110 kHz IF bandwidth)
TNC -50 dBm (110 kHz IF bandwidth)
TNC (off-air test mode) -101 dBm (2 µV 10 dB SINAD in 30 kHz IF bandwidth and CCITT weighting)

Demodulation
Accuracy maintained on signals greater than -60 dBm

Receiver Bandwidths
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Demodulation Filters
As audio analyzer plus 5 kHz lowpass (±0.3 dB at less than 3.4 kHz relative to 1 kHz)

Audio Output
Available in to an internal loudspeaker, demodulated output or accessory socket for external loudspeaker or headphones

Switching Speed
Nominally less than 1 ms channel to channel up to 50 MHz apart, settling to within 1 kHz of final frequency

Demodulated Output
Nominal output impedance less than 10 Ω. Output voltage is range dependent (2 V peak at top of range).

Squelch
A manual squelch control is provided with a variable threshold

AMPLITUDE MODULATION

Frequency Range
100 kHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

AM Depth Range
0 to 99.9%

Resolution
0.1% AM

Indication
3 digits and bar chart with peak hold

Accuracy (up to 85% AM)[1] [5]
±3% of reading, ±1% AM, 250 Hz to 5 kHz.
Typically ±5% of reading, ±1% AM, 50 Hz to 15 kHz

Demodulation Distortion[1]
Less than 1% at 1 kHz, CCITT weighted

Residual AM
Less than 0.1% AM, CCITT weighted

FREQUENCY MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

Deviation Range
0 to 100 kHz

Resolution
10 Hz below 10 kHz deviation; 100 Hz below 100 kHz deviation

Indication
3 digits and bar chart with peak hold

Accuracy[1] [3] [5]
±3% ± resolution for modulation frequency of 1 kHz
±5% ± resolution for modulation frequencies from 100 Hz to 15 kHz

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted.

Residual FM
Less than 25 Hz RMS CCITT weighted

PHASE MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
250 Hz to 5 kHz

Deviation Range
0 to 20 rads

Resolution
0.01 rads

Indication
3 digits and bar chart with peak hold

Accuracy[1] [3] [5]
±5% ± resolution

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted

Audio Generators

See section on modulation generators for interaction of audio and modulation generators.

FREQUENCY

Range[6]
1 Hz to 20 kHz AF Gens 1, 2 & 3 or 1 Hz to 100 kHz AF Gen 4.

Setting
Keyboard entry, delta increment/decrement function and rotary control.

Indication
6 digits

Resolution
0.1 Hz

Accuracy
As frequency standard

LEVEL

Range
0.1 mV to 5 V RMS (maximum AF output 7 V peak, all generators combined)

Setting
Keyboard entry, delta increment/decrement function and rotary control

Indication
4 digits

Resolution
0.1 mV

Accuracy
±3% ±1 digit, 250 Hz to 5 kHz
±5% ±1 digit, 10 Hz to 20 kHz
±10% ±1 digit, 20 kHz to 75 kHz

Output Impedance
Nominally 5 Ω

Protection
Maximum applied voltage 50 V

SIGNAL PURITY

Distortion[2]
Less than 0.5% at 1 kHz measured in a 30 kHz bandwidth.
Less than 1% from 20 Hz to 20 kHz measured in an 80 kHz bandwidth.
Typically 0.1% for levels greater than 100 mV

Residual Noise
Less than 50 µV RMS (CCITT weighted)

DC Offset
Less than 10 mV

Signaling Encoder/Decoder

Sequential tones functions
Encodes and decodes up to 40 tones.
CCIR, ZVEI, DZVEI, EEA, EIA or user defined.
Any of the tones may be extended.
Continuous, burst and single step modes available.

User defined tones
Up to three frequency plans may be defined and stored within the 2968 for sequential tones.
Any of the standard tone frequency plans may be copied to user defined and modified.
Tone length 10 ms to 1 s.
Extended tone length 100 ms to 10 s.

CTCSS tones mode
Standard tone frequencies may be selected from a menu

DTMF Encoder/Decode
Generation and decode of DTMF tones, displaying Hi/Lo frequencies, frequency error, timing information and twist.

DCS Encode/Decode
Generation and decoding of digitally coded squelch

POCSAG generator
Generation of POCSAG code CCIR No.1 Rec 584. Bit rates from 400 to 9600 bit/s.

Audio Monitor

Audio and demodulation signals may be monitored via the internal loudspeaker or via the accessory socket output or BNC socket on the rear panel.

SSB Option

SSB Tx

Frequency, range and meter accuracy	– as RF frequency
Power, level and meter accuracy	– as Broadband power
Detection Range	– 100 µV to 150 W
AF Demod range	– 10 Hz to 5 kHz
Demod distortion	– <2% @ 1 kHz CCITT weighted
Carrier and Alternate s/band suppression	– Better than –50 dBc
Sideband/CW Analyzer	– max 5 kHz full span frequency range
Spectrum Analyzer	– as RF spectrum analyzer
Audio Generator	– two – as audio generator
Sideband Selection	– LSB, USB, CW

SSB Rx

Sideband Generator	– as RF Gen (AM mode)
Offset measurement	– to 0.1 Hz resolution
SINAD	– as SINAD meter
Distortion	– as Distortion meter

Note: No audio is available in SSB option

General Features

INTERFACES
Keyboard and Display
Logical colour coded keyboard with bright high resolution CRT.

GPIB
Full control of all major instrument functions via the GPIB interface.
Flexibility is further enhanced by IFR's implementation of IEEE-488.2.

Capability
Complies with the following subsets as defined in IEEE-488.1-1978:- SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, E1.

Serial
Serial interface is provided for connection of RS-232 for instrument remote control. 9 Way socket. Control language is based on IEEE P1174.

Parallel
Connector 25 way female D-Type. Provides graphics screen dump. A selection of printer drivers are included.

Accessory Socket
Allows the connection of various optional accessories.
With suitable adapters is compatible with most 2955 series accessories.

Memory Card
Meets PCMCIA2/JEIDA – 4 standard. The memory card facility allows the storage of analog system test results and set ups.

Video Output
Color, compatible with most VGA monitors. 15 way Sub Miniature D Type.

Frequency Standard

Internal Frequency Standard Output

Frequency
10 MHz

Level
Nominally 2 V pk-pk

Output Impedance
Nominally 50 Ω

Temperature Stability
Better than 5 in 10^8, 5 to 50°C

Ageing Rate
Better than 1 in 10^7 per year, after 1 month continuous use

Warm Up Time
Less than 10 minutes to within 2 in 10^7 at 20°C

External Frequency Standard Input

Frequencies
1, 2, 5 and 10 MHz

Level
Greater than 2 V pk-pk

Input Impedance
Nominally 1 MΩ in parallel with 40 pF

Power Requirements

AC supply

Voltage
88 V to 132 V and 188 V to 265 V

Supply frequency
45 Hz to 65 Hz

Power
Nominally 135 W, 260 W maximum, for future options

Electromagnetic Compatibility

Conforms with the protection requirements of Council directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2, 3, 4
EN60555-2	IEC 555-2

Safety

Complies with IEC1010-1, BS EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Environmental

Rated Range Of Use
0 to 50°C and up to 95% relative humidity at 40°C

User Calibration

User calibrations are provided to maintain high accuracy for any ambient temperature (e.g. in ATE racks or in field measurements). Having allowed the instrument to stabilize, running the user calibrations optimizes the performance at that temperature.
A change in temperature of 5°C from the calibration temperature affects readings as below. These figures are provided as a guide to typical performance.
Typical variations are as follows for a 5°C change in temperature.

Power Meter:	Burst	0.5 dB
	Broadband	2%
	Selective	0.5 dB
Spectrum Analyzer Level		0.5 dB
Audio Analyzer & Modulation Filters		
	Audio Voltage	0.4%
	Demod depth & deviation	0.4%
Multimeter:	Voltage	0.5%
	Current	0.5%

STORAGE AND TRANSPORT

Temperature
-40 to +70°C

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential).

Internal Test Software

OPTION 10 NMT CELLULAR SOFTWARE

NMT450	NMT900
Benelux	NMTF
Austria	Spain
Malaysia	Indonesia
Saudi 1	Saudi 2
Thailand	Oman
Tunisia	Hungary
Poland	Russia
Czech	Bulgaria
Slovenia	Turkey

USER DEFINED NMT

OPTION 11 AMPS CELLULAR SOFTWARE
E-AMPS N-AMPS
USER DEFINED AMPS

OPTION 12 TACS CELLULAR SOFTWARE

E-TACS	TACS-2
C-TACS I	C-TACS II
J-TACS	N-TACS

USER DEFINED TACS

OPTION 13 MPT1327 TRUNKING SOFTWARE

Band III	JRC
UK Water	Hong Kong
Autonet	AMT
Madeira	NL-TRAXYS
NZ MPT1327	PH-INDO

USER DEFINED MPT

OPTION 14 PMRTEST SOFTWARE
USER DEFINED PMR for FM radios

OPTION 21 GSM (900 MHz) DIGITAL CELLULAR SOFTWARE
GSM Phase 1 and 2

General Features (Systems)

Test Modes
Manual Test/Auto Test

Note: Autotest not available for TETRA

Auto Test Programs (Analog and GSM)
Call Processing Only
Call and RF Testing
Brief Testing
Comprehensive Testing
User Defined Test

Digital Parametric Auto Test Routines (GSM)
Tx Timing
Tx Power Level
Tx Power Profile
Tx Frequency Error
Tx RMS Phase Error
Tx Peak Phase Error
Rx BER Class I
Rx BER Class II
Rx RBER Class Ib
Rx RBER Class II
Rx Frame Erasure
Rx Sensitivity
Rx RSSI Report

Analog Parametric Auto Test Routines

AF Frequency	AF Level
FM Deviation	Mod Frequency
Rx Distortion	Rx Expansion
Rx Sensitivity	Rx SINAD
Rx S/N	Tx Compression
Tx Distortion	Tx Frequency
Tx Level	Tx Power Level
Tx Limiting	Tx Mod Level
Tx Noise	Tx SINAD
Tx S/N	SAT Deviation
SAT Frequency	ST Duration
ST Frequency	ST Deviation
Data Deviation	DSAT Deviation

Signaling Auto Test Routines
Registration/Roaming Update
Place Call
Clear From Mobile
Page Mobile
Handoff
Clear From Land
Speech Quality
Hook Flash
DTMF Decode
Data Performance
PTT On
PTT Off
Auto Test Pause Modes
Pause Manual Only
Pause On Failure
Pause Always

Dimensions and Weight

Excluding handle, feet and covers.

Height	*Width*	*Depth*
177 mm (6.9 in)	370 mm (14.5 in)	540 mm (21.2 in)

Including handle, feet and covers.

Height	*Width*	*Depth*
203 mm (7.9 in)	420 mm (16.5 in)	600 mm (23.6 in)

Weight
Less than 19.5 kg (42.9 lb)

NOTES
(1) At low modulation levels the residual AM/FM may become significant.
(2) At low audio levels the residual noise may become significant.
(3) Audio and Modulation filter passband errors not included.
(4) Typical performance figures are non-warranted.
(5) Refer to USER CALIBRATION section.
(6) Either 3 modulation plus 3 audio generators up to 20 kHz or 1 modulation or 1 audio generator to 100 kHz.

Versions and Accessories

When ordering please quote the full ordering number information

Ordering Numbers	*Versions*
2968	TETRA Radio Test Set
	Options
Option 01	French Language Version
Option 02	Spanish Language Version
Option 03	German Language Version
Option 08	Wideband FM
Option 09	SSB Receiver Option
Option 10	NMT Cellular Radio Option
Option 11	AMPS Cellular Radio Option (including N-AMPS)
Option 12	TACS Cellular Radio Option (including N-TACS)
Option 13	MPT 1327/MPT 1343 Trunked Radio Option
Option 14	PMRTEST for AM/FM/ΦM radios
Option 21	GSM (900 MHz) Digital Cellular
Option 22	Mobile Tuning Range Test

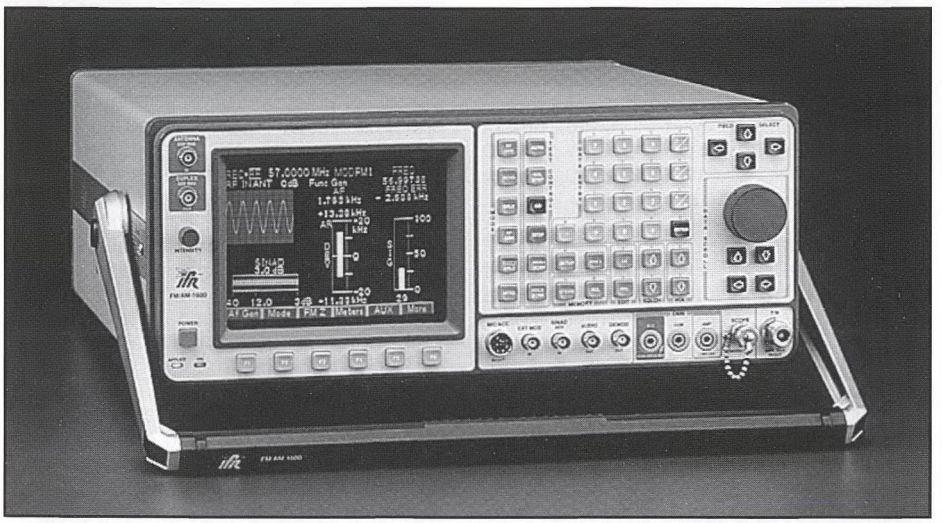
Contact your local sales outlet for details of availability of options

	Supplied with
	AC Supply Lead
	Operating Manual
	Multimeter Lead Kit (Two 4 mm leads to test points)
	Accessories
54421/001	BNC Telescopic antenna.
54431/023	20 dB AF attenuator (BNC)
54112/158	Hard Transit Case
54112/157	Soft Carrying Case
54212/001	GSM Phase 2 Plug-In TEST SIM
54212/002	GSM Phase 2 Full Size TEST SIM
54127/310	Rack Mounting Kit
59000/189	Memory Card (128 K)
54411/052	600 Ω interface and 20 dB AF attenuator (requires 46884/645 Accessory socket adapter)
46884/645	Accessory socket adapter (for use with 2955 accessories)
46884/646	Accessory Socket 'Y' adapter
46884/560	Parallel Printer Interface Cable.
46884/649	Serial port to PC Cable (25 way)
46884/650	Serial port to PC Cable (9 way)
43129/189	GPIB Cable
43130/596	Coaxial cable N-Type(m) to TNC(m) (double screened)
54311/095	Coaxial cable N-Type(m) to N-Type(m) (1 meter)
54311/071	TNC(m) to BNC(f) Adapter
54311/092	N-Type(m) to BNC(f) Adapter
52388/900	1 GHz Active Probe
54441/012	Power supply for probe 52388/900
B27033	Edit & Runtime Software, Single User, Dongled
B27071	GPIB Software Driver
	Service Support
W2	Two year warranty
W3	Three year warranty

Contact your local sales outlet for availability of these and other service plans.

TS-4317-X
Frequency Agile Communications Test Sets

IFR is the leader in Defense Test Systems for Military Tactical Communications with comprehensive solutions for SINCGARS, Have Quick, Special Tactics, Life Support, Airborne and International Military Communication systems



- 250 kHz to 1 GHz frequency coverage
- Single, portable, self-contained communications measurement instrument
- Ruggedized for military applications
- Solutions oriented, configurable platform for communications systems testing

TS-4317-X Overview

The TS-4317-X is a microprocessor controlled, digitally synthesized communication service monitor that combines the operations of many different test instruments into a single, compact unit. The TS-4317-X is capable of performing the following functions:-

RF Generator
RF Receiver
Duplex
AF Generator
Spectrum Analyzer
Oscilloscope
Digital Multi-Meter
Deviation (Peak) Meter
Distortion Meter
SINAD Meter
Audio Frequency Meter
Frequency Error Meter
RF Power Meter
Modulation Meter
Signal Strength Meter
Bit Error Rate Meter
Phase Modulation Meter
Deviation (RMS) Meter
Tracking Generator
Cable Fault Detector

The TS-4317-X utilizes an alphanumeric keypad, dedicated function keys, multi-task soft function keys and a high resolution color CRT to display, enter and edit functions and data. Testing with this instrument can be accomplished via remote control or manually by front panel control. Tests performed with the TS-4317-X can use pre-programmed set ups or formats determined at the time of the test. Microprocessor controlled memory allows storage and recall of parameters for each of the testing modes as well as storage and recall of oscilloscope and spectrum analyzer traces for signal comparison.

RF Generator

The RF Generator of the TS-4317-X is capable of generating modulated or unmodulated carrier signals from 250 kHz to 999.9999 MHz (in 100 Hz steps). The output level is variable from -137 dBm to 0 dBm. Modulation types include AM, FM and PM. Modulation can also be applied from an external source. The RF Generator also functions as a tracking generator for swept measurements or as an offset generator in Duplex Mode. Metering functions available for this operation mode include SINAD, Digital Multimeter (DMM), Distortion and Audio Frequency Level meters. The Oscilloscope and Spectrum Analyzer are also available for use with the RF Generator Operation Screen. The TS-4317-X Generator is capable of executing user defined frequency scan and frequency list operations as well as single frequency operations.

RF Receiver

The Receiver of the TS-4317-X is capable of receiving modulated and unmodulated signals from 250 kHz to 999.9999 MHz (in 100 Hz steps). The TS-4317-X receives AM, FM, PM, and SSB modulated signals. Metering functions in the TS-4317-X available with the Receiver include RF Power, Modulation, Deviation, Distortion, Frequency Error, AF Frequency, Signal Strength and SINAD meters and counters. The Oscilloscope and Spectrum Analyzer are also available for use on the Receiver Operation Screen. The TS-4317-X Receiver is capable of executing user defined frequency scan and frequency list operations as well as single frequency operations. The Receiver accesses "off the air" signals through the ANTENNA IN connector, higher-powered signals are accessed through the T/R connector.

Duplex

The TS-4317-X combines the independent RF Generator and Receiver from 250 kHz to 999.9999 MHz for duplex operation. The operator has the option of monitoring on screen the transmitter under test, receiver under test or both. All features available with the RF Generator and Receiver are available in duplex as well as the ability to use an offset frequency from -999.7499 to +999.7499 MHz to test communication equipment capable of generating and receiving simultaneously on different frequencies.

Oscilloscope

The TS-4317-X includes a 1 MHz single trace Oscilloscope as one of its major test capabilities. The Oscilloscope allows input from 1 mV to 50 V per division with a maximum input voltage of 200 Vdc.

Sweep rates range from 1 µs/div to 100 ms/div in a 1-2-5 sequence. The TS-4317-X Oscilloscope has a store and recall ability of up to nine signals. The

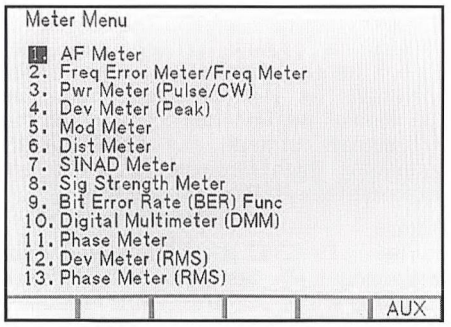
Frequency Agile Communications Test Set

recalled trace can be shown simultaneously with a live trace, giving the operator the opportunity to compare the two traces. Signals available for use include AC, DC, GND, Receiver IF, Demodulated Audio, Function Generators, External Audio, SINAD/BER and RF Power. The Oscilloscope is available as a stand-alone instrument or in combination with all major Operation Modes except where Duplex Transmitter and Receiver are shown simultaneously. Size options for views in other modes are full-size and quarter-size.

Spectrum Analyzer

The Spectrum Analyzer monitors internal and external signals from 250 kHz to 999.9999 MHz. Scan widths range from 1 kHz to 100 MHz as well as zero scan. Available log scales are 2 and 10 dB/div. with amplitude scale units of dBm, dBmV, dBV, dBmW and dBW. Memory functions for the Spectrum Analyzer include store and recall of a trace, compare a stored trace to a live trace and peak hold. External signals can be displayed "off-the-air" through the ANTENNA IN connector or applied through the T/R connector. The Spectrum Analyzer has variable stepped attenuation through both connectors. The Spectrum Analyzer also has a tracking generator function with a variable level from -137 to 0 dBm. The Spectrum Analyzer is available for display alone or in all major operation modes except where the Duplex Transmit and Receive functions are shown simultaneously. Size options for views in other modes are full-size and quarter-size.

Meters



Meter menu selection screen

The TS-4317-X provides the meters listed above for use as independent test functions as well as synthesizing them into the major mode functions. As independent functions, the meters provide a bar graph display and digital data. On the major operations screens, these meters display as bar graph display and digital data or just as digital data, depending on the Oscilloscope/Spectrum Analyzer display size. The meters are used to monitor both internal and external inputs.

Audio Function Generator

There are two Audio Function Generators included in the TS-4317-X with a range of 10 Hz through 40 kHz. Available waveforms include sine, square, triangle, ramp, pulse and DC levels. The TS-4317-X is also capable of creating Manchester digital data bit patterns of 100 to 100,000 bits. Data rates include 75, 150, 300, 600, 1200, 2400, 4800 and 16000 bps. Pattern types include random, fixed and user defined.

Data Entry and Display

Unless the TS-4317-X is configured for remote testing, all data received by the operator is in the form of screens and menus. Each major test operation has a dedicated operation screen with subordinate set up menus. The microprocessor edits operation screens to reflect changes in parameters imposed by the operator or reflects changes in data delivered by the Unit Under Test (UUT).

Individual meters also have dedicated operation screens and subordinate set up menus. The meter operation screens can be accessed through the mode operation screen that is being supported by that specific meter operation or through the Meter Menu.

Once a specific mode of operation is selected, the operation screen appears on the CRT. The parameters shown reflect the parameters last entered in that operation. This specific operation screen is accessed with one of six dedicated MODE Keys.

Set up menus on all mode operation screens are accessed from the specific operation screen by pressing the SET UP Key. Operator entry and edit of data is performed on the operation screen or on the set up menu.

The operation screen and menus have active cursors that the operator can use to access a specific parameter. Once the parameter is accessed, data can be selected with DATA SCROLL Spinner or DATA SCROLL Keys or by using the alphanumeric DATA ENTRY Keypad.

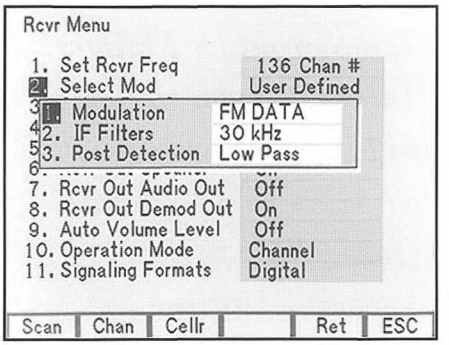
Multitask "Soft" Function Keys are also provided to perform set up, edit and entry. Each operation screen defines Soft Function Keys to fit the specific needs for that operation. These definitions are displayed on the screen above the defined key. Each operation screen may have several definitions for each Soft Function Key or make a definition unavailable depending on the parameters of the operation. Various functions performed by these multitask keys include toggling between two values, selecting connectors for access, entering data or selecting a field for edit.

Set up storage and recall functions are available for each of the MODE screens. This allows the user to store up to nine set ups in each MODE screen for future recall. Selecting the Auxiliary Function (AUX) menu and selecting the store function may also save the system configuration. This allows the user to store and recall up to nine system configurations.

The Receiver and Generator have a frequency list capability. This allows the user to store up to 100 frequencies into a list for use when performing tasks that require the same instrument set up to be utilized on many different frequencies.

Set up Menus

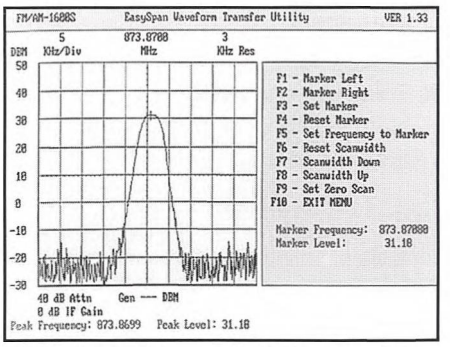
The major modes of operation each provide additional set up and control of functions not available for edit on the operation screen. A typical example set up screen for the receiver is shown below. Functions such as signal routings to the front panel connectors, AGC control, user defined IF and Post Detector bandwidth settings and signal formats are configured via this menu.



Set up menu screen for receiver function

Application Software

The remote language has a screen for access of up to greater than 2 MBytes of optional application software files. Application programs are available for many different measurement applications or the user may develop his/her own routines. Expansion capability exists for additional memory, if required.



Application software example of the EasySpan waveform transfer utility

Radio Testing Software

The following application programs are available for use on the TS-4317-X family of Frequency Agile Communications Test Sets. These software packages and their associated interconnection groups allow the Test Set to perform semi-automated verification, testing and repair of the following LRUs:

TS-4317-X Radio Testing Software

RADIO SYSTEM	*LRU*	*DESCRIPTION*
VRC-12	RT-246	VHF/FM Vehicular
	RT-524	R/T (Manual)
	R-442	Receiver (Auxiliary)
PRC-77	RT-841	VHF/FM Manpack Transceiver
LST-5	LST-5A	Lightweight

Frequency Agile Communications Test Set

	LST-5B	Satellite Terminal
	LST-5C	
PSC-7	HST-4A	UHF SATCOM
	HST-4B	LOS Transceivers
	HST-4C	
	MST-20	Miniature Satellite Transceiver
PRC-117	PRC-117A	VHF/FM Manpack
	PRC-117B	VHF/FM Manpack
	PRC-117C	VHF/UHF, AM/FM Transceiver
PRC-113	RT-1319	Manpack
	RT-1319B	Transceiver (HQ II)
URC	URC-100	Manpack Tactical
	URC-101	LOS/SATCOM
	URC-104	Tactical Manpack
	URC-110	Tactical Data Transceiver

TS-4317-X Family

The TS-4317-X family is designated by the customer as indicated below, however, no customer restrictions or limitations on availability are implied. The TS-4317-X family of test sets supports and maintains total interchangeability and interoperability with all Radio Personality Modules and Radio Test Applications Programs.

TS-4317	Army/Marine Corp Test Set
TS-4317-1	Air Force Test Set
TS-4317-2	Korean Military Test Set
TS-4317-3	Special Forces Test Set
TS-4317A	2 GHz Digital Test Set

Radio Communications Test Systems

In government communications, IFR provided the first multi-functional, multi-radio integrated test set (AN/GRM-114) fielded for the US Armed Forces. Its successors, the AN/GRM-114A, AN/GRM-114B, AN/GRM-122 and the AN/ARM-204 continued the migration path with increased capabilities designed to meet the growing demands of advanced communications systems.

Our experienced government staff continue to evolve our test equipment to provide "State of the Art" capabilities for semi-automated verification testing and/or fault isolation of military communications systems from a single, portable platform.

Radio Personality Modules (RPMs)

The TS-4317-X family of frequency agile radio communications test sets along with the J-4843A generic appliqué unit and its associated Radio Personality Modules (RPMs) provides our customers a solutions oriented, cost effective, configurable approach to communication systems testing. Our ability to reduce life cycle cost, while assuring the highest degree of confidence in the military communications equipment, has successfully established a migration path with increased capabilities designed to meet the growing demands of advanced communications systems in the digital battlefield.

The RPM based configurable approach to LRU testing provides a cost-effective method to accomplish complete pin-to-pin functional communications systems testing. This approach is typically utilized for more complex communications systems testing requirements where multiple LRUs (Radios, RF Amplifier, Vehicular Adapter, Fill Device, Battery Box, etc.) are required to be tested in all their operational modes.

Additional information on the Radio Communications Test System (RCTS) family of products and their applications is included in the following pages.

Specification

General Notes

A warm-up time of 20 minutes is permitted for the following performance requirements.
RF measurements are referenced to 50 Ω.
Accuracy and Resolution stated in percent are referenced to measured or selected value unless otherwise stated.
Where specified resolution exceeds specified accuracy, specified resolution takes precedence.

RF Signal Generator - T/R Connector

FREQUENCY

Range
250 kHz thru 999.9999 MHz

Resolution
100 Hz

Accuracy
Same as Master Oscillator

LEVEL

Range
-137 dBm thru 0 dBm, -40 dBm Max with Reverse Power Present

Resolution
0.1 dB

Accuracy
±1.0 dB, 0 dBm to ≥-110 dBm
±2.5 dB <-110 dBm to -127 dBm

Output Impedance
50 Ω (Return Loss > 16 DBRL)

SPECTRAL PURITY

Residual FM
Post Detection BW 0.3 kHz to 3 kHz
<10 Hz RMS from 1.0 MHz to 500.0 MHz
<20 Hz RMS from >500.0 MHz
Post Detection BW 50 Hz thru 15 kHz
<45 Hz RMS from 1.0 MHz thru 100.0 MHz
<140 Hz RMS for <1.0 MHz & >100.0 MHz

S.S.B. Phase Noise
<-80 dBc/Hz at 20 kHz from carrier ≤1 MHz
<-90 dBc/Hz at 20 kHz from carrier <930 MHz
<-85 dBc/Hz at 20 kHz from carrier ≥930 MHz

Harmonics
<-26 dBc

Non-Harmonics
<-50 dBc

Residual AM
Post Detection BW 0.3 kHz to 3 kHz
<0.10% RMS, >1 MHz
Post Detection BW 50 Hz thru 15 kHz
<0.10% RMS, >1 MHz

Input Protection
See Power Meter

Duplex Generator: At Duplex Connector

FREQUENCY (Independent of Receiver Frequency Setting)

Range
250 kHz thru 999.9999 MHz

Resolution
100 Hz

Accuracy
Same as Master Oscillator

LEVEL

Range
-120 dBm thru +7 dBm

Resolution
0.1 dB

Accuracy
±1.0 dB, (Levels ≥ -100 dBm)
±2.5 dB, (Levels < -100 dBm)

Output Impedance
50 Ω Nominal (Return Loss >16 DBRL)

SPECTRAL PURITY

Residual FM
Post Detection BW 0.3 kHz to 3 kHz
<10 Hz RMS from 1.0 MHz to 500.0 MHz
<20 Hz RMS from > 500.0 MHz
Post Detection BW 50 Hz thru 15 kHz
<45 Hz RMS from 1.0 MHz thru 100.0 MHz
<140 Hz RMS for <1.0 MHz & >100.0 MHz

S.S.B. Phase Noise
<-80 dBc/Hz at 20 kHz from carrier ≤1 MHz
<-90 dBc/Hz at 20 kHz from carrier <930 MHz
<-85 dBc/Hz at 20 kHz from carrier ≥930 MHz

Harmonics
<-26 dBc

Non-Harmonics
<-50 dBc

RESIDUAL AM
Post Detection BW 0.3 kHz to 3 kHz
<0.10% rms, >1 MHz
Post Detection BW 50 Hz thru 15 kHz
< 0.10% rms, >1 MHz

Input Protection
Up to 65 Watts for 15 Seconds with Alarm

RF Signal Modulation (T/R & Duplex Connectors)

INTERNAL FM

Deviation
Range
Off, ±100 Hz thru ±100.0 kHz (fc ≥1 MHz)
Accuracy
±5%, ±1.0 kHz thru ±20.0 kHz
±10%, < ±1.0 kHz and > ±20.0 kHz

Resolution
100 Hz

Modulation
Rate: Off, 30.0 Hz thru 20.0 kHz (1)
Up to 20 kbs Digital
Wave Forms: Sine, Square, Triangle, Ramp and Pulse

Total Harmonic Distortion
(Sine wave only), >6 kHz Deviation
<0.7%, (700 Hz thru 1.1 kHz)
<1.0%, (30 Hz thru 10.0 kHz)
<2.0%, (>10.0 kHz thru 20.0 kHz)
<3 out of 10^6 BER for Digital

INTERNAL AM

RF Generator Range
250 kHz thru 999.9999 MHz

AM Range
Off, 1% thru 90%

AM Accuracy
± 5% of setting (30% thru 90% modulation)

AM Resolution
1%

Modulation
AM Rate
100.0 Hz thru 10.0 kHz (1)
Wave Forms
Sine, Square, Triangle, Ramp and Pulse

Total Harmonic Distortion (Sine Wave Only)
For 30% thru 70% modulation
< 0.7% Hz thru 1.1 kHz (700 Hz thru 1.1 kHz)
<1.5% (100 Hz thru 6.0 kHz)
<2.5%, (>6 kHz thru 10.0 kHz)

NOTE (1): Reference AF Generator for modulation rate accuracy and resolution.

Frequency Agile Communications Test Sets

INTERNAL PHASE MODULATION

Phase Modulation
Range
Off, 0.1 to 10 Radians
Accuracy
± 10% (@ 1 kHz rate, >0.3 Rad)
Resolution
0.1 Radians

Modulation
Rate
Off, 30 Hz to 6 kHz (see Note 1)
Waveforms
Sine, Square, Triangle, Ramp and Pulse
Distortion
<2% (1 kHz rate, 0.3 kHz to 3 kHz BW, ≥0.5 Rad)

EXTERNAL
External inputs with the same characteristics as the internal modulation sources are supported.
A 10 Vp-p injection level is required to obtain indicated setting ±10%.

Frequency Agility

(For both RF Generator & Receiver)

Settling Time
1.5 ms to within 1.0 kHz of desired freq. from 10.0 MHz thru 900.0 MHz, (25.0 kHz steps), measured from time UUT completes outputting the 16 bit frequency word.

AF Generator #1 and #2

FREQUENCY

Range
10.0 Hz thru 40.0 kHz

Resolution
0.1 Hz < 2.0 kHz
1.0 Hz > 2.0 kHz

Accuracy
±0. 1 %

LEVEL

Range
0.7 mV RMS thru 2.5 VRMS (150 Ω), up to 3.0 VRMS (600 Ω)

Resolution
0.1 mV for 1.0 mV thru 200.0 mV
0.8 mV RMS (>200 mV RMS)

Accuracy
(150 Ω load)
±0.1 mV or 3% for ≤10 kHz
5% for >10 kHz to ≤25 kHz

SPECTRAL PURITY

Total Harmonic Distortion
<0.5% (sinewave, 700 Hz to 1.1 kHz, >100 mV RMS)
<1.0% (sinewave, < 700 Hz and > 1.1 kHz, >100 mV RMS)

WAVESHAPE
Sine, Square, Triangle, Ramp, and Pulse

Digital Data Generator

DIGITAL DATA GENERATOR and Pattern Generator for BER
Generates Manchester style data.

Data Rates
75, 150, 300, 600,1200, 2400, 4800 BPS & 16 KBPS

Data Pattern Size
100 to 100,000 bits

Data Pattern Type
Random, Fixed & User Defined

Accuracy
1×10^{-8}

LEVEL

Range
Digital 0.1 V to 5.0 V.

Resolution
0.1 V

Accuracy
±3%

Audio Frequency Counter

FREQUENCY

Range
10.0 Hz thru 40.00 kHz (in 4-decade ranges)

Accuracy
Same as Master Oscillator ± 1 count

Resolution
0.1 Hz from 10.0 Hz thru ≤2.0 kHz
1.0 Hz from >2.0 kHz thru ≤20.0 kHz
10.0 Hz from >20.0 kHz to 40.0 kHz

Input Waveform
Sine or Square Wave

EXTERNAL INPUTS

External Level
0.5 VRMS to 30 VRMS (SINAD/BER input)
0.1 VRMS to 3.5 VRMS (EXT MOD input)

Impedance
1 MΩ Nominal (SINAD/BER input)
100 kΩ Nominal (EXT MOD input)

RF Error Meter / RF Counter

RADIO FREQUENCY COUNTER

Range
250 kHz thru 999.9999 MHz

Accuracy
Same as Master Oscillator

Resolution
1 Hz - <20 MHz
10 Hz - ≥20 MHz

Level
-10 dBm thru +50 dBm at the T/R connector
-80 dBm thru +10 dBm at the ANT connector

RADIO FREQUENCY ERROR COUNTER/METER

Frequency Counter Range
0 thru ± 150.000 kHz [2]

Frequency Meter Range
0 thru ± 100.0 kHz [2] (in 4 decade ranges)

Counter/Meter Accuracy
Same as Master Oscillator

Counter/Meter Resolution
1 Hz from ± 1.0 Hz to ≤± 10.0 kHz
10 Hz from >±10 kHz to ± 150.0 kHz

Counter/Meter Level
-10 dBm thru +50 dBm at the T/R connector
-80 dBm thru +10 dBm at the ANT connector

Note [2]: Receiver Bandwidth will determine the upper limits.

RF Power Meter

FREQUENCY

Range
1.5 MHz thru 999.9999 MHz

LEVEL

Input Level
0.2 mW to 200 W

Ranges
20.0 mW, 200.0 W full scale (1-2-5 sequence)

Resolution
1% or 0.1 mW

Accuracy
±10%, ± 1 count

RETURN LOSS
1.5 MHz thru 100.0 MHz, >23.0 DBRL
>100.0 MHz thru 400.0 MHz, >20.0 DBRL
>400.0 MHz thru 999.9999 MHz, >16.0 DBRL

OPERATING CONDITIONS
50 W continuous at 25.0°C ambient
or 30.0 sec on, 2.0 minutes off at 100 W & 50.0°C ambient
or 15.0 sec on, 2.0 minutes off at 200 W & 50.0°C ambient
Over temperature alarm provided for all input levels.

Receiver

Frequency Range
250.0 kHz thru 999.9999 MHz

Sensitivity
≤5 µV for 10.0 dB SINAD (fc ≥1 MHz) 30 kHz IF Bandwidth (1.0 kHz Tone, 6 kHz deviation 10 kHz Audio Bandwidth)

Selectivity

Mode	*Rec. IF BW*	*Audio BW*
FM 4	300 kHz	100 kHz
FM 3	300 kHz	20 kHz
FM 2	30 kHz	10 kHz
FM 1	30 kHz	3 kHz
AM 2	30 kHz	10 kHz
AM 1	2.9 kHz	3.0 kHz
USB (3)	2.9 kHz	3.0 kHz
LSB (3)	2.9 kHz	3.0 kHz
PM	30 kHz	3.0 kHz

Adjacent Channel Rejection

Receiver Nominal 3.0 dB Bandwidth	*Greater Than 30.0 dB Down*
300 kHz	±485 kHz Max
30 kHz	±52 kHz Max
2.9 kHz	+2.5 kHz Max[3]

Note [3]: For USB & LSB Operation: Center frequency shifted +1.825 kHz or -1.825 kHz according to mode of operation.

DEMODULATION OUTPUT

Impedance
600 Ω

Output Level
(FM): 5 Vp-p ±10% (at full scale, into 600 Ω)
(PM): 40 mV RMS ±10% (5 Rad, into 600 Ω)
(AM): 1 VRMS ±10% (80% modulation, into 600 Ω)
(SSB): 1.15 VRMS ±1 0% (Beat tone, into 600 Ω)

Receiver, Antenna Connector:
Input Protection: 65 W for 15 sec. with alarm

FM Deviation Meter

Range
±1 kHz to ±100 kHz

Resolution
10 Hz, ≤20 kHz Ranges 1 kHz, >20 kHz Ranges

Accuracy
±4.0% ±2 counts + source residual
(for 300 kHz IF, <20 kHz Rate, FM-zeroed)

Modulation Rate
100 Hz to < 40 kHz (300 kHz IF)
100 Hz to < 3 kHz (30 kHz IF)

Carrier Range
500 kHz thru 999.9999 MHz

Carrier Level
-10 dBm thru +50 dBm at the T/R connector
-80 dBm thru +10 dBm at the ANT connector

AM Modulation Meter

Range
1% thru 95%

Resolution
1%

Accuracy
5% full scale, ± 1 count + source residual from 30% thru 90%

Modulation Rate
100.0 Hz thru 10.0 kHz

Carrier Range
1 MHz thru 999.9999 MHz

Carrier Level
-10 dBm thru +47 dBm on the T/R connector
-80 dBm thru +10 dBm on the ANT connector

PM Deviation Meter

Range
0 Rad to 10 Rad (Peak)

Frequency Agile Communications Test Sets

Resolution
0.01 Rad (≤5 Rad)
0.1 Rad (>5 Rad)

Accuracy
±3% full scale ± 1 count + source residual (@ 1 kHz rate > 0.3 Rad)

Modulation Rate
300 Hz to 4 kHz

Carrier Range
500 kHz to 999.9999 MHz

Carrier Level
-10 dBm to +50 dBm (T/R connector)
-60 dBm to +10 dBm (ANT connector)

Distortion Meter

Range
0.1 % thru 20.0%

Resolution
0.1%

Accuracy
± 20.7% Distortion, ± 1 count from 1.0% thru ≤10.0%,
±2.0% Distortion, ± 1 count from >10.0% thru 20.0%

Signal Frequency
600 Hz thru 1400 Hz

Signal Level
0.1 VRMS thru 30.0 VRMS, SINAD/BER input

SINAD Meter

Range
3.0 dB thru 30.0 dB

Resolution
0.1 dB

Accuracy
± 1.0 dB, ± 1 count

Signal Frequency
600 Hz thru 1400 Hz

Signal Level
0.1 VRMS thru 30.0 VRMS, SINAD/BER input

Digital Multimeter

VOLTMETER (DC/AC)

Ranges
200.0 mV, 2.000V, 20.00 V, 200.0 V, 2000 V[4], full scale, (1 MΩ)

Note [4]: 1000.0 V max DC OR 500.0 V max AC (true RMS)

Resolution
3.5-digit display, Max. resolution 0.1 mV on 200 mV Scale.

Accuracy
± 5%, full scale (AC)[5], ± 1 count
± 1%, full scale (DC), ± 1 count,

Note [5]: AC accuracy applies for AC Volts times kHz product <140.

Frequency
DC, AC mode 50 Hz thru 20 kHz

Input Impedance
Selectable ± 5%
150 Ω (speaker load)
600 Ω (line load)
1 MΩ NOMINAL (shunted by <150 pF)

OHMMETER

Ranges
200.0 Ω, 2.000 kΩ, 20.00 kΩ, 200.0 kΩ, 2.000 MΩ, 20.00 MΩ (full scale)

Resolution
3.5-digit display, Max. resolution 0.1 Ω on 200.0 Ω scale.

Accuracy
±5% full scale, or 0.1 Ω, ±1 count

CURRENT METER (DC/AC)

Ranges
20.00 mA, 200.0 mA, 2.000 A full scale
(20.0 A[6]) OUT - Via an External Shunt, using the Voltmeter on the 0.2 V scale)

Note [6]: 10 A max DC or 5 A max AC (True RMS)

Resolution
3.5-digit display, Max. resolution
0.01 mA on 20.0 mA Scale.

Accuracy
±5% full scale, or 0.1 mA, ± 1 count

Oscilloscope

Display Size
8.64 cm (3.4 in) X 9.65 cm (3.8 in)

VERTICAL

Bandwidth
1.0 MHz (-3 dB)

Input Ranges
2 mV/Div to 50 V/Div
(1-2-5 sequence, 8 divisions)

Max Input Voltage
200 V

Accuracy
± 5% of full scale
(± 10% with x 10 probe)
± 10% of full scale in 2mV range
(± 10% with x 10 probe)

Resolution
1.25% of full scale, (digital scope data range 0 to 255, in 8 divisions)

Coupling
DC, AC, and GND

HORIZONTAL

Rate
1 µs/Div to 100 ms/Div
(1-2-5 sequence, 10 divisions)

Accuracy
±3% of full scale

Resolution
1 %, (digital scope data sweep 400 points displayed per sweep)

External Input Impedance
1.0 MΩ, (NOMINAL), shunted by 27 pF

Spectrum Analyzer

Display Size
86.4 mm (3.4 in) X 96.5 mm (3.8 in)

Range
500 kHz thru 999.9999 MHz

FREQUENCY SPAN

Range
1 kHz/Div to 100 MHz/Div plus zero scan
(10 divisions in a 1-2-5 sequence)

Accuracy
± 5% of Span Width

Reference Accuracy
See Master Oscillator

LEVEL

Vertical Range
Log, 10 dB/Div and 2 dB/Div

Vertical Resolution
1 dB (10 dB/Div)
0.4 dB (2 dB/Div)

Range (Dynamic)
60 dB (@ 0 dB atten, <1 MHz/Div)

Bandwidth Switching Error
<2 dB (5 kHz/Div thru 1 MHz/Div)
<3 dB (<5 kHz/Div, >1 MHz/Div)

Overall Accuracy
± 4 dB (1 MHz to 400.0 MHz, normalized)
± 5 dB (>400.0 MHz to 999.9999 MHz, normalized)

Attenuator
0, 20, 40 dB at ANT connector
40 dB, 60 dB, 80 dB
(User selectable, Pwr < 2 W, T/R)
60 dB, 80 dB, 100 dB
(User selectable, Pwr > 2 W, T/R)

MODES

Resolution	
Scan Width[7]	***Bandwidth***
100 MHz/Div	3 MHz
50 MHz/Div	3 MHz
20 MHz/Div	300 kHz
10 MHz/Div	300 kHz
5 MHz/Div	300 kHz
2 MHz/Div	300 kHz
1 MHz/Div	300 kHz
500 kHz/Div	30 kHz
200 kHz/Div	30 kHz
100 kHz/Div	30 kHz
50 kHz/Div	30 kHz
20 kHz/Div	3 kHz
10 kHz/Div	3 kHz
5 kHz/Div	3 kHz
2 kHz/Div	300 Hz
1 kHz/Div	300 Hz
0 kHz/Div	30 kHz

NOTE [7]: The receiver is fixed on the center frequency for monitoring while the analyzer scans as specified.

Bit Error Rate Meter (BER)

Data generated by Digital Data Generator. Inputs to BER meter from received RF or from front panel connector. Decodes Manchester style data.

Range
1 x 10^{-1} to 1 x 10^{-5}

DATA

Rates
75, 150, 300, 600, 1200, 2400, 4800 bps & 16 kbps

Data Pattern Size
100 to 100,000 bits

Data Pattern Type
Random, Fixed, & User Definable

Accuracy
1 x 10^{-6}

EXTERNAL INPUT LEVEL

Signal Level
300 mVp-p to 5 Vp-p (SINAD/BER input)

Input/Output (I/O) Connectors

IEEE-488.1-1987 CONNECTOR
(24 pin IEEE connector)
The hardware interface is in accordance with IEEE-488.1-1987. All of the functions in the set (including the analyzer, scope and DMM) can be controlled through this interface. No manual intervention shall be required except for power on/off. The interface provides talker/listener modes for all the functions in this specification.

The following are provided:
SH1, AH1, TI, T2, TE0, L2, LE0, SR1, RL2
PP0, DC1, DT1, (C0, 1, 2, 3, 4)*
*user selectable

RS-232 CONNECTOR - (ASYNCHRONOUS)
(9 PIN SUB-MINIATURE D, MALE CONNECTOR)

Operations Mode
Off, PC (Input/Output), Printer (Output)

Baud Rates
300, 600, 1200, 2400, 4800, 9600, 19200

Stop Bits
1, 2

Parity
Odd, Even, Mark, Space, None

AUXILIARY BOX INTERFACE (SCSI)
(50 PIN IEEE CONNECTOR)
Interface connector for auxiliary box interface per the ANSI X3.131- 1986 standard.

EXTERNAL VIDEO
(9 pin sub-miniature D, female connector)
EGA (Enhanced Graphic Adapter) interface for external EGA computer monitor.

Frequency Agile Communications Test Sets

Master Oscillator

TCXO Temperature Stability
±0.15 ppm (0 to 50°C)

Ageing
± 0.3 ppm per year

Accuracy
± 0.5 ppm

Adjustment Resolution
Approximately 0.005 ppm over 4.0 ppm adjustment range

General Characteristics

Dimensions
432 mm (17 in) wide, 187 mm (7.4 in) high,
559 mm (22 in) deep
(without bail handle, front panel cover in place)

477 mm (18.8 in) wide, 187 mm (7.4 in) high,
635 mm (25 in) deep
(with bail handle, front panel cover in place)

Weight
21.8 kg (48 lb)

Operating Temperature Range
0 to 50°C

Power Requirements

Line
95 to 130 VAC 50 to 400 Hz
190 to 260 VAC 50 to 400 Hz
180 Watts typical (TS-4317-X)

External DC
22 thru 30 VDC

Display

Type
Color, 70 degrees deflection, in-line

Size
132 mm (5.2 in) wide, 142 mm (5.6 in) high,
173 mm (6.8 in) diagonal

Resolution
640 pixel x 350 Lines

Environmental

Design	Per MIL-T-28800
Safety	Per MIL-STD-882B
EMI/RFI	Per MIL-STD-461/462
Reliability	Per MIL-HDBK-781
Storage Temperature	-40 to +70°C
Operating Temperature	0 to 50°C
Humidity	0 to 95%
Vibration	2 g
Shock	40 g

Self Test

Built-in in the form of user accessible Self-Operational Check (SOC).
Appliqué units have Built In Test (BIT) with > 90% coverage.

Accessories

Microphone
Antenna (flexible)
DC Shunt
20 dB Pad
10 dB Pad
DC Power Cord
AC Power Cord
DMM Probes
Scope Probe
Extra Fuses

Versions and Accessories

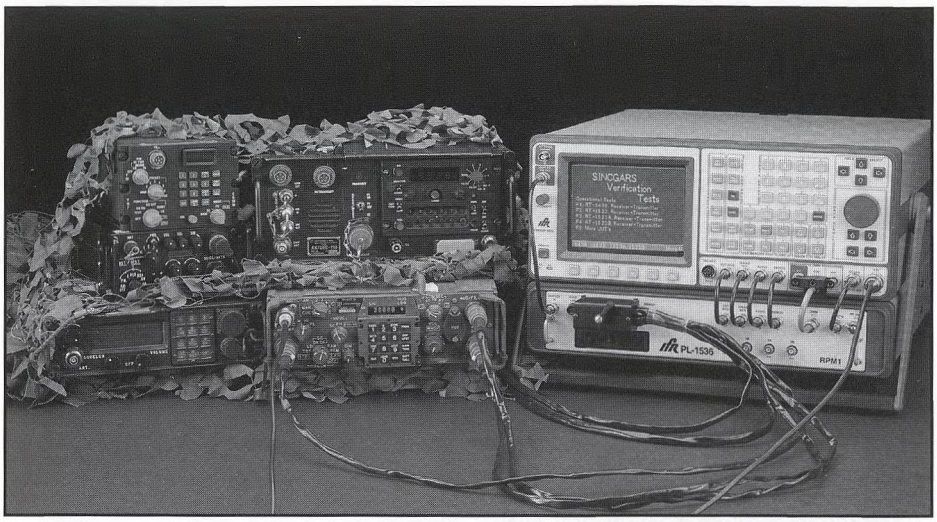
When ordering please quote full ordering number information.

AAT012	Microphone
AAT013	ANT-2 Telescoping Antenna
AAT015	1600 Soft Padded Carrying Case
AAT016	1600/J160x Soft Padded Carrying Case
AAT014	Hardside Case (Cetacea)
AAT017	Hardside Case (Siltion)
AATS11	AMPS Cellular System Analyzer
AATS12	AMPS Mobile Station Test
AATS13	SINAD/Distortion Meter (Special for –2)
AATS14	NT400 Cellular Test
AATS15	NAMPS Encode/Decode
AATS16	NAMPS Cellular Monitor
AATS17	NAMPS Cellular Mobile
AATS18	Flash Memory File System (Standard in all TS units)
AAT020	+20 dB Generate Amplifier
AAT024	Rebidium Frequency Standard (0.001 ppm)
AAJ105	Calibration Key for TS-4317 Family
AAT023	TS-4317-X Maintenance/Service Kit
AAT001	EasySpan (Wave Form Transfer Software)
AAT002	EasySpan for Windows (Wave Form Transfer Software)
AAT003	EasyCom-FM (Land Mobile Test Software)
AAT004	EasyScan (Spectral Usage Software)
AAT005	VRC-12/PRC-77 Radio Test Software
AAT006	EasySweep (Swept Antenna Measurements)
AAT007	LST-5 Series Radio Test
AAT008	PRC-113 Series Radio Test Software
AAT009	HST-4 & AN/PSC-7 Series Radio Test Software
AAT010	AN/PRC-117 Series Radio Test Software
AAT011	AN/URC Series Radio Test Software
AAT019	Return Loss Bridge (5 MHz to 1 GHz)
AAT018	Rack Mount Kit - (Test Set Only)
AAPS02	Rack Mount Kit – (RCTS)
AAT021	Auxillary Box Development Kit
AAT022	Auxillary Box Cable Kit

© EasySpan, EasyCom-FM, EasyScan and Easy Sweep are copyrighted by IFR Americas, Inc.

Defense Test Systems
Radio Communications Test Systems

- Easily expandable platform
- Semi-unattended testing
- Portable
- More complete testing in less time
- Operator skill level requirement Reduced
- Less test equipment required
- Reduced calibration cost
- Less set up and operation test time required
- Reduced chance of human error occurrence
- Automated data logging and recording
- No "Gold" LRU equipment required
- Test and troubleshooting procedures are significantly simplified
- Semi-automated test environment for multiple LRUs
- Guided probing for troubleshooting
- Supports all levels of maintenance
  - Forward "Mobile" installations
  - Forward "Fixed" installations
  - Rear depot installations
- Support all test requirement applications
  - Factory final acceptance of LRUs
  - Functional verification on delivery
  - Preventive maintenance
  - Verification testing prior to fielding
  - Fault detection and reporting
  - Fault isolation to defective SRU
  - Verification of repair and return to service



IFR Americas, Inc. Aerospace & Defense Group continues to use advanced communications test techniques to successfully support the Military's Tactical Communications requirements in the following areas; conventional ground radio systems, SINCGARS, Have Quick, Special Tactics, Life Support, Airborne Communications and Foreign Military requirements.

In the current conditions experienced in a tactical battlefield environment, frequency-hopping communications, beacons and position location have become a necessity. With the need to transmit not only voice but also data and position information, a reliable communications link is of paramount importance. In hostile conditions, enemy jamming has become a primary tool to disrupt or disable Communications, Command, Control and Computer (C4). The new frequency hopping and multi-mission transceiver systems, with their ability to encode, interleave, error correct and act as a beacon/transponder capable of supplying ranging and personnel identification information provide effective countermeasures with low probability of intercept.

With this philosophy in place, IFR Americas, Inc. Aerospace & Defense Group has provided the military with the proper test equipment to verify the reliability and functionality of all aspects of these communications devices. The frequency agile AN/GRM-122 and its next generation derivatives have proven to be the only test solution capable of providing this level of operational verification and maintainability assurance. By its acceptance in the US Army, US Marine Corps, US Navy and US Air Force, these test systems have proven their ability to provide our customers with reliable field communications.

The Radio Communications Test System (RCTS-XXX) is made up of the TS-4317-X Frequency Agile Communications Test Set and the J-4843A Appliqué Unit with the PL-XXXX Radio Personality Module (RPM-00X). The TS-4317-X has been designed to work with an appliqué unit as a natural extension of its operation. The division of functions between the two units is based on the TS-4317-X providing all basic measurement and stimulus functions associated with the testing and servicing of communications equipment. The appliqué unit is responsible for any special UUT input and output signal routing or conditioning and handles all unique controls and measurements that a specific UUT may require.

By utilizing the general purpose, frequency agile, radio communications Test Set (TS-4317-X) as the host platform, two possible approaches may be utilized to support the maintenance of Line Repairable Units (LRUs). Approach one (1) utilizes custom Radio Test Applications Programs stored in the Test Set's flash memory for verification testing and/or fault detection and repair of the military communications systems. These Test Programs are typically utilized for less complex transceivers (single channel, non-frequency hopping) or when minimal performance testing (RF only) is all that is required. Approach two (2) utilizes the J-4843A generic appliqué housing with its associated Radio Personality Modules (RPMs) to provide a cost effective, configurable approach to complete pin-to-pin functional communications systems testing. This approach is typically utilized for more complex systems test requirements where multiple LRUs (Radios, RF Amplifier, Vehicular Adapter, Fill Device, Battery Box, etc.) are required to be tested in all modes of operation. This approach utilizes custom hardware (contained in the RPM) to provide the necessary stimulus

Defense Test Systems

and response routing for complete pin-to-pin functional testing. This approach is also utilized for complex modulation schemes (TDMA, CDMA, Spread Spectrum, Frequency Hopping, etc.) and where complex baseband processing is required.

The Radio Communications Test System (RCTS-XXX) provides "State of the Art" capabilities for semi-automated testing of multiple LRUs from a single, portable platform. This results in more complete testing of the LRUs which can now be accomplished in less time than in the past. Typical field results demonstrate test time reductions on complex LRUs from 4 to 6 hours to less than 25 minutes and for simpler radios this time is reduced to less than 10 minutes. In addition, with the testing being performed in a semi-automated environment, there has been a significant reduction in problems associated with human error. With these enhanced capabilities technicians are able to fully test any remote interfaces (2-wire, 6-wire, RS-232, RS-422, MIL-STD-1553, etc.) and then utilize this same interface to remotely control the Unit Under Test (UUT). Electronic recording of test results is available, providing permanent records of LRU performance. Hardcopy printouts may be supplied with the faulty LRU being evacuated to a higher maintenance level.

Defense Product Configurations

Commercial Model	*Military Model*	*Military NSN #*
Systems		
1600/1601	AN/GRM-114B	6625-01-309-2824
RCTS-001	AN/GRM-122	6625-01-432-8369
RCTS-002	AN/ARM-204	6625-01-454-4611BY
RCTS-003	TS-4317-3/J-1603	6625-01-457-1265
RCTS-004	TBD	N/A
RCTS-005	TBD	N/A
Communications Test Sets		
FM/AM-1600	TS-4317/GRM	6625-01-309-2825
FM/AM-1600-1	TS-4317-1	6625-01-389-3546
FM/AM-1600-2	TS-4317-2	N/A
FM/AM-1600-3	TS-4317-3	6625-01-422-2485
FM/AM-1900-M	TS-4317ATBD	
Appliqué Units		
J-1601	J-4843/GRM-114B	6625-01-309-2827
J-1601A	J-4843A/GRM	6625-01-432-8368
J-1603	J-1603	6625-01-421-8180
Radio Personality Modules		
RPM-001	PL-1536/GRM	6625-01-432-3819
RPM-002	PL-1538/ARM-204	6625-01-454-4273BY
RPM-003	TBD	TBD
RPM-004	TBD	TBD
RPM-005	TBD	TBD
Accessories		
PS-001	PP-8468/ARM-204	6625-01-454-4265BY

Radio Personality Modules (Current and Planned)

RPM	*Status*	*Application*	*Radio Systems Supported*	
RPM-001	Available Now	SINCGARS (Army/Marines/ITT)	PRC-119 VRC-87 VRC-88 VRC-89 VRC-90 VRC-91 VRC-92 ARC-201	Manpack Vehicular Short Range Vehicular Short Range Dismountable Vehicular Long/Short Range Vehicular Long Range Vehicular Long Range Dismountable Vehicular Dual Long Range Airborne SINCGARS
RPM-002	Available Now	RSC Tactical (Air Force/RSC)	ARC-164 ARC-186 ARC-187 ARC-222 ARS (Air Force) PRC-113 VRC-83 MXF-4xx MXF-6xx	UHF/Have Quick VHF/UHF SATCOM SINCG Manpack Have Quick PRC-113 HQ Vehicular Adapter (PSC-5, 430, 440, 483, 484, 460) (626E, 626F)
RPM-003	Available Now	Life Support (Special Forces)	PRC-112 PRC-90 PRC-90-2 URT-33 CSEL (Future)	Transceiver w/DME Transceiver/Beacon Transceiver/Beacon Beacon Combat Survivor Evasion Locator
RPM-004	Available in 1998	IRIS Canada (CDC/DND)	CNR(P) LAR UDR A/G/A CNR(HF)	(BCC 68 Jaguar Type) (PRC-521 Type) (Supported by RPM-002) (Supported by TS Application Program)
RPM-005	Planned for 1999	BOWMAN UK (Archer Comm.)	HF Vehicular HF Manpack Personal Radio VHF Radio System Tactical Gnd/Air	 (Handheld UHF Portable) (Supported by RPM-001) (Supported by RPM-002)
RPM-006	Available in 1999	EPLRS	RT-1719 RT-1720 VECP Radio URO EPA	MIL-STD-1553 Air Force only ADZI X.25 Interface Production Model Remote Control EPLRS Power Adapter
RPM-007	Planned for 1999	Racal Tactical (US) (Racal Comm Inc.)	MBITR PRC-139 PRC-6725E MSHR Leprechaun LWSR	Multiband Inter-Team Radio Scope Shield II Enhanced Tactical Handheld Radio Miniature Secure Handheld Radio Secure, Anti-Jam Handheld Land Warrior Squad Radio
RPM-008	Planned for 1999	Racal Tactical (UK) (Racal Comm Ltd.)	Jaguar Panther Cougar PRM4700	Frequency Hopping Radio Family Frequency Hopping Radio Family Frequency Hopping Radio Family Tactical VHF FM Transceiver
RPM-009	Requirement Under Review	R/C Tactical (Rockwell/Collins)	ARC-182 ARC-186 ARC-210 ARC-217 ARC-220	VHF/UHF AM/FM VHF Transceiver VHF/UHF AM/FM Airborne HF HF NOE Airborne Comm Sys
RPM-010	Available in 1999	IRIS Canada - SHF (CDC/DND)	MH-344 BCU	SHF Band IV Radio Band V Converter Unit
RPM-011	Requirement Under Review	Harris Tactical(Harris)	PRC-117 PRC-138 VRC-94 RF-5000 Falcon II	VHF/UHF Manpack HF/SSB Manpack VHF/FM Vehicular Falcon HF/SSB Next Generation

RCTS-001 Radio Test Systems

RCTS-001 Radio Test System

The RCTS-001 (AN/GRM-122) is the new radio test system that is currently being fielded for use by the military to verify, test and repair the SINCGARS radios and their associated LRUs. The RCTS-001 (AN/GRM-122) SINCGARS Test System is made up of the general purpose FM/AM-1600S (TS-4317-X) Frequency Agile Communication Test Set in association with the J-1601A (J-4843A/GRM) Generic Appliqué Housing with RPM-001 (PL-1536/GRM) SINCGARS appliqué in support of SINCGARS Ground and Airborne radio system verification, testing and repair. RPM-001 provides the interface functions necessary for level translation, signal conditioning, data communication and data processing between the FM/AM-1600S and the SINCGARS radios. Through this interface the radio's receiver and transmitter functions can be fully exercised and tested in both single channel mode and frequency hopping mode per pre-defined test criteria. All SINCGARS LRUs listed below (Reference detailed list opposite) can be verified, tested and repaired when used in conjunction with the ON-373A (Cables, Repair Manuals, Special Tools, etc).

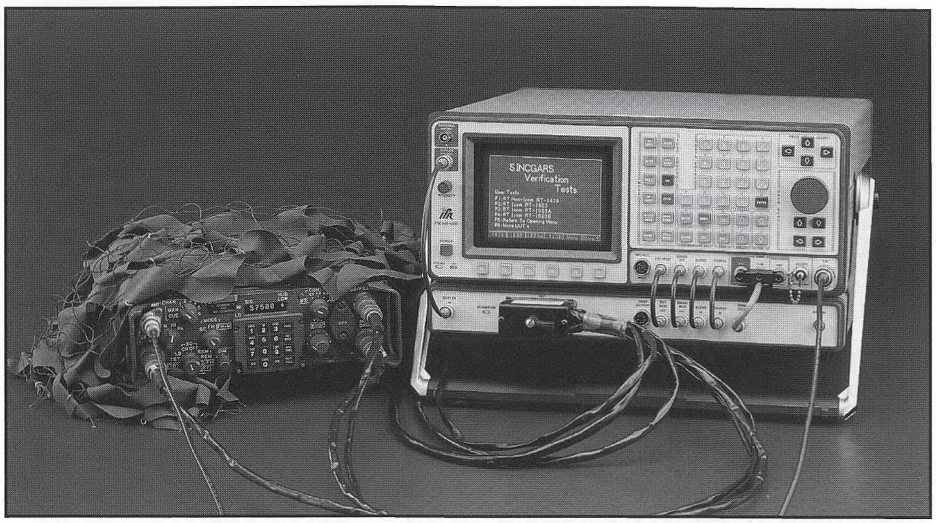
- Ground Radios
- Airborne Radios
- Remote Controls
- Fill Devices
- Control Monitors
- RF Amplifiers
- Battery Box
- Battery Tray
- Loudspeaker
- Dual RF PA
- Single Radio Mount
- Amplifier Adapters
- Remote Control Unit
- Y Cable
- FH Mux

RPM-001 (PL-1536) SINCGARS RPM Accessories

IFR Accessory Number	*Equivalent Military Model No*	*Description*
J-1601AR	(J-4843AR)	J-4843 to J-4843A/PL-1536 upgrade Kit
AC8340		Antenna Matching Network for RPM-001
TF-119A	(TF-119A)	BIT Test Adapter for RPM-001
LK-122		Lockout Key for RPM-001
ON-373A	(ON-373A)	SINCGARS Maintenance Group - SIP
ON-373UG		SINCGARS Maintenance Group Upgrade (ON-373 to ON-373A)
ON-AVIM		SINCGARS Maintenance Group - Airborne

RPM-001 (PL-1536) SINCGARS (SIP) LRUs Supported

The RPM-001 (PL1536) SINCGARS (SIP) Radio Personality Module modelled after the J-4843/GRM-114B and is used with the general purpose TS-4317-X to support all current and future SINCGARS Airborne and Ground radio system verification, testing and repair. The J-1601A and RPM-001 are the first unit to use the "Plug and Play" approach to LRU verification, testing and repair. This approach uses the front panel removable/replaceable Radio Personality Module (RPM) to allow ease of system verification, testing and repair of the LRU configurations listed below.



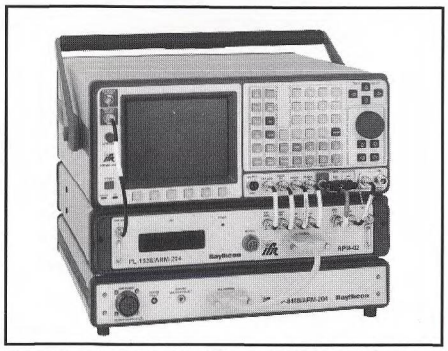
RPM-001 (PL-1536) SINCGARS (SIP) LRUS Supported

LRU	*G/A 1*	*DESCRIPTION*	*VERSION*	*MANUFACTURER*
RT-1439	G	RT	Non-ICOM	ITT
RT-1523	G	RT	ICOM	ITT
RT-1523A	G	RT	ICOM	GDLS
RT-1523B	G	RT	ICOM PI/Cosite	ITT
RT-1523C	G	RT	ICOM SIP	ITT
RT-1523D	G	RT	ICOM SIP	GDLS
RT-1476	A	RT		ITT
RT-1476A	A	RT	ICOM Capable	ITT
RT-1476C	A	RT	PI	ITT
RT-1477	A	RT Remote		ITT
RT-1477A	A	RT Remote	ICOM Capable	ITT
RT-1477C	A	RT Remote	PI	ITT
RT-1478	A	RT 1553		ITT
RT-1478A	A	RT 1553	ICOM Capable	ITT
RT-1478C	A	RT 1553	PI	ITT
RT-1478D	A	RT 1553	SIP	ITT
C-11466	A	Remote control		ITT
C-11466A	A	Remote control	ICOM	ITT
MX-10579	G	Fill Device	Non-ICOM	ITT
MX-18290	G	Fill Device	ICOM	ITT
C-11291	G	Control-Monitor		ITT
C-11291A	G	Control-Monitor		GDLS
AM-7238	G	RF Amplifier		ITT
AM-7238A	G	RF Amplifier		GDLS
AM-7238B	G	RF Amplifier	"Bathtub"	ITT
CY-8664	G	Battery Tray		ITT
CY-8523A	G	Battery Box		ITT
CY-8523B	G	Battery Box		GDLS
CY-8523C	G	Battery Box		(TBD)
LS-671	G	Loudspeaker		ITT
MT-6353	G	Dual RF PA		ITT
MX-10862	G	Single Radio Mount		ITT
AM-7239	G	Amplifier Adapter		ITT
AM-7239A	G	Amplifier Adapter		GDLS
AM-7239B	G	Amplifier Adapter	Dual Xmit	ITT
AM-7239C	G	Amplifier Adapter	SIP	ITT
AM-7239D	G	Amplifier Adapter	SIP	GDLS
C-11561	G	Remote Control Unit		ITT
CX-13417	G	Y Cable		ITT
TD-1456	G	FH Mux		XETRON

Note 1: G/A Denotes Aircraft (A) or Ground (G) LRU Type.

RCTS-002 Radio Test Set

RCTS-002 Radio Test System



TS-4317-1 & RSC/Air Force SINCGARS Appliqué (J-4843A/RPM-002/PS-001) (AN/ARM-204)

The RCTS-002 Radio Test System is made up of the general purpose TS-4317-1 and the J-4843A with the PL-1538 and PP-8468. The RCTS-002 is a self-contained, transportable, semi-automated Test System that may be used for a "go/no-go" evaluation, full functional testing, and troubleshooting. The basic Test System provides the capability to test in the VHF, UHF, and HF frequency bands; AM, FM, and FSK modulation types; Have Quick II and SINCGARS waveforms; MIL-STD-1553 interfaces; and SATCOM operation. Testing of additional radio sets in the VHF, UHF, and HF bands may be added to the RCTS-002 by simple replacement of the "plug and play" module. Future expansions may include SATURN and frequency agile HF. All LRUs (Reference detailed list opposite) listed below can be verified, tested and repaired when used in conjunction with the maintenance group (Cables, Repair Manuals, Special Tools, etc.) supplied by Hughes.

Ground Radios
Airborne Radios
Handheld Radios
Remote Controls
RF Amplifiers
Signal Distribution Unit

RPM-002 (PL-1538) RSC/AIRFORCE RPM Accessories

IFR Accessory Number	*Corresponding Military No*	*Description*
TF-204A	(TF-204A)	BIT Test Adapter for RPM-002
LK-204		Lockout Key for RPM-002
ON-RSC		Maintenance Group for RPM-002 (Custom Configured)

The RPM-002 Radio Personality Module is currently used with the generic appliqué unit J-1601A. The J-1601A and RPM-002 utilizes the "Plug & Play" approach to LRU verification, testing and repair.

RPM-002 (PL-1538) RSC/Air Force LRUs Supported

RADIO SYSTEM	*LRU*	*G/A 1*	*DESCRIPTION*	*VERSION*	*MANUFACTURER*
ARC-222	RT-1704	A	RT SINCGARS	Remote (1553 capable)	Raytheon Systems
	C-12319	A	Control Set		Raytheon Systems
	MXF-258B	A	Control Set		Raytheon Systems
	MXF-258C	A	Control Set		Raytheon Systems
ARC-164	RT-1145B	A	RT UHF-AM	Remote	Raytheon Systems
	RT-1145C	A	RT UHF-AM	Remote HQ I	Raytheon Systems
	RT-1145F	A	RT UHF-AM	Remote HQ I (1553)	Raytheon Systems
	RT-1167B	A	RT UHF-AM	Panel (ARMY)	Raytheon Systems
	RT-1167C	A	RT UHF-AM	Panel (ARMY) HQ I	Raytheon Systems
	RT-1168B	A	RT UHF-AM	Panel (USAF)	Raytheon Systems
	RT-1168C	A	RT UHF-AM	Panel (USAF) HQ I	Raytheon Systems
	RT-1504	A	RT UHF-AM	Remote HQ II	Raytheon Systems
	RT-1505	A	RT UHF-AM	Panel (USAF) HQ II	Raytheon Systems
	RT-1505A	A	RT UHF-AM	Panel (USAF) HQ II (LCD)	Raytheon Systems
	RT-1518	A	RT UHF-AM	Panel (Army) HQ II	Raytheon Systems
	RT-1518C	A	RT UHF-AM	Panel (Army) HQ II (LCD)	Raytheon Systems
	RT-1614	A	RT UHF-AM	Remote Mount - 1553	Raytheon Systems
	C-9533	A	Control Set	Non-HQ	Raytheon Systems
	C-9533A	A	Control Set	HQ (Fill Port)	Raytheon Systems
	C-9680	A	Control Set	Non-HQ	Raytheon Systems
	C-9680A	A	Control Set	HQ	Raytheon Systems
	C-9682	A	Control Set	Non-HQ	Raytheon Systems
	C-9682A	A	Control Set	HQ	Raytheon Systems
	C-11718	A	Control Set	HQ (LCD Front Panel)	Raytheon Systems
	C-11719	A	Control Set	HQ (LCD Front Panel)	Raytheon Systems
	C-11721	A	Control Set	HQ (LCD Front Panel)	Raytheon Systems
	C-11815	A	Control Set	HQ (LCD Front Panel)	Raytheon Systems
	C-12046	A	Control Set	HQ (LCD Front Panel)	Raytheon Systems
	ID-1961B	A	Indicator		Raytheon Systems
	ID-1961C	A	Indicator		Raytheon Systems
	ID-2244	A	Indicator		Raytheon Systems
ARC-187	RT-1571	A	RT UHF	SATCOM/LOS	Raytheon Systems
	C-11950	A	Control Set	25 kHz Channels	Raytheon Systems
	C-12391	A	Control Set	5 & 25 kHz Channels	Raytheon Systems
	AM-7373	A	Audio Amp	LINK 11 Interface	Raytheon Systems
PRC-113	RT-1319	G	RT	Manpack	Raytheon Systems
	RT-1319B	G	RT	Manpack HQ	Raytheon Systems
VRC-83	VRC-83	G	RT VHF/UHF	Vehicular Transceiver	Raytheon Systems
	AM-7176	G	RF Amp	Non-HQ	Raytheon Systems
	AM-7176A	G	RF Amp	HQ	Raytheon Systems
MXF-4XX	PSC-5	G	RT UHF/VHF	LOS/SATCOM (EMUT)	Raytheon Systems
	MXF-430 (T)	A	RT UHF/VHF	LOS/HQII/GPS	Raytheon Systems
	MXF-440	A	RT UHF/VHF	ARC-187 Replacement	Raytheon Systems
	MXF-483	A	RT UHF/VHF	ARC-164 Replacement	Raytheon Systems
	MXF-484	A	RT UHF/VHF	ARC-164 Replacement	Raytheon Systems
	MXF-460	A	RT UHF/VHF	LOS/SATCOM	Raytheon Systems
	TAC G/A (UK)	A	RT UHF/VHF	Stripped down 430	Raytheon Systems
MXF-6XX	MXF-626E	A	ARC-222 type	Guard Receiver	Raytheon Systems
	MXF-626F	A	ARC-222 type	High VHF/ Maritime band	Raytheon Systems
GRC	GRC RSC	G	Control Set	Remote Control	Raytheon Systems
	GRC SDU	G		Signal Distribution Unit	Raytheon Systems
General	MXF-243	A	Remote Control	HQ Capable	Raytheon Systems
	MXF-243A	A	Remote Control	HQ Capable	Raytheon Systems
	MXF-266	A	Remote Control		Raytheon Systems
	C-12435	A	Control Set	ARC-187 1553 Capable	Raytheon Systems
ARC-186	RT-1299	A	RT	Airborne VHF Transceiver	Rockwell/Collins
	RT-1300	A	RT		Rockwell/Collins
	RT-1300A	A	RT		Rockwell/Collins
	RT-1300B	A	RT		Rockwell/Collins
	RT-1300C	A	RT		Rockwell/Collins
	RT-1354	A	RT		Rockwell/Collins
	C-11029	A	Remote Control		Rockwell/Collins
	C-10604	A	Remote Control		Rockwell/Collins
	C-10605	A	Remote Control		Rockwell/Collins
	C-10606	A	Remote Control		Rockwell/Collins
	MT-6050	A	Mounting Base		Rockwell/Collins

Note 1: G/A Denotes Aircraft (A) or Ground (G) LRU Type

RCTS-003/004 Radio Test Systems & Accessories

RCTS-003 Radio Test Systems

The RCTS-003 Test System is the current generation self-contained, transportable, semi-automated Radio Test System that is currently fielded for use by the US Armed Forces. The instrument is used for operational verification testing and/or repairs of Life Support radio systems. Full functional testing of all operational modes are available: single channel voice, beacon and DME transponder testing. The RCTS-003 Test System consists of the FM/AM-1600-3 (TS-4317-3) Frequency Agile Communications Test Set and the J-1601A (J-4843A) Generic Appliqué Housing with the RPM-003 (PL-xxxx) Life Support Radio Personality Module (RPM). All Life Support LRUs listed below can be verified, tested and repaired when used in conjunction with the maintenance group (Cables, Repair Manuals, Special Tools, etc.) supplied by IFR.

PRC-112	PRC-90
PRC-112A	PRC-90-1
PRC-112B	URT-33

Future expansion may include an upgrade to support for the new Combat Survivor Evader Locator (CSEL) radio.

PM-003 LIFE SUPPORT RPM ACCESSORIES

RPM-003 Kit	Life Support Kit (PRC-112, PRC-90, URT-33)
PRC-112 Kit	Life Support Kit (PRC-112 Only)
PRC-90 Kit	Life Support Kit (PRC-90 Family Only)
URT-33 Kit	Life Support Kit (URT-33 Only)
Accessory Bag for Cables and Adapters	

RPM-003 LIFE SUPPORT LRUs SUPPORTED

The RPM-003 Life Support application unit is used with the general purpose TS-4317-3 and the generic appliqué unit J-1601A. The J-1601A and RPM-003 utilizes the "Plug & Play" approach to LRU verification, testing and repair.

LRU	*G/A 1*	*DESCRIPTION*	*MANUFACTURER*
PRC-112	G/A	Multimission Transceiver w/DME Transponder	Motorola Inc.
PRC-90	G/A	Emergency Locator Transceiver	Oklahoma Aerotronics
PRC-90-2	G/A	Aircrew Survival Radio	Dowty Avionics
URT-33	G/A	VHF Beacon	

Note 1: G/A Denotes Aircraft (A) or Ground (G) LRU Type.

RCTS-004 Radio Test Systems

The RCTS-004 is the radio test system that is currently used by the Canadian military to verify, test and repair the Canadian IRIS family of radios. The RCTS-004 Communications Test System is made up of the general purpose TS-4317-3 Frequency Agile Communications Test Set and the J-4843A Generic Appliqué Housing with RPM-004 and the PS-001 LRU Power Supply. The RCTS-004 is a self-contained, transportable, semi-automated Test System that may be used for a "go/no-go" evaluation, full functional testing, and troubleshooting. All LRUs listed below can be verified, tested and repaired when used in conjunction with the maintenance group (Cables, Repair Manuals, Special Tools, etc.) supplied by IFR.

CNR(P) Radio
CNR(P) VIU
LAR
UDR

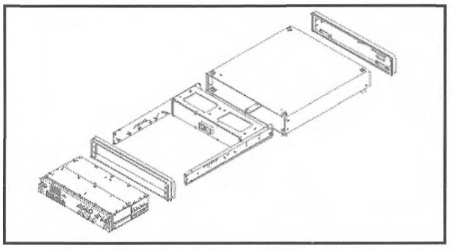
RPM-004 CANADA IRIS RPM ACCESSORIES

TF-400	BIT Test Adapter for RPM-004
LK-400	Lockout Key for RPM-004

RCTS Radio Test System Accessories

J-1601A (J-4843A) Generic Appliqué Unit

The J-1601A is a generic appliqué housing, configurable via different Radio Personality Modules (RPMs) for testing Military Communications devices. The J-1601A, when used in conjunction with a RPM, expands on the features and functions of the TS-4317-X. The J-1601A generic housing will support all current and future RPMs. This includes support for all Military Tactical Communications requirements in the following areas; Conventional Ground Radio Systems, SINCGARS, Have Quick, Special Tactics, Life Support, Airborne Communications and Foreign Military requirements. IFR Americas, Inc. works very closely with the major radio manufacturers and the military to assure support for communications systems concurrently with fielding plans.



Exploded View of the Applique Housing With RPM in Front

PS-001 Generic LRU Power Supply

The PS-001 is capable of connecting to the bottom of an RCTS configuration to supply primary power for the Units Under Test (UUT) and in some cases to the J-Box and RPM. The PS-001 is capable of supplying programmable voltage levels from 3 to 30 Volts at up to 20 Amps. Additional voltages are provided for secondary needs.

PS-001 Power Supply Configurations

Supply Output	*Output Voltage (VDC)*	*Line Regulation %*	*Total Regulation %*	*Peak Ripple (mV)*	*Minimum Load(A)*	*Typical Load(A)*	*Maximum Load(A)*
Switched Outputs:							
1	3.00 - 14.99	± 2.0 (NL--FL)	± 7 (NL--FL)	<220	0.8	N/A	10
1	15.00 - 33.00	± 2.0 (NL--FL)	± 7 (NL--FL)	<220	0.8	N/A	22
2	2.50 - 5.00	± 8.0 (NL--FL)	± 12 (NL--FL)	<70	0.8	N/A	2
3	2.00 - 28.00	± 8.0 (NL--FL)	± 12 (NL--FL)	<70	0.8	N/A	1
4	6	± 2.0 (NL--FL)	± 4 (NL--FL)	<70	0.5	0.5	1
5	12	± 2.0 (NL--FL)	± 10 (NL--FL)	<70	0.2	0.35	1
Continuous Outputs:							
6	24	± 2.0 (10%FL--FL)	±8(10%FL--FL)	<70	0.1	1.5	1.8
7	5	± 2.0 (10%FL--FL)	±4(10%FL--FL)	<70	2.2	3	4
8	15	± 2.0 (10%FL--FL)	±4(10%FL--FL)	<70	0.75	1	2
9	15	± 2.0 (10%FL--FL)	±4(10%FL--FL)	<70	0.075	0.1	0.5



Signal Generators & Analyzers

IFR has a comprehensive range of signal generators covering frequencies from 9 kHz to 5.4 GHz. The range offers performance characteristics to suit every application, from research and development through production test to routine service and maintenance.

Careful attention to design and innovation has produced a range of signal generators with a unique combination of high performance and low cost. Coupled with a wide range of options and accessories IFR can provide a tailor made signal generation solution to meet any requirement.

SIGNAL GENERATORS

2023A/B, 2025 — 2.2
9 kHz to 2.51 GHz

2023A/B, 2025 — 2.6
Option 12 SINAD

2026 — 2.8
10 kHz to 2.4 GHz MultiSource

2026Q — 2.12
CDMA Interferer MultiSource

2030 series — 2.15
10 kHz to 5.4 GHz

2040 series — 2.20
10 kHz to 5.4 GHz Low Noise

2050 series — 2.25
10 kHz to 5.4 GHz Digital and Vector

2050T — 2.29
Digital and Vector for TETRA

2030 series Option 5 — 2.33
GSM PCN PCS

2030/40/50 series Option 8 — 2.35
RF Profile and Complex Sweep

2030 series Option 9 — 2.37
Internal Pulse Generator

(For 2030 Avionics options see section 3.1)

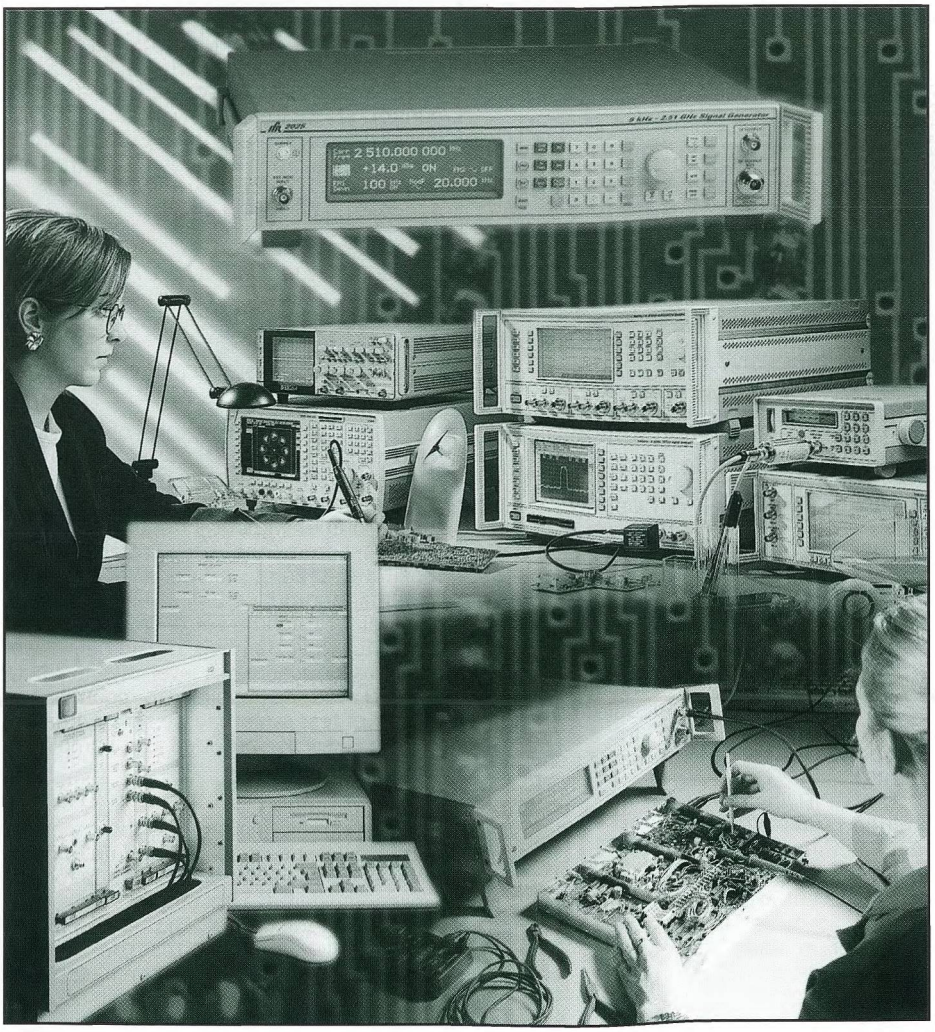
3002 — 2.39
VXI Signal Generator

TEM Test Cell — 2.42

Accessories — 2.43

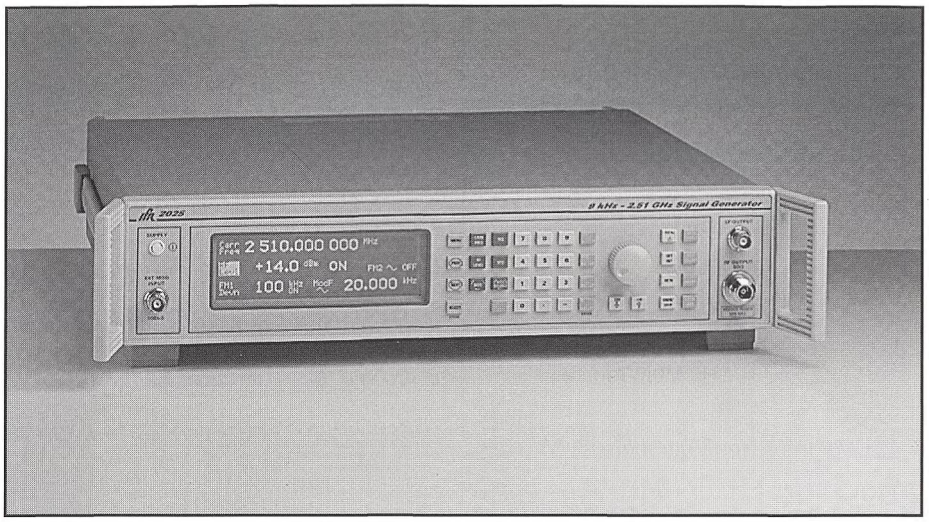
SIGNAL ANALYZERS

2310 — 2.44
TETRA Signal Analyzer



2023A/B, 2025
9 kHz to 1.2/2.05/2.51 GHz Signal Generators

With its level of performance, this compact general purpose range of signal generators delivers outstanding value for money



- Wide frequency coverage:-
  9 kHz to 1.2 GHz (2023A)
  9 kHz to 2.05 GHz (2023B)
  9 kHz to 2.51 GHz (2025)
- Excellent spectral purity
- Linear and logarithmic sweep mode
- RPP to 50 W
- Sine, triangular and square wave two tone modulation source
- RS-232 and GPIB control
- Comprehensive modulation:-
  AM, FM, ∅M, Pulse & FSK
- 3.9 kHz Bessel filtered FSK
- Optional +25 dBm RF output
- SINAD measurement option

The 2023A/B and 2025 signal generators are portable and lightweight, offering carrier frequencies from 9 kHz to 1.2 GHz (2023A), 9 kHz to 2.05 GHz (2023B) and 9 kHz to 2.51 GHz (2025) with a wide choice of modulation modes.

The instruments are suitable for a wide range of applications in laboratory, production, and maintenance environments.

The GPIB facility allows the unit to be included in ATE systems for faster manufacturing throughput.

An RS-232 interface is provided with a command set in common with the GPIB to simplify remote control of the signal generator in basic test systems or via a modem.

Operation

Front panel control is achieved through a flexible combination of keyboard selection, cursor selection and a rotary control in conjunction with a clear and intuitive menu presentation on a bright panel display. This ensures the instrument can be set up into any desired mode of operation quickly and simply.

Frequency Selection

Frequency resolution of 1 Hz across the complete frequency range of 1.2 GHz, 2.05 GHz or 2.51 GHz ensures adequate resolution to characterize narrow band communication systems and components.

RF Output

Peak RF output levels of between +13 dBm and -140 dBm can be set accurately with a resolution of 0.1 dB. An attenuator hold function allows control of the RF output without introducing RF level dropouts from the step attenuator to facilitate testing of receiver squelch systems, and during EMI investigations. A RF level limit can be set to limit the output power to avoid damage to external, power sensitive devices. RF level offsets up to ±5 dB can be applied to counter the effects of test system losses etc. A carrier ON/OFF key is provided to completely disable the output.

50 W Protection

An electronic trip protects the generator output against reverse power of up to 50 W from a source with a VSWR's of up to 5:1, preventing damage to output circuits if a RF transmitter or DC power supply is accidentally applied to the output connector. This feature contributes to long service life and low cost of ownership.

Size and Weight

The 2023A/B and 2025 occupy a full rack width, but only 2 units high to minimize rack occupancy in manufacturing and test systems and for instrument stacks in benchtop use.

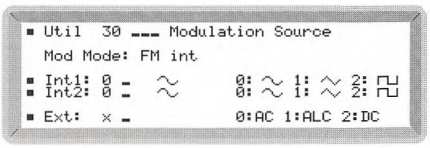
The low weight of the product makes it ideal for portable applications within maintenance environments.

Spectral Purity

Measurement of receiver selectivity and ultimate signal to noise ratio requires good spectral purity. The 2023A/B and 2025 have a low residual FM of typically 3 Hz and a commendable sideband noise of typically -121 dBc/Hz at 1 GHz, (20 kHz offset) to allow demanding measurements to be made at an affordable cost. Good close in phase noise is also achieved with results at 100 Hz offsets typically <-85 dBc.

Modulation

Comprehensive amplitude, frequency, phase, FSK and pulse modulation facilities are provided for testing all types of receivers. A MOD ON/OFF key simplifies the testing of signal to noise ratio.



Amplitude and Pulse Modulation

Amplitude modulation with a 1 dB bandwidth of 30 kHz and modulation depths of up to 99.9% with a resolution of 0.1% ensures the generator is suitable for testing AM systems and undertaking EMC immunity measurements. The standard pulse modulation facility has an on/off ratio

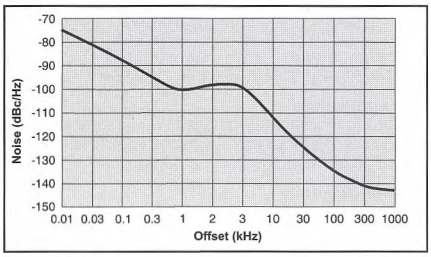
of better than 40 dB and a rise/fall time of less than 10 µs enabling characterization of TDMA or TDD bursts in RF amplifiers and modules. The internal square wave modulation source may be used to self pulse modulate the generator for use in EMI applications.

An optional Fast Pulse modulator improves the on/off ratio to typically >80 dB with rise and fall times of <20 ns.

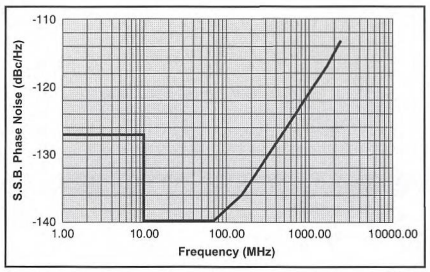
Frequency and Phase Modulation

With a 1 dB FM bandwidth of 275 kHz and a deviation range of 0 to 12.8 MHz, the 2023A/B and 2025 signal generators offer a wide range frequency modulation capability. AC or DC coupled FM can be selected with very low carrier frequency error and drift in the DC coupled mode ideal for testing paging and DCS (Digitally Coded Squelch) equipment accurately.

The phase modulation facility is ideal for testing narrow band analog radios with a deviation range of 0 to 10 radians and a 3 dB bandwidth up to 10 kHz.



Typical SSB Phase noise at 1 GHz (OCXO fitted)



Typical SSB Phase noise at 20 kHz offset

FSK

The generation of 2 level and 4 level FSK signals is possible directly from external logic inputs. The TTL data is automatically filtered using a 8th Order 3.9 kHz Bessel filter to reduce spectral spreading, as required by both ERMES and FLEX™ paging systems. The required FM deviation is set from the front panel.

Modulation Oscillator

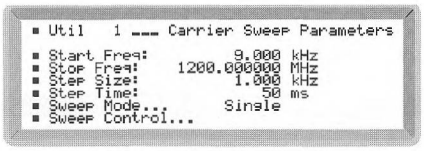
An internal modulation oscillator is provided which is capable of generating one or two tones in the frequency range of 0.01 Hz to 20 kHz. In addition to a sine wave output, a triangular or square wave is provided. Internal and external modulation sources may be combined to produce more complex modulation types.

Sweep

The sweep facility of the 2023A/B and 2025 offers linear and logarithmic sweeps. The user can program all sweep parameters including start and stop frequency, size of step, time per step and a percentage increment in the case of logarithmic sweep.

The sweep can be paused and the frequency varied by the rotary control to investigate a problem area.

The sweep can be initiated from the keyboard or by a external trigger input and can be set to single, continuous, stepped or start/stop operation.



The frequency sweep facility is particularly well suited to EMI testing. During a frequency sweep, the RF level can be altered using the rotary control to manually correct the level at the output of amplifiers. The square wave modulation source allows the generation of square wave amplitude modulation to simulate the effect of TDMA bursts from communication systems on devices being tested for EMI.

The optional high RF output power to +25 dBm can eliminate the need for external amplifiers when using small test cells.

Instrument Stores

The 2023A/B and 2025 signal generators provide extensive storage facilities for simplifying repetitive tests. Up to 100 carrier frequency values and 100 complete instrument settings can be saved to non-volatile stores. Storage is achieved without the need for batteries and so avoids problems of periodic replacement.

A software protection system ensures that individual stored settings cannot be accidentally overwritten.

A further 100 volatile stores are available for complete instrument settings. Their contents can be downloaded over GPIB and then recalled by store number to reduce the time overhead introduced by the handling of the GPIB protocol.

Sequencing

A software facility allows 9 sequences of stored instrument settings to be defined. The incrementing facilities can then be used to cycle through the settings in manually operated test systems or be operated via an external trigger.

Calibration Data

All alignment data, including the internal frequency standard adjustment, is digitally derived and realignment can be undertaken without removal of external covers, by protected front panel functions or via the GPIB. Use of digitally stored realignment eliminates the use of mechanical adjusters to minimize long term drift and vulnerability to mechanical shock.

Status information is stored, including an identity string (type and serial number), choice of internal or external standard and GPIB address.

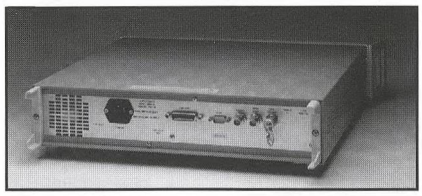
An elapsed time facility allows the monitoring of the number of hours the product has been in use. A recommended calibration interval of 2 years helps towards low cost of ownership.

Programming

A GPIB interface is fitted as standard with all functions controllable over the bus. The protocol and syntax of GPIB commands are designed in accordance with IEEE 488.2 standard to simplify the generation of ATE programs.

In talk mode, the current settings, instrument status and the identity string can be read.

A RS-232 interface is fitted as standard with a common command set to GPIB commands. RS-232 control is particularly suitable for use with simple external controllers or RF modems when the instrument is being used in a remote location.



Memory Cloning

The stored settings in one signal generator can be transferred to others without the use of an external controller using the direct interconnection of GPIB or RS-232 interfaces. This facility is particularly useful for duplicating test set ups on manual production lines.

OPTIONS

The standard features of the signal generator can be enhanced by taking advantage of the various options available.

No Attenuator Option

This option reduces the instrument cost by deleting the internal attenuator. An RF output range from -2 dBm to +15 dBm is provided and is a very economic solution for applications requiring a local oscillator.

High Power

A high power option is available which extends the RF output up to +25 dBm ideal for use as a local oscillator or for testing passive and active components.

SINAD Measurement

A fully independent high performance SINAD meter with selectable weighting filters can be fitted for receiver sensitivity measurements.

Fast Pulse Modulator

A pulse modulator suitable for generating fast pulses with high isolation for applications in radar and EMI.

High Stability Frequency Standard

An OCXO internal reference can replace the standard TCXO where improved frequency stability is required.

DC Operation

The DC supply option allows the signal generator to be used in vehicles, remote areas or where the integrity of the AC supply is not guaranteed.

2023A/B, 2025

Rear Panel Connectors

All front panel connectors may be removed and fitted to the rear panel for use in production racks.

Specification

General Description

The 2023A/B and 2025 cover the frequency range 9 kHz to 1.2 GHz, 2.05 GHz and 2.51 GHz respectively.
The RF output can be amplitude, frequency, phase or pulse modulated. An internal synthesized programmable AF source is capable of generating single or simultaneous two tone modulation.
GPIB and RS-232 are included as standard to enable remote control of all functions except the supply switch.

Carrier Frequency

Range
9 kHz to 1.2 GHz (2023A)
9 kHz to 2.05 GHz (2023B)
9 kHz to 2.51 GHz (2025)

Resolution
1 Hz

Accuracy
As frequency standard.

Phase incrementing
The carrier phase can be advanced or retarded in steps as low as 0.09° using the rotary control.

RF Output

Range
-140 dBm to +13 dBm, 0.1 dB resolution. When AM is selected, the maximum RF output level decreases linearly with increasing AM depth to +7 dBm at 99.9% depth.

RF Level Units
Units may be set to µV, mV, EMF or PD; dB relative to 1 µV 1 mV EMF or PD; or dBm. Conversion between dB and linear units may be achieved by pressing the appropriate units key (dB or V, mV, µV.) The output level can be normalized for 75 Ω operation with an impedance converter.

Level Accuracy(1)

Frequency	>-127 dBm	>-100 dBm	Temp Coefficient
9 kHz to 1.2 GHz	±0.8	±0.8	±0.02 dB/°C
1.2 GHz to 2.05 GHz	±1.4	±1.2	±0.03 dB/°C
2.05 GHz to 2.51 GHz	±1.6	±1.6	±0.03 dB/°C

(1) Over range +17°C to +27°C

Attenuator Hold
Selection of Attenuator hold provides for uncalibrated level reduction of at least 10 dB without the Mechanical Attenuator operating.

VSWR
For output levels less than -5 dBm, output VSWR is less than 1.3:1 for carrier frequencies up to 1.2 GHz and less than 1.5:1 for carrier frequencies up to 2.51 GHz.
For output levels greater than -5 dBm output VSWR is less than 1.5:1 for all carrier frequencies.

RF Output Connector
50 Ω type N connector to MIL 390123D.

Output Protection
Protected from a source of reverse power up to 50 W from 50 Ω or 25 W from a source VSWR of 5:1. Protection circuit can be reset from the front panel or via the GPIB/RS-232 interfaces.

Spectral Purity

At RF levels up to +7 dBm:

Harmonics
Typically better than -30 dBc for RF levels up to +7 dBm.
Typically better than -25 dBc for RF levels up to +13 dBm.

Non-Harmonics (for offsets >3 kHz)
Better than -70 dBc to 1 GHz, better than -64 dBc between 1 and 2.05 GHz better than -60 dBc above 2.05 GHz.

Residual FM (FM off)
Less than 4.5 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 1 GHz.

SSB Phase Noise
Better than -124 dBc/Hz at 20 kHz offset from a carrier frequency of 470 MHz, typically -121 dBc/Hz at 20 kHz offset from a carrier frequency of 1 GHz.

Carrier leakage
Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm diameter loop, 25 mm from the surface of the signal generator.

ΦM on AM
Typically 0.1 radians at 30% depth at 470 MHz.

Modulation Modes

Internal and external modulation can be simultaneously enabled to allow combined amplitude and frequency (or phase) modulation.
Pulse modulation can be used in combination with the other forms of modulation from an external pulse source.

Frequency Modulation

Resolution
1 Hz

Deviation

CW Range (MHz)	*Max Deviation (kHz)*
1200 - 2510	12800
600 - 1200	6400
300 - 600	3200
150 - 300	1600
75 - 150	800
37.5 - 75	400
18.75 - 37.5	200
0.009 - 18.75	100

Accuracy at 1 kHz
±4%

Bandwidth (1 dB)
DC to 275 kHz (DC coupled)
10 Hz to 275 kHz (AC coupled)
20 Hz to 275 kHz (AC coupled with ALC).

Group delay
Less than 5 µs to 100 kHz.

Carrier frequency offset (DC coupled)
Less than 1% of the set frequency deviation.

Distortion
<1% at 1 kHz rate for deviations up to 20% of max available deviation, typically 0.1% for deviations of 2% of max available deviation and <3% at max available deviation

Modulation source
Internal LF generator or external via front panel BNC.

FSK

Modes
2 level or 4 level FSK

Data source
External data connected to TRIGGER connector (2 level) or TRIGGER and PULSE connectors (4 level). Note with option 7 fitted, rear panel PULSE input is labelled FSK2.

Frequency shift
Settable up to ±100 kHz

Accuracy
As FM deviation accuracy.

Timing jitter
±3.2 µs

Filter
8th order Bessel, -3 dB at 3.9 kHz

Phase Modulation

Deviation
0 to 10 radians, 3 digits or 0.01 resolution.

Accuracy at 1 kHz
±4% of indicated deviation excluding residual phase modulation.

3 dB bandwidth
100 Hz to 10 kHz

Distortion
Less than 3% at 10 radians at 1 kHz modulation rate. Typically <0.5% for deviations up to 1 radian at 1 kHz

Modulation source
Internal LF generator or external via front panel BNC.

Amplitude Modulation

For carrier frequencies <500 MHz, useable to 2 GHz.

Range
0 to 99.9%, 0.1% resolution.

Accuracy
±5% of set depth at 1 kHz (at +17°C to 27°C ambient temperature), temperature coefficient <±0.02%/°C.

1 dB bandwidth
DC to 30 kHz (DC coupled)
10 Hz to 30 kHz (AC coupled)
20 Hz to 30 kHz (AC coupled with ALC)

Distortion
<2.5% at 1 kHz rate for modulation depths up to 80% and <1.5% at 1 kHz rate for modulation depths up to 30%.

Modulation source
Internal LF generator or external via front panel BNC.

Pulse Modulation

For Fast Pulse Modulator see options.

Frequency range
32 MHz to 2.51 GHz, useable to 10 MHz

RF output range
Maximum guaranteed output is reduced to +8 dBm. (+20 dBm or +14 dBm with high power option when pulse modulation is selected)

RF level accuracy
When pulse modulation is enabled, adds ±0.5 dB to the RF level accuracy specification.

On/off ratio
Better than 45 dB below 1.2 GHz, better than 40 dB above 1.2 GHz.

Rise and fall times
Less than 10 µs

Control
Pulse input is on a rear panel BNC with 10 kΩ nominal input impedance. A HCT logic 0 (0 V to 0.8 V) turns the carrier off, a HCT logic 1 (2.0 V to 5 V) turns the carrier on. Max safe input is ±15 V

Internal LF Generator

Frequency range
0.01 Hz to 20 kHz

Resolution
5 digit

Frequency accuracy
As frequency standard

Distortion
Less than 0.1% THD at 1 kHz

Waveforms
Sine wave to 20 kHz and a triangular or square wave to 3 kHz

Square wave jitter
<6.4 µs on any edge

Audio output
The modulation oscillator signal is available on a front panel BNC connector at a level of 2 V RMS EMF from a 600 Ω source impedance.

External Modulation

Input on the front panel via BNC connector. 1 V RMS (1.414 V pk) sine wave for set deviation. Input sensitivity may be optionally specified for 1 V pk (option 10). Input impedance is 100 kΩ nominal.

Modulation ALC

The external modulation input can be levelled by a peak levelling ALC system over the input voltage range of 0.5 V to 1.25 V RMS sine wave.
High and low indicators on the display indicate when the input is outside the levelling range.

Sweep Mode

Control parameters
Start and stop values of carrier frequency.

Linear sweep
Frequency step size of 1 Hz minimum.

Logarithmic sweep
Percentage increment of 0.01% to 50% in 0.01% steps.

Step time
50 ms to 10 s per step.

Trigger
A trigger input is available on a rear panel BNC connector and can be used for single, continuous, start/stop or single step mode.

Frequency Standard

TCXO
10 MHz

Temperature Stability
Better than ±5 in 10^7 over the operating range of 0 to 55°C.

Ageing rate
Less than ±1 in 10^6 per year

External input
Rear panel BNC connector accepts an external input of 1 MHz or 10 MHz at a level of 220 mV RMS to 1.8 V RMS into 1 kΩ.

Output
Rear panel BNC connector provides an output of 10 MHz at a nominal level of 2 V pk-pk into 50 Ω.

General

REMOTE CONTROL

GPIB
All functions except the supply switch are remotely programmable.

Capabilities
Designed in accordance with IEEE 488.2.
The GPIB interface complies with the following subsets as defined in IEEE standard 488.1:
SH1, AH1, T6, TEØ, L4, LEØ SR1, RL1, PP0, DC1, DT1, C0, E2

RS-232
All functions except the supply switch are remotely programmable.

Connector
9 way male D-type.

Bit rate
300 to 9600 bits/s

Handshake
Hardware: DTR, RTS, CTS and DSR
Software: XON and XOFF

Electrical
Interface to EIA-232-D

ELECTRO-MAGNETIC COMPATIBILITY
Conforms with European Directive 89/336/EEC and associated International Standards. Complies with the limits specified in the following standards:

EN55011	Class B CISPR II
EN50082-1	IEC 801-2,3,4
EN60555-2	IEC 555-2

SAFETY
Complies with IEC 1010-1, BS EN61010-1 class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

RATED RANGE OF USE
(Over which full specification is met)

Temperature
0 to 55°C

Humidity
Up to 93% at 40°C

Altitude
Up to 3050 m (10,000 ft)

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
-40°C to +71°C

Humidity
Up to 95% at 40°C

Altitude
Up to 4600 m (15,000 ft)

POWER REQUIREMENTS

AC Supply
90 to 132 V or 188 to 264 V
47 Hz to 63 Hz 175 VA maximum

CALIBRATION INTERVAL
2 years

DIMENSIONS AND WEIGHT
(over projections but excluding front panel handles)

Height	Width	Depth	Weight
107 mm	419 mm	440 mm	<8 kg

Options

NO ATTENUATOR
(cannot be specified with option 7 or option 3)
Omits the internal step attenuator. Specification as standard instrument with following exceptions:

RF output range
From -2 dBm to +15 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +9 dBm at maximum AM depth.

Pulse modulation
Not available with option 1.

Output protection
Reverse power protection is not provided.

DC OPERATION
Allows for operation from an external DC power source in addition to an AC power source. Specification as standard instrument with the following additions:

DC supply range
11 V to 32 V.

AC Supply Frequency
47 Hz to 440 Hz at 90 to 132 V
47 Hz to 63 Hz at 188 to 264 V
200 VA maximum

DC consumption
70 W with option 3 not fitted. 95 W with option 3 and 4 fitted.

HIGH POWER
Specifications as standard instrument with the following exceptions:

RF output range
-140 dBm to +25 dBm (Output power is uncalibrated above +19 dBm for carrier frequencies above 1.2 GHz and above +14 dBm above 2.4 GHz). Maximum output is reduced by 5 dB when standard pulse modulation is selected and/or by up to 6 dB dependent upon set AM depth.

RF Level Accuracy Above +7 dBm (over temperature range 17°C to 27°C)

	<1.2 GHz	<2.51 GHz
	±1 dB	±2 dB
Temperature Stability dB/°C	<±0.02	<±0.03

Harmonics
Typically better than -25 dBc for levels 6 dB below the maximum specified output.

HIGH STABILITY FREQUENCY STANDARD
Replaces the internal TCXO with a high stability OCXO. Specification as standard instrument with the following exceptions:

Ageing rate
±2.5 in 10^7 per year, ±5 in 10^9 per day after 2 months continuous use.

Stability
Better than ±5 in 10^8 over the temperature range 0 to 50°C.

Warm up time
Within 2 in 10^7 of final frequency 10 minutes after switch on at a temperature of 20°C.

REAR PANEL CONNECTORS
RF output, modulation input and LF output connectors are transferred to the rear panel. The signal generator specification is not altered.

FAST PULSE MODULATOR
With option 7 fitted, a BNC Pulse input connector is fitted to the front panel and the existing front panel LF output connector becomes a combined modulation input/output connector. Specification as standard instrument with the following exceptions.

Frequency range
100 kHz to 2.51 GHz. (useable to 9 kHz)

RF output range
-140 dBm to +10 dBm (useable to +13 dBm) when pulse enabled.

RF level accuracy
Additional ±0.01 dB/°C temperature coefficient when pulse enabled.

On/Off ratio
>80 dB below 1.2 GHz
>70 dB up to 2.05 GHz (typically >80 dB)
>65 dB up to 2.51 GHz (typically >70 dB at 2.51 GHz)

Rise & fall times
<20 ns (typically 10 ns)

Maximum repetition frequency
10 MHz

Control
TTL levels into 50 Ω input impedance. A HCT logic 0 (0 V to 0.8 V) turns the carrier off, a HCT logic 1 (2.0 V to 5 V) turns the carrier on. Maximum input is ±10 V

FAST PULSE MODULATOR WITH HIGH POWER
Pulse operation as Option 7. RF output as Option 3 with the following exception.

RF output range
Maximum output level is reduced by 3 dB when Pulse is selected.

SINAD MEASUREMENT
See separate SINAD Measurement data sheet 46891-002

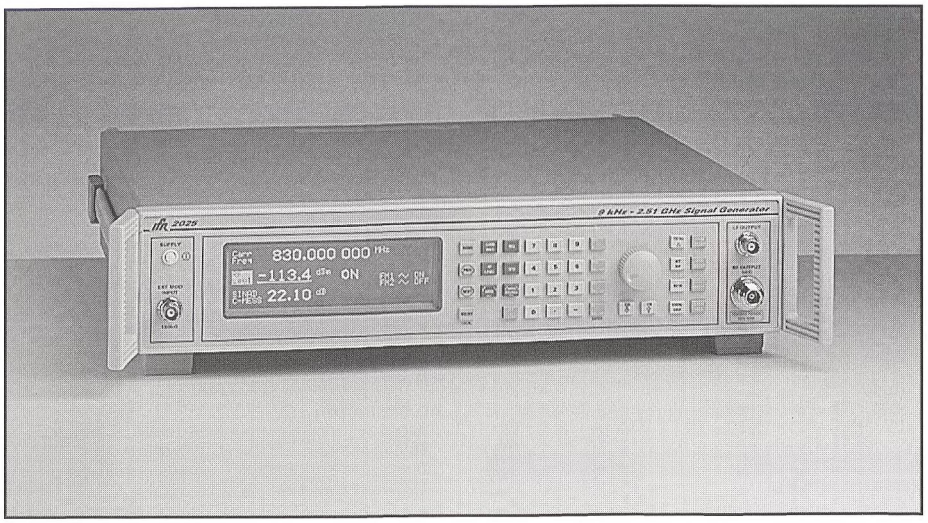
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2023A	9 kHz to 1.2 GHz Signal Generator
2023B	9 kHz to 2.05 GHz Signal Generator
2025	9 kHz to 2.51 GHz Signal Generator
	Options
Option 1	No attenuator (not available with option 3, 7 or 11)
Option 2	DC operation
Option 3	High power (not available with option 1, 7 or 11)
Option 4	High stability frequency standard
Option 5	Rear panel outputs
Option 7	Fast Pulse Modulator (not available with option 1, 3 or 11)
Option 10	Mod input sensitivity 1 V pk
Option 11	Fast Pulse with High Power (not available with options 1,3 or 7)
Option 12	SINAD Measurement
	Supplied with
	AC power supply lead
46882/373	Operating Manual
43130/119	DC supply lead (option 2 only)
	Accessories
54311/208	50/75 Ω adapter. N type (m) to BNC (f). 5.7 dB loss DC to 1 GHz.
46880/068	Service manual
46884/792	Front bracket handle mounting kit
46662/601	Transit case
46662/602	Soft carry case
46884/650	RS-232 cable, 9-way female to 9-way female, 1.5 m
43129/189	1 m GPIB lead
59999/724	TC5010 TEM Cell (see separate sheet)
59000/317	VISA Plug 'n' Play driver software

2023A/B, 2025
Option 12 SINAD Measurement

Option 12 further enhances the versatility of the 2023A/B, 2025 range providing a complete receiver sensitivity test solution in an economical, space saving package



- High performance SINAD measurement
- 50 dB measurement range
- Accurate DSP based CMESS, CCITT P53 and un-weighted filters
- RS-232 and GPIB control
- User selectable measurement averaging
- Simple menu set up
- Over/under range indication

Option 12 provides the user with a high performance SINAD measurement function which can be used for receiver testing in development, production and servicing.

The SINAD function can be used independently of the signal source as a genuine second instrument. Alternatively the SINAD measurement can be operated with the source in manual or automatic control of RF level mode.

Simple Operation

Set up of the measurement selections from a utility menu ensures simple and fast operation.

```
■ Util 49  ___ SINAD Measurement
■ Average:  22 ___          (1 - 127)
■ Weighting Filter: 2 _ C-MESS
   0: Unweighted  1: CCITT  2: C-MESS
■ SINAD: 1 _ Enabled
   0: Disable  1: Enable  2: AUTO
```

2023A/B and 2025 simultaneously displays the signal RF source parameters and the SINAD measurement result. The user is able to manually control the source amplitude and frequency and see at a glance the resulting SINAD. Input level over range and under range warning messages confirm valid measurement values.

```
Carr Freq   850.000 000 MHz
RF Levl   -115.0 dBm  ON      FM1 ~ ON
                              FM2 ~ OFF
SINAD C-MESS  20.0 dB
```

Automatic RF Level Coupled Operation

An automatic RF level adjustment mode to achieve a user defined SINAD value for a receiver under test is available for even simpler bench operation. In this mode the RF level is automatically reduced from a pre-set level until the measured SINAD value matches the user input value.

```
Carr Freq   850.000 000 MHz
RF Levl   -115.0 dBm  ON      Mod Disable
                              FM1 ~ ON
                              FM2 ~ OFF
SINAD C-MESS  20.0 dB  AUTO 12.0 dB
                       SINAD SEEKING
```

Weighting Filters

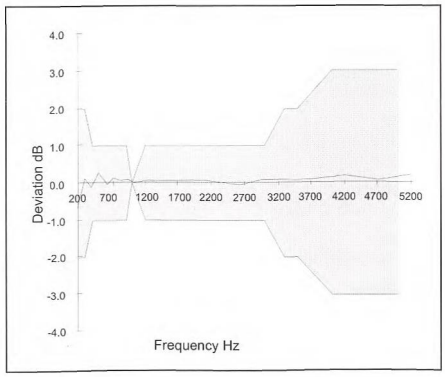
SINAD measurements can be made un-weighted or through accurate and stable DSP based CMESSAGE or CCITT P53 psophometric weighting filters.

Result Averaging

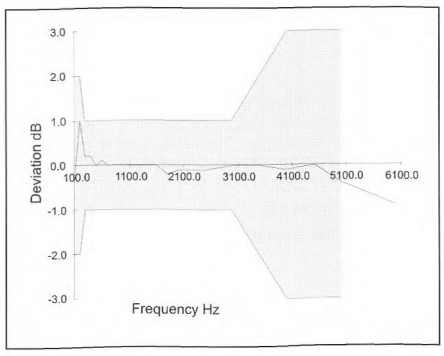
A user selectable result averaging function in the range 1-127 can be applied to the displayed SINAD result.

Instrument Stores

The extensive volatile and non-volatile storage facilities on 2023A/B and 2025 are available for use with Option 12 SINAD to simplify repetitive test sequences for manual or GPIB operation.



Filter response compared to CMESSAGE standard error band



Filter response compared to CCITT standard error band

Specification

General Description

This option provides an independent high performance SINAD measurement function featuring 50 dB SINAD measurement range, with automatic over/under range indication, user selectable weighting filters and result averaging. An automatic generator level seek mode from a user SINAD input value is included. Available with all existing 2023A/B and 2025 family options.

Measurement Range

50 dB

Accuracy

±0.5 dB

Display

Resolution
0.01 dB

Averaging
User selectable result averaging from 1-127 measurements - Default setting is 5 measurements.

Over/under range indication
Automatic display warning when input signal level is out of range.

Weighting Filters

Selectable CMESS, CCITT P53 weighted measurement filters or un-weighted measurement (50 Hz - 7.0 kHz 3 dB bandwidth)

Modulation Frequency

1 kHz ±20 Hz notch filter range

Input Signal

Sensitivity
50 mV RMS - 3.0 V RMS (250 mV RMS for 50 dB SINAD). Max. safe input level ± 15 V

Input impedance
100 kΩ (nominal)

Input Connectivity
SINAD baseband input is via front panel Ext Mod Input connector, (MOD I/O connector when option 7 or 11 are fitted).

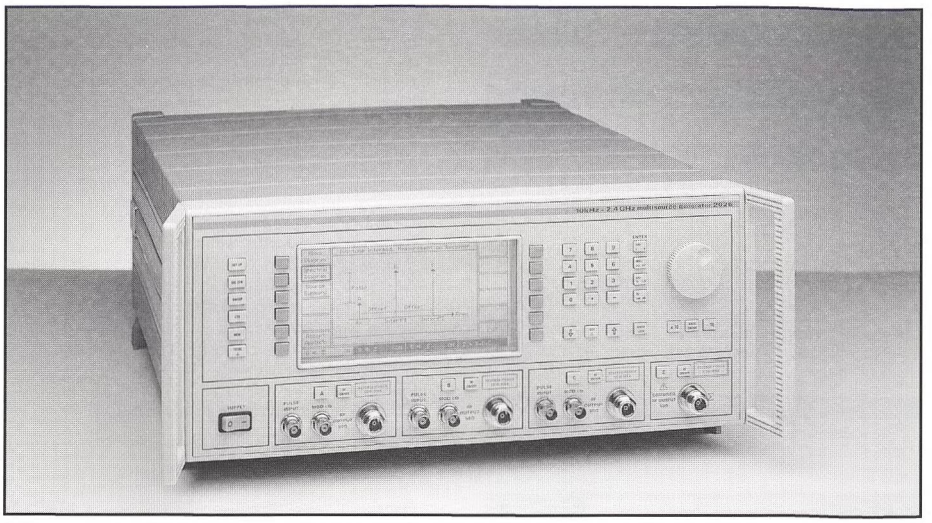
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2023A	9 kHz to 1.2 GHz Signal Generator
2023B	9 kHz to 2.05 GHz Signal Generator
2025	9 kHz to 2.51 GHz Signal Generator
	Options
Option 1	No attenuator (not available with option 3, 7 or 11)
Option 2	DC operation
Option 3	High power (not available with option 1, 7 or 11)
Option 4	High stability frequency standard
Option 5	Rear panel outputs
Option 7	Fast Pulse Modulator (not available with option 1, 3 or 11)
Option 10	Mod input sensitivity 1 V Pk
Option 11	Fast Pulse Modulator with High Power (not available with options 1,3 or 7)
Option 12	SINAD Measurement
	Supplied with
	AC power supply lead
46882/373	Operating Manual
43130/119	DC supply lead (option 2 only)
	Accessories
54311/208	50/75 Ω adapter. N type (m) to BNC (f). 5.7 dB loss DC to 1 GHz.
46880/088	Service manual
46884/792	Front bracket handle mounting kit
46662/601	Transit case
46662/602	Soft carry case
46884/650	RS-232 cable, 9-way female to 9-way female, 1.5m
43129/189	1m GPIB lead
59999/724	TC5010 TEM Cell (see separate sheet)
59000/317	VISA Plug 'n' Play driver software

2026
10 kHz to 2.4 GHz MultiSource Generator

Up to three fully functional signal generators in one unit offering a unique solution for complex tests on receivers, components and systems



- Two or three high quality RF signal generators in a space efficient format
- Ideal for intermodulation and receiver characterization
- Wide frequency coverage:- 10 kHz to 2.4 GHz
- +24 dBm RF output for effective component testing
- Support for an external signal generator
- Application specific test modes simplify measurement procedures
- User defined tracking between signal sources
- Adjustable carrier phase to allow peaking of three tone intermodulation
- Built-in switched combiner network improves measurement uncertainty

The 2026 is a multiple source generator which offers two RF signal generators in one box with a third source available as an option. Each source is a fully functional RF signal generator with AM, FM, ΦM, 2FSK, 4FSK and pulse modulation capability.

The 2026 is ideal for use in R&D and manufacturing where there is a need for two or three combined sources for conducting tests such as intermodulation and selectivity performance of components and receiver assemblies.

To aid the user to undertake difficult test procedures simply and without ambiguity, the 2026 provides application-specific modes of operation. Application modes include amplifier two and three-tone intermodulation, receiver intermodulation and receiver selectivity. A rotary control and up/down keys allow easy modification of the selected parameters.

Measurement Accuracy

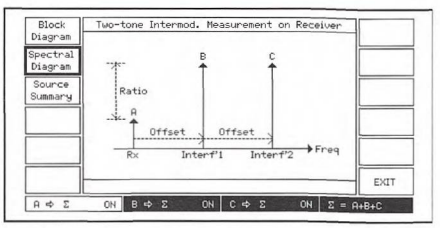
The use of a built in combiner, switches and cables eliminates many of the measurement uncertainties introduced by connecting together separate signal generators. The 2026 thereby guarantees the level of intermodulation products introduced during amplifier or receiver intermodulation testing.

All alignment processes, including the internal frequency standard and the correction factors for the signal source RF paths, are digitally derived so realignment can be undertaken without removal of external covers. Digital adjustment also eliminates the use of mechanical adjusters, minimizing long term drift and vulnerability to mechanical shock.

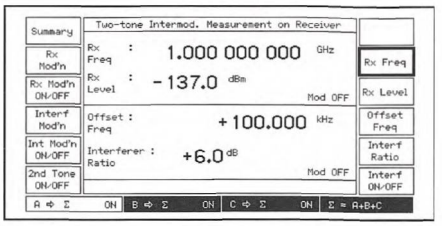
Application Modes

The 2026 has a Set Up Key to enable the applications to be selected. Each Set Up is displayed as a pictorial representation of the internal signal source routing. A spectral diagram is used to show the parameters to be entered in each application in well known engineering terminology.

For example, selecting 'Intermodulation on a Receiver Test' allows the signal sources to be automatically set by entering the receiver input frequency and level, the ratio of the level of the two interferers (relative to the receiver input level) and the offset frequency (channel spacing).



Spectral diagram of two tone intermodulation on a receiver



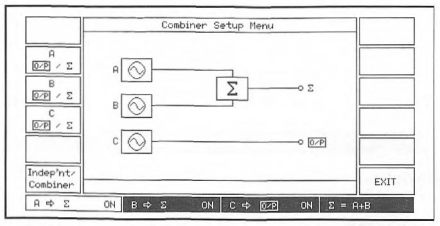
Application mode for intermodulation test on a receiver

Other application modes include 2 and 3 tone intermodulation tests on amplifiers, and receiver selectivity.

Flexible Source Routing

Each of the signal sources can either be routed to a separate output connector or switched to the input of an RF combiner network before being fed to the combiner output connector. The combiner routing is set up quickly and effectively using the Combiner Set Up menu. The flexibility of the signal routing allows the 2026 to accept an external signal generator, such as the 2050 Digital and Vector Generator, to substitute for one of the internal

sources, to enable different forms of carrier signals to be produced.

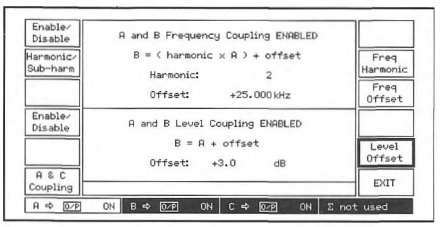


Setting up the source and combiner routing

Automatic Source Coupling

As an alternative to the application modes, the 2026 MultiSource Generator allows the frequency and level of the internal RF sources to be coupled together with a user defined offset. The source frequencies can have an offset with an additional harmonic (or sub-harmonic) relationship to simplify the testing of harmonic converters and divider systems.

The coupling factors are entered by an easily understood format using a dedicated coupling menu.



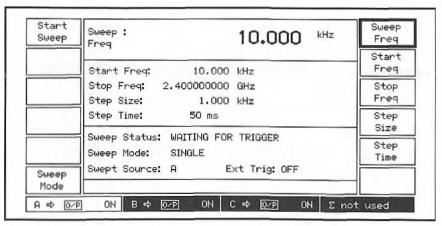
Setting up coupling

The ability to set sources to track each other greatly simplifies the testing of mixers, multipliers and dividers by reducing the number of active controls required.

Sweep

The 2026 allows one of the RF sources to be frequency swept with user defined start, stop, and step values to reduce the amount of operator time or GPIB overhead. By enabling the coupling facility, sweeping one source will simultaneously sweep the other internal RF sources to allow automated swept measurements on frequency conversion devices to be made.

The sweep can be performed with modulation enabled for swept measurements of receiver immunity characteristics.



2026 sweep menu

HIGH RF OUTPUT

The high RF level of the individual outputs is ideal for testing components and ensures that the 2026 can generate high RF levels at the combiner output while maintaining low levels of intermodulation.

Comprehensive Modulation

Each signal source is capable of being independently modulated from its own fully programmable modulation source to ensure maximum flexibility. The internal modulation sources are each capable of generating sine, triangle or square wave signals.

Amplitude, frequency and phase modulated carriers can be generated from the internal modulation sources or from the independent external inputs. The frequency modulation system provides excellent performance in the DC coupled mode with very low carrier frequency error and stability ensuring that the generator can accurately test receivers sensitive to small frequency errors.

Pulse Modulation

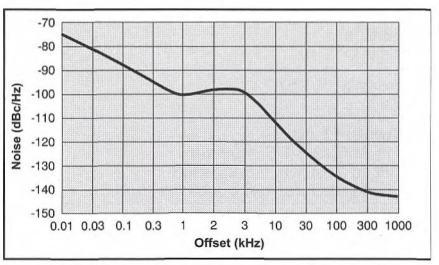
Each source is capable of being independently pulse modulated to allow the simulation of TDD or TDMA RF signal bursts with pulse on/off ratios of better than 40 dB and a rise time of less than 10 µs.

FSK

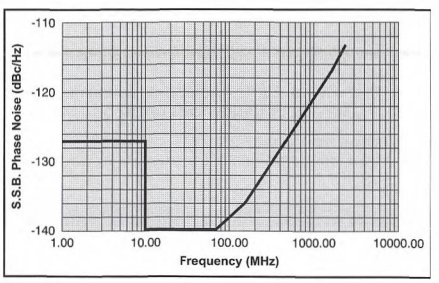
In addition to the analog FM facilities, the 2026 MultiSource Generator supports 2 and 4-level FSK signals from external logic inputs. The FM deviation generated is set by keyboard entry of the required deviation. The facility is ideal for testing paging receivers and RF modems.

HIGH SPECTRAL PURITY

Measurement of receiver selectivity and ultimate signal-to-noise ratio requires good spectral purity. The 2026 has a low residual FM of typically 3 Hz and typical sideband noise of -121 dBc/Hz at 20 kHz offset from 1 GHz, to allow demanding measurements to be made.



Typical SSB Phase Noise at 1 GHz



Typical Phase Noise at 20 kHz offset

Programming

A GPIB interface is fitted so that all standard signal generator functions are controllable over the bus. The protocol and syntax of GPIB commands has been designed in accordance with IEEE 488.2 standard to facilitate the generation of ATE programs.

Low Cost of Ownership

An electronic trip protects the individual source outputs against the accidental application of reverse power.

Careful attention to the thermal design and the use of well-proven signal generator modules gives high reliability and calibration validity.

The use of flash memory and software download via the RS-232 interface means the 2026 can be upgraded with its covers fitted.

OPTIONS

Third Source

The 2026 as standard is supplied with two RF sources. A version with 3 sources is available as an option to support applications such as intermodulation tests on a receiver.

Rear Panel Connections

The RF connectors for all sources, their associated modulation and pulse inputs and the combiner output connector can be mounted on the rear panel for ease of use within an ATE environment, as a factory option.

OCXO

For applications requiring improved frequency stability and close-in phase noise, the standard TCXO can be replaced by a high performance OCXO.

Specification

General Description

The 2026 MultiSource Generator is a synthesized signal generator offering up to three independent RF sources with separate outputs or one or more of the signals routed via a combiner. Each signal source covers the frequency range 10 kHz to 2.4 GHz.
An external signal generator can be fed into the standard 2-source 2026.
Each signal source can be controlled independently in frequency and level and each has its own amplitude, frequency, phase and pulse modulation capability. All parameters can be entered from the front panel keyboard and a rotary control can be used to adjust most settings.
The following signal generator specifications apply to all the sources fitted.

Carrier Frequency

Range
10 kHz to 2.4 GHz with a resolution of 1 Hz.

Accuracy
As frequency standard.

RF Output

Range
Individual outputs
-137 dBm to +24 dBm(1)
Combiner outputs
-137 dBm to +4 dBm(2) (settable to +10 dBm)
Maximum output is reduced by 5 dB when pulse modulation is selected and/or by up to 6 dB when AM is selected dependent upon AM depth.

Resolution
0.1 dB

RF Level Units
Units may be set to µV, mV, EMF or PD; dB relative to 1 µV, 1 mV, EMF or PD; or dBm. Conversion between dB and linear units may be achieved by pressing the appropriate units key (dB or V, mV, µV). The output level can be normalized for 75 Ω operation with an optional external impedance converter (applies to all outputs simultaneously).

Accuracy
Up to 1.2 GHz (over temp range 17 to 27°C)

RF level	***-127 dBm to +6 dBm***	***+6 dBm to +24 dBm[3]***
Individual outputs	±0.8 dB	±1.0 dB
RF level	***>-127 dBm[4] to +4 dBm***	
Combiner output	±1.0 dB	

Accuracy
Up to 2.4 GHz (over temp range 17 to 27°C)

RF level	***-127 dBm to +6 dBm***	***+6 dBm to +20 dBm***
Individual outputs	±1.6 dB	±2.0 dB
RF level	***>-127 dBm to 0 dBm***	
Combiner output	±2.0 dB	
Temp stability dB/°C	***<1.2 GHz*** <±0.02	***>1.2 GHz*** <±0.04

RF level tracking (over temp range +17 to +27°C)
Relative level accuracy between any two or more combined signals (of equal amplitude), is typically: [5]

RF level	***<1.2 GHz***	***<2.4 GHz***
-18 dBm to +4 dBm[6]	±0.3 dB[3]	±0.6 dB
<-18 dBm	±0.6 dB	±1.2 dB

Attenuator hold
Inhibits operation of the step attenuator from the level at which the key is enabled. Useable for a level reduction of at least 10 dB. Typical accuracy ±3 dB.

VSWR
Individual outputs
For output levels less than -5 dBm, output VSWR is less than 1.5:1 for carrier frequencies up to 1.2 GHz and less than 1.7:1 for carrier frequencies up to 2.4 GHz.
Combined output
Output VSWR is less than 1.22:1 for carrier frequencies up to 1.2 GHz and less than 1.32:1 for carrier frequencies up to 2.4 GHz.

RF Output connector
50 Ω type N connector to MIL 390123D.

Output protection
Individual outputs
Protected from a source of reverse power up to 50 W from 50 Ω or 25 W from a source VSWR of 5:1. Protection circuit can be reset from the front panel or via the GPIB or RS-232 interface.
Combined output
No reverse power protection. Maximum total safe power 0.5 W.

Spectral Purity

Harmonics
Individual outputs:
Typically better than -30 dBc for RF level up to +6 dBm, typically better than -25 dBc for RF levels up to +18 dBm (+14 dBm above 1.2 GHz).
Combined output:
Typically better than -30 dBc for RF level up to -14 dBm, typically better than -25 dBc for RF levels up to +4 dBm. (0 dBm above 1.2 GHz).

Non-Harmonics (for offsets > 3 kHz)
Better than -70 dBc to 1 GHz, better than -64 dBc above 1 GHz, better than -60 dBc above 2 GHz.

Isolation
Better than 80 dB between individual outputs in use.
Better than 60 dB from a used individual output and the combiner output.
Better than 40 dB between the combiner output and an unused individual output.

Intermodulation
At an RF output level of 0 dBm on the combiner:

Frequency Range	***Two Tone Intermodulation****
1 MHz to 100 MHz	<-75 dBc
100 MHz to 1 GHz	<-80 dBc
1 GHz to 2.4 GHz	<-75 dBc

*Third order intermodulation products. Intermodulation levels reduce with reducing RF Level.

Residual FM (FM off)
Less than 4.5 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 1 GHz.
Typically <1 Hz at 249 MHz, <2 Hz at 501 MHz <3 Hz at 1001 MHz <6 Hz at 2001 MHz.

SSB phase noise
Better than -124 dBc/Hz at 20 kHz offset from a carrier frequency of 470 MHz, typically -121 dBc/Hz at 20 kHz offset from a carrier frequency of 1 GHz.

Carrier Leakage
Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm diameter loop, 25 mm from the surface of the signal generator.

External RF input
The following applies when an external input is connected at the rear panel and the combiner set up for 'independent' external RF input.

Insertion loss	15 dB ±1 dB
Frequency range	10 kHz to 4 GHz[7]
Return loss	>20 dB to 2.4 GHz
Max input power	0.5 W

Modulation Capability

FM, AM or phase modulation can be applied to the carriers generated by each signal source from independent internal or external modulation sources. The internal modulation sources are capable of generating two simultaneous signals into any one of the modulation channels. Each internal and external modulation source can be simultaneously enabled to produce combined amplitude and frequency (or phase) modulation.
Pulse modulation can be applied to each of the carriers from external pulse sources. The pulse modulation can be used in combination with the other forms of modulation.
2 level or 4 level FSK modulation can be applied to each carrier using data from an external source.

Frequency Modulation

Deviation
0 to 100 kHz

Resolution
3 digits or 1 Hz

Accuracy at 1 kHz
±5%

Bandwidth (1 dB)
DC to 100 kHz (DC coupled)
10 Hz to 100 kHz (AC coupled)
20 Hz to 100 kHz (AC coupled with ALC).

Group delay
Less then 5 µs to 100 kHz.

Carrier frequency offset (DC coupled)
Less than 1% of the set frequency deviation.

Distortion
Less than 1% at 1 kHz rate for deviations up to 100 kHz.
Typically ≤0.3% at 1 kHz rate for deviations up to 10 kHz.
Less than 3% at 1 kHz rate and deviations upto 100 kHz for carrier frequencies below 50 MHz.

Modulation source
Internal modulation oscillator or external via front panel BNC.

FSK

Modes
2 level or 4 level FSK.

Data source
External data input via a 25 way rear panel D Type connector.

Frequency shift
Variable up to ±100 kHz.

Accuracy
As FM deviation accuracy.

Timing jitter
±3.2 µs.

Filter
8th order Bessel, -3 dB at 20 kHz

Phase Modulation

Deviation
0 to 10 radians

Resolution
3 digits or 0.01 radians.

Accuracy at 1 kHz
±5% of indicated deviation excluding residual phase modulation.

3 dB Bandwidth
100 Hz to 10 kHz.

Distortion
Less than 3% at 10 radians at 1 kHz modulation rate. Typically <0.5% for deviations up to 1 radian at 1 kHz.

Modulation source
Internal LF generator or external via front panel BNC.

Amplitude Modulation

For carrier frequencies <500 MHz, useable to 1.5 GHz.

Range
0 to 99.9%

Resolution
0.1%

Accuracy[6]
±5% of set depth at 1 kHz, over temperature range 17°C to 27 °C
Temperature coefficient < 0.02% /°C

1 dB Bandwidth
DC to 30 kHz (DC coupled)
10 Hz to 30 kHz (AC coupled)
20 Hz to 30 kHz (AC coupled with ALC)

Distortion[8]
<1.5% at 1 kHz rate for modulation depths up to 30%
<2.5% at 1 kHz rate for modulation depths up to 80%

Modulation source
Internal LF generator or external, via front panel BNC.

PM on AM
Typically 0.1 radians at 30% depth at 470 MHz.

Pulse Modulation

Frequency range
32 MHz to 2.4 GHz, useable to 10 MHz.

RF level range
Maximum guaranteed output is reduced by 5 dB when pulse modulation is selected.

RF level accuracy
When pulse modulation is enabled, adds ±0.5 dB to the RF level accuracy specification.

Control
Pulse input is on a front panel BNC with 10 KΩ nominal input impedance.
A logic 0 (0 V to 1 V) turns the carrier off, a logic 1 (3.5 V to 5 V) turns the carrier on.
Maximum input is ±15 V.

On/off ratio
Better than 45 dB below 1.2 GHz, better than 40 dB above 1.2 GHz.

Rise and fall times
Less than 10 µs.

Overshoot
<1 dB

Modulation Oscillator

The internal modulation oscillator for each signal source is capable of generating one or two modulation tones simultaneously in one modulation

channel.

Frequency range
0.01 Hz to 20 kHz with a resolution of 0.01 Hz.

Frequency accuracy
As frequency standard.

Distortion
Less than 0.1% THD at 1 kHz.

Waveforms
Sine wave to 20 kHz and a triangular or square wave to 3 kHz.

Square wave jitter
<6.4 µs on any edge.

Audio Output
The modulation oscillator signal from each source is available on the front panel Modulation Input/Output BNC connector at a nominal level of 2 V RMS EMF from a 600 Ω source impedance.

External Modulation

Input on the front panel Modulation Input/Output connector. The modulation is calibrated with 1.414 V peak (1V RMS sine wave) applied. Input impedance is 100 kΩ nominal. Maximum safe input ±15 V.

MODULATION ALC
The external modulation input can be levelled by a peak levelling ALC system over the input voltage range of 0.75 V to 1.25 V RMS sine wave. High and low indicators in the display indicate when the input is outside levelling range.

SWEEP MODE
The carrier frequency of one source can be swept. To enable more than one source to be swept the coupling facility must be invoked.

Control parameters
Start/stop values of carrier frequency, frequency step size and time per step.

Step time
50 ms to 10 s per step.

Trigger
A trigger input is available on a rear panel BNC connector and can be used in single, continuous, start/stop or single step mode.

Frequency Standard

FREQUENCY STANDARD

TCXO
10 MHz.

Temperature Stability
Better than ±5 in 10^7 over the operating range of 0 to 55°C.

Ageing rate
Less than ±1 in 10^6 per year.

External input/output
Rear panel BNC connector accepts an external input of 1 MHz or 10 MHz at a level of 220 mV RMS to 1.8 V RMS into 1 kΩ. Rear panel BNC connector provides an output of 10 MHz at a nominal level of 2 V pk-pk into 50 Ω.

General

GPIB INTERFACE
All signal source parameters except the supply switch are remotely programmable.

Capabilities
Designed in accordance with IEEE 488.2.
The GPIB interface complies with the following subsets as defined in IEEE standard 488.1: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

RS-232
All signal source parameters except the supply switch are remotely programmable.
Connector is 9 way D type, baud rate 300 to 9600 bits per second.
Handshake hardware is DTR, RTS, CTS and DSR and software is XON and XOFF.
Electrical interface is to EIA-232-D.

ELECTRO-MAGNETIC COMPATIBILITY
Conforms with the protection requirements of Council Directive 89/336/EEC. Complies with the limits specified in the following standards:

EN55011 Class B	CISPR II
EN50082-1	IEC 801-2,3,4
AS/NZS 2064.1/2	AS/NZS 4252.1
EN60555-2	IEC 555-2

SAFETY
Complies with IEC 1010-1, BS EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.

RATED RANGE OF USE
(Over which full specification is met unless otherwise indicated).

Temperature
0 to 55°C.

Humidity
Up to 93% at 40°C.

Altitude
Up to 3050 m (10,000 ft).

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
-40°C to +71°C.

Humidity
Up to 93% at 40°C.

Altitude
Up to 4600 m (15000 ft).

POWER REQUIREMENTS

AC Supply
90 to 132 V or 188 to 255 V.
47 Hz to 63 Hz.
250 VA maximum.

CALIBRATION INTERVAL
2 years.

DIMENSIONS AND WEIGHT
(over projections but excluding front panel handles)

Height	Width	Depth	Weight
177 mm	419 mm	488 mm	16 kg

Options

3 Source Signal Generator
Includes 3 signal sources.

HIGH STABILITY FREQUENCY STANDARD
Replaces the internal TCXO with a high stability OCXO. Specification as standard instrument with the following exceptions:

Ageing rate
±2.5 in 10^{-7} per year, <±5 in 10^{-9} per day after two months continuous use.

Stability
Better than ±5 in 10^8 over the temperature range 0 to 50°C.

Warm up time
Within 2 in 10^7 of final frequency 10 minutes after switch on at a temperature of 20°C.

REAR PANEL INPUTS
RF output, modulation input and LF output connectors are transferred to the rear panel. The signal generator specification is not altered.

Versions and Accessories

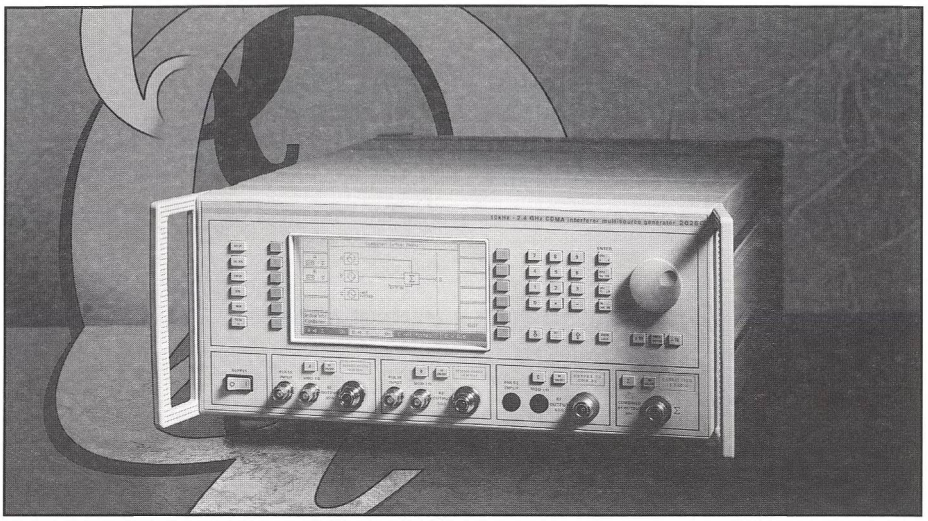
When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2026	10 kHz to 2.4 GHz MultiSource Generator (2 internal sources)
	Options
Option 1	Add third internal source
Option 3	High stability frequency standard
Option 4	Rear panel outputs
	Supplied with
43129/003	AC power supply lead
46882/294	Operating Manual
	Optional Accessories
54311/208	50/75 Ω adapter
46880/077	Service manual
46884/293	Rack mounting kit, depths from 480 mm to 680 mm
46884/294	Rack mounting kit, depths from 680 mm to 840 mm
46884/931	Rack mounting kit containing front panel brackets only
46662/614	Soft carrying case
43129/189	1.5 m GPIB lead
59999/724	TEM Cell
46884/650	RS-232 Cable 9 way female to a 9 way female 1.5m
46884/649	RS-232 Cable 9 way female to a 25 way female 1.5m
54112/165	Hard carrying case

(1) Level uncalibrated above +20 dBm for frequencies >1.2 GHz.
(2) Level uncalibrated above +4 dBm for frequencies >1.2 GHz.
(3) Level accuracy is unspecified below 100 kHz for levels >+6 dBm (>-18 dBm on combined output).
(4) Accuracy is unspecified below 100 kHz for O/P levels >-18 dBm.
(5) Does not apply to external RF input signals to combiner.
(6) RF level tracking is unspecified below 100 kHz for levels >-18 dBm.
(7) Usable to 5 GHz.
(8) For RF levels not exceeding +10 dBm (individual output) or -4 dBm (combined output).

2026Q
CDMA Interferer MultiSource Generator

The 2026Q is designed to work with a CDMA radio test set to provide a fully integrated radio receiver test solution for CDMA and PCS systems in accordance with IS-97-A/98-A



- Two tone interference generation for AMPS/CDMA receiver testing in accordance with IS-97-A/IS-98-A
- Combiner output frequency range from 800 MHz to 2.0 GHz
- Provides single calibrated point of reference for the transceiver under test.
- Excellent phase noise and spectral purity.
- Elimination of additional RF combining or signal conditioning
- High internal isolation of returned signals
- Includes two independent, fully featured RF signal generators 10 kHz to 2.4 GHz
- Very low levels of internally generated intermodulation products
- Single box solution for CDMA interference testing

2026Q for IS-97-A/IS-98-A Testing

The 2026Q is a new derivative of the popular 2026 MultiSource RF signal generator. It has been designed to work directly with a CDMA radio test set to produce a fully integrated radio receiver test solution for CDMA cellular and PCS systems in accordance with IS-97-A/ IS-98-A.

Calibrated and Combined Signal Path

It is designed to produce a fully calibrated combined RF output containing any mix of internally generated interference signals from its two RF sources, together with a calibrated signal path for a radio test set transmit output. A return path from the transceiver back to the radio test set receiver input is also provided through the instrument as illustrated in figure 1.

This allows a CDMA receiver to be tested for sensitivity in the presence of single or dual tone interference. The interfering signals are combined without the need for any RF switching mechanism that would otherwise affect the test result.

High Isolation

2026Q is configured to ensure high levels of isolation between each of the transmit and receive paths between the radio test set, the interfering signal sources and the transceiver under test.

Path loss test data is supplied with each instrument for the frequency bands 865 MHz-895 MHz, 1750 MHz-1990 MHz. Drift influences within these bands is minimal ensuring a level accuracy of better than ±0.75 dB. The frequency response across each of these bands is flat to within ±0.1 dB, thus minimizing the need for additional system calibration.

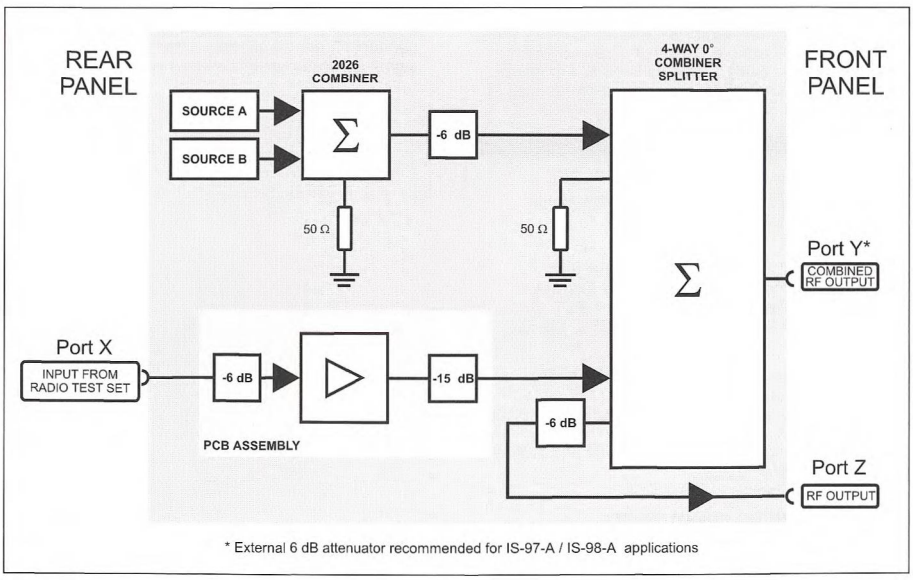


Figure 1 2026Q configured for radio testing with a test set

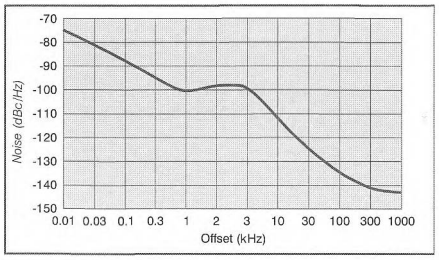
Independent Signal Generators

Each of the RF generators contained within 2026Q may be used independently, routed to their individual RF connectors. In this mode, each generator covers the full frequency range 10 kHz to 2.4 GHz with an output power of between -137 dBm and +24 dBm. Each source may be independently modulated either from an internal or external source(s). Modulation modes include AM, FM, PM, Pulse and 2/4 level FSK. The standard 2026 specification applies when used in this mode.

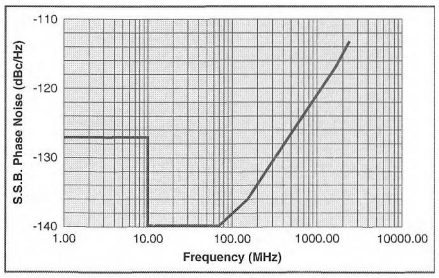
Excellent Spectral Purity

Very low phase noise and spurious responses are achieved making them ideal for CDMA handset interference tests and other general purpose applications. The 2026Q has a low residual FM of typically 3 Hz and typical sideband noise of -121 dBc/Hz at 20 kHz offset from 1 GHz.

The excellent noise floor performance is more than adequate for mobile handset and base station testing.



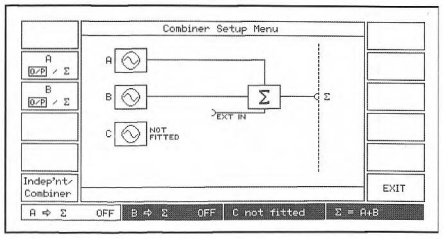
Typical SSB Phase Noise at 1 GHz



Typical Phase Noise at 20 kHz offset

Flexible Source Routing

Each of the signal sources can either be routed to a separate output connector or switched to the input of an RF combiner network before being fed to the combiner output connector. The combiner routing is set up quickly and effectively using the Combiner Set Up menu.

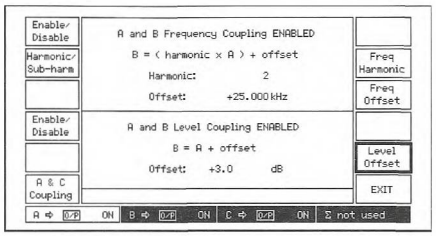


Setting up the source and combiner routing

The flexibility of the signal routing allows the 2026Q to accept an external input from another signal generator, such as the 2050 Digital and Vector Generator producing CDMA modulation or a radio test set.

Automatic Source Coupling

The two internal generators can have their frequency and level 'coupled'. In the case of RF level this coupling can be any fixed offset enabling control of a single parameter to manifest a change in both sources. For RF frequency this coupling can be both a fixed frequency offset or a harmonically related offset and again allow simple programming and control of the instrument.



Setting up coupling

Sweep

The 2026Q allows either of the independent RF sources to be frequency swept with user defined start, stop, and step values to reduce the amount of operator time or GPIB overhead. By enabling the coupling facility, sweeping one source will simultaneously sweep the other internal RF source to allow automated swept measurements on frequency conversion devices to be made.

High RF Output

Each of the RF signal generators is able to deliver up to +24 dBm at their output, making them ideal for testing components such as mixers and amplifiers etc.

Comprehensive Modulation

Each signal source is capable of being independently modulated from its own fully programmable modulation source to ensure maximum flexibility. The internal modulation sources are each capable of generating sine, triangle or square wave signals.

Amplitude, frequency and phase modulated carriers can be generated from the internal modulation sources or from the independent external inputs.

The frequency modulation system provides excellent performance in the DC coupled mode with very low carrier frequency error and stability ensuring that the generator can accurately test receivers sensitive to small frequency errors.

Programming

A GPIB interface is fitted so that all standard signal generator functions are controllable over the bus. The protocol and syntax of GPIB commands has been designed in accordance with IEEE 488.2 standard to facilitate the generation of ATE programs.

A RS-232 interface is fitted as standard with a common command set to GPIB commands. RS-232 control is particularly suitable for use with simple external controllers or RF modems when the instrument is being used in a remote location.

Low Cost of Ownership

An electronic trip protects the individual source outputs against the accidental application of reverse power.

Careful attention to the thermal design and the use of well-proven signal generator modules gives high reliability and calibration validity.

The use of flash memory and software download via the RS-232 interface means the 2026Q can be upgraded with its covers fitted.

Specification

General Description

The 2026Q CDMA Interferer MultiSource Generator is a purpose built instrument for testing CDMA hand-set and base station equipment. It features two synthesized RF signal generators with both independent and combined RF outputs. The combined RF output provides a path to and from the radio under test and an appropriate CDMA radio test set. Each signal source covers the frequency range 10 kHz to 2.4 GHz, whilst the combined path covers the range 800 MHz to 2.0 GHz.

Carrier Frequency

Independent source frequency range
10 kHz to 2.4 GHz with a resolution of 1 Hz.

Combined output frequency range
800 MHz to 2.0 GHz with a resolution of 1 Hz.

Accuracy
As frequency standard.

RF Output

Range
Individual outputs
-137 dBm to +24 dBm(1)
Combiner outputs
-137 dBm to -3 dBm(1)
Maximum output is reduced by 5 dB when pulse modulation is selected and/or by up to 6 dB when AM is selected dependent upon AM depth.

Resolution
0.1 dB or 3 digits for linear units.

Accuracy (Individual RF outputs)
(over temp range 17 to 27°C)

RF level	*-127 dBm to +6 dBm*	*>+6 dBm to +24 dBm(2)*	*Temp stability*
Up to 1.2 GHz	±0.8 dB	±1.0 dB	<±0.02 dB/°C
Above 1.2 GHz	±1.6 dB	±2.0 dB	<±0.04 dB/°C

Accuracy (Combined RF output)
(over temp range 17 to 27°C and level range -20 dBm to -35 dBm)

RF Frequency range	*Level Accuracy*
865 MHz - 895 MHz	±0.75 dB
1750 MHz - 1990 MHz	±0.75 dB

Attenuator hold
Inhibits operation of the step attenuator from the level at which the key is enabled. Useable for a level reduction of at least 10 dB. Typical accuracy ±3 dB.

VSWR
Individual outputs
For output levels less than -5 dBm, output VSWR is less than 1.5:1 for carrier frequencies up to 1.2 GHz and less than 1.7:1 for carrier frequencies up to 2.4 GHz.

Path Loss

	865 MHz to 895 MHz	*1750 MHz to 1990 MHz*
(X → Y)*	14 dB typ.	15 dB typ.
(Y → Z)	13.5 dB typ.	13.5 dB typ.
(Y → X)	>40 dB	> 40 dB

* measured values are supplied with each instrument with a frequency response of < ± 0.1 dB across the frequency bands 865 MHz to 895 MHz, 1750 MHz to 1780 MHz and 1930 MHz to 1990 MHz. Measurement uncertainty of ± 0.25 dB applies.
Options are available providing lower path loss figures - please contact your IFR sales office for further details.

VSWR (refer to Figure 1)

	865 MHz to 895 MHz	*1750 MHz to 1990 MHz*
Port X	<1.2:1	<1.35:1
Port Y	<1.6:1*	<1.6:1*
Port Z	<1.35:1	<1.35:1

*Typically <1.25:1

Maximum Safe Power (matched)

Port X	+19 dBm
Port Y	+33 dBm
Port Z	+33 dBm

RF Output connector
50 Ω type N connector to MIL 390123D.

Output protection
Individual outputs
Protected from a source of reverse power up to 50 W from 50 Ω or 25 W from a source VSWR of 5:1. Protection circuit can be reset from the front panel or via the GPIB interface.
Combined output
No reverse power protection.

Spectral Purity

Harmonics
Individual outputs:
Typically better than -30 dBc for RF level up to +6 dBm, typically better than -25 dBc for RF levels up to +18 dBm (+14 dBm above 1.2 GHz).
Combined output:
Typically better than -30 dBc for RF level up to -36 dBm, typically better than -25 dBc for RF levels up to -13 dBm.

Non-Harmonics
Better than -70 dBc to 1 GHz, better than -64 dBc above 1 GHz, better than -60 dBc above 2 GHz.

Isolation
Better than 80 dB between individual outputs in use.
Better than 60 dB from a used individual output and the combiner output.

Intermodulation
<-80 dBc at an RF output level of -22 dBm on the combiner, across the range 800 MHz to 2.0 GHz Intermodulation levels reduce with reducing RF Level.

Residual FM (FM off)
Less then 4.5 Hz RMS deviation in a 300 Hz to 3.4 kHz un-weighted bandwidth at 1 GHz.
Typically <1 Hz at 249 MHz, <3 Hz at 1001 MHz.

Radio Connections
Refer to Figure 1

SSB phase noise
Better than -124 dBc/Hz at 20 kHz offset from a carrier frequency of 470 MHz, typically -121 dBc/Hz at 20 kHz offset from a carrier frequency of 1 GHz.

Carrier Leakage
Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm diameter loop, 25 mm from the surface of the signal generator.

Modulation Capability

FM, AM or phase modulation can be applied to the carriers generated by each signal source from independent internal or external modulation sources. The internal modulation sources are capable of generating two simultaneous signals into any one of the modulation channels. Each internal and external modulation source can be simultaneously enabled to produce combined amplitude and frequency (or phase) modulation.
Pulse modulation can be applied to each of the carriers from external pulse sources. The pulse modulation can be used in combination with the other forms of modulation.
2 level or 4 level FSK modulation can be applied to each carrier using data from an external source.
With the following exception modulation performance is as standard 2026 product. Please refer to data sheet 46891-003.

AMPLITUDE MODULATION
Accuracy [3] ±5% of set depth at 1 kHz rate

Frequency Standard

FREQUENCY STANDARD

OCXO
10 MHz.

Ageing rate
± 2.5 in 10^7 per year, ± 5 in 10^9 per day after 2 months continuous use.

Temperature Stability
Better than ± 5 in 10^8 over the temperature range 0 to 50°C.

Warm up time
Within 2 in 10^7 of final frequency 10 minutes after switch on at a temperature of 20°C.

External input/output
Rear panel BNC connector accepts an external input of 1 MHz or 10 MHz at a level of 220 mV RMS to 1.8 V RMS into 1 kΩ. Rear panel BNC connector provides an output of 10 MHz at a nominal level of 2 V pk-pk into 50 Ω.

General

As 2026 standard specification with the following exception. Refer to data sheet part number 46891-003 for more detail.

DIMENSIONS AND WEIGHT
(over projections but excluding front panel handles)

Height	Width	Depth	Weight
177 mm	419 mm	488 mm	<17kg

Versions and Accessories

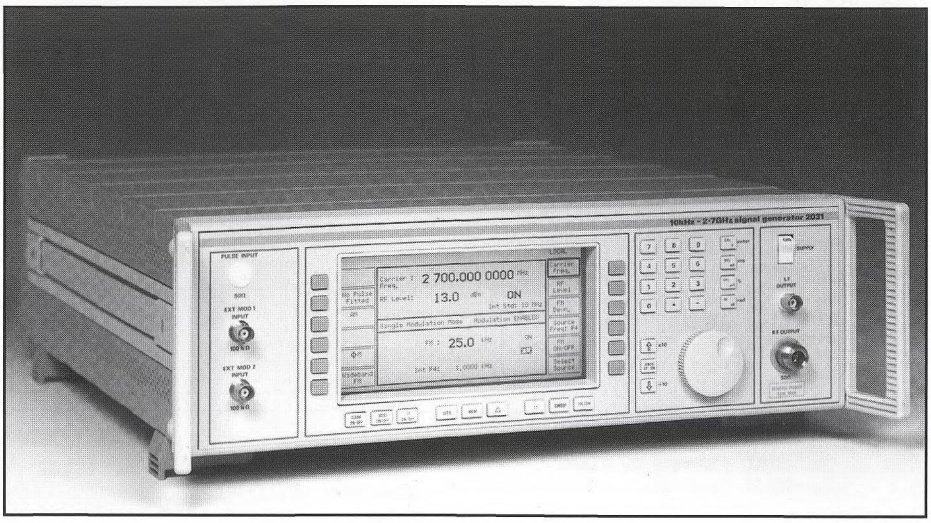
When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2026Q	CDMA Interferer MultiSource Generator
	Supplied with
	AC power supply lead
46882/361	Operating Manual
46880/087	Service Manual
	Optional Accessories
54311/208	50/75 Ω adapter
46884/293	Rack mounting kit, depths from 480 mm to 680 mm
46884/294	Rack mounting kit, depths from 680 mm to 840 mm
46884/931	Rack mounting kit containing front panel brackets only
46662/614	Soft carrying case
43129/189	1.5 m GPIB lead
46884/650	RS-232 Cable 9 way female to a 9 way female 1.5m
46884/649	RS-232 Cable 9 way female to a 25 way female 1.5m

[1] Level uncalibrated above +20 dBm for frequencies >1.2 GHz (-7 dBm at combiner output)
[2] Level accuracy is unspecified below 100 kHz for levels > +6 dBm
[3] For RF output levels not exceeding +10 dBm (-22 dBm at combiner output)

2030 series
10 kHz to 5.4 GHz Signal Generator

A high performance signal generator with programmable modulation sources and LF output, wide modulation bandwidths, sweep capability and excellent accuracy



- Wideband cover:-
  - 10 kHz to 1.35 GHz (2030)
  - 10 kHz to 2.7 GHz (2031)
  - 10 kHz to 5.4 GHz (2032)
- 0.1 Hz frequency resolution
- 0.1 Hz to 500 kHz modulation oscillator
- Wideband FM with 10 MHz bandwidth
- Single, dual, composite and dual composite modulation modes
- GPIB programming (IEEE 488.2 standard)
- Simple operation through menu selection of modes

The 2030 series of signal generators offers increased flexibility with combinations of frequency, phase, amplitude and pulse modulation over the frequency ranges 10 kHz to 1.35 GHz (2030), 10 kHz to 2.7 GHz (2031) and 10 kHz to 5.4 GHz (2032). These instruments are suitable for a wide variety of applications ranging from RF component characterization to radio communications system testing. Set up time is reduced by recalling previously stored instrument settings from the non-volatile memory. Remote programming via the GPIB is provided as a standard feature, allowing the instruments to be included in automatic test systems.

Operation

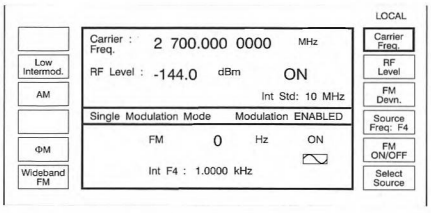
Operation of the instrument is performed by simply selecting the required operating mode and entering parameter values using the numeric keypad. Parameter values may be varied by means of the rotary control knob or by use of the ⇧⇩keys.

The Signal Generator, Sweep, LF, Delta, Memory and Utility displays are selectable at any point of operation using the keys below the screen. Within each display, soft keys are assigned alongside the display to allow parameter entry or to select the relevant functions.

Display

A large screen, dot matrix liquid crystal display, with backlighting, offers excellent clarity and low power consumption. Contrast may be varied using the knob to optimize the viewing angle and differing lighting conditions may be accommodated by adjusting the backlight intensity.

The parameters displayed on the screen depend on the operating mode selected; for example in the Signal Generator mode, carrier frequency, modulation and RF level are shown in separate horizontal regions. Status information is also shown with error messages being displayed in a single line at the top of the screen.



Frequency selection

Carrier frequency entry is selected via a soft key option on the signal generator screen and data is then entered directly via the keyboard. Frequency is resolved to within 0.1 Hz across the complete range of the instrument. Carrier frequencies can be stored in the non-volatile memory for recall at any time. A CARRIER ON-OFF switch is provided to completely disable the output.

RF Output

RF output up to +13 dBm can be set by direct keyboard entry with a resolution of 0.1 dB or better over the entire range. An extended hysterisis facility allows for extended electronic control of RF output level without introducing mechanical attenuator transients when testing squelch systems and an overrange facility allows the generator to produce RF levels above the normal operating range. A high output option is available to extend the maximum calibrated level to +19 dBm on 2030.

A low intermodulation mode can be selected which freezes the RF levelling system and improves the intermodulation performance when combining the outputs of two signal generators.

Calibration Units

A choice of calibration units is available to the operator and provision is made for the simple conversion of units (for example, dBm to mV). For units without Option 8 the output level can be offset by up to ±2 dB by keyboard entry. Offsets from the calibrated value may be used to compensate for cable or switching losses external to the generator. The operator may also use this facility as a means of deliberately offsetting the output level to ensure that all generators in an area give identical measurements. While using the offset facility, the calibration of the signal generator is not lost and may be returned

to at any time.

Units with RF profile and complex sweep option (Option 8) have a much more comprehensive profiling and offsetting capability.

50 W Protection

An electronic trip protects the generator output against reverse power of up to 50 W, preventing damage to output circuits when RF or DC power is accidentally applied. This feature contributes to long unit life and low cost of ownership.

MODULATION

Comprehensive amplitude, frequency (plus Wideband FM), phase and optional pulse generation and modulation are provided for testing all types of receivers.

Modulation Oscillator

An internal modulation oscillator is provided with a frequency range of 0.1 Hz to 500 kHz, resolved to 0.1 Hz. In addition to the normal sine wave output, alternative triangular or square waveforms may be selected. A second oscillator may be added as an option. Two independent BNC inputs on the front panel allow external modulation signals to be mixed with the internal signal(s) allowing a maximum of four modulations channels to be active at one time.

Modulation Modes

Four modulation modes are provided – single, dual, composite and dual composite. In the single mode only one type of modulation can be active at any time. Selecting alternative modulation cancels any other active modulation. In the dual mode two types of modulation may be obtained allowing one form of frequency modulation to be combined with one form of amplitude modulation. In the composite mode, only one type of modulation can be active, and is fed by two independent channels. The dual composite mode combines the facilities of the dual mode with the composite mode and provides two types of modulation each fed from two sources.

Frequency and Phase Modulation

The wide range frequency modulation capability provides a 1 dB bandwidth of 300 kHz and provides FM deviation up to a maximum of 1 MHz for frequencies up to 21 MHz and 1% of carrier frequency elsewhere. Phase modulation is also available with a 10 kHz bandwidth up to a maximum of 10 radians.

Both AC and DC coupled FM are available and in the DC coupled mode a patented offset correction system eliminates the large carrier frequency offsets that occur with normal signal generators. As a result the 2030 series signal generators can be used confidently for testing tone and message paging equipment.

Wideband FM

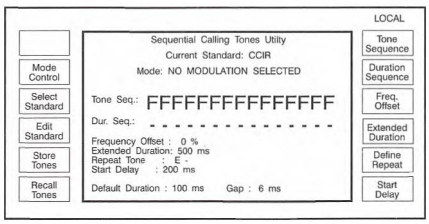
Broadband frequency modulation with a 3 dB bandwidth of 10 MHz is provided via a rear panel BNC socket. This is ideal for tests on equipment using frequency shift keying for high speed digital transmission.

Amplitude and Pulse Modulation

Amplitude modulation with a 1 dB bandwidth of 30 kHz and with modulation depths of up to 99.9% is available with a resolution of 0.1%. Pulse modulation is available as an option with typical rise and fall times of 5 ns and 70 dB on/off ratio.

Modulation Levelling

An automatic level control facility is provided for both of the external modulation inputs and provides correctly calibrated modulation for input levels varying from 0.7 V to 1.4 V RMS. HI and LO indications show when the input level is outside the range of the ALC system.



Tone Signaling

The signaling facility allows testing of radios with DTMF, sequential and sub-audible tone capability. A wide range of tone system standards are built in and provision is also made for user definable standards to cover special requirements. Tone sequences can be set up with up to 16 tones in length and the complete sequence can be sent from 1 to 9 times or set to repeat on a continuous basis. Sub-audible tones are normally used in the composite modulation mode where the modulation level for the tone and the in-band modulation can be set independently.

INCREMENTING

All major parameters can be incremented or decremented in step sizes entered via the keyboard or the GPIB.

⇧⇩ keys

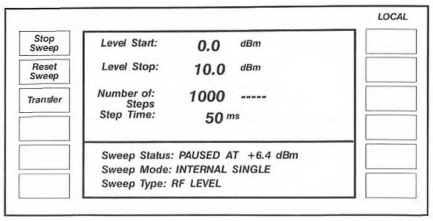
If the knob is disabled, a single touch on either the ⇧ or ⇩ key moves the parameter by a single step and holding the key pressed causes the signal generator to step continuously at a rate of about three steps per second.

Rotary Control

When the rotary control is enabled the parameters can be varied using the knob, whose sensitivity may be altered by factors of ten using the ⇧10 and ⇩0.1 keys. The digits affected by the rotary control are indicated on the display by lines above and below the numeric display.

Delta Display

The Delta menu allows the increment for all the parameters to be set and also includes a TOTAL SHIFT key to show the variations in the parameters from their last keyed in value, a RETURN key to reset the selected parameter to its start value and a TRANSFER key to update the parameter value to equal the shifted value.



SWEEP

The digital sweep capability of the 2030 series allows dynamic testing of systems and includes capabilities for sweeping carrier frequency, RF level, LF frequency and LF level. Four parameters are entered to specify the sweep – start value, stop value, number of steps and time per step.

Option 8 provides additional sweep capabilities which allow the step size, step time and RF level to be entered.

Markers and Ramp Output

Six markers may be defined and a marker output is provided on a rear panel socket together with a 0-10 V ramp signal for driving the X axis of an oscilloscope or X-Y plotter.

Start/Stop

A single key press starts the sweep and a horizontal bar graph on the display shows the progress of the sweep. The sweep can be stopped at any time and the ⇧⇩ keys used to step forwards or backwards for search purposes. Transfer of the current sweep value into the signal generator or LF modes for more detailed analysis is also possible. The sweep facility can be used in conjunction with a simple X-Y display unit, an oscilloscope or an X-Y plotter.

NON-VOLATILE MEMORY

True non-volatile memory needing no battery back-up is fitted to the 2030 series and is used to store details of instrument settings and calibration information.

Instrument Settings

Details of instrument settings are stored in four areas of memory. One area stores 50 complete instrument settings (including data on parameters which are not currently active), a second area stores 50 partial settings (consisting of details about the currently active parameters), a third area stores details of 100 carrier frequency values and a fourth area stores details of 20 sweep settings. Facilities are provided to prevent the memories from being accidentally overwritten and for recalling a specified memory at switch-on.

Calibration Data

In addition to storage and recall of measurement settings, the non-volatile memory contains data on instrument status and calibration. All calibration data on RF level, FM accuracy, internal frequency standard adjustment and modulation are retained and may be altered from the front panel or via the GPIB after disabling the software protection. Status information stored includes the identity string (type and serial number), choice of internal/external standard, GPIB

address, elapsed time and a date alarm for calibration due reminders.

Memory Content Protection

To prevent accidental interference with the contents of status and calibration data, internal data is protected by a secure key sequence. Two levels of protection are offered, appropriate to the function being accessed. The most secure is reserved for features that alter the calibration data, change the time and date setting or blank the displays when memories are recalled. The first level of protection is less severe, enabling the user to access features which are relevant to normal operation, for example, selection of RF level calibration units, RF level offsets, external standard frequency and switch-on status.

Unprotected features provide a range of additional operating features, such as the ability to display status information, elapsed time, time and date, etc.

PROGRAMMING

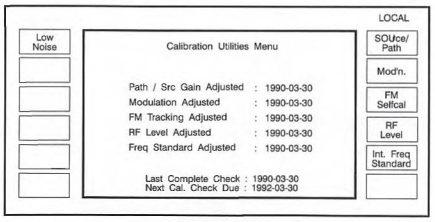
A GPIB interface is fitted as standard so that all functions are controllable over this interface. The instruments function as talkers as well as listeners and the interface has been designed in accordance with the IEEE 488.2 standard.

CALIBRATION

The 2030 series has a two year recommended calibration interval, with the user being able to calibrate some functions. The calibration display is available via soft key selection in the utilities menu.

Software Assisted Calibration

When carrying out calibration manually (via the keyboard), the instrument displays information on the procedure and in the case of FM tracking even carries out the full adjustment process automatically. No internal adjustments are provided, or required, for calibration and even the internal frequency standard can be adjusted from the front panel. Calibration may also be carried out via the GPIB allowing a fully automated recalibration of all parameters to be performed.



Automatic Date Stamping

Having completed a readjustment of a parameter the instrument updates the calibration data and uses the information from the real time clock to record the date of adjustment. The calibration engineer can also set a calibration due date and when this date is reached a message will be displayed advising the operator to return the unit for calibration.

Low cost of ownership

In keeping with the IFR philosophy of cost-effectiveness with innovation, the 2030 series has been designed for minimal maintenance and low operating costs. The two year calibration interval combined with the high reliability ensures a low overall cost of ownership.

OPTIONS

The standard features may be supplemented by taking advantage of the various options available. See list below.

Second Modulation Oscillator

An additional modulation oscillator can be fitted to the 2030 series to enable greater flexibility. This second oscillator has the same specification as the first and allows full use of complex modulation modes and is particularly useful where two tone modulation is required.

Pulse Modulation

This optional facility allows radar RF and IF stages to be tested and features rise and fall times of less than 25 ns with an on/off ratio of better than 70 dB.

Pulse Generation

Provides internal pulses which, when used with pulse modulation, generates pulsed RF outputs to eliminate the need for an external function generator.

19 dBm Output

A high output option is available for 2030 and provides an extra 6 dB of calibrated output level making it ideal for use as a local oscillator or in testing passive components.

GSM PCN Modulation

An option is available for 2030 series which provides GMSK Bt 0.3 modulation at a clock rate of 270.833 kHz in accordance with the GSM specification. The option includes a comprehensive internal data generator.

Avionics & DME

This optional facility provides for the internal generation modulation waveforms suitable for the testing of Instrument Landing Systems (ILS) and VHF Omni Range (VOR) beacons.

Additional modes of operation support the testing of ADF, Marker Beacons and the SELCAL signaling system.

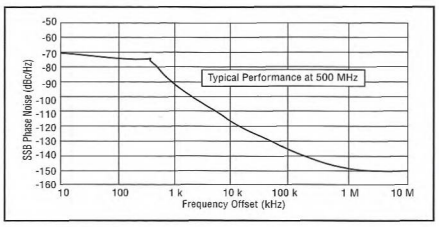
Another additional option creates Gaussian shaped double pulses to produce the correct DME RF signals to test DME receivers.

RF Profiles and Complex Sweep

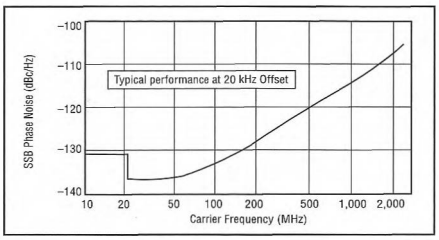
The RF Profile facility allows the signal generator to compensate for frequency dependent level errors introduced by cables, amplifiers and signal combiners. The Complex Sweep facility allows for the generation of sweeps whose step size, step time and RF level change while the sweep is in progress. These features are particularly useful for EMC, Tempest and ATE applications.

Electronic Attenuator

An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications.



Variation of SSB Phase Noise with Offset



Variation of SSB Phase Noise with Frequency

Specification

General Description

2030 series signal generators cover the frequency ranges of 10 kHz to 1.35 GHz, 10 kHz to 2.7 GHz and 10 kHz to 5.4 GHz. A large screen dot matrix display with soft key function selection allows flexibility of operation and ease of use. The output may be amplitude, phase or frequency modulated with pulse generation and modulation available as an option. Modulation is available using a combination of an internal synthesized LF oscillator with up to two external signal inputs.
A second internal source is available as an option.

Carrier Frequency

Range
10 kHz to 1.35 GHz (2030)
10 kHz to 2.7 GHz (2031)
10 kHz to 5.4 GHz (2032)

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
11 digits with annunciators.

Resolution
0.1 Hz

Accuracy
As frequency standard.

Phase incrementing
The carrier phase can be advanced or retarded in steps of 1.5° using the rotary control.

RF Frequency

Range
-144 dBm to +13 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +7 dBm at maximum AM depth.

Overrange
Selectable overrange mode allows uncalibrated levels up to +19 dBm to be generated (typically up to +25 dBm for 2030 with Option 003 fitted). Selectable extended hysterisis provides for uncalibrated RF level control with up to 24 dB range without level interruption.

Selection
By keyboard entry of data. Variation by UP/DOWN keys and by rotary control. Units may be µV, mV, V EMF or PD; dB relative to 1 µV, 1 mV EMF or PD; dBm. Conversion between dB and voltage units may be achieved by pressing the appropriate units key (dB, or V, mV, µV).

Indication
4 digits with unit annunciators.

Resolution
0.1 dB

VSWR
For output levels less than 0 dBm: Less than 1.25:1 to 2.2 GHz, less than 1.4:1 to 2.7 GHz, less than 1.5:1 to 5.4 GHz.

Output Protection
Reverse power of 50 W from a source VSWR of up to 5:1.

Accuracy at 22°C ±5°C

	<1.35 GHz	<2.7 GHz	<5.4 GHz
>0 dBm	±0.5 dB	±0.7 dB	±1 dB
>-50 dBm	±0.85 dB	±1 dB	±1.5 dB
>-127 dBm	±0.85 dB	±1 dB	-

Temperature stability dB/°C

<1.35 GHz	<2.7 GHz	<5.4 GHz
±0.005	±0.01	±0.02

Spectral Purity

At RF levels up to +7 dBm:-

Harmonics
2030, 2031: Better than -30 dBc to 1 GHz; better than -27 dBc above 1 GHz.
2032: Better than -30 dB to 1 GHz; better than -27 dBc to 1.35 GHz; better than -25 dBc above 1.35 GHz.

Sub-harmonics
Better than -90 dBc to 1.35 GHz; better than -40 dBc to 2.3 GHz; better than -30 dBc to 5.4 GHz.

Non-Harmonics
Better than -70 dBc at offsets from the carrier frequency of 3 kHz or greater.

Residual FM (FM off)
Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.

SSB phase noise
Less than -116 dBc/Hz (typically -122 dBc/Hz) at an offset of 20 kHz from a carrier frequency of 470 MHz.

RF Leakage
Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm loop, 25 mm or more from any part of the case.

FM on AM
Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.

ΦM on AM
Typically less than 0.1 radians at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

Modulation Modes

Four modulation modes are available:

Single
FM, Wideband FM, ΦM, AM or pulse (optional).

Dual
Two independent channels of differing modulation type (e.g. AM with FM).

Composite
Two independent channels of the same modulation type (e.g. FM1 with FM2).

Dual composite
A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

Frequency Modulation

Deviation
Peak deviation from 0 to 1 MHz for carrier frequencies up to 21.09375 MHz. Peak deviation from 0 to 1% of carrier frequency above 21.09375 MHz.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
3 digits with annunciators.

Displayed Resolution
1 Hz or 1 least significant digit, whichever is greater.

Accuracy at 1 kHz
±5% of indication ±10 Hz excluding residual FM.

Bandwidth (1 dB)
DC to 300 kHz (DC coupled).
10 Hz to 300 kHz (AC coupled).
Input is capable of accepting external sources of FSK signals. Typical 3 dB bandwidth is greater than 1 MHz.

Group delay
Less than 1 µs from 3 kHz to 500 kHz.

Carrier Frequency Offset
In DC FM less than ±(1 Hz + 0.1% of set deviation) after using DC FM nulling facility.

Distortion
Using external modulation without ALC: Less than 3% at maximum deviation for modulation frequencies up to 20 kHz. Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.

Modulation source
Internal LF generator or external via front panel sockets.

Wideband FM

Deviation
As FM.

Indication
3 digits with annunciators.

Selection
By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the value of deviation nearest to the requested value.

Input level
1.414 V peak (1 V RMS sine wave) to achieve indicated deviation.

Accuracy
As FM.

3 dB Bandwidth
Typically 10 MHz (DC or AC coupled).

Group Delay
Less than 0.5 µs from 3 kHz to 10 MHz.

Modulation Source
External via rear panel socket (50 Ω impedance).

Phase Modulation

Deviation
0 to 10 radians.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
3 digits with annunciators.

Resolution
0.01 radians.

Accuracy at 1 kHz
±5% of indicated deviation excluding residual phase modulation.

3 dB Bandwidth
100 Hz to 10 kHz.

Distortion
Less than 3% at maximum deviation at 1 kHz modulation rate.

Modulation Source
Internal LF generator or external via front panel sockets.

Amplitude Modulation

For carrier frequencies up to 1 GHz

Range
0 to 99.9%.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
3 digits with annunciator.

Resolution
0.1%.

Accuracy
±4% of setting ±1%.

1 dB Bandwidth
With modulation ALC off: DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode.
Typical modulation bandwidth exceeds 50 kHz.

Distortion
For a modulation rate of 1 kHz: Less than 1% total harmonic distortion for depths up to 30%, less than 3% total harmonic distortion for depths up to 80%.

Modulation source
Internal LF generator or external via front panel sockets.

Modulation Oscillator

Frequency range
0.1 Hz to 500 kHz.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
7 digits with annunciators.

Resolution
0.1 Hz.

Frequency accuracy
As frequency standard.

Distortion
Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz.

Alternative waveforms
A triangular wave is available for frequencies up to 100 kHz.
A square wave is available for frequencies up to 2 kHz.

Signaling tones
The modulation oscillator can be used to generate sequential (up to 16 tones) or sub-audible signaling tones in accordance with EIA, ZVEI, DZVEI, CCIR, EURO 1, EEA, NATAL and DTMF* standards. Facilities are also available for creating and storing user defined tone systems.
* Requires second modulation oscillator (option 001) to be fitted.

External Modulation

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied.
Input impedance 100 kΩ nominal.

Modulation ALC

The EXT MOD 1 and EXT MOD 2 modulation inputs can be levelled by an ALC system.

Level Range
1 V to 2 V peak (0.7 V RMS to 1.4 V RMS sine wave).

Distortion
Less than 0.1% additional distortion for frequencies up to 20 kHz (typically less than 0.1% up to 50 kHz).

1 dB Bandwidth
Typically 10 Hz to 500 kHz.

LF Output

Front panel BNC connector. The output may be configured in the LF Generator Mode to give an output from the internal modulation oscillator and in the LF Monitor Mode to give an output from the internal modulation signal paths.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
7 digits with unit annunciators for frequency and 3 digits with unit annunciators for level.

Level
100 µV to 5 V RMS with a load impedance of greater than 600 Ω. 100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω.

Source impedance
5.6 Ω nominal.

Level accuracy at 1 kHz
With a load impedance of greater than 10 kΩ: ±5% for levels above 50 mV and ±10% for levels from 500 µV to 50 mV.

Frequency response
Typically better than ±1 dB, 0.1 Hz to 300 kHz.

Sweep

Control modes
Start/stop values of selected parameter. Number of steps. Time per step.

Step time
1 ms to 10 s per step.

Sweep ramp
Synchronized analog ramp with a nominal amplitude of 0 to 10 V peak on rear panel BNC connector.

Markers
User selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to +5 V from 600 Ω on rear panel BNC socket.

Trigger
Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep. Socket is internally connected via 10 kΩ pull-up resistor to +5 V.

Frequency Standard

Frequency
10 MHz.

Temperature stability
Better than ±5 in 10^8 over the operating range of 0 to 50°C.

Warm up time
Within 2 in 10^7 of final frequency within 10 minutes from switch on at 20°C ambient.

Ageing rate
Better than 2 in 10^7 per year.

Output
Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω. This output can be disabled.

External input
Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with an input level in the range 220 mV to 1.8 V RMS into 1 kΩ.

General

GPIB INTERFACE
A GPIB interface is fitted as standard. All functions except the supply switch and display contrast are remotely programmable.

Capabilities
Designed in accordance with IEEE 488.2.
Complies with the following subsets as defined in IEEE Std.488.1. SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

ELECTRO-MAGNETIC COMPATIBILITY
Conforms with the protection requirements of Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2,3,4
EN60555-2	IEC 555-2.

SAFETY
Complies with IEC 348, HD401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.
Approved to UL 1244.

RATED RANGE OF USE
(Over which full specification is met)

Temperature
0 to 55°C.

Humidity
Up to 93% at 40°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
-40 to +71°C.

Humidity
Up to 93% relative humidity at 40°C.

Altitude
Up to 4600 m (15,000 ft).

POWER REQUIREMENTS

AC supply
Four settings covering 90-115 V, 105-32 V, 188-242 V and 216-265 V.
45 Hz to 400 Hz. 120 VA to 180 VA depending on version and options fitted.

CALIBRATION INTERVAL
2 years.

DIMENSIONS AND WEIGHT
(Over projections but excluding front panel handles)

Height	Width	Depth	Weight
152 mm	425 mm	525 mm	16.5 kg
6 in	16.6 in	20.5 in	36 lb

Options

SECOND MODULATION OSCILLATOR OPTION
Specification as Modulation Oscillator.

PULSE MODULATION OPTION

Modulation Modes
Pulse modulation may be used alone or in conjunction with FM, ΦM or Wideband FM.

Rise Time
25 ns (Typically 5 ns).

Control
0 V for carrier off, +5 V for carrier on.
Threshold level typically +2.5 V.

ON/OFF Ratio
Better than 70 dB.

Input impedance
50 Ω.

OPTION 105
Modifies pulse modulation option for a typical rise and fall time of 2 µs.

+19 dBm RF OUTPUT LEVEL OPTION
For 2030 model only.

RF Output Range
–144 dBm to +19 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +13 dBm at maximum AM depth.

Harmonics
At RF levels up to +7 dBm: better than –27 dBc.

GSM/PCN/PCS OPTION
See separate sheet.

AVIONICS OPTION
See separate sheet.

RF PROFILE AND COMPLEX SWEEP
See separate sheet.

PULSE GENERATION OPTION
See separate sheet

DME OPTION
See separate sheet

ELECTRONIC ATTENUATOR
Carrier Frequency Range
250 kHz* to 1.35 GHz (2030),
250 kHz* to 2.7 GHz (2031).
* Useable to 10 kHz

RF Output Range
-138 dBm to +10 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +4 dBm at maximum AM depth.

Accuracy
±1.2 dB for output levels >-127 dBm at 22°C ±5°C

Temperature Stability
±0.01 dB/°C

VSWR
<1.5:1 for output levels less than 0 dBm

Reverse Power Handling
1 W from a source VSWR of up to 5:1.

Amplitude Modulation
Standard specification applies for carrier frequencies above 50 MHz.

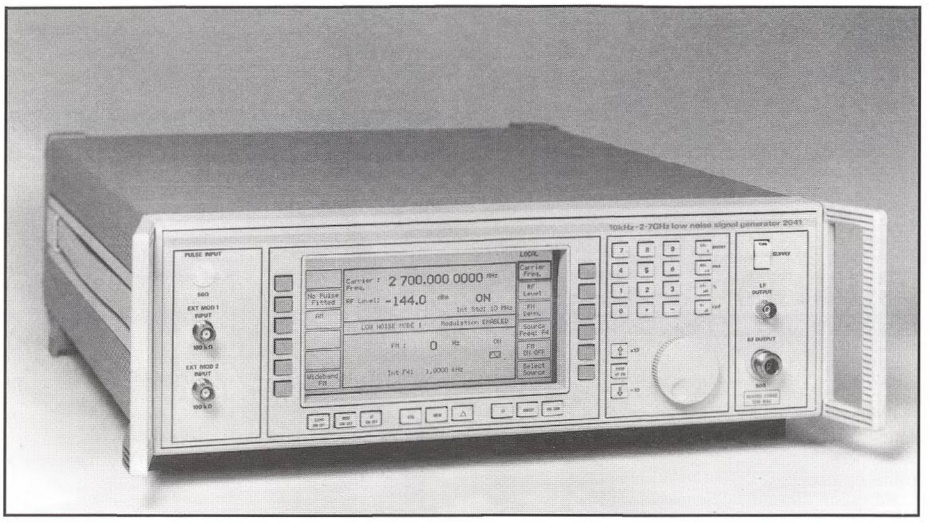
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
	Options
Option 001	Second internal modulation oscillator
Option 002	Pulse Modulation
Option 003	+19 dBm Output Level (2030 only).
Option 005	GSM/PCN/PCS (GMSK Bt 0.3 Modulation).
Option 006	Avionics (requires Option 001, cannot be used with Option 003).
Option 008	RF Profiles and Complex Sweep.
Option 009	Internal Pulse Generator. Needs Option 002.
Option 010	DME (requires Option 001 and 006, cannot be used with Option 003 or Option 005).
Option 012	Electronic Attenuator (2030 and 2031 only). Not available with options 003 or 010
Option 105	Modifies the Pulse Modulation option for slower rise and fall time (order with option 002).
Option 112	Ext. mod 2 Input 600 Ω
	Supplied with
	AC supply lead. Operating Manual.
	Optional Accessories
46881/978	Service manual.
43126/012	RF connector cable, 50 Ω, 1.5 m, BNC.
54311/092	Coaxial adapter N male to BNC female.
59999/163	Precision coaxial adapter N male to SMA female.
54411/051	Impedance adapter, 50 to 75 Ω, BNC connectors.
54311/095	RF connector cable, 1 m, type N connectors.
43129/189	GPIB Lead assembly.
46883/408	IEEE/IEC Adapter block for GPIB socket.
46884/291	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884/292	Rack mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884/541	Rack mounting kit containing front mounting brackets only.
46884/444	Maintenance kit for 2030 series.
46662/525	Transit case.
54112/164	Soft carry case.
54499/044	DECT Filter.

2040 series
10 kHz to 5.4 GHz Low Noise Signal Generator

Excellent noise characteristics and low spurious signals for a wide range of critical measurements



- Wide band cover:
  - 10 kHz to 1.35 GHz (2040)
  - 10 kHz to 2.7 GHz (2041)
  - 10 kHz to 5.4 GHz (2042)
- Low residual FM noise: 0.3 Hz RMS at 1 GHz
- Low spurious signals: –90 dBc non-harmonics
- Low phase noise: –140 dBc/Hz at 1 GHz
- Comprehensive modulation modes
- +13 dBm output (+19 dBm optional)
- 0.1 Hz to 500 kHz modulation oscillator
- Comprehensive frequency and amplitude sweep capabilities

The 2040 series of low noise signal generators covers a wide range of frequencies from 10 kHz to 1.35 GHz (2040), 10 kHz to 2.7 GHz (2041) and 10 kHz to 5.4 GHz (2042). With a choice of operating modes, two low noise modes for improved SSB phase noise and normal mode for increased flexibility, the 2040 series can be used in a wide variety of applications. Microprocessor control coupled with a large screen dot matrix display provides ease of use via menu driven displays. Set up time is further reduced by recalling previously stored instrument settings from the non-volatile memory. Remote programming via the GPIB is provided as a standard feature, allowing the instruments to be incorporated in automatic test systems.

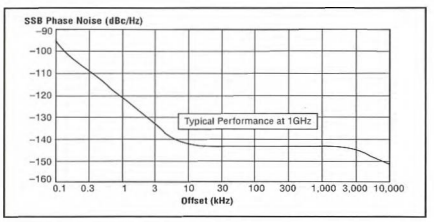
EXCELLENT SPECTRAL PURITY

The excellent noise characteristics and the low level of spurious signals of the 2040 series enable the instruments to be used with confidence for a wide range of critical measurements.

Low SSB Phase Noise

With a specified SSB phase noise performance of better than –140 dBc/Hz at 20 kHz offset from a carrier of 1 GHz, the 2040 series of signal generators is easily able to measure UHF receiver selectivities beyond 90 dB.

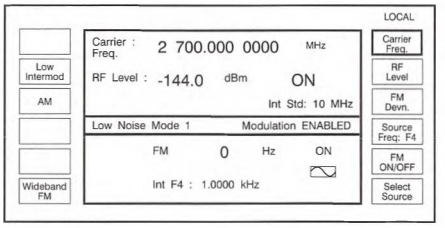
The low residual FM noise figure (less than 0.3 Hz RMS at 1 GHz) gives the 2040 series the capability of measuring UHF receiver signal to noise ratios as high as 80 dB.



Typical phase noise performance at 1 GHz

Low spurious signal content

A specified non-harmonic spurious signal content of –90 dBc ensures the suitability of the 2040 series for the most demanding measurements on modern receivers and RF systems.



Display

A large screen, dot matrix liquid crystal display, with backlighting, offers excellent clarity and low power consumption.

The parameters displayed on the screen depend on the operating mode selected; for example in the Signal Generator mode, carrier frequency, modulation and RF level are shown in separate horizontal regions. Status information is also shown with error messages being displayed in a single line at the top of the screen.

Frequency selection

Carrier frequency entry is selected via a soft key option on the signal generator screen and data is then entered directly via the keyboard. Frequency is resolved to within 0.1 Hz across the complete range of the instrument. Carrier frequencies can be stored in the non-volatile memory for recall at any time. A CARRIER ON-OFF switch is provided to completely disable the output.

RF Output

RF output up to +13 dBm can be set by direct keyboard entry with a resolution of 0.1 dB or better over the entire range. An extended hysterisis facility allows for extended electronic control of RF output level without introducing mechanical attenuator transients when testing squelch systems and an overrange facility allows

the generator to produce RF levels above the normal operating range. A high output option is available to extend the maximum calibrated level to +19 dBm on 2040.

A low intermodulation mode can be selected which disables the RF levelling system and improves the intermodulation performance when combining the outputs of two signal generators.

50 W Protection

An electronic trip protects the generator output against reverse power of up to 50 W, preventing damage to output circuits when RF or DC power is accidentally applied. This feature contributes to long unit life and low cost of ownership.

VERSATILE MODULATION CAPABILITIES

Comprehensive amplitude, frequency (plus Wideband FM), phase and optional high speed pulse modulation are provided for testing all types of receivers.

Modulation Oscillator

An internal modulation oscillator is provided with a frequency range of 0.1 Hz to 500 kHz, resolved to 0.1 Hz. In addition to the normal sine wave output an alternative triangular or square waveform may be selected for sweep applications. A second oscillator may be added as an option. Two independent BNC inputs on the front panel allow external modulation signals to be mixed with the internal signal(s) allowing a maximum of four modulation channels to be active at one time.

Modulation Modes

Four modulation modes are provided – single, dual, composite and dual composite. In the single mode only one type of modulation can be active at any time. Selecting alternative modulation cancels any other active modulation. In the dual mode two types of modulation may be obtained allowing one form of frequency modulation to be combined with one form of amplitude modulation. In the composite mode, only one type of modulation can be active, and is fed by two independent channels. The dual composite mode combines the facilities of the dual mode with the composite mode and provides two types of modulation each fed from two sources.

Frequency and Phase Modulation

The wide range frequency modulation capability provides a 1 dB bandwidth of 300 kHz and provides FM deviation up to a maximum of 1 MHz for frequencies up to 21 MHz, 1% of carrier frequency elsewhere. Phase modulation is also available with a 10 kHz bandwidth up to a maximum of 10 radians.

Both AC and DC coupled FM are available and in the DC coupled mode a patented offset correction system eliminates the large carrier frequency offsets that occur with normal signal generators. As a result the 2040 series signal generators can be used confidently for testing tone and message paging equipment.

Wideband FM

Broadband frequency modulation with a 3 dB bandwidth of 10 MHz is provided via a rear panel BNC socket. This is ideal for tests on equipment using frequency shift keying for high speed digital transmission.

Amplitude and Pulse Modulation

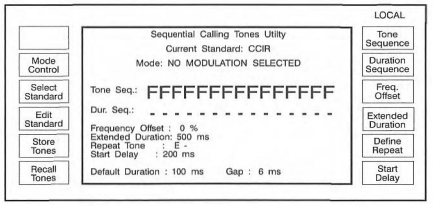
Amplitude modulation with a 1 dB bandwidth of 30 kHz and with modulation depths of up to 99.9% is available with a resolution of 0.1%. Fast pulse modulation is available as an option with rise and fall times of less than 25 ns and a 70 dB on/off ratio.

Modulation Levelling

An automatic level control facility is provided for both of the external modulation inputs and provides correctly calibrated modulation for input levels varying from 0.7 to 1.4 V RMS. HI and LO indications show when the input level is outside the range of the ALC system.

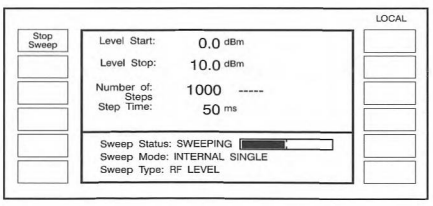
Tone Signaling

The signaling facility allows testing of radios with DTMF, sequential and sub-audible tone capability. A wide range of tone system standards are built in and provision is also made for user definable standards to cover special requirements. Tone sequences can be set up with up to 16 tones in length and the complete sequence can be sent from 1 to 9 times or set to repeat on a continuous basis. Sub-audible tones are normally used in the composite modulation mode where the modulation level for the tone and the in-band modulation can be set independently.



Delta Display

The Delta menu allows the increment values for all the parameters to be set and also includes a TOTAL SHIFT key to show the variations in the parameters from their last keyed in value, a RETURN key to reset the selected parameter to its start value and a TRANSFER key to update the parameter value to equal the shifted value.



FREQUENCY AND LEVEL SWEEP

The digital sweep capability of the 2040 series allows dynamic testing of systems and includes capabilities for sweeping carrier frequency, RF level, LF frequency and LF level. Four parameters are entered to specify the sweep – start value, stop value, number of steps and time per step.

Markers and Ramp Output

Five markers may be defined and a marker output is provided on a rear panel socket together with a 0 to 10 V ramp signal for driving the X axis of an oscilloscope or X-Y plotter.

Option 8 provides additional sweep capabilities which allow the step size, step time and RF level to be entered.

Start/Stop

A single key press starts the sweep and a horizontal bar graph on the display shows the progress of the sweep. The sweep can be stopped at any time and the Up/Down keys used to step forwards or backwards for search purposes. Transfer of the current sweep value into the signal generator or LF modes for more detailed analysis is also possible. The sweep facility can be used in conjunction with a simple X-Y display unit, an oscilloscope or an X-Y plotter.

POWERFUL NON-VOLATILE MEMORY

True non-volatile memory needing no battery back-up is fitted to the 2040 series and is used to store details of instrument settings and calibration information.

Instrument Settings

Details of instrument settings are stored in four areas of memory. One area stores 50 complete instrument settings (including data on parameters which are not currently active), a second area stores 50 partial settings (consisting of details about the currently active parameters), a third area stores details of 100 carrier frequency values and a fourth area stores details of 20 sweep settings. Facilities are provided to prevent the memories from being accidentally overwritten and for recalling a specified memory at switch-on.

Calibration Data

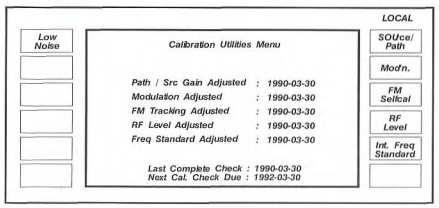
In addition to storage and recall of measurement settings, the non-volatile memory contains data on instrument status and calibration. All calibration data on RF level, FM accuracy, internal frequency standard adjustment and modulation are retained and may be altered from the front panel or via the GPIB after disabling the software protection. Status information stored includes the identity string (type and serial number), choice of internal/external standard, GPIB address, elapsed time and a date alarm for calibration due reminders.

GPIB 488.2 PROGRAMMING

A GPIB interface is fitted as standard so that all functions are controllable over the bus. The instruments function as talkers as well as listeners and the interface has been designed in accordance with the IEEE 488.2 standard.

SIMPLE CALIBRATION

The 2040 has a two year recommended calibration interval, with all routine calibration adjustments carried out without removing the instrument covers. The calibration display is available via soft key selection in the utilities menu.



Low Cost of Ownership

In keeping with the IFR philosophy of cost effectiveness with innovation, the 2040 series has been designed for minimal maintenance and low operating costs. The two year calibration interval combined with the high reliability ensures a low overall cost of ownership.

OPTIONS EXTEND RANGE OF APPLICATIONS

The standard features may be supplemented by taking advantage of the various options available.

Second Modulation Oscillator

An additional modulation oscillator can be fitted to the 2040 series to enable greater flexibility. This second oscillator has the same specification as the first and allows full use of complex modulation modes and is particularly useful where two tone modulation is required.

Pulse Modulation

This optional facility allows radar RF and IF stages to be tested and features rise and fall times of less than 25 ns with an on/off ratio of better than 70 dB.

+19 dBm RF Output Level

A high output option is available for 2040 and provides an extra 6 dB of output level making it ideal for use as a local oscillator or in testing passive components.

Avionics

This optional facility provides for the internal generation of modulation waveforms suitable for the testing of Instrument Landing Systems (ILS) and VHF Omni Range (VOR) beacons. Additional modes of operation support the testing of ADF, Marker Beacons and the SELCAL signaling system.

RF Profiles and Complex Sweep

The RF Profile facility allows the signal generator to compensate for frequency dependent level errors introduced by cables, amplifiers and signal combiners. The Complex Sweep facility allows for the generation of sweeps whose step size, step time and RF level changes while the sweep is in progress. These features are particularly useful for EMC, Tempest and ATE applications.

Electronic Attenuator

An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications

Specification

General Description

2040 series signal generators cover the frequency ranges 10 kHz to 1.35 GHz, 10 kHz to 2.7 GHz and 10 kHz to 5.4 GHz. A large screen dot matrix display with soft key function selection allows flexibility of operation and ease of use. The output may be amplitude, phase or frequency modulated with pulse modulation available as an option. Modulation is available using a combination of an internal synthesized LF oscillator with up to two external signal inputs. A second internal source is available as an option.

Carrier Frequency

Range
10 kHz to 1.35 GHz (2040).
10 kHz to 2.7 GHz (2041).
10 kHz to 5.4 GHz (2042).

Overrange
Selectable overrange mode allows uncalibrated levels up to +19 dBm to be generated (typically up to +25 dBm for 2030/40 with Option 003 fitted). Selectable extended hysterisis provides for uncalibrated RF level control with up to 24 dB range without level interruption.

Selection
By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication
11 digits with annunciators.

Resolution
0.1 Hz.

Accuracy
As frequency standard.

Phase Incrementing
The carrier phase can be advanced or retarded in steps of $\pi/128$ radians (approximately 1.4°) using the rotary control.

RF Output

Range
–144 dBm to +13 dBm.
When AM is selected the maximum output level reduces linearly with AM depth to +7 dBm at maximum AM depth.

Selection
By keyboard entry of data. Variation by UP/DOWN keys and by rotary control. Units may be µV, mV, V EMF or PD; dB relative to 1 mV, 1 µV EMF or PD; dBm.
Conversion between dB and voltage units may be achieved by pressing the appropriate units key (dB, or V, mV, µV).

Indication
4 digits with unit annunciators.

Resolution
0.1 dB.

Accuracy At 22°C ±5°C

	<1.35 GHz	<2.7 GHz	<5.4 GHz
>0 dBm	±0.5 dB	±0.7 dB	±1 dB
>-100 dBm	±0.85 dB	±1 dB	±1.5 dB
>-127 dBm	±0.85 dB	±1 dB	-

Temperature stability dB/°C			
	±0.005	±0.01	±0.02

VSWR
For output levels less than 0 dBm:
Less than 1.25:1 to 2.2 GHz.
Less than 1.4:1 to 2.7 GHz.
Less than 1.5:1 to 5.4 GHz.

Output Protection
Reverse power of 50 W from a source VSWR of up to 5:1.

Noise Modes

Three noise modes are offered with the following characteristics:

Low Noise Mode 1
Lowest phase noise with a restricted FM deviation capability and reduced AM bandwidth.

Low Noise Mode 2
Low phase noise with restricted FM deviation capability and full AM bandwidth.

Normal Mode
Full FM deviation capability and AM bandwidth.

Spectral purity

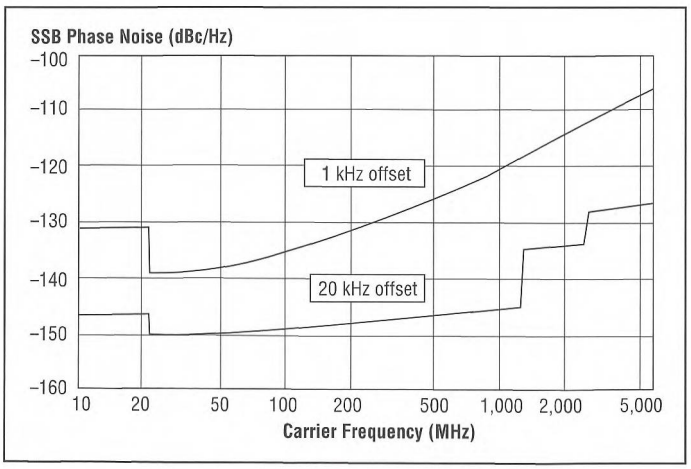
At RF levels up to +7 dBm:

Harmonics
2040, 2041:
Better than –30 dBc to 1 GHz;
Better than –27 dBc above 1 GHz.
2042:
Better than –30 dBc to 1 GHz;
Better than –27 dBc to 1.35 GHz;
Better than –25 dBc above 1.35 GHz.

Sub-Harmonics
Better than –90 dBc to 1.35 GHz.
Better than –40 dBc to 2.3 GHz.
Better than –30 dBc to 5.4 GHz.

Non-Harmonics (offsets greater than 3 kHz)
In low noise modes:
Better than –70 dBc up to 21.09375 MHz.
Better than –90 dBc from 21.09375 MHz to 2.7 GHz.
Better than –84 dBc above 2.7 GHz.
In normal mode:
Better than –70 dBc.

Residual FM (FM off)
Low noise mode: Less than 0.3 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at



Typical Phase Noise Variation with Frequency

1 GHz
Normal mode: Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.

SSB Φ Noise

Carrier Frequency Range	*SSB Phase Noise in dBc/Hz at offset frequencies of:*		
	100 Hz	1 kHz	20 kHz & Above
<1.35 GHz	-75	-115	-140
<675 MHz	-81	-121	-140
<337.5 MHz	-87	-121	-140
<168.7 MHz	-92	-127	-143
<84.3 MHz	-96	-131	-143
<42.1 MHz	-96	-131	-143
<21 MHz	-82	-127	-140

RF Leakage
Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm loop 25 mm or more from any part of the case.

FM on AM
Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.

ΦM on AM
Typically less than 0.1 radians at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

Modulation Modes

Four modulation modes are available:

Single
FM, Wideband FM, ΦM, AM or Pulse (optional).

Dual
Two independent channels of differing modulation type (e.g. AM with FM).

Composite
Two independent channels of the same modulation type (e.g. FM1 with FM2).

Dual composite
A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

FREQUENCY MODULATION

Deviation
Peak deviation available varies with carrier frequency and noise mode selected as follows:

Carrier Frequency Range	*Maximum FM Deviation available:* Normal Mode	Low Noise Modes
2.7 to 5.4 GHz	27-54 MHz*	200 kHz
1.35 to 2.7 GHz	13.5-27 MHz*	100 kHz
675 to 1350 MHz	6.75-13.5 MHz*	50 kHz
337.5 to 675.0 MHz	3.375-6.75 MHz*	25 kHz
168.75 to 337.5 MHz	1.687-3.375 MHz*	12.5 kHz
84.375 to 168.75 MHz	843-1687 kHz*	6.25 kHz
42.1875 to 84.375 MHz	421-843 kHz*	3.125 kHz
21.09375 to 42.1875 MHz	210-421 kHz*	1.56 kHz
10 kHz to 21.09375 MHz	1 MHz	6.25 kHz

*Maximum FM deviation available is 1% of carrier frequency value when in normal noise mode.

Selection
By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication
3 digits with annunciators.

Displayed Resolution
1 Hz or 1 least significant digit, whichever is greater.

Accuracy at 1 kHz
In low noise modes:
±6% of indication ±1 Hz excluding residual FM.
In normal mode:
±5% of indication ±10 Hz excluding residual FM.

Bandwidth (1 dB)
DC to 300 kHz (DC coupled).
10 Hz to 300 kHz (AC coupled).
Bandwidth is limited to 100 kHz in low noise modes.
Input is capable of accepting external sources of FSK signals. Typical 3 dB bandwidth in normal mode is greater than 1 MHz.

Group delay
Less than 1 µs from 3 kHz to 500 kHz in normal mode.
Less than 3 µs from 3 kHz to 250 kHz in low noise modes.
Carrier Frequency Offset
In DC FM mode less than ±(1 Hz +0.1% of set deviation) after using DC FM nulling facility.

Distortion
Using external modulation without ALC:
Less than 3% at maximum deviation for modulation frequencies up to 20 kHz.
Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.

Modulation Source
Internal LF generator or external via front panel sockets.

Wideband FM

Deviation
As FM.

Indication
3 digits with annunciators.

Selection
By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the value of deviation nearest to the requested value.

Input level
1 V RMS to achieve indicated deviation.

Accuracy
As FM.

3 dB Bandwidth
In normal noise mode typically 10 MHz (DC or AC coupled).
In low noise modes typically 250 kHz (DC or AC coupled).

Group delay
Less than 0.5 µs from 3 kHz to 10 MHz in normal modes.

Modulation Source
External via rear panel socket (50 Ω impedance).

Phase Modulation

(Normal mode only)

Deviation
0 to 10 radians.

Selection
By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication
3 digits with annunciators.

Resolution
0.01 radians.

Accuracy at 1 kHz
±5% of indicated deviation excluding residual phase modulation.

3 dB Bandwidth
100 Hz to 10 kHz.

Distortion
Less than 3% at maximum deviation at 1 kHz modulation rate.

Modulation Source
Internal LF generator or external via front panel sockets.

Amplitude Modulation

For Carrier Frequencies up to 1 GHz:

Range
0 to 99.9%.

Selection
By keyboard entry of data. Variation by up/down keys and by rotary control.

Indication
3 digits with annunciator.

Resolution
0.1%.

Accuracy
±4% of setting +1%.

1 dB Bandwidth
In normal and low noise mode 2:
With Modulation ALC off; DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode.
Typical modulation bandwidth exceeds 50 kHz.
In low noise mode 1:
With Modulation ALC off; Useable from DC to 1.5 kHz in DC coupled mode and 10 Hz to 1.5 kHz in AC coupled mode.

Distortion
For a modulation rate of 1 kHz:
Less than 1% total harmonic distortion for depths up to 30%.
Less than 3% total harmonic distortion for depths up to 80%.

Modulation Source
Internal LF generator or external via front panel sockets.

Modulation Oscillator

Frequency Range
0.1 Hz to 500 kHz.

Selection
By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication
7 digits with annunciators.

Resolution
0.1 Hz.

Frequency Accuracy
As frequency standard.

Distortion
Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz.

Alternative Waveform
A triangular wave is available for frequencies up to 100 kHz and a square wave up to 2 kHz.

Signaling Tones
The modulation oscillator can be used to generate sub-audible or sequential (up to 16 tones) signaling tones in accordance with EIA, ZVEI, DZVEI, CCIR, EURO 1, EEA, NATAL and DTMF* standards.
Facilities are also available for creating and storing user defined tone systems.
* Requires second modulation oscillator (Option 001) to be fitted.

External Modulation

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1 V RMS sine wave applied. Input impedance 100 kΩ nominal.

Modulation ALC

The EXT MOD 1 and EXT MOD 2 modulation inputs can each be levelled by an ALC system.

Level Range
0.7 V RMS to 1.4 V RMS sine wave.

Distortion
Less than 0.1% additional distortion for frequencies up to 20 kHz (typically less than 0.1% up to 50 kHz).

1 dB Bandwidth
Typically 10 Hz to 500 kHz.

LF Output

Front panel BNC connector. The output may be configured in the LF Generator Mode to give an output from the internal modulation oscillator and in the LF Monitor Mode to give an output from the internal modulation signal paths.

Selection
By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication
7 digits with unit annunciators for frequency and 4 digits with unit annunciators for level.
Level

100 µV to 5 V RMS with a load impedance of greater than 600 Ω.
100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω.

Common mode voltage
±0.5 V maximum.

Source impedance
5.6 Ω nominal.

Level Accuracy at 1 kHz
With a load impedance of greater than 10 kΩ: +5% for levels above 50 mV and ±10% for levels from 500 µV to 50 mV.

Frequency Response
Typically better than ±1 dB from 0.1 Hz to 300 kHz.

Sweep

Not available in low noise mode.

Control Modes
Start/stop values of selected parameter.
Number of steps.
Time per step.

Step Time
1 ms to 10 s per step.

Sweep Ramp
Synchronized analog ramp with an amplitude of nominally 0 to 10 V peak on rear panel BNC connector.

Markers
Five user selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to + 5 V from 600 Ω on rear panel BNC socket.

Trigger
Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep or steps from point to point on the sweep. Socket is internally connected via 10 kΩ pull-up resistor to +5 V.

Frequency Standard

Frequency
10 MHz.

Temperature Stability
Better than ±5 in 10^8 over the operating range of 0 to 50°C.

Warm up time
Within 2 in 10^7 of final frequency within 10 minutes from switch on at 20°C ambient.

Ageing Rate
Better than 2 in 10^7 per year.

Output
Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω.

External input
Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with an input level in the range 220 mV to 1.8 V RMS into 1 kΩ.

General

GPIB INTERFACE
A GPIB interface designed in accordance with IEEE 488.2 is fitted as standard.

Capabilities
Complies with the following subsets as defined in IEEE Std.488.1. SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

ELECTRO-MAGNETIC COMPATIBILITY:
Conforms with the protection requirements of Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:
EN55011 Class B CISPR 11
EN50082-1 IEC 801-2,3,4
EN60555-2 IEC 555-2

SAFETY
Complies with IEC 348, HD401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.
Approved to UL 1244.

RATED RANGE OF USE

(Over which full specification is met)

Temperature
0 to 55°C.

Humidity
Up to 93% at 40°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
–40 to +71°C.

Humidity
Up to 93% relative humidity at 40°C.

Altitude
Up to 4600 m (15,000 ft).

POWER REQUIREMENTS

AC supply
Four settings covering 90-115 V, 105-132 V, 188-242 V and 216-265 V.
45 Hz to 400 Hz.
120 to 180 VA depending on version and options fitted.

CALIBRATION INTERVAL
2 years.

DIMENSIONS AND WEIGHT

(Over projections but excluding front panel handles)

Height	Width	Depth	Weight
152 mm	425 mm	525 mm	21kg
6 in	16.6 in	20.5 in	46 lb

Options

SECOND MODULATION OSCILLATOR OPTION
Specification as Modulation Oscillator.

PULSE MODULATION OPTION

Modulation Modes
Pulse modulation may be used alone or in conjunction with FM, ΦM or Wideband FM.

Rise Time
Less than 25 ns.

Control
0 to +1 V for carrier off, +3.5 to +5 V for carrier on.

ON/OFF Ratio
Better than 70 dB, typically exceeds 80 dB.

Additional level error
Less than ±0.5 dB.

Propagation delay
Typically 80 ns from pulse input to RF pulse output.

Input Impedance
50 Ω nominal.

OPTION 105
Modifies pulse modulation option for a typical rise and fall time of 2 µs.

+19 dBm RF OUTPUT LEVEL OPTION
For 2040 model only.

RF Output Range
–144 dBm to +19 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +13 dBm at maximum AM depth.
Overrange allows levels up to +25 dBm to be requested.

Harmonics
At RF levels up to +7 dBm: better than –27 dBc.

AVIONICS OPTION
See separate sheet.

RF PROFILE AND COMPLEX SWEEP
See separate sheet.

ELECTRONIC ATTENUATOR
Carrier Frequency Range
250 kHz* to 1.35 GHz (2040),
250 kHz* to 2.7 GHz (2041).
* Useable to 10 kHz

RF Output Range
-138 dBm to +10 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +4 dBm at maximum AM depth.

Accuracy
±1.2 dB for output levels > -127 dBm at 22°C ±5°C

Temperature Stability
±0.01 dB/°C

VSWR
<1.5:1 for output levels less than 0 dBm.

Reverse Power Handling
1 W from a source VSWR of up to 5:1.

Amplitude Modulation
Standard specification applies for carrier frequencies above 50 MHz.

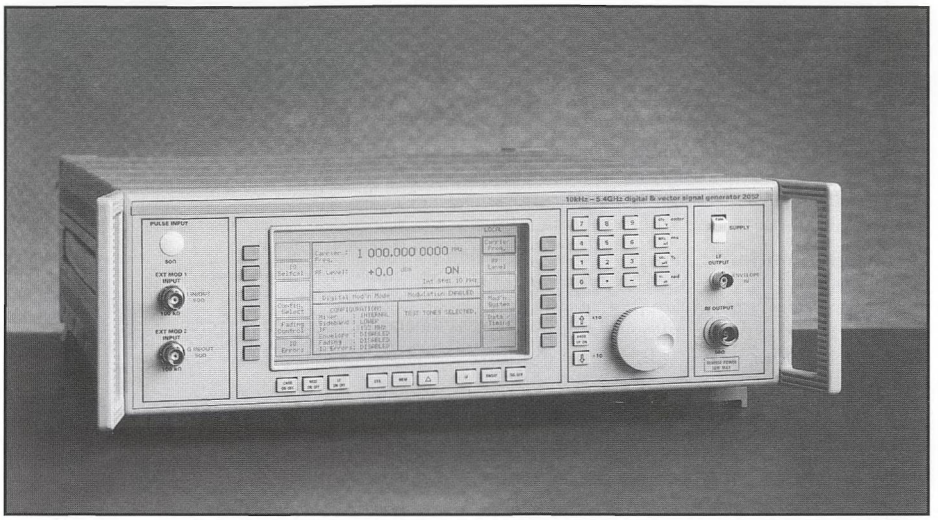
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2040	10 kHz to 1.35 GHz Signal Generator
2041	10 kHz to 2.7 GHz Signal Generator
2042	10 kHz to 5.4 GHz Signal Generator
	Options
	Options are factory fitted only and must be specified at the time of ordering.
Option 001	Second internal modulation oscillator.
Option 002	Pulse Modulation.
Option 003	+19 dBm Output Level (2040 only).
Option 006	Avionics (requires Option 001, not with Option 003).
Option 008	RF Profile and Complex Sweep.
Option 012	Electronic attenuator (2040 and 2041 only). not available with option 003
Option 105	Modifies the pulse modulation option for slower rise and fall time (order with Option 002).
Option 112	Ext. mod 2 Input 600 Ω
	Supplied with
	AC supply lead.
	Operating Manual.
	Optional Accessories
46880-050	Service manual.
43126-012	RF connector cable, TM 4969/3, 50 Ω, 1.5 m, BNC.
54311-092	Coaxial adapter N male to BNC female.
59999-163	Precision coaxial adapter N male to SMA female.
54411-051	Impedance adapter, 50 to 75 Ω, BNC connectors.
54311-095	RF connector cable, 1 m, type N connectors.
43129-189	GPIB Lead assembly.
46883-408	IEEE/IEC Adapter block for GPIB socket.
46884-291	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884-292	Rack Mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884-541	Rack mounting kit containing front mounting bracket only.
46884-444	Maintenance kit 2030/40 series.
46662-525	Transit case.
46662-559	Soft carry case.
54499-044	DECT filter.

2050 series
Digital and Vector Signal Generator

Designed to meet the needs of modern digital radio technologies to 5.4 GHz



- PSK, FSK, QAM, GMSK
- I and Q modulation to 10 MHz (1 dB bw.)
- External digital data input
- Internal PRBS data source
- Excellent accuracy and stability
- Envelope control for RF bursts
- Programmable channel filter characteristics
- Variable data rate control
- NADC, PDC, GSM, TETRA plus others
- Wide band DCFM for fast FSK
- Baseband I & Q outputs
- Electronic attenuator option

The 2050 series of digital and vector signal generators covers the frequency range 10 kHz to 1.35 GHz (2050), 10 kHz to 2.7 GHz (2051) and 10 kHz to 5.4 GHz (2052). These instruments are suitable for a wide range of applications including the testing of new digital communication systems.

Modulation Capability

The 2050 combines comprehensive analog modes, AM, FM, PM and Pulse (optional), with I Q vector modulation. A digital mode using internal DSP (digital signal processing) is provided to convert digital data into complex modulation formats as shown in the following table.

FSK	2 and 4 level
GMSK	
PSK	2, 4 and 8 level
DPSK (Differential)	2, 4 and 8 level
Phase Offset DPSK	2, 4 and 8 level
Time Offset PSK	4 level
QAM	4, 16, 64 and 256 level

Two FM modes are available, wideband FM (>10 MHz) for fast FSK or video applications and a 1 MHz bandwidth mode. Both modes offer FM deviations up to 1% of carrier frequency. FM is available as either DC or AC coupled. A patented FM nulling correction system eliminates carrier frequency offsets that occur with lesser generators when using DCFM, and allows the 2050 to be used confidently with Wireless LAN or paging equipment such as POCSAG, FLEX™ and ERMES.

Vector Modulation

In Vector mode the signal generator accepts I and Q modulation inputs with 10 MHz, 1 dB bandwidth. This precision modulator enables any modulation characteristic to be simulated with a high degree of accuracy, typical vector errors of less than 0.5% are possible. The excellent temperature stability and drift characteristics of the modulator ensure calibrated signals are always available making this the ideal choice for demanding research and development applications as well as in manufacturing of digital communications systems.

The wide IQ bandwidth allows the generation of Direct Sequence Spread Spectrum signals as used in CDMA as well as QAM and OFDM signals as used in new broadcasting formats such as DAB (Digital Audio Broadcast).

Precision radar Chirp signals can be simulated in conjunction with an Arbitrary Waveform Generator to test radar receivers.

Digital Modulation

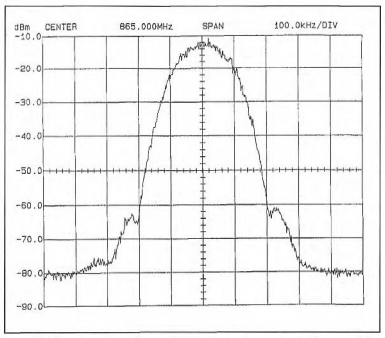
In digital mode, the signal generator is able to produce a wide array of digital modulation types and in each case the user is free to modify the data rate and filter characteristics to suit individual application needs. This level of control and flexibility means that the 2050 series is fully prepared today for the digital formats of tomorrow's narrow band digital radio communications equipment.

For common standards, the 2050 is already pre-programmed to generate the required modulation format from a single key press and so aid ease of use. Proprietary schemes can be created and stored into non volatile user memories.

Mod Type	*System*
π/4 DQPSK	NADC (DAMPS), PDC (JDC), TETRA, TFTS, APCO25
GMSK	GSM, Mobitex, CDPD, MC9, DSRR, MD24-192N/W, Modacom
OQPSK	Inmarsat M
FSK	POCSAG, CITYRUF
4FSK	ERMES, APCO25
8DPSK	VDR (VDL)

Data rates up to 34 ksymbols/sec can either be generated internally from a pseudo random sequence generator or supplied externally as a serial or parallel data stream into a flexible digital interface. A burst control input allows TDMA or TDD bursts to be generated synchronously with the data. A separate analog envelope control input allows linear control of the RF level to simulate bursted modulation conforming to power time template and

adjacent channel spectrum requirements.



In digital mode the user can introduce defined errors to the modulation as skew, gain imbalance and carrier leakage, and so aid investigation of design limitations.

Fading Simulation

The built-in Rician and Rayleigh fading simulator with programmable path ratio and Doppler speed allows testing of receivers under 'real life' propagation conditions in which receivers must operate. The availability of fading simulation at the early design stages of new communications equipment simplifies the development of more robust designs and reduces the time taken for full compliance testing.

Software Assisted Calibration

All calibration and re-alignment procedures can be carried out without removal of the instrument covers and can be performed either manually or automatically via the GPIB. No internal adjustments are necessary; even the frequency standard is adjusted via the front panel or GPIB. During manual alignment full instructions are given on the instrument display. In digital and vector modes a self calibration system optimizes the performance of the vector modulator; a warning is displayed when environmental changes or elapsed time warrant a re-calibration of the modulator.

Electronic Attenuator

An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications.

Specification

General Description

2050 series signal generators have a large screen dot matrix display with softkey function selection which allows flexibility of operation. Hardkey and data entry key together with a rotary control knob are also provided. The output may be modulated using FM, ΦM, AM, IQ vector or complex digital modulation. Pulse modulation is optional.

Carrier Frequency

Range
10 kHz to 1.35 GHz (2050)
10 kHz to 2.7 GHz (2051)
10 kHz to 5.4 GHz (2052)
In digital and vector modes the lowest frequency is 10 MHz and for 2052 the highest frequency is reduced to 2.7 GHz.

Selection
By keyboard entry of data.
Variation by up/down keys and by rotary control.

Indication
11 digits with annunciators.

Resolution
0.1 Hz.

Accuracy
As frequency standard.

Phase incrementing
The carrier phase can be advanced or retarded in steps of 1.5° using the rotary control.

RF Output

Range (Analog mode)
–144 dBm to +13 dBm
Max guaranteed output above 2.7 GHz is +11 dBm. With AM selected, the maximum output level reduces linearly with AM depth to +7 dBm at maximum AM depth.

Range (Digital or Vector mode)
–138 to +6 dBm peak envelope power.
RF level is defined with a PRBS modulation applied in digital mode or with 0.5 V applied to either the I or Q input in vector mode.

Selectable Overrange Mode
Uncalibrated levels up to +19 dBm.

Selectable Extended Hysterisis
Uncalibrated RF level control over a range of 24 dB (maximum) without level interruption.

Selection
By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control. Units may be µV, mV, V, EMF or PD; dB relative to 1 µV, 1 mV, EMF or PD; dBm.

Indication
4 digits with unit annunciators.

Resolution
0.1 dB.

Accuracy
At 22°C ±5°C in non Digital or Vector modes:

	<1.35 GHz	<2.7 GHz	<5.4 GHz
>0 dBm	±0.5 dB	±0.7 dB	±1 dB
>–50 dBm	±0.85 dB	±1 dB	±1.5 dB
>–127 dBm	±0.85 dB	±1 dB	–
Temperature stability dB/°C	0.005	0.01	0.02

In Digital or Vector Mode:
At a temperature of 22°C ±5°C
<2 GHz ±1.5 dB
<2.7 GHz ±2 dB
Temperature coefficient : <0.04 dB/°C

VSWR
For output levels less than 0 dBm:
<2.2 GHz<1.25:1 (19.1 dB return loss)
<2.7 GHz<1.4:1 (15.6 dB return loss)
<5.4 GHz<1.5:1 (14 dB return loss)

Spectral Purity

At RF levels up to +7 dBm in CW and analog modulation modes:

Harmonics	≤1 GHz	1 GHz to 1.35 GHz	>1.35 GHz
2050 & 2051	<-30 dBc	<-27 dBc	<-27 dBc
2052	<-30 dBc	<-27 dBc	<-25 dBc

Sub-Harmonics
< –90 dBc to 1.35 GHz, < -40 dBc to 2.3 GHz, < –30 dBc to 5.4 GHz.

Non-Harmonics
< –70 dBc at offsets from the carrier frequency of 3 kHz or greater.

Residual FM
Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.

SSB phase noise
Less than –116 dBc/Hz (typically –122 dBc/Hz) at an offset of 20 kHz from a carrier frequency of 470 MHz.

RF Leakage
Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm loop, 25 mm or more from any part of the case.

FM on AM
Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.

ΦM on AM
Typically less than 0.1 radians at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

In digital and vector modes of operation:
Modulation is generated by converting a 120 MHz, 132 MHz, 160 MHz or 176 MHz intermediate frequency (IF) to the required carrier frequency. Additional signals are present at the local oscillator frequency, image frequency and frequencies equivalent to the harmonics of the IF mixed with the local oscillator.

Phase noise
In vector mode: As analog modulation and CW modes.
In digital mode: As analog modulation modes for offsets >100 kHz ; < –108 dBc/Hz at 20 kHz offset from a 1 GHz carrier.

Modulation Modes

Six modulation modes are available:

Single
FM, Wideband FM, ΦM, AM or pulse (optional).

Dual
Two independent channels of differing modulation type (e.g. AM with FM).

Composite
Two independent channels of the same modulation type (e.g. FM1 with FM2).

Dual composite
A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

Vector
Provides IQ modulation facility.

Digital
Accepts digital inputs and converts the signal to QAM, PSK , GMSK or FSK formats.

Frequency Modulation

Deviation
Peak deviation from 0 to 1 MHz for carrier frequencies up to 21.09375 MHz. Peak deviation from 0 to 1% of carrier frequency above 21.09375 MHz.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
3 digits with annunciators.

Displayed Resolution
1 Hz or 1 least significant digit, whichever is greater.

Accuracy at 1 kHz
±5% of indication ±10 Hz excluding residual FM.

Bandwidth (1 dB)
DC to 300 kHz (DC coupled).
10 Hz to 300 kHz (AC coupled).
Input is capable of accepting external sources of FSK signals. Typical 3 dB bandwidth is >1 MHz.

Group delay
Less than 1 µs from 3 kHz to 500 kHz.

Carrier Frequency Offset
In DC FM less than ± (1 Hz + 0.1% of set deviation) after using DC FM nulling facility.

Distortion
Using external modulation without ALC: Less than 3% at maximum deviation for modulation frequencies up to 20 kHz. Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.

Modulation source
Internal LF generator or external via front panel sockets.

Wideband FM

Deviation
As FM.

Indication
3 digits with annunciators.

Selection
By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the nearest value of deviation to that requested.

Input level
1.414 V peak (1 V RMS sine wave) to achieve indicated deviation.

Accuracy
As FM.

3 dB Bandwidth
Typically 10 MHz (DC or AC coupled).

Group Delay
Less than 0.5 ms from 3 kHz to 10 MHz.

Modulation Source
External via rear panel socket (50 Ω impedance).

Phase Modulation

Deviation
0 to 10 radians.

Selection
By keyboard entry of data.
Variation by up/down keys (or ⇧⇩) and by rotary control.

Indication
3 digits with annunciators.

Resolution
0.01 radians.

Accuracy at 1 kHz
±5% of indicated deviation excluding residual phase modulation.

3 dB Bandwidth
100 Hz to 10 kHz.

Distortion
Less than 3% at maximum deviation at 1 kHz modulation rate.

Modulation Source
Internal LF generator or external via front panel sockets.

Amplitude Modulation

For carrier frequencies up to 1 GHz.

Range
0 to 99.9%.

Selection
By keyboard entry of data.
Variation by up/down keys (or ⇧⇩) and by rotary control.

Indication
3 digits with annunciator.

Resolution
0.1%.

Accuracy
±4% of setting ±1%.

1 dB Bandwidth
With modulation ALC off; DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode.
Typical modulation bandwidth exceeds 50 kHz.

Distortion
For a modulation rate of 1 kHz: Less than 1% total harmonic distortion for depths up to 30%, less than 3% total harmonic distortion for depths up to 80%.

Modulation source
Internal LF generator or external via front panel connectors.

Digital Modulation

In digital mode the instrument can be used over the carrier frequency range 10 MHz to 1.35/2.7 GHz and accepts internal or external data to modulate the RF output. The modulation can be applied in common digital formats and the channel filter characteristics specified.

Internal Data
All 0's, 1's or selectable PN 2 to 7, 9, 10, 11 or 15 PRBS sequence.
Note with GSM selected PRBS is limited to PN9 & 15. All 0's and all 1's are available.

External data
Accepts data as a serial input or parallel input from a 25 way auxiliary D Type connector on the rear panel. Accepts symbols containing 1 to 8 data bits with internally or externally generated clock sources. All inputs and outputs are TTL/CMOS logic compatible.
Note, in GSM mode, external data must be supplied as 8 bit parallel.

Symbol Rate

Mod Type	*min sym/s*	*max sym/s*	*Filter*
PSK, QAM	1900	34000	Nyquist/Root Nyquist
PSK, QAM	1900	25000	Gaussian
FSK,	1900	25000	Nyquist/Root Nyquist
FSK, GMSK	512	25000	Gaussian
OQPSK	1900	16000	All filters

Symbol source can be internal or external, internal symbol rate is adjustable in steps of 0.1 symbols/s. Symbol rate must be within 2% of external symbol rate to maintain modulation accuracy.

Generic Modulation types
Can select PSK, Differential PSK, Differential Phase Offset PSK (i.e π/4DQPSK), Time Offset QPSK, QAM, GMSK and FSK. The number of bits per symbol can be selected from 2 to 8 for QAM, 1 to 3 for PSK and 1 or 2 for FSK systems.

RF Channel Filters
Root raised cosine, raised cosine or Gaussian. Filter bandwidth can be selected as follows: Raised cosine or root raised cosine for α from 0.2 to 0.8 in 0.01 steps. Gaussian 3 dB bandwidth from 0.4 of the symbol rate (0.2 of symbol rate as IQ baseband filter) up to a maximum of 22.6 kHz.

Pre-defined Modulation Types
The following can be selected:

Mod Type	*System*
π/4 DQPSK	NADC (DAMPS), PDC (JDC), TETRA, TFTS, APCO25
GMSK	GSM, Mobitex, CDPD, MC9, DSRR, MD24-192N/W, Modacom
OQPSK	Inmarsat M
FSK	POCSAG, CITYRUF
4FSK	ERMES, APCO25
8DPSK	VDR (VDL)

Modulation Accuracy
At the decision points with the envelope input at 1 V or disabled and filter above 0.25 for raised cosine filters and 0.3 for root raised cosine filters:
- PSK & QAM <1.5% RMS vector error
- NADC, PDC <1% RMS vector error (EIA, RCR 27A method)
- GSM & CDPD <3° RMS phase error (typical)

FSK/GMSK
Frequency deviation can be set with 1 Hz resolution across the range 100 Hz to 20 kHz.
Accuracy: <1% of set deviation.

Modulation errors
Modulation errors can be added to simulate:
IQ skew from 0 to ± 20° in 0.1° steps
IQ imbalance from 0 to ±10 dB in 0.1 dB steps
Carrier leak from 0 to 10% in 0.1% steps
Range of errors allowed is limited by the peak envelope power.
Note: modulation errors are not available in either GSM or OQPSK modes.

IQ Outputs
Baseband IQ output signals available on the front panel at a level of 0.5 V p.d. nominal into 50 Ω.

Burst control
Available on the rear panel D Type connector. A logic 1 on the burst control turns the RF on over a time interval corresponding to 3 data symbols. Propagation delay is matched to the data path delay. Can be used with the Envelope input.

ON/OFF Ratio
Greater than 80 dB.

Vector Modulation

Provides for IQ modulation of the carrier output from an external source for carrier frequencies of 10 MHz to 1.35/2.7 GHz.

Carrier Leakage and SSB Image Rejection
Following self-calibration, the RF carrier leakage and SSB image rejection are typically 50 dB.

Vector inputs
IQ inputs on the front panel. The RF level requested is obtained with 0.5 V DC applied to one of the inputs. Input impedance is selectable between 50 Ω and 300 Ω.

DC Vector accuracy
For carrier frequencies up to 2 GHz:
±1% amplitude of FS.
±1° at FS.
For carrier frequencies above 2 GHz:
±1.5% amplitude of FS.
±1.5° at FS.

Vector bandwidth
±0.5 dB wrt DC for modulation frequencies up to 3 MHz.
±1 dB wrt DC for modulation frequencies up to 10 MHz and carrier frequencies up to 2 GHz.
±1.3 dB wrt DC for carrier frequencies up to 2.7 GHz.

IQ Modulation Calibration

The signal generator can calibrate the IQ modulator automatically. After a 0.5 hour warm up period the calibration remains valid for at least 3 hours over a temperature range of ±5°C. The instrument displays a warning if the calibration validity time or temperature range has been exceeded. Calibration is valid for both digital and vector modes.

Fading Simulation

Rayleigh and Rician fading can be simulated in both Vector and Digital modulation modes. Doppler speed can be entered from 0 to 200 Hz with a maximum ratio of 2:1 between direct and scattered speed. Path ratio can be set to ±50 dB.
Note: Fading is not available in either GSM or OQPSK modes.

Envelope Control

The RF level can be varied by applying a control voltage to the envelope input in digital and vector modes. The input may be used to shape the rise and fall of an RF burst and simulate the effect of varying RF levels being received from mobiles in TDMA systems. Applying 1 V gives the set RF level and 0 V suppresses the carrier.

Linear range
Greater than 30 dB.
Linearity typically better than 0.5 dB at –20 dBV (100 mV input).

ON/OFF ratio
Greater than 80 dB.

Envelope delay
< 10 µs, typically 6 µs.

Rise/fall time
Less than 13 µs to –70 dBc.

IF Output

An IF output is available on the rear panel which is modulated by the selected digital or vector modulation. The IF output can be inhibited by software control. The IF output can be used to provide modulated carriers at higher frequencies by external frequency conversion. The RF output from the front panel connector can be used as an LO for external frequency conversion.

Modulation Oscillator

Frequency range
0.1 Hz to 500 kHz.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
7 digits with annunciators.

Resolution
0.1 Hz.

Frequency accuracy
As frequency standard.

Distortion
Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz.

Alternative waveform
A triangular wave is available in addition to the sine wave for frequencies up to 100 kHz.

2050 series

Signaling tones
The modulation oscillator can be used to generate sequential (up to 16 tones) or sub-audible signaling tones in accordance with EIA, ZVEI, DZVEI, CCIR, EURO 1, EEA, NATAL and DTMF* standards. Facilities are also available for creating and storing user defined tone systems.
* Requires second modulation oscillator (option 001) to be fitted.

External Modulation

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance 100 kΩ nominal.

MODULATION ALC
The EXT MOD 1 and EXT MOD 2 modulation inputs can be levelled by an ALC system.

Level Range
1 V to 2 V peak (0.7 to 1.4 V RMS sine wave).

Distortion
Less than 0.1% additional distortion for frequencies up to 20 kHz (typically less than 0.1% up to 50 kHz).

1 dB Bandwidth
Typically 10 Hz to 500 kHz.

LF Output

Front panel BNC connector. The output may be configured in the LF Generator Mode to give an output from the internal modulation oscillator and in the LF Monitor Mode to give an output from the internal modulation signal paths.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
7 digits with unit annunciators for frequency and 4 digits with unit annunciators for level.

Level
100 µV to 5 V RMS with a load impedance of greater than 600 Ω.
100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω.

Source impedance
5.6 Ω nominal.

Level accuracy at 1 kHz
With a load impedance of greater than 10 kΩ: LF ±5% for levels above 50 mV LF ±10% for levels from 500 µV to 50 mV.

Frequency response
Typically < ±1 dB from 0.1 Hz to 300 kHz.

Sweep

Control modes
Start/stop values of selected parameter. Number of steps. Time per step.

Step time
1 ms to 20 s per step.

Sweep ramp
Synchronized analog ramp with a nominal amplitude of 0 to 10 V peak on rear panel BNC connector.

Markers
User selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to +5 V from 600 Ω on rear panel BNC socket.

Trigger
Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep. Connector is internally connected via 10 kΩ pull-up resistor to +5 V.

Frequency Standard

Frequency
10 MHz.

Temperature stability
Better than ±5 in 10^8 in the operating range of 0 to 50°C.

Warm up time
Within 2 in 10^7 final frequency within 10 minutes from switch on at 20°C ambient.

Ageing rate
Better than 2 in 10^7 per year.

Output
Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω. Output can be disabled.

External input
Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with an input level in the range 220 mV to 1.8 V RMS into 1 kΩ.

General

GPIB INTERFACE
A GPIB interface is fitted. All functions except the supply switch and display contrast are remotely programmable.

Capabilities
Designed in accordance with IEEE488.2.
Complies with the following subsets as defined in IEEE Std. 488.1. SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

ELECTROMAGNETIC COMPATIBILITY
Conforms with the protection requirements of EEC Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2,3,4
EN60555-2	IEC 555-2.

SAFETY
Complies with IEC 348, HD401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.
Approved to UL 1244.

RATED RANGE OF USE
(Over which full specification is met)

Temperature
0 to 55°C.

Humidity
Up to 93% at 40°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
–40°C to +71°C.

Humidity
Up to 93% relative humidity at 40°C.

Altitude
Up to 4600 m (15,000 ft).

POWER REQUIREMENTS

AC supply
Four settings covering 90-115 V, 105-32 V, 188-242 V and 216-265 V.
45 Hz to 400 Hz. 120 VA to 180 VA depending on version and options fitted.

CALIBRATION INTERVAL
2 years.

DIMENSIONS AND WEIGHT

(Over projections but excluding handles)

Height	Width	Depth	Weight
152 mm	425 mm	525 mm	21 kg
6 in	16.6 in	20.5 in	46 lb

Options

SECOND MODULATION OSCILLATOR OPTION
Specification as Modulation Oscillator.

PULSE MODULATION OPTION

Modulation Modes
Pulse modulation may be used alone or in conjunction with FM, ΦM, Wideband FM, Vector or Digital Modulation.

Rise/Fall Time
25 ns.

Control
0 V for carrier off, +5 V for carrier on.
Threshold level is typically +2.5 V.

ON/OFF Ratio
Better than 70 dB.
Input impedance 50 Ω.

OPTION 105
Modifies pulse modulation option for a typical rise and fall time of 1 µs.

AVIONICS OPTION
See separate sheet.

RF PROFILE AND COMPLEX SWEEP
See separate sheet.

ELECTRONIC ATTENUATOR

Carrier Frequency Range
250 kHz* to 1.35 GHz (2050),
250 kHz* to 2.7 GHz (2051).
* Useable to 10 kHz (50 MHz in Digital or Vector modes, useable to 10 MHz)

RF Output
Range (Analog mode)
-138 dBm to +10 dBm When AM is selected the maximum output level reduces linearly with AM depth to +4 dBm at maximum AM depth.
Range (Digital or Vector mode)
-132 dBm to +3 dBm peak envelope power.

Accuracy
±1.2 dB in non Digital or Vector modes for output levels > -127 dBm at 22°C ±5°C

Temperature Stability
±0.01 dB/°C

VSWR
< 1.5:1 for output levels less than 0 dBm.

Reverse Power Handling
1 W from a source VSWR of up to 5:1.

Amplitude Modulation
Standard specification applies for carrier frequencies above 50 MHz.

Versions and Accessories

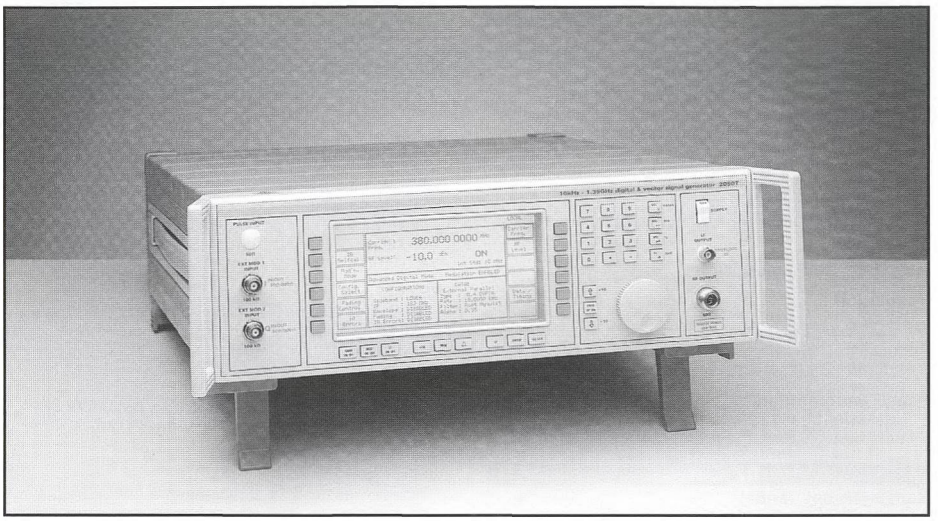
When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2050	10 kHz to 1.35 GHz Digital and Vector Signal Generator.
2051	10 kHz to 2.7 GHz Digital and Vector Signal Generator.
2052	10 kHz to 5.4 GHz Digital and Vector Signal Generator.
	Supplied with
	AC supply lead.
	Operating Manual.
	Options
Option 001	Second modulation oscillator
Option 002	Pulse modulation.
Option 006	Avionics (must be ordered with Option 001).
Option 008	RF Profiles and complex sweep
Option 012	Electronic attenuator (2050 and 2051 only).
Option 105	Increased pulse modulation rise and fall time (must be ordered with Option 002).
Option 112	Ext. mod 2 Input 600 Ω.
	Optional Accessories
44991-144	Break out box. Converts auxiliary D type connector to 8 data, 1 burst line, and a it/symbol clocks on BNC connectors. Daisy chain connection allows the monitoring of the signals (on BNC connectors).
43126-012	RF connector cable, 50 Ω, 1.5 m, BNC.
54311-092	Coaxial adapter N male to BNC female.
59999-163	Precision coaxial adapter N male to SMA female.
54411-051	Impedance adapter, 50 to 75 Ω, BNC connectors.
54311-095	RF connector cable, 1 m, type N connectors.
43129-189	GPIB Lead assembly.
46883-408	IEEE/IEC Adapter block for GPIB socket.
46884-291	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884-292	Rack mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884-541	Rack mounting kit containing front mounting brackets only.
46884-444	Maintenance kit 2030/40/50 series.
46662-525	Transit case.
46662-559	Soft carry case.
54499-044	DECT Filter.
46880-062	Service manual.

Note, FLEX is a registered trademark of the Motorola Corporation.

2050T
Digital & Vector Signal Generator for TETRA

A new standard in low adjacent channel power for TETRA modulation



- <-70 dBc Adjacent Channel Power
- TETRA modulation
- Excellent vector accuracy
- Rayleigh & Rician fading
- Burst control
- Internal PRBS data source
- Baseband IQ outputs
- IQ vector modulation

The new 2050T series are variants of the successful 2050 series of digital and vector signal generators. They have been designed to satisfy the challenging needs of TETRA radio development and production but without compromising any of the 2050's original features.

Adjacent Channel Power

For TETRA radio development and production, a new level of signal generator performance is demanded. For selectivity testing of TETRA radio receivers, the level of adjacent channel power from the interfering source (TETRA T2) must be lower than -70 dBc.

Throughout all areas of TETRA development, the problem of adjacent channel power is a key issue which the 2050T series have been specifically designed to address.

The 2050T series offer better than -70 dBc adjacent channel power across the RF frequency range 100 MHz to 490 MHz and throughout their RF level range whilst maintaining a RMS vector error of better than 1.5%.

TETRA Modulation

The modulation characteristics of TETRA are faithfully reproduced within the 2050T series. $\pi/4$ Differential QPSK is only one of many modulation types provided. In Advanced Digital Mode the modulation parameters are fixed to those demanded by TETRA. In Normal Digital Mode it is possible to modify subtle aspects of the modulation such as filter alpha coefficients or modulation data rates.

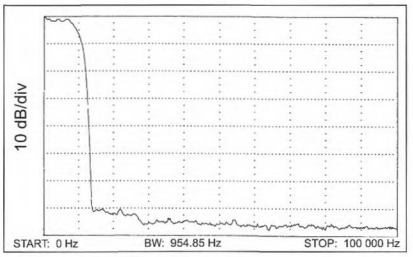


Figure 1 : TETRA ACP Spectrum

Rayleigh and Rician Fading

It is easy to introduce Rayleigh or Rician fading together with modulation impairments, such as IQ imbalance, skew and carrier leakage to each of the baseband, IF and RF outputs.

Burst Control

The TDMA characteristics of TETRA can be readily simulated. Using the 2050T series Envelope Control, bursts of modulation with over 80 dB dynamic range are possible. The Envelope Control features a linear modulator allowing careful definition of burst ramps. Alternatively if the 2050T series are used with an external data source, RF bursts may be defined digitally by a simple TTL or CMOS control which produces controlled ramp profiles.

Digital Data Source

The 2050T series feature an internal data generator able to produce various PRBS sequences as per CCITT V.52 recommendations. Alternatively, it is possible to input serial or parallel TTL/CMOS data sequences in real time from an external data source. External data may be clocked in using Bit and Symbol clocks supplied internally from the 2050T series or from external sources.

IQ Outputs

The 2050T series feature an IQ vector modulator which may be driven from external I and Q analog drives or from internally DSP generated signals. The internally generated I and Q filtered signals, together with any fading and selected impairments, are available as I and Q analog outputs. They may then be used to drive external modulators or used as test signals in cartesian feedback designs.

Electronic Attenuator

An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications.

Specification

General Description

2050T series signal generators have a large screen dot matrix display with softkey function selection which allows flexibility of operation. Hardkey and data entry key together with a rotary control knob are also provided. The output may be modulated using FM, ΦM, AM, IQ vector or complex digital modulation. Pulse modulation is optional.

Carrier Frequency

Range
10 kHz to 1.35 GHz (2050T)
10 kHz to 2.7 GHz (2051T)
10 kHz to 5.4 GHz (2052T)
In digital and vector modes the lowest frequency is 10 MHz and for 2052T the highest frequency is reduced to 2.7 GHz.

Selection
By keyboard entry of data.
Variation by up/down keys and by rotary control.

Indication
11 digits with annunciators.

Resolution
0.1 Hz.

Accuracy
As frequency standard.

Phase incrementing
The carrier phase can be advanced or retarded in steps of 1.5° using the rotary control.

RF Output

Range (Analog mode)
–144 dBm to +13 dBm
Max guaranteed output above 2.7 GHz is +11 dBm.
With AM selected, the maximum output level reduces linearly with AM depth to +7 dBm at maximum AM depth.

Range (Digital or Vector mode)
–138 to +6 dBm* peak envelope power.
RF level is defined with a PRBS modulation applied in digital mode or with 0.5 V applied to either the I or Q input in vector mode.
*Maximum level is reduced to -6 dBm PEP when in advanced digital mode

Selectable Overrange Mode
Uncalibrated levels up to +19 dBm in analog mode.

Selectable Extended Hysterisis
Uncalibrated RF level control over a range of 24 dB (maximum) without level interruption.

Selection
By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control. Units may be µV, mV, V, EMF or PD; dB relative to 1 µV, 1 mV, EMF or PD; dBm.

Indication
4 digits with unit annunciators.

Resolution
0.1 dB.

Accuracy
At 22°C ±5°C in non Digital or Vector modes:

	<1.35 GHz	<2.7 GHz	<5.4 GHz
>0 dBm	±0.5 dB	±0.7 dB	±1 dB
>–50 dBm	±0.85 dB	±1 dB	±1.5 dB
>–127 dBm	±0.85 dB	±1 dB	–
Temperature stability dB/°C	0.005	0.01	0.02

In Digital or Vector Mode:
At a temperature of 22°C ±5°C
<2 GHz ±1.5 dB
<2.7 GHz ±2 dB
Temperature coefficient: < 0.04 dB/°C

VSWR
For output levels less than 0 dBm:
<2.2 GHz<1.25:1 (19.1 dB return loss)
<2.7 GHz<1.4:1 (15.6 dB return loss)
<5.4 GHz<1.5:1 (14 dB return loss)

Output Protection
Reverse power of 50 W from a source VSWR of upto 5:1

Spectral Purity

At RF levels up to +7 dBm in CW and analog modulation modes:

Harmonics

	≤1 GHz	1 GHz to 1.35 GHz	>1.35 GHz
2050T & 2051T	<-30 dBc	<-27 dBc	<-27 dBc
2052T	<-30 dBc	<-27 dBc	<-25 dBc

Sub-Harmonics
< –90 dBc to 1.35 GHz, < -40 dBc to 2.3 GHz, < –30 dBc to 5.4 GHz.

Non-Harmonics
< –70 dBc at offsets from the carrier frequency of 3 kHz or greater.

Residual FM
Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.

SSB phase noise
Less than –116 dBc/Hz (typically –122 dBc/Hz) at an offset of 20 kHz from a carrier frequency of 470 MHz.

RF Leakage
Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm loop, 25 mm or more from any part of the case.

FM on AM
Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.

ΦM on AM
Typically less than 0.1 radians at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

In digital and vector modes of operation:
Modulation is generated by converting a 120 MHz, 132 MHz, 160 MHz or 176 MHz intermediate frequency (IF) to the required carrier frequency. Additional signals are present at the local oscillator frequency, image frequency and frequencies equivalent to the harmonics of the IF mixed with the local oscillator.

Phase noise
In vector mode: As analog modulation and CW modes.
In digital mode: As analog modulation modes for offsets >100 kHz ; < –108 dBc/Hz at 20 kHz offset from a 1 GHz carrier.

Modulation Modes

Seven modulation modes are available:

Single
FM, Wideband FM, ΦM, AM or pulse (optional).

Dual
Two independent channels of differing modulation type (e.g. AM with FM).

Composite
Two independent channels of the same modulation type (e.g. FM1 with FM2).

Dual composite
A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

Vector
Provides IQ modulation facility.

Digital
Accepts digital inputs and converts the signal to QAM, PSK , GMSK or FSK formats.

Advanced Digital
Accepts digital inputs and converts the signal to accurate TETRA modulation with low levels of adjacent channel power.

Frequency Modulation

Deviation
Peak deviation from 0 to 1 MHz for carrier frequencies up to 21.09375 MHz. Peak deviation from 0 to 1% of carrier frequency above 21.09375 MHz.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
3 digits with annunciators.

Displayed Resolution
1 Hz or 1 least significant digit, whichever is greater.

Accuracy at 1 kHz
±5% of indication ±10 Hz excluding residual FM.

Bandwidth (1 dB)
DC to 300 kHz (DC coupled).
10 Hz to 300 kHz (AC coupled).
Input is capable of accepting external sources of FSK signals. Typical 3 dB bandwidth is >1 MHz.

Group delay
Less than 1 µs from 3 kHz to 500 kHz.

Carrier Frequency Offset
In DC FM less than ± (1 Hz + 0.1% of set deviation) after using DC FM nulling facility.

Distortion
Using external modulation without ALC: Less than 3% at maximum deviation for modulation frequencies up to 20 kHz. Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.

Modulation source
Internal LF generator or external via front panel sockets.

Wideband FM

Deviation
As FM.

Indication
3 digits with annunciators.

Selection
By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the nearest value of deviation to that requested.

Input level
1.414 V peak (1 V RMS sine wave) to achieve indicated deviation.

Accuracy
As FM.

3 dB Bandwidth
Typically 10 MHz (DC or AC coupled).

Group Delay
Less than 0.5 µs from 3 kHz to 10 MHz.

Modulation Source
External via rear panel socket (50 Ω impedance).

Phase Modulation

Deviation
0 to 10 radians.

Selection
By keyboard entry of data.
Variation by up/down keys (or ↑↓) and by rotary control.

Indication
3 digits with annunciators.

Resolution
0.01 radians.

Accuracy at 1 kHz
±5% of indicated deviation excluding residual phase modulation.

3 dB Bandwidth
100 Hz to 10 kHz.

Distortion
Less than 3% at maximum deviation at 1 kHz modulation rate.

Modulation Source
Internal LF generator or external via front panel sockets.

Amplitude Modulation

For carrier frequencies up to 1 GHz.

Range
0 to 99.9%.

Selection
By keyboard entry of data.
Variation by up/down keys (or ↑↓) and by rotary

http://www.ifrinternational.com

control.

Indication
3 digits with annunciator.

Resolution
0.1%.

Accuracy
±4% of setting ±1%.

1 dB Bandwidth
With modulation ALC off; DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode.
Typical modulation bandwidth exceeds 50 kHz.

Distortion
For a modulation rate of 1 kHz: Less than 1% total harmonic distortion for depths up to 30%, less than 3% total harmonic distortion for depths up to 80%.

Modulation source
Internal LF generator or external via front panel connectors.

Digital Modulation

In digital mode the instrument can be used over the carrier frequency range 10 MHz to 1.35/2.7 GHz and accepts internal or external data to modulate the RF output. The modulation can be applied in common digital formats and the channel filter characteristics specified.

Internal Data
All 0's, 1's or selectable PN 2 to 7, 9, 10, 11 or 15 PRBS sequence.
Note with GSM selected PRBS is limited to PN9 & 15. All 0's and all 1's are available.

External data
Accepts data as a serial input or parallel input from a 25 way auxiliary D Type connector on the rear panel. Accepts symbols containing 1 to 8 data bits with internally or externally generated clock sources. All inputs and outputs are TTL/CMOS logic compatible.
Note, in GSM mode, external data must be supplied as 8 bit parallel.

Symbol Rate

Mod Type	min sym/s	max sym/s	Filter
PSK, QAM	1900	34000	Nyquist/Root Nyquist
PSK, QAM	1900	25000	Gaussian
FSK,	1900	25000	Nyquist/Root Nyquist
FSK, GMSK	512	25000	Gaussian
OQPSK	1900	16000	All filters

Symbol source can be internal or external, internal symbol rate is adjustable in steps of 0.1 symbols/s. Symbol rate must be within 2% of external symbol rate to maintain modulation accuracy.

Generic Modulation types
Can select PSK, Differential PSK, Differential Phase Offset PSK (i.e π/4DQPSK), Time Offset QPSK, QAM, GMSK and FSK. The number of bits per symbol can be selected from 2 to 8 for QAM, 1 to 3 for PSK and 1 or 2 for FSK systems.

RF Channel Filters
Root raised cosine, raised cosine or Gaussian. Filter bandwidth can be selected as follows: Raised cosine or root raised cosine for α from 0.2 to 0.8 in 0.01 steps. Gaussian 3 dB bandwidth from 0.4 of the symbol rate (0.2 of symbol rate as IQ baseband filter) up to a maximum of 22.6 kHz.

Pre-defined Modulation Types
The following can be selected:

Mod Type	*System*
π/4 DQPSK	NADC (DAMPS), PDC (JDC), TETRA, TFTS, APCO25
GMSK	GSM, Mobitex, CDPD, MC9, DSRR, MD24-192N/W, Modacom
OQPSK	Inmarsat M
FSK	POCSAG, CITYRUF
4FSK	ERMES, APCO25
8DPSK	VDR (VDL)

Modulation Accuracy
At the decision points with the envelope input at 1 V or disabled and filter above 0.25 for raised cosine filters and 0.3 for root raised cosine filters:
- PSK & QAM <1.5% RMS vector error
- NADC, PDC <1% RMS vector error (EIA, RCR 27A method)
- GSM & CDPD <3° RMS phase error (typical)

FSK/GMSK
Frequency deviation can be set with 1 Hz resolution across the range 100 Hz to 20 kHz.
Accuracy : <1% of set deviation .

Modulation errors
Modulation errors can be added to simulate:
IQ skew from 0 to ± 20° in 0.1° steps
IQ imbalance from 0 to ±10 dB in 0.1 dB steps
Carrier leak from 0 to 10% in 0.1% steps
Range of errors allowed is limited by the peak envelope power.
Note: modulation errors are not available in either GSM or OQPSK modes.

IQ Outputs
Baseband IQ output signals available on the front panel at a level of 0.5 V p.d. nominal into 50 Ω. Levels are reduced by 12 dB in advanced digital mode.

Burst control
Available on the rear panel D Type connector. A logic 1 on the burst control turns the RF on over a time interval corresponding to 3 data symbols. Propagation delay is matched to the data path delay. Can be used with the Envelope input.

ON/OFF Ratio
Greater than 80 dB.

Advanced Digital Modulation

In advanced digital mode the instrument will produce TETRA modulation, π/4DQPSK at 18 ksymbols/s through a Root Raised Cosine Filter with α of 0.35.

Adjacent Channel Power

Adjacent Channel Power across RF frequency range 100 MHz to 490 MHz and temperature range +25°C ±5°C with IQ errors and fading disabled

Frequency Offset from Carrier	Adjacent Channel Power
±25 kHz	<-70 dBc

Carrier Leak
Better than -35 dBc (typically <-38 dBc)

Vector Modulation

Provides for IQ modulation of the carrier output from an external source for carrier frequencies of 10 MHz to 1.35/2.7 GHz.

Carrier Leakage and SSB Image Rejection
Following self-calibration, the RF carrier leakage and SSB image rejection are typically 50 dB.

Vector inputs
IQ inputs on the front panel. The RF level requested is obtained with 0.5 V DC applied to one of the inputs. Input impedance is selectable between 50 Ω and 300 Ω.

DC Vector accuracy
For carrier frequencies up to 2 GHz:
±1% amplitude of FS.
±1° at FS.
For carrier frequencies above 2 GHz:
±1.5% amplitude of FS.
±1.5° at FS.

Vector bandwidth
±0.5 dB wrt DC for modulation frequencies up to 3 MHz.
±1 dB wrt DC for modulation frequencies up to 10 MHz and carrier frequencies up to 2 GHz.
±1.3 dB wrt DC for carrier frequencies up to 2.7 GHz.

IQ Modulation Calibration

The signal generator can calibrate the IQ modulator automatically. After a 0.5 hour warm up period the calibration remains valid for at least 3 hours over a temperature range of ±5°C. The instrument displays a warning if the calibration validity time or temperature range has been exceeded. Calibration is valid for both digital and vector modes.

Fading Simulation

Rayleigh and Rician fading can be simulated in both Vector and Digital modulation modes. Doppler speed can be entered from 0 to 200 Hz with a maximum ratio of 2:1 between direct and scattered speed.
Path ratio can be set to ±50 dB.
Note: Fading is not available in either GSM or OQPSK modes.

Envelope Control

The RF level can be varied by applying a control voltage to the envelope input in digital and vector modes. The input may be used to shape the rise and fall of an RF burst and simulate the effect of varying RF levels being received from mobiles in TDMA systems. Applying 1 V gives the set RF level and 0 V suppresses the carrier.

Linear range
Greater than 30 dB.
Linearity typically better than 0.5 dB at –20 dBV (100 mV input).

ON/OFF ratio
Greater than 80 dB.

Envelope delay
< 10 µs, typically 6 µs.

Rise/fall time
Less than 13 µs to –70 dBc.

IF Output

An IF output is available on the rear panel which is modulated by the selected digital or vector modulation. The IF output can be inhibited by software control. The IF output can be used to provide modulated carriers at higher frequencies by external frequency conversion. The RF output from the front panel connector can be used as an LO for external frequency conversion.

Modulation Oscillator

Frequency range
0.1 Hz to 500 kHz.

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
7 digits with annunciators.

Resolution
0.1 Hz.

Frequency accuracy
As frequency standard.

Distortion
Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz.

Alternative waveform
A triangular wave is available in addition to the sine wave for frequencies up to 100 kHz.

Signaling tones
The modulation oscillator can be used to generate sequential (up to 16 tones) or sub-audible signaling tones in accordance with EIA, ZVEI, DZVEI, CCIR, EURO 1, EEA, NATAL and DTMF* standards. Facilities are also available for creating and storing user defined tone systems.
* Requires second modulation oscillator (option 001) to be fitted.

External Modulation

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance 100 kΩ nominal.

MODULATION ALC
The EXT MOD 1 and EXT MOD 2 modulation inputs can be levelled by an ALC system.

Level Range
1 V to 2 V peak (0.7 to 1.4 V RMS sine wave).

Distortion
Less than 0.1% additional distortion for frequencies up to 20 kHz (typically less than 0.1% up to 50 kHz).

1 dB Bandwidth
Typically 10 Hz to 500 kHz.

LF Output

Front panel BNC connector. The output may be configured in the LF Generator Mode to give an output from the internal modulation oscillator and in the LF Monitor Mode to give an output from the internal modulation signal paths.

2050T

Selection
By keyboard entry of data.
Variation by ⇧⇩ keys and by rotary control.

Indication
7 digits with unit annunciators for frequency and 4 digits with unit annunciators for level.

Level
100 µV to 5 V RMS with a load impedance of greater than 600 Ω.
100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω.

Source impedance
5.6 Ω nominal.

Level accuracy at 1 kHz
With a load impedance of greater than 10 kΩ: LF ±5% for levels above 50 mV LF ±10% for levels from 500 µV to 50 mV.

Frequency response
Typically < ±1 dB from 0.1 Hz to 300 kHz.

Sweep

Control modes
Start/stop values of selected parameter. Number of steps. Time per step.

Step time
1 ms to 20 s per step.

Sweep ramp
Synchronized analog ramp with a nominal amplitude of 0 to 10 V peak on rear panel BNC connector.

Markers
User selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to +5 V from 600 Ω on rear panel BNC socket.

Trigger
Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep. Connector is internally connected via 10 kΩ pull-up resistor to +5 V.

Frequency Standard

Frequency
10 MHz.

Temperature stability
Better than ±5 in 10^8 in the operating range of 0 to 50°C.

Warm up time
Within 2 in 10^7 final frequency within 10 minutes from switch on at 20°C ambient.

Ageing rate
Better than 2 in 10^7 per year.

Output
Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω. Output can be disabled.

External input
Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with an input level in the range 220 mV to 1.8 V RMS into 1 kΩ.

General

GPIB INTERFACE
A GPIB interface is fitted. All functions except the supply switch and display contrast are remotely programmable.

Capabilities
Designed in accordance with IEEE488.2.
Complies with the following subsets as defined in IEEE Std. 488.1. SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

ELECTROMAGNETIC COMPATIBILITY
Conforms with the protection requirements of EEC Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2,3,4
EN60555-2	IEC 555-2.

SAFETY
Complies with IEC 348, HD401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.
Approved to UL 1244.

RATED RANGE OF USE
(Over which full specification is met unless otherwise stated)

Temperature
0 to 55°C.

Humidity
Up to 93% at 40°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
–40°C to +71°C.

Humidity
Up to 93% relative humidity at 40°C.

Altitude
Up to 4600 m (15,000 ft).

POWER REQUIREMENTS

AC supply
Four settings covering 90-115 V, 105-32 V, 188-242 V and 216-265 V.
45 Hz to 400 Hz. 120 VA to 180 VA depending on version and options fitted.

CALIBRATION INTERVAL
2 years.

DIMENSIONS AND WEIGHT

(Over projections but excluding handles)

Height	Width	Depth	Weight
152 mm	425 mm	525 mm	21 kg
6 in	16.6 in	20.5 in	46 lb

Options

SECOND MODULATION OSCILLATOR OPTION
Specification as Modulation Oscillator.

PULSE MODULATION OPTION

Modulation Modes
Pulse modulation may be used alone or in conjunction with FM, ΦM, Wideband FM, Vector or Digital Modulation.

Rise/Fall Time
25 ns.

Control
0 V for carrier off, +5 V for carrier on.
Threshold level is typically +2.5 V.

ON/OFF Ratio
Better than 70 dB.
Input impedance 50 Ω.

OPTION 105
Modifies pulse modulation option for a typical rise and fall time of 1 µs.

AVIONICS OPTION
See separate sheet.

RF PROFILE AND COMPLEX SWEEP
See separate sheet.

ELECTRONIC ATTENUATOR

Carrier Frequency Range
250 kHz* to 1.35 GHz (2050T),
250 kHz* to 2.7 GHz (2051T).
* Useable to 10 kHz (50 MHz in Digital, Advanced Digital or Vector modes, useable to 10 MHz)

RF Output
Range (Analog mode)
-138 dBm to +10 dBm When AM is selected the maximum output level reduces linearly with AM depth to +4 dBm at maximum AM depth.
Range (Digital or Vector mode)
-132 dBm to +3 dBm peak envelope power.
Range (Advanced digital mode)
-144 dBm to -9 dBm

Accuracy
±1.2 dB in non Digital or Vector modes for output levels > -127 dBm at 22°C ±5°C

Temperature Stability
±0.01 dB/°C

VSWR
< 1.5:1 for output levels less than 0 dBm.

Reverse Power Handling
1 W from a source VSWR of up to 5:1.

Amplitude Modulation
Standard specification applies for carrier frequencies above 50 MHz.

Version and Accessories

When ordering please quote the full ordering number information.

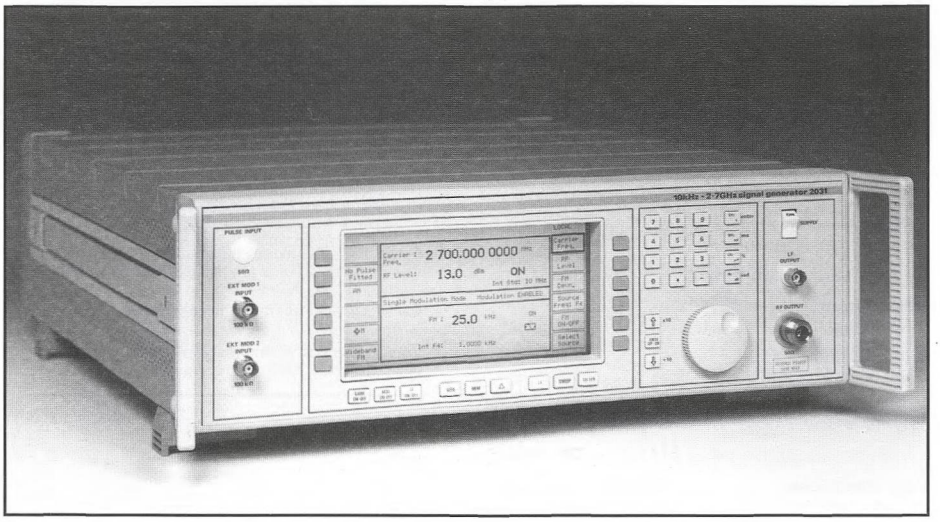
Ordering Numbers	*Versions*
2050T	10 kHz to 1.35 GHz Digital and Vector Signal Generator.
2051T	10 kHz to 2.7 GHz Digital and Vector Signal Generator.
2052T	10 kHz to 5.4 GHz Digital and Vector Signal Generator.
	Supplied with
	AC supply lead.
	Operating Manual.
	Options
Option 001	Second modulation oscillator
Option 002	Pulse modulation.
Option 006	Avionics (must be ordered with Option 001).
Option 008	RF Profiles and complex sweep
Option 012	Electronic attenuator (2050T and 2051T only).
Option 105	Increased pulse modulation rise and fall time (must be ordered with Option 002).
Option 112	Ext. mod 2 Input 600 Ω.
	Optional Accessories
44991-144	Break out box. Converts auxiliary D type connector to 8 data, 1 burst line, and a it/symbol clocks on BNC connectors. Daisy chain connection allows the monitoring of the signals (on BNC connectors).
43126-012	RF connector cable, 50 Ω, 1.5 m, BNC.
54311-092	Coaxial adapter N male to BNC female.
59999-163	Precision coaxial adapter N male to SMA female.
54411-051	Impedance adapter, 50 to 75 Ω, BNC connectors.
54311-095	RF connector cable, 1 m, type N connectors.
43129-189	GPIB Lead assembly.
46883-408	IEEE/IEC Adapter block for GPIB socket.
46884-291	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884-292	Rack mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884-541	Rack mounting kit containing front mounting brackets only.
46884-444	Maintenance kit 2030/40/50 series.
46662-525	Transit case.
46662-559	Soft carry case.
54499-044	DECT Filter.
46880-062	Service manual.

Note, FLEX is a registered trademark of the Motorola Corporation.

http://www.ifrinternational.com

2030 series
Option 5 GSM PCN PCS

Generates GMSK modulation to the GSM, DCS1800 standards and PCS standards, allowing internal data to be easily entered and edited for mobile phone, base station and component testing



- Wideband cover:
  10 MHz to 1.35 GHz (2030)
  10 MHz to 2.7 GHz (2031)
  10 MHz to 5.4 GHz (2032)
- GMSK Bt 0.3 Modulation
- Internal data generator
- Data editor
- External data / clock modulation
- Excellent phase accuracy
- Wideband FM

GMSK Option

Option 5 GSM PCN PCS for 2030, 2031 and 2032 Signal Generators provide a signal modulated with GMSK Bt 0.3 modulation at a clock rate of 270.833 kHz. The wideband frequency cover enables the generator to be used for testing Global System for Mobile Communications (GSM) and Personal Communications Network/Service (PCN/PCS) receivers. The carrier can be modulated from an internal data generator or from an external data and clock source. Excellent phase accuracy and stability are ensured by the use of a precision modulator.

Internal Modulation

An internal data generator can be used to modulate the carrier. The data can be entered and edited at bit level within a slot and the stored slots assembled into frames, multiframes and superframes either from the keyboard or from an external GPIB controller. Null and pseudo random data slots are also available.

External Modulation

An external source of data and 270.833 kHz clock can be used. The data is internally filtered to provide GMSK Bt 0.3 modulation and the RF envelope can be set to be externally controlled. In this mode the generator frequency standard is phase locked to the external clock signal.

Store and Recall

The availability of non-volatile stores ensures that internal data can be stored for future use and simplifies stand alone operation. The internal data can be edited to bit level within a slot and slots can be assembled into frames, multiframes and superframes.

Specification

General Description

This option adds GMSK (Gaussian Minimum Shift Keying) modulation at a bit rate of 270.833 kHz to the 2030 series. This modulation is used by the GSM and UK PCN systems.
Front panel connectors provide external modulation inputs for Clock, Data and Envelope control.
Facilities are provided for internal modulation by data sequences which can be internally edited and stored. The front panel connectors provide outputs for Clock and Data.
Instruments may be connected using the SYNC connectors to provide multiple RF Outputs with synchronized slot and frame structures.
2030, 2031 or 2032 Signal Generators fitted with the GMSK option conform to the 2030 series specification in the GMSK mode except as follows:

Carrier Frequency Range

Range
2030: 10 MHz to 1.34675 GHz.
2031: 10 MHz to 2.69675 GHz.
2032: 10 MHz to 5.4 GHz.*
*(GMSK modulation limited to 10 MHz - 2.7 GHz)

RF OUTPUT

Range
0 dBm to –144 dBm.
(-3dBm max with Option 12 Electronic Attenuator)

Accuracy
2 dB.

Output VSWR
As for 2030 series for levels below –6 dBm.

Spectral Purity

Non-Harmonic Output
GMSK signals are generated by mixing a local oscillator with a 3.25 MHz IF signal carrying the GMSK signal. Additional signals are present at the local oscillator frequency, image frequency and frequencies equivalent to the harmonics of the IF mixed with the local oscillator.

Frequency Standard

In GMSK mode an input or output at 13 MHz, 10 MHz, 5 MHz or 1 MHz is available.

GMSK Modulation

Modulation Type
GMSK Bt 0.3 to GSM recommendation 0.5.04.

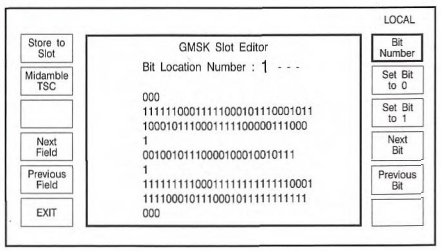
Modulation Accuracy
Phase accuracy as defined by GSM 05.05 – 4.6 is 1° RMS, 3° peak for carrier frequencies up to 1 GHz. A second Bt is available which gives an RMS phase error of 5°.

Data Coding

Selectable as uncoded, or differentially coded to GSM rec 05.04 – 2.3 for internal or external modulation.

Internal Modulation

An internal data source provides a Traffic Channel format superframe hierarchy.
Individual slots may be null data, fixed data, or contain (2^{29}–1) PRBS data as defined in CCITT rec V.52. Successive slots contain 156, 156, 156, 157 bits. The internal data source provides data and clock output. Internal data can be edited from the front panel and stored or can be entered using the GPIB.
The RF envelope may be ramped up and down to GSM 05.05 annex 2 and GSM 05.05 – 4.2.2.
The internal data generator can be used with an external clock as in 'External Modulation'.



Data Storage
Data in the data generator can be stored and edited from the front panel or via the GPIB.
Store sizes are:
100 slots of which 2 are defined as null (S0) and PRBS (S99).
100 Frames containing any of the stored slots in any order.
100 multiframes containing any of the stored frames in any order.
40 superframes containing any of the stored multiframes in any order.

Internal Modulation Output

Data Output
TTL compatible.

Clock Output
TTL compatible.

External Modulation

Clock and Data input at TTL compatible levels. Data must be valid on the falling edge of the clock input.

Data Input level
TTL compatible.

Clock Input level
TTL compatible.

Clock Input frequency
270.833 kHz ±25 ppm or a clock of the same bit rate but including one clock period of 1¼ bits per slot.

Envelope Input Impedance
15 kΩ nominal.

Doppler FM Input Impedance
50 Ω.

Envelope Control

Selectable constant level, internal level control, or controlled from the external envelope input: External envelope control voltages are 0 V for off, +1 V for specified RF level. The RF output voltage varies linearly with applied voltage.

External Input risetime
Less than 4 µs.

Off Slot Suppression
Better than –70 dBc.

Modulation Sense

Output can be set to use upper or lower sideband. Modulation sense can be inverted.

Synchronization

Instruments may be synchronized by use of the Sync Input/Output. One instrument in MASTER mode sources a bit clock and the SYNC signal. The SYNC signal goes active low for one bit during the transition of the internal data from slot 7, bit 156 to slot 0, bit 0. Instruments in SLAVE mode use Clock and SYNC signals to maintain a synchronized data structure.

Synchronization input/output
Open collector TTL, 2 mA pull-up, active low, bidirectional.

Versions and Accessories

When ordering please quote the full ordering number information.

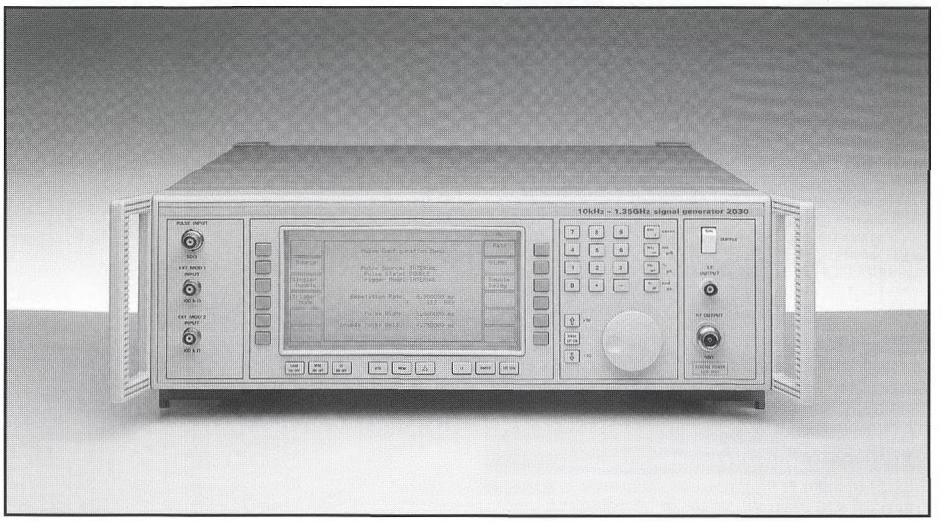
Ordering Numbers	*Versions*
2030	10 kHz to 1.35 GHz Signal Generator.
2031	10 kHz to 2.7 GHz Signal Generator.
2032	10 kHz to 5.4 GHz Signal Generator.
Option 005	GSM PCN PCS (GMSK Bt 0.3).
	Supplied with
	AC power lead
	Operating Manual
	Options
Option 001	Second internal modulation oscillator.
Option 002	Pulse Modulation.
Option 003	19 dBm Output (2030 only).
Option 006	Avionics (requires Option 001, cannot be ordered with Option 003).
Option 008	RF Profiles and complex sweep.
Option 012	Electronic Attenuator (2030 and 2031 only). Not available with options 003 or 010.
Option 105	Modifies the pulse modulation option for slower rise and fall times (order with Option 002).
Option 112	Ext. mod 2 Input 600 Ω.

Note: Option 5 is currently not available with option 9 or option 10 or on 2040 and 2050 series

http://www.ifrinternational.com

2030/40/50 series
Option 8 RF Profile and Complex Sweep

Ability to offset for insertion loss or gain of external devices, and provides complex carrier sweeps. Particularly useful for EMC testing and for ATE applications



- Calibration of RF power at a remote connector
- Frequency dependent RF output power
- Complex sweep capability
- 20 ms to 20 s step time
- Sine, triangle and square wave modulation

Option 8 RF Profile and Complex Sweep provides additional software features which are particularly well suited for Electromagnetic Immunity, Tempest testing and other applications using signal generators with external devices which introduce frequency dependent RF level errors.

Careful attention to transient states ensures that positive overshoots that could damage power amplifiers are not generated.

RF Profile and Offset

The RF Profile and Offset facility allows the user to reduce RF level errors introduced by using external amplifiers, attenuators or signal combiners. The signal generator accepts and displays RF level requests for the power referred to the output of the external device. The facility reduces the calibration effort required in ATE systems and minimizes the probability of operator induced errors when performing manual tests. The RF Profile facility allows the entry of 10 profiles containing up to 100 correction points with linear interpolation to minimize the RF level frequency response errors introduced by the external device.

The use of a large LCD panel and a flexible menu driven user interface provides a simple means of rapidly generating, selecting and editing profiles in an intuitive way whilst minimizing any ambiguity in the setting of the generator.

Segmented Sweep

The Segmented Sweep facility allows the generation of sweeps with up to 10 segments, each of which can have independent sweep parameter settings. The ability of each segment to have a different RF level permits swept immunity tests to be undertaken which follow the frequency dependent immunity limits specified in EMC standards. The independent frequency step size allows the sweep speed to be increased at higher carrier frequencies to minimize the test time.

The independent stop and start frequencies for adjacent segments also allows the generation of sweeps which deliberately omit sections of the RF spectrum to test systems with on-line signals or to speed up tests on multiband systems.

The sweep can be halted at any time if a device response is obtained and the signal generator settings can then be varied to explore the device response before then continuing with the sweep from the point where the sweep was halted.

Programmable frequency step times between 20 ms and 10 s combined with frequency step sizes down to 0.1 Hz allow the generation of fast swept signals or the slow sweeps associated with EMC testing.

Complex Sweeps

The segmented sweep can be combined with the RF Offset and RF Profile facility to produce complex sweeps which manipulate the RF output level of the signal generator to correct for the frequency response of amplifiers, cables, combiners and antenna characteristics. The ability to include correction factors in sweep mode allows the signal generator to be used in computer controlled test system which allow for manual intervention of the test without losing the system calibration information.

The use of the extended hysterisis facility with the sweep facility to minimize the number of attenuator level transients during a swept test is particularly useful for testing devices which are susceptible to large rapid changes in RF level.

Options

The Option 8 software is available on all versions of the 2030/40/50/50T series signal generators and can be combined with the second modulation oscillator, pulse modulation and generation, GSM PCN and Avionics options to provide a flexible signal generator capable of undertaking tests on most RF and receiver systems.

Specification

General Description

Option 8 software provides additional sweep, RF offset and RF level profiling facilities to support the use of 2030, 2040A 2050 and 2050T series Signal Generators with external amplifiers and attenuators. The RF output from the external device can be calibrated and displayed on the front panel of the signal generator using the RF Offset and RF Profile facilities.

RF Offsets

Displayed signal generator output level can be offset by +80 dB to –40 dB from the actual RF output level. RF Offsets may be used in normal signal generator

modes or combined with segmented sweeps.

RF Profile

RF output level can be adjusted by ±40 dB from its nominal value without changing the displayed RF output level. Ten profiles can be created each containing up to 100 correction points and the RF output level is linearly interpolated between correction points.
RF Profiles can be used in normal signal generator modes or combined with the segmented sweep.

Segmented Sweep

Carrier frequency sweeps can be generated which contain defined segments each of which can have a different step size, start and stop frequency, step time and RF level.
Sweep facility is available for 2030 and 2050(T) series in analog modes and for 2040 series in Normal Noise mode.

Start and Stop
Start and stop frequency for each segment can be freely defined within the frequency capability of the signal generator.

Step Size
Minimum step size is 0.1 Hz.
Number of steps is implied by the step size and the start and stop frequencies.

Step Time
20 ms to 20 seconds per step.

Segments
Up to 10 segments may be freely combined together in any order.

Modulation Waveforms

Sine, triangle or square wave modulation is available to provide amplitude, phase or frequency modulation.

Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	***Versions***
2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
2040	10 kHz to 1.35 GHz Low Noise Signal Generator
2041	10 kHz to 2.7 GHz Low Noise Signal Generator
2042	10 kHz to 5.4 GHz Low Noise Signal Generator
2050	10 kHz to 1.35 GHz Digital and Vector Signal Generator
2051	10 kHz to 2.7 GHz Digital and Vector Signal Generator
2052	10 kHz to 5.4 GHz Digital and Vector Signal Generator
2050T	10 kHz to 1.35 GHz Digital and Vector Signal Generator.
2051T	10 kHz to 2.7 GHz Digital and Vector Signal Generator.
2052T	10 kHz to 5.4 GHz Digital and Vector Signal Generator.
Option 008	RF Profile and Complex Sweep
	Supplied with
	AC power lead
	Operating manual
	Options
Option 001	Second internal modulation oscillator
Option 002	Pulse Modulation
Option 003	+19 dBm Output (2030 and 2040 only)
Option 005	GSM PCN PCS (GMSK Bt 0.3) (2030 series only)
Option 006	Avionics Option (must be ordered with Option 001)
Option 009	Internal Pulse Generator (cannot be used with Option 005) only available on 2030 series
Option 010	DME (requires Option 001 and 006, only available on 2030 series, cannot be fitted with Option 005)
Option 105	Increased pulse rise and fall times(for tests on Time Domain Duplex and Time Domain Multiple Access receivers)

2030 series
Option 9 Internal Pulse Generator

Internal generator producing single or double pulse RF carriers for testing radar RF and IF stages



- Programmable pulse parameters
- External trigger function
- Single and double pulse
- Variable pulse repetition frequency
- Variable pulse delay
- Variable pulse pair spacing
- Variable pulse width
- Wide frequency range (with Opt 2)
- On/Off ratio of 80 dB (with Opt 2)
- Eliminates external pulse generator

Option 9 Pulse Generator provides the user with internally generated single or double pulses. When combined with Option 2, Pulse Modulation, a solution is provided to aid the testing of radars, EMC or TDMA systems.

The pulse generator can be used with FM, PM and wideband FM or with unmodulated carriers.

With the Pulse Generator allowing variable control of the pulse parameters, many different types of systems can be efficiently and easily evaluated.

Simple Interface

Parameters can be adjusted by keyboard entry of data or by using the ⇧⇩ keys. The use of a large screen dot matrix display ensures clear and unambiguous readout. Within each display, soft keys are assigned alongside the display to allow parameter entry or to select the relevant functions.

Pulse Generator

With Options 2 and 9 combined, single and double pulsed RF carrier outputs can be generated. Pulse width can be varied from 50 ns to 100 ms. Pulse delays can be set from 1 µs to 100 ms in single trigger mode and pulse pair spacing can varied from 100 ns to 100 ms. Triggering can be continuous or via an external source. See Figures 1 and 2 for more details.

The pulse generator with Option 2 can be used over the entire frequency range of the 2030 series, with the level range of -144 dBm to +13 dBm.

Output Control

Synchronization and video outputs are available on rear panel BNC connectors. SYNC provides a 400 ns pulse indicating the start of the pulse. VIDEO provides square waves with fixed rise and fall times and variable parameters such as pulse delay, width and repetition rate.

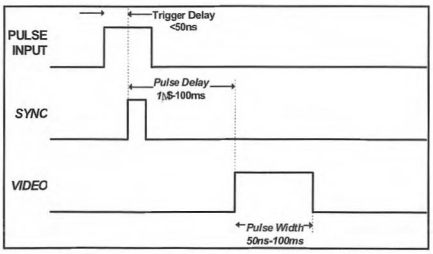


Figure 1 - single pulse, external trigger

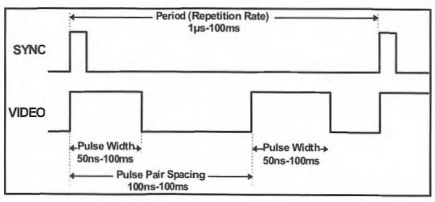


Figure 2 - double pulse, internal trigger

Specification

Specifications remain as standard 2030 series with the following additions.

Video Output (Rear Panel BNC)

Pulse Width(s)
50 ns to 100 ms, resolution 50 ns

Repetition Rate/ Period (internal trigger)
1 µs to 100 ms, resolution 50 ns

Pulse Delay (Single or Double pulse)
1 µs to 100 ms, resolution 50 ns

Double Pulse Pair Spacing
100 ns to 100 ms, resolution 50 ns

Level
Pseudo TTL (Typ. 0 to 4.5 V, 0 to 2.5 V into 50 Ω)

Rise/Fall Time
Less than 5 ns

SYNC Output (Rear Panel BNC)

Pulse Width
Typically 400 ns

Level
Pseudo TTL (Typ. 0 to 4.5 V, 0 to 2.5 V into 50 Ω)

Rise/Fall Time
Less than 5 ns

External Trigger ('Pulse Input')

Characteristics
Rising edge, TTL level into 50 Ω
Min. Pulse Width 10 ns

Trigger to SYNC Delay
Less than 50 ns

Trigger to SYNC Jitter
Typically 25 ns

RF Output (With Option 2 fitted)

Level Range
-144 dBm to +13 dBm overrange to +19 dBm uncalibrated

Accuracy
Additional level error of ±0.5 dB

Modulation Modes
Pulse modulation may be used at the same time as

FM, PM or wideband FM.

Pulse Characteristics
As above, except;

Rise/Fall Time
Typically <25 ns

ON/OFF Ratio
Better than 70 dB, typically better than 80 dB

Versions and Accessories

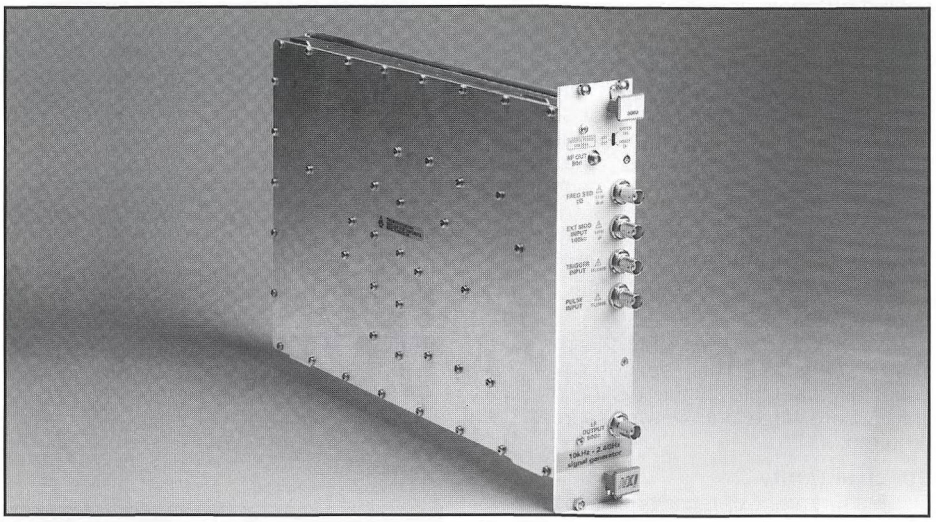
When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
Option 009	Pulse generator (cannot be used with Option 005)
	Options
Option 001	Second internal modulation oscillator
Option 002	Pulse modulation
Option 003	19 dBm Output (2030 only)
Option 006	Avionics (requires Option 001, cannot be used with Option 003)
Option 008	RF Profiles and complex sweep
Option 010	DME (requires Option 001 & 006, cannot be used with Option 005)
Option 112	Ext. mod 2 input 600 Ω

Note: Option 9 is currently not available with Option 5 or on 2040 and 2050 series.

3002
VXI Signal Generator

A unique product offering full signal generator functionality with high performance in a VXI module



- Wide frequency coverage:- 9 kHz to 2.4 GHz
- Sweep mode
- Reverse Power Protection to 50 W
- Simultaneous two tone generation
- Sine, triangular and square wave modulation source
- Modulation capabilities:- Amplitude, Frequency, Phase, Pulse, FSK
- Soft front panel interface
- VXI plug & play compatible
- LabView and LabWindows drivers
- -137 dBm to +25 dBm RF output

The 3002, with its wide frequency coverage from 9 kHz to 2.4 GHz, internal modulation source and built-in attenuator, packs into only 2 C-sized VXI slots, not a signal source, but a fully fledged, high functionality signal generator.

To ensure ease of use, the instrument has been designed to be fully compatible with the requirements of the IEEE 1155 specification and those of the VXI plug & play Systems Alliance. Software drivers and a simple 'soft front panel' interface, allow the module to be easily programmed, with parameters changed via keyboard and mouse.

The signal generator is suitable for a wide range of applications in the laboratory and production where an alternative to rack and stack systems is advantageous.

Operation

The 3002 is a message-based instrument and can be programmed using software drivers or by direct sending of ASCII strings to the instrument. Settings of frequency only, or of the full instrument, can be stored in memory allowing recall simply by memory number. Features which provide enhanced operation include non-volatile memories, memory sequencing and the use of VXI triggers for progressing test sequences.

Frequency selection

Frequency resolution of 1 Hz across the complete frequency range of 2.4 GHz ensures adequate resolution to characterize narrow band communication systems and components.

RF Output

Output levels up to +25 dBm (+19 dBm above 1.2 GHz) can be set with a resolution of 0.1 dB over the entire range. An attenuator hold function allows control of the RF output without introducing RF level dropouts from the step attenuator to facilitate testing of receiver squelch systems. Also included are five RF level offsets which enable the user to calibrate out any path losses or small gains up to 5 dB.

50 W Protection

An electronic trip protects the generator output against reverse power of up to 50 W from source VSWRs of up to 5:1, preventing damage to output circuits if an RF transmitter or DC power supply is accidentally applied to the output connector. This feature contributes to long service life and low cost of ownership.

Modulation

Comprehensive amplitude, frequency, phase, FSK and pulse modulation facilities are provided for testing all types of receivers.

Modulation Oscillator

An internal modulation oscillator is provided which is capable of generating one or two tones in the frequency range of 0.01 Hz to 20 kHz. As an alternative to a sine wave output, a triangular or square wave output is provided. A front panel input enables an external modulation signal to be combined with the internal modulation to simplify the testing of complex receiver systems.

Frequency and Phase Modulation

With a 1 dB FM bandwidth of 100 kHz and a deviation range of 0 to 100 kHz, the 3002 signal generator offers wide frequency modulation capability. AC or DC coupled FM can be selected with very low carrier frequency error and drift in the DC coupled mode. The DC coupled mode is ideal for testing tone and message paging equipment accurately. The phase modulation is ideal for testing narrow band analog radios with a deviation range of 0 to 10 radians and a 3 dB bandwidth up to 10 kHz.

Amplitude and pulse modulation

Amplitude modulation with a 1 dB bandwidth of 30 kHz and modulation depths of up to 99.9% with a resolution of 0.1% ensures the generator is suitable for testing AM systems and undertaking EMC immunity measurements. The pulse modulation facility has an on/off ratio of better than 45 dB up to 1.2 GHz and a rise time of less than 10 µs enabling

characterization of TDMA or TDD bursts in RF amplifiers and modules.

2 and 4 level FSK

In addition to the analog FM facilities, the 3002 signal generator allows the generation of 2 and 4 level FSK signals from external logic levels. The FM deviation generated is set by programmed command. The facility is ideal for testing paging receivers and RF modems.

Sweep

When configured as a swept carrier frequency generator, the start and stop frequency, step size and time per step can be programmed along with a choice of linear or logarithmic sweep. The sweep can be set to single or continuous operation and can be initiated by a command, a trigger applied to the front panel input or from the VXI backplane. A single step facility is also provided.

Size and weight

The 3002 occupies only 2 slots in a C-size chassis. This space saving is especially valuable in the testing of FDM links where large numbers of sources are required.

Spectral Purity

Measurement of receiver selectivity and ultimate signal to noise ratio requires good spectral purity. The 3002 has a low residual FM of typically 3 Hz and sideband noise of –121 dBc/Hz at 1 GHz to allow demanding measurements to be made at an affordable cost.

Instrument stores

The 3002 signal generator provides extensive storage facilities for simplifying repetitive test scenarios. Up to 100 carrier frequency values and 100 complete instrument settings can be stored. All of these stores are non-volatile. A software protection system ensures that the stored settings cannot be accidentally overwritten. The use of an electronic storage medium without back-up batteries ensures long storage lifetime and avoids periodic replacement of batteries. A large volatile storage system capable of storing 100 instrument settings is also provided for use by automatic test systems. The values can be downloaded and then recalled by store number to avoid the time overhead introduced by the handling of the message based protocol of full instrument settings.

Sequencing

A software facility allows sequences of stored instrument settings to be defined. The trigger commands, front panel or backplane triggers, can then be used to cycle through the sequence of settings to give the highest throughput rates in automatic test systems.

Calibration Data

All alignment data, including the internal frequency standard adjustment, is digitally derived and realignment can be undertaken by protected functions and does not require the removal of instrument covers. Status information stored includes model type and serial number. An elapsed time facility allows the monitoring of the number of users hours the product has been in use. With a recommended calibration interval of 2 years, ownership costs are kept low.

Programming

The protocol and syntax of the standard commands have been designed in accordance with IEEE 488.2 standard to simplify the generation of test programs.

To further assist in test program generation and debug, the current instrument setting and status can be read back.

Specification

General Description

The 3002 covers the frequency range 9 kHz to 2.4 GHz. The RF output can be amplitude, frequency, phase or pulse modulated. An internal synthesized programmable AF source is capable of generating single or two tone modulation.

Carrier Frequency

Range
9 kHz to 2.4 GHz

Resolution
1 Hz

Accuracy
As frequency standard.

RF Output

Range
–137 dBm to +25 dBm, (+19 dBm above 1.2 GHz) 0.1 dB resolution. When AM is selected the maximum RF output level decreases linearly with increasing AM depths to at 99.9% depth.

RF Level Units
Units may be programmed in µV, mV, EMF or PD, dB relative to 1 µV, 1 mV EMF or PD, or dBm. The output level can be normalized for 75 Ω operation with an impedance converter.

Level Accuracy

Temperature >–127 dBm	*17 to 27°C <1.2 GHz*	*<2.4 GHz*
	±1.0 dB	±2.0 dB
Temp	0 to 55°C	
	<1.2 GHz	<2.4 GHz
Coefficient/°C	<±0.02 dB	<±0.04 dB

Attenuator Hold
Selection of Attenuator hold provides for uncalibrated level reduction of at least 10 dB without the Mechanical Attenuator operating.

VSWR
For output levels less than –5 dBm, output VSWR is less than 1.3:1 for carrier frequencies up to 1.2 GHz and less than 1.5:1 for carrier frequencies up to 2.4 GHz.

Output Impedance
50 Ω SMA female connector to MIL 390123D.

Output Protection
Protected from a source of reverse power up to 50 W from 50 Ω or 25 W from a source VSWR of 5:1. Protection circuit can be reset remotely. Tripping the reverse power protection illuminates a front panel LED and causes an interrupt.

Spectral Purity

Harmonics
Typically better than –30 dBc for RF levels up to +7 dBm.
Typically better than –25 dBc for RF levels up to 6 dBm below maximum specified output.

Non-Harmonics (offsets > 3 kHz)
Better than –70 dBc to 1 GHz.
Better than –64 dBc above 1 GHz
Better than –60 dBc above 2 GHz

Residual FM (FM off)
Less than 4.5 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 1 GHz.

SSB Phase Noise
Better than –124 dBc/Hz at 20 kHz offset from a carrier frequency of 470 MHz,
typically –121 dBc/Hz at 20 kHz offset from a carrier frequency of 1 GHz.

ΦM on AM
Typically 0.1 radians at 30% depth at 470 MHz.

Modulation Modes

Internal and external modulation can be simultaneously enabled to allow combined amplitude and frequency (or phase) modulation. Pulse modulation can be use in combination with the other forms of modulation.

Frequency Modulation

Deviation
0 to 100 kHz, 3 digits or 1 Hz resolution

Accuracy at 1 kHz
±5%

Bandwidth (1 dB)
DC to 100 kHz (DC coupled)
10 Hz to 100 kHz (AC coupled)
20 Hz to 100 kHz (AC coupled with ALC)

Group delay
Less than 5 µs to 100 kHz.

Carrier frequency offset
(DC coupled)
Less than 1% of the set frequency deviation.

Distortion
Less than 3% at 1 kHz rate for deviations up to 100 kHz. Typically < 0.5% at 1 kHz rate for deviations up to 10 kHz.

Modulation source
Internal LF generator or external via front panel BNC.

FSK

Modes
2 level or 4 level FSK.

Data Source
External data connected to Trigger input connector (2 level) or Trigger and Pulse input connectors (4 level).

Frequency Shift
Settable up to ±100 kHz.

Accuracy
As FM deviation accuracy.

Timing Jitter
±3.2 µs.

Filter
8th order Bessel, –3 dB at 20 kHz.

Phase Modulation

Deviation
0 to 10 radians, 3 digits or 0.01 resolution.

Accuracy at 1 kHz
±5% of indicated deviation excluding residual phase modulation.

3 dB Bandwidth
100 Hz to 10 kHz

Distortion
Less than 3% at 10 radians at 1 kHz modulation rate. Typically < 0.5% for deviations up to 1 radian at 1 kHz

Modulation source
Internal LF generator or external via front panel BNC.

Amplitude Modulation

For carrier frequencies < 500 MHz, useable to 2 GHz.

Range
0 to 99.9%, 0.1% resolution.

Accuracy
±5% of set depth at 1 kHz for temperatures 17 to 27°C
Temperature coefficient <0.02%/°C

1 dB Bandwidth
DC to 30 kHz (DC coupled)
10 Hz to 30 kHz (AC coupled)
20 Hz to 30 kHz (AC coupled with ALC)

Distortion
<2.5% at 1 kHz rate for modulation depths up to

80%, and <1.5% at 1 kHz rate for modulation depths up to 30%.

Modulation source
Internal LF generator or external, via front panel BNC.

Pulse Modulation

Frequency Range
32 MHz to 2.4 GHz, useable down to 10 MHz

RF Level Range
Maximum guaranteed output is reduced to +20 dBm, +14 dBm above 1.2 GHz.

RF Level Accuracy
When pulse modulation is enabled, adds ±0.5 dB to the RF level accuracy.

Control
TTL/CMOS compatible pulse input is on front panel BNC with 10 kΩ input impedance.
A logic 0 turns the carrier off, a logic 1 turns the carrier on. Maximum input is ±15 V.

On/Off Ratio
Better than 45 dB below 1.2 GHz, better than 40 dB above 1.2 GHz.

Rise And Fall Times
Less than 10 µs

Internal LF Generator

Frequency Range
0.01 Hz to 20 kHz

Resolution
0.01 Hz for frequencies up to 100 Hz
0.1 Hz for frequencies up to 1 kHz
1 Hz for frequencies up to 20 kHz

Frequency Accuracy
As frequency standard

Distortion
Less than 0.1% THD at 1 kHz

Waveforms
Sine wave to 20 kHz and triangular or square wave to 3 kHz

Audio Output
The modulation oscillator signal is available on a front panel BNC connector at a level of 2 V RMS EMF from a 600 Ω source impedance.

External Modulation

Input on the front panel via BNC connector. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance is 100 kΩ nominal.

Modulation ALC

The external modulation input can be levelled by a peak levelling ALC system over the input voltage range of 0.75 V to 1.25 V RMS sine wave. High and low indications are reported as part of the instrument status when the input is outside the levelling range.

Sweep Mode

Control Parameters
Start/stop values of carrier frequency, size of step and time per step.

Sweep Time
50 ms to 10 s per step

Linear Sweep
Frequency step size of 1 Hz minimum.

Logarithmic Sweep
Percentage increment of 0.01% to 50% in 0.01% steps.

Sweep Mode
Single, continuous or external trigger.

Trigger
A trigger input is available on a front panel BNC. A step or the complete sweep may be triggered by the front panel input, VXI backplane trigger or VXI command.

Frequency Standard

TCXO
10 MHz

Temperature Stability
Better than ±5 in 10^7 over the operating range of 0 to 55°C.

Ageing Rate
Less than ±1 in 10^6 per year

External input
Front panel BNC connector accepts an input of 1 MHz or 10 MHz at 220 mV RMS to 1.8 V RMS into 1 kΩ.

General

VXI-bus INTERFACE CAPABILITIES
Complies with revisions 1.3 and 1.4 of the VXIBus specification for message based instruments

Logical address
Manual selection (1-254).

Device type
A16 D16 message based servant, programmable interrupter.
Protocol
Word serial IEEE 488.2
Fast Handshake not supported.

Connectors
P1, P2 (highest slot of a 2 slot allocation).

TTLTRG
Used to trigger sweep mode and step memory sequences.

CLK10
Not used.

Local Bus
Not used.

ECLTRG
Not used

Peak Current & Power Consumption

	+24 V	+12 V	+5 V	–12 V
Ipm	1.2 A	1.0 A	2.0 A	0.6 A
Idm	0.1 A	0.1 A	1.3 A	0.1 A

Total Power 60 W max.
Cooling (per slot): 2.4 litre/s at 1 mm H_2O back pressure for 10°C maximum temperature rise.

BITE (built-in test equipment)
LEDs or modules front panel indicate Power OK (green), System Failure (red) and Reverse Power Protection Tripped (red).

RFI COMPATIBILITY
Complies with VXIBus revision 1.3/1.4 specifications below 1 GHz.

ELECTRO-MAGNETIC COMPATIBILITY
Conforms with VXI specifications revision 1.4, and with the protection requirements of Council Directive 89/336/EEC.
Complies with:-

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2,3,4

SAFETY
Complies with IEC 1010-1, BS EN61010-1 for class III portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 supply.

RATED RANGE OF USE
(Over which full specification is met)

Temperature
0 to 55°C

Humidity
Up to 93% at 40°C

Altitude
Up to 3050 m (10,000 ft)

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
–40 to +70°C

Humidity
Up to 93% at 40°C

Altitude
Up to 4600 m (15,000 ft)

CALIBRATION INTERVAL
2 years

DIMENSIONS AND WEIGHT

Dimensions	2 slot, C Size
Weight	Less than 4 kg

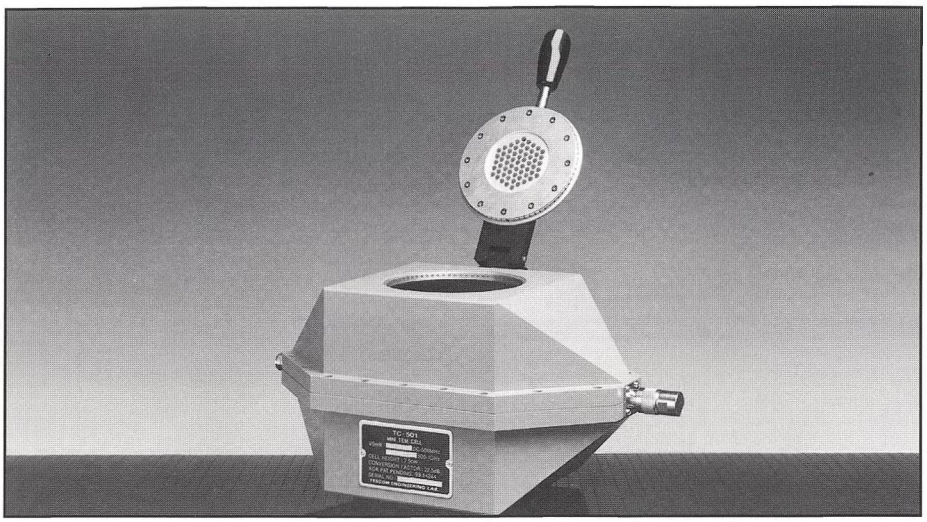
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
3002	9 kHz to 2.4 GHz Signal Generator
	Supplied with
46882/226	Operating manual.
59000/285	LabWindows/CVI® driver.
59000/286	VXI plug & play soft front panel.
	Optional Accessories
46880/069	Service manual.

TEM Test Cell

The TEM Test Cell provides a controlled screened environment for testing small RF devices

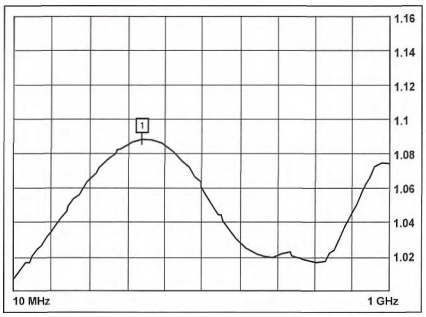


- Accurate linear field for pager testing
- Small size and low weight for bench top mounting
- Low VSWR and through loss
- Additional BNC connector for signal probe
- Excellent immunity from external signals
- Includes access holes for manual adjustment

The TC 5010B is a Transverse Electric Mode (TEM) cell for generating accurate electromagnetic fields to test small RF devices, such as pagers, with integral aerials. With the aid of an external signal generator (e.g. 2023A/B, 2025, 2026) or a test set (e.g. 2945A), accurate linear RF fields can be generated from DC to beyond 1 GHz. Low input VSWR and through loss combined with a robust construction ensures that accurate fields can be generated.

An access hatch allows the unit under test to be quickly mounted in a fixture and the use of robust RF shielding on the lid ensures long service life, low RF leakage and high immunity to external fields.

The combination of high immunity and excellent screening ensures that cells can be used in close proximity to each other without affecting measurement results. Apertures through the access hatch allow the use of adjustment tools for the device alignments without compromising the performance of the TEM cell.



Typical VSWR of TEM Cell

The TC 5010B provides an effective low cost alternative to the use of screened rooms for pager testing. The TEM cell can be used to measure pager sensitivity and selectivity. In addition the cell can be used to effectively pick up radiated signals for the alignment of IF strips and local oscillators.

The high accuracy of the cell can be used to check RF field probes and for pre-compliance testing of small RF devices for unwanted radiated emissions and immunity to external fields.

Specification

Frequency Range
DC to 1 GHz, useable to 1.5 GHz.

Input VSWR
<1.2 DC to 1 GHz, typically <1.1

Insertion Loss
<0.2 dB DC to 1 GHz.

Field Conversion Factor
For a signal level of 1 µV applied to the cell input a field strength of 13.33 µV/m (22.5 dBµV/m) is generated in cell test area.

Dimensions and Weight

Hatch Diameter	Height	Width	Depth	Weight
134mm	190mm	380mm	185mm	4.8 kg

Versions and Accessories

When ordering please quote the full ordering number information

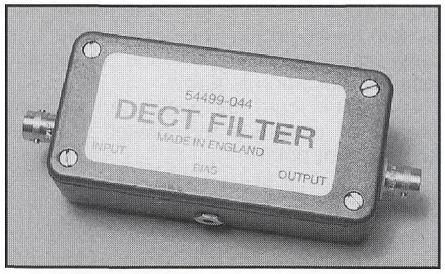
Ordering Numbers	*Versions*
59999/724	TC 5010B TEM Cell Supplied with Operating instructions 50 Ω termination Mounting fixture
	Optional Accessories
59999/725	Spare Blank lid For user modification to suit individual pager adjustment hole positions
59999/726	Spare Drilled lid Increased adjustment hole diameter with shielding level 56 dB
59999/727	Pager adjustable fixing jig
	Recommended RF sources
2023A/B, 2025	9 kHz to 1.2, 2.05, 2.51 GHz Signal Generator
2026	MultiSource Generator
2030	10 kHz to 1.35 GHz Signal Generator
2945A	Communications Service Monitor
2965A	Radio Test Set

Signal Generator Accessories

A range of accessories are available for the complete IFR range of signal generators designed to further enhance the versatility and portability of this product range

DECT Filter

A DECT filter is available as an optional accessory for 2030, 2040 and 2050 series signal generators. The filter provides a simple method of connecting a CMOS data source to the FM port of the signal generator and provides an analog filter to shape the signal to correspond with the modulation requirements of the Digital European Cordless Telephone. Information on the use of the filter can be obtained in Publication No. 46889-450 from your IFR representative.



Order Number	Description
54499-044	DECT Filter Accessory

Option 105 TDMA Pulse Modulator

Option 105 slow rise and fall time pulse modulation is available for all versions of 2030, 2040 and 2050 series signal generators supplied with the pulse modulation option. The rise and fall time of the modulator is increased from 25 ns to typically 2 µs. The option finds application where RF signal bursts similar to those used in TDD or TDMA signals are required to be simulated. The slower rise and fall time results in lower spectrum spread compared to that generated by a fast pulse modulator. Generators requiring this facility should be ordered with Option 2 and Option 105. The specification is as Option 2 but with a typical rise time of 2 µs.

Order Number	Description
Option 105	Order with any 2030, 2040 or 2050 series signal generator. Must be ordered with Option 002

Rack Mounting Kits

2023A/B, 2025

The rack mounting kit for the 2023A/B, 2025 contains front panel brackets only, which ensures the instrument is secure in the rack.

2026

Has the same full rack mount kit as the 2030/40/50 series, but is designed for 4U high.

2030, 2040 and 2050 series

Two types of rack mount kit are offered which allow the generator to be installed in a rack and occupy a height of 3 units (5¼ inches).

The full rack mount kits are supplied with a set of front mounting brackets which allow the instrument to be mounted with or without the front panel handles. Telescopic slides support the weight of the instrument and provide a simple means of removing the generator from the rack. Two kits are available to allow for mounting in racks with a depth between the front and rear mounting faces of either 480 mm to 680 mm or from 680 mm to 840 mm.

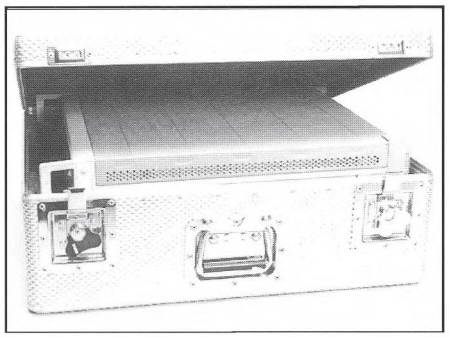
The more basic rack mounting kit provides a set of front mounting brackets which allow the instrument to be mounted with or without the front panel handles. This kit must be used in conjunction with a method of supporting the weight of the instrument in the rack.

Order Numbers	
	2023A/B, 2025
46884-792	Front bracket handle mounting kit
	2026
46884-293	Rack mounting kit (with slides) 480 mm to 680 mm
46884-294	Rack mounting kit 680 mm to 840 mm
	2030, 2040 and 2050 series
46884-291	Rack mounting kit (with slides) for rack cabinets from 480 mm to 680 mm
46884-292	Rack mounting kit (with slides) for rack cabinets from 680 mm to 840 mm
46884-541	Rack mounting kit containing front mounting brackets only

2030/40/50 series Transit and Carry Case

The transit case provides a high degree of protection for all 2030, 2040 and 2050 series signal generators. It is made from aluminium with a high density foam insert to protect and isolate the signal generator. The case has rounded welded corners and has adequate room for including power cords and an operating manual.

The soft carry case provides a convenient way to protect and carry the 2030/40/50 series signal generator. Made from a tough padded material it offers an adequate level of protection for many requirements.



Order Numbers	Description
46662-525	Transit case.
54112-164	Soft carry case.

2050 Series Break Out Box

The Break Out Box for Option 7 provides a convenient method of interfacing to the Auxiliary Connector. The interface converts the data, clock and burst inputs on BNC connectors to a D Type connector. The provision of a second D Type connector allows the break out box to be used to monitor the signals being supplied to the auxiliary connector from an external source. Supplied with a male to female D Type lead.

Order numbers	Description
44991-144	2050 series break out box

General Accessories

Order numbers	Description
43126-012	RF connector cable, TM 4969/3, 50 Ω, 1.5 m, BNC
54311-092	Coaxial adapter N male to BNC female
59999-163	Precision coaxial adapter N male to SMA female
54411-051	Impedance adapter, 50 to 75 Ω, BNC connectors
54311-095	RF connector cable, 1 m, type N connectors
43129-189	GPIB Lead assembly
46883-408	IEEE/IEC Adapter block for GPIB socket

2310
TETRA Signal Analyzer

Setting new standards in TETRA transmitter analysis where speed and accuracy counts



- Accurate TETRA transmitter measurements
- Test TETRA base stations, terminals and direct mode radios
- All measurements made in accordance with ETSI, ETS300 394-1
- 80 dB instantaneous dynamic range for Adjacent Channel Power (ACP)
- Spectral displays of TETRA signals
- Modulation analysis, with vector and constellation diagrams
- Large color LCD display
- 40 W continuous power handling
- Wideband noise and discrete spurious measurements

The new world standard for mobile radio, TErrestrial Trunked RAdio (TETRA) has been defined by ETSI. TETRA is a digital trunked radio system that uses time multiplexing (TDMA) with $\pi/4$ DQPSK modulation. It is designed to offer radio users a high quality Voice and Data (V+D) network and improve upon the spectrum efficiency of older analog networks.

Having been designed specifically to make TETRA transmitter measurements with speed and accuracy, the 2310 TETRA Signal Analyzer is the most comprehensive TETRA transmitter tester available. TETRA networks will be used alongside existing analog networks. This places specific demands on the characteristics of the transmitter to prevent interference. A consequence of this requirement is that transmitters need to be measured to a higher level of performance than has been necessary with analog systems.

When in the TETRA mode, the 2310 measures the following transmitter parameters, according to ETSI, ETS 300 394-1.

- Average transmitter output power
- Transmitter power vs time
- Adjacent channel power due to modulation
- Adjacent channel power due to switching
- Unwanted power in nonactive transmit state
- Modulation and frequency accuracy
- Wideband noise emissions
- Discrete spurious emissions

The 2310 architecture is based on a single stage down conversion. The use of a local oscillator with low phase noise and a high performance digital IF stage results in an instrument with excellent phase noise and linearity. 2310 digitizes the time domain signal and then performs a FFT in order to display in the frequency domain. This architecture gives the 2310 the capability to measure with high dynamic range and good power accuracy. The 2310 can also capture a single TETRA burst with phase and magnitude information for modulation analysis.

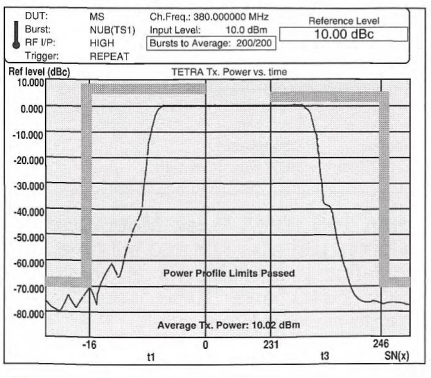
Average Transmitter Power

The 2310 can measure 40 W continuously and up to 50 W with a TETRA like burst profile. This means that all TETRA base stations and terminals can be measured directly without the need for external attenuation. The value of the average transmitter power is displayed and used as the reference for other relative power measurements, such as ACP (Adjacent Channel Power).

Transmitter Power vs Time

The burst profile of a TETRA burst is measured and displayed. A dynamic range of >80 dB means that the full burst profile can be seen when measured through the TETRA filter. The user can select to view the whole burst, or to view the ramp-up (t1) and ramp-down (t3) periods of the burst in more detail. The burst profile limit mask can be displayed and automatic pass/fail indication is given.

A marker can be positioned on any symbol to measure the power value at each symbol point.



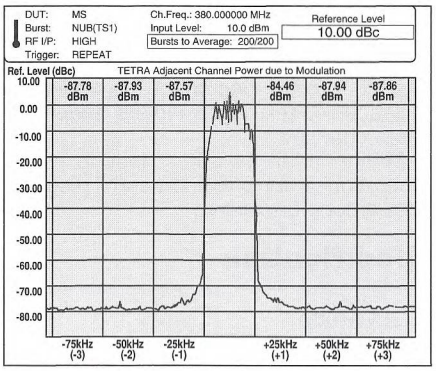
ACP due to Modulation

2310 measures ACP due to modulation with >80 dB dynamic range through the TETRA filter. The results can be displayed either in tabular format or viewed as a

spectrum. Intelligent limits compare the measured ACP against the -60 dBc value (for channels ±1) or the -36 dBm value defined in ETSI, ETS 300 394-1 as appropriate. Alternatively, it is possible to set up user defined limits.

In the tabular format the ACP in each of the ±1, ±2 and ±3 channels is displayed and a pass/fail indication given. In spectrum mode the ACP is shown with lines indicating the channel location and a numeric display of the power in each channel. ACP powers displayed are always measured through a TETRA filter. In spectrum mode the displayed trace is measured using a narrower filter. In this way, it is possible to identify if power is resulting from discrete spurious or noise.

On a production line the ACP values can be measured quickly. The spectrum display provides a powerful diagnostic tool for the investigation of ACP measurement failures.



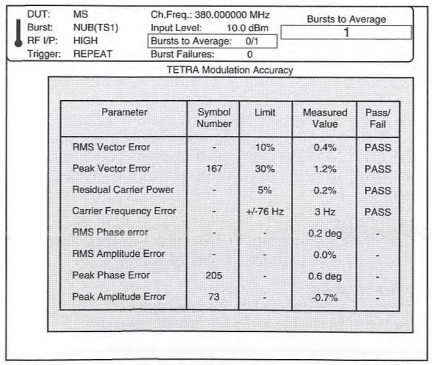
ACP due to Switching

The fast rise and fall of the transmitter burst can result in spectral spreading into adjacent channels. ACP due to switching measures this spectral spreading. The measurement is made at ±25 kHz from the nominal carrier.

Power in the Nonactive Timeslots

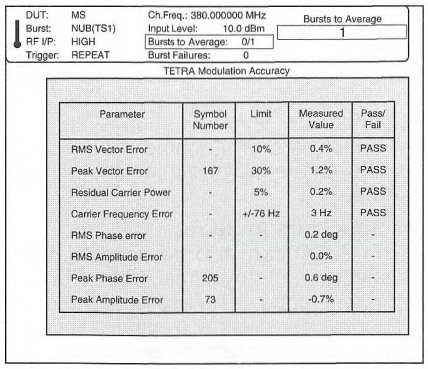
The 2310 is capable of measuring the power in each of the three nonactive timeslots.

Modulation Accuracy



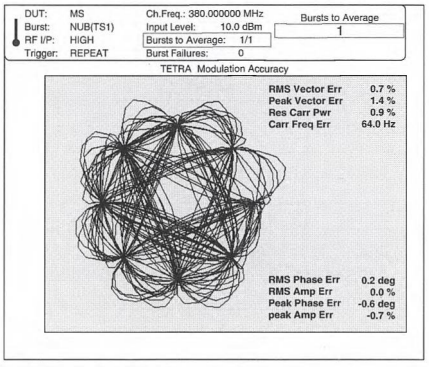
The 2310 can demodulate and display the TETRA bursts. A symbol table displays the detected bits of a TETRA burst and groups them by symbol. To make interpretation of the data easier on the 2310 display, data is color coded according to function, for example training sequence, scrambled data, guard bits.

The data within a single burst can be output via the GPIB interface.



A constellation diagram gives a display of the modulation accuracy at the symbol points. Vector error tolerance rings can be displayed at each phase state for rapid validation of modulation accuracy. Only symbols from the useful part of the burst are displayed, so for discontinuous bursts the ramp up and ramp down periods are not displayed.

A vector diagram displays both the modulation phase states at the symbol points and the path trajectory between states. Again only the useful part of the burst is displayed. When setting up a digital transmitter modulator it is beneficial to be able to see the overall effect of tuning on the modulation. A special feature of 2310 called rotated vector, superimposes each of the phase states on a single point. Having selected rotated vector it is possible to view the overall effect of any changes to the modulator's characteristic.



Wideband Noise

The 2310 is capable of measuring wideband noise over the frequency range 100 MHz to 2.4 GHz. Wideband noise is defined as the broadband power that is transmitted by a TETRA radio and is measured through the TETRA filter at frequency offsets greater than 100 kHz from the on-channel. The user may specify up to 20 frequency offsets. For each offset, the average power of 20 bursts is calculated and displayed.

Discrete Spurious Emissions

Discrete spurious emissions are unwanted emissions far from the carrier which occur during the transmission of a TETRA burst. The 2310 is capable of measuring the average power of a discrete signal in the frequency range 100 MHz to 1 GHz. Up to 20 measurement frequencies may be specified by the user. For each frequency, the average power of 20 bursts is measured and displayed. When a discrete spurious signal with a level greater than the allowed limit is detected, the 2310 subtracts the maximum permitted level of wideband noise from the measured value before deciding whether the limit has been exceeded.

Auto Pre-Scan

In order to assist with the configuration of the wideband noise and discrete spurious measurements, an automatic pre-scan facility is provided. Start and stop frequencies can be specified and once the pre-scan has been performed, the user is able to view the frequency spectrum of interest. Any potential discrete spurious emission or a high level of wideband noise can be identified. By using the marker facility, the frequencies of interest can be loaded into the appropriate wideband noise or discrete spurious measurement table.

Linearization Bursts

The 2310 measures the unwanted emissions produced by a mobile or base station when an initial linearization burst is transmitted. The measurement is made in a TETRA filter at frequency offsets ±25 kHz from the on-channel. A mobile operates in the non-transmit (receive) state for four minutes prior to transmitting a linearization burst. A base station operates in test transmit mode prior to the linearization burst being transmitted.

Instrument Configuration

A dedicated TETRA hard key configures the 2310 immediately for analysis of TETRA signals.

The 2310 can test all TETRA base stations, terminals and direct mode transmitters. The 2310 synchronizes to the training sequence that is transmitted in every TETRA burst. The training sequence gives the analyzer a time reference against which all measurements are made. Typically, 2310 captures and analyzes one slot in each frame and captures every 5th frame. This results in a single burst being captured and displayed in 0.3 seconds. As an example, when measuring power burst profile, 200 bursts are measured in under 30 seconds.

Fast Measurement Set-Up

Once TETRA mode is selected, the set up process is a simple five stage procedure:

- Define the radio type (eg, Base Station/Terminal)
- Define the burst type (eg, Normal Downlink/Control Burst)
- Enter the transmitter frequency
- Enter nominal transmitter power
- Select the measurement

For measurements defined by ETSI, ETS 300 394-1 the 2310 automatically

configures itself to average the correct number of bursts and apply the TETRA filter as necessary. This makes measurement set up fast and simple, ensuring that all measurements are made correctly.

The limits for each measurement as defined by ETSI, ETS 300 394-1 are stored in the 2310. Users can define their own limits for design proving or to take into account external sources of measurement uncertainty.

GPIB code is also minimized reducing the time taken to write production test programmes.

Large Color Display

A large 6.5 in color TFT LCD displays all instrument settings and measurement results. Results are displayed either in numeric tabular format or as traces as appropriate.

A measurement information area at the top of the display clearly shows the measurement status of the instrument, including transmitter type, burst type and number of bursts to average. The main screen area shows measurement results in spectrum, power vs time or numeric data format.

Pre-Conformance Testing and Development Proving

During the design proving stages of radio development, there is a need for powerful and flexible test instruments. The 2310 measures TETRA transmitters exactly as required by ETSI, ETS 300, 394-1. However, it is designed to be flexible, giving the user the ability to define the number of bursts to average or set their own test limits.

The 2310 can be used to form the basis of a pre-conformance test system. When used with IFR's TETRA signal generator (2050T) and radio test set (2968), all the major TETRA tests can be performed. This enables extensive product evaluation to be made before submitting a radio to a full conformance test house. As a result, the radio is more likely to pass first time. Full data sheets covering the 2050T and 2968 are available from IFR.

Production Testing

In a production test environment, speed of test is paramount. The 2310 is capable of testing TETRA radios faster and more accurately than any spectrum analyzer based system. The use of a single stage downconverter followed by a digital IF stage provides the required dynamic range much faster than is possible with swept frequency systems.

It is also possible to reconfigure the measurement with a minimum of GPIB commands. Measurement results and pass /fail status can be read directly. Radios are tested more quickly and accurately with the 2310.

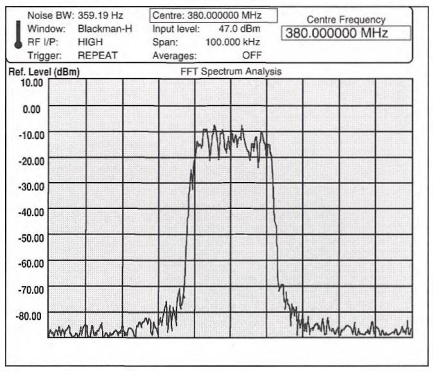
GPIB Control

Measurement speed in production environments is vital. Due to its dedicated hardware platform, the 2310 can be configured with the minimum of GPIB control commands. The instrument is rapidly set up to pre-determined values or sensible presets. All programming uses SCPI-like commands and is based on the MEASURE, READ, FETCH structure. This means that programs can be written quickly using high level commands without needing to have an in-depth knowledge of the instrument. For production test programs, low level commands are given that enable the programmer to use status bits to optimize programming and minimize test time.

FFT Spectrum Analyzer

The 2310 can also be used to display the spectrum of any signal in the 100 MHz to 2.4 GHz band. The use of a patented A to D converter gives a dynamic range and sensitivity unmatched by any swept tuned (superhetrodyne), based analyzer. Third order intermodulation free dynamic range is -90 dBc for two tones of -26 dBm at the input mixer. Maximum sensitivity is -150 dBm in a 1 Hz bandwidth. This delivers an instrument that is ideal for measuring unwanted intermodulation products in radio systems and measuring extremely low level spurious. Absolute amplitude accuracy is ±1 dB and so signal levels can be measured precisely. Close to carrier analysis is also possible due to the excellent phase noise and use of digital filters with good shape factor.

The in-built FFT spectrum analyzer delivers a powerful tool during the design phase of any radio system. An optional 1 GHz active probe enables the design engineer to make measurements on a radio circuit without loading.



Cost Of Ownership

To minimize cost of ownership, careful consideration has been given to the design and assembly of the 2310. The recommended calibration interval is two years. A module exchange policy is used for the repair of major assemblies. These assemblies are fully calibrated. As a result, repairs can be carried out in the shortest time possible.

The use of FLASH memory and software download via the RS-232 interface or 3.5 in floppy disk drive means the 2310 can be upgraded without having to remove its covers.

Printing Made Easy

By connecting directly to the parallel printer port interface, measurement results and trace data may be sent to any parallel printer which is compatible with the HP PCL printer language PCL3 or higher (eg HP DeskJet/LaserJet)

On pressing the PRINT key, a monochrome graphical or tabular display is produced as appropriate. In addition, the hard copy produced includes current instrument configuration, time and date plus an optional user heading line which is specified under the utilities.

The output is buffered to allow the measurement process to continue whilst printing.

MIPlot Measurement Presentation Software

The MIPlot measurement presentation software provides a powerful tool to enable insertion of measurement traces into standard office PC packages. The software enables the capture of trace data from the 2310 using a PC with a standard GPIB card. The traces can be inserted into word processed documents or graphics packages using .OLE formatting. Once inserted into the document the traces can be rescaled, text and markers added and colors changed.

MIPlot is an excellent tool for report generation or for presentation of results to large groups of people.

Specification

TETRA Mode

Specifications in the TETRA mode section of this data sheet apply for frequencies from 100 MHz to 1000 MHz.
All measurements are made in accordance with the ETSI, ETS 300 394-1 specification.

Burst Types Measured - Base Station Test
NDB - Normal Down Link (cont.) using TS1 or TS2
SB - Synchronization Burst (cont.)
NDB - Normal Down Link (discont.) using TS1 or TS2
SB - Synchronization Burst (discont.)

Burst Types Measured - Mobile Test
CB - Control Uplink Burst (Half Slot discont.)
NUB - Normal Uplink Burst (discont.) TS1 or TS2

Burst Types - Direct Mode of Operation Test
DNB - Direct Mode Normal Burst (discont) using TS1 or TS2
DSB - Direct Mode Synchronization Burst (discont)

Measurement speed
2310 captures and analyzes 1 slot in each frame, typically capturing every fifth frame.

Dynamic range
Capable of measuring a dynamic range of > 80 dB in a TETRA measurement bandwidth filter.
Input signal level for optimum dynamic range
+3 dBm to +46 dBm on the high power input.
-10 dBm to +27 dBm on the lower power input.
-20 dBm to +27 dBm on maximum sensitivity setting.

TETRA filter
2310 has an internal TETRA filter - a root Nyquist filter with a roll-off factor (α) of 0.35.

Trigger modes
Single; (user defined burst average)
Continuous; (user defined rolling average)

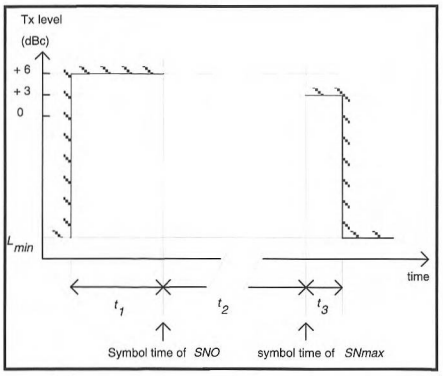
Average Transmitter Output Power

Average transmitter output power measured over the useful part of a burst.
2310 measures the average transmitter output power through the TETRA filter for both base station (BS) or mobile station (MS) power class transmissions.

Accuracy (for input attenuation >10 dB)
±0.5 dB (following self calibration, 100 MHz to 1 GHz, 25°C ±5°C). ±1.0 dB all other conditions.

Transmitter Power Versus Time

The 2310 measures the power profile of a TETRA burst and compares it to the power versus time mask below:



Accuracy
±0.2 dB ± residual error

Residual noise floor
<-80 dBc

Measurement Time
200 bursts measured and displayed in <30 seconds

Display Mode
Graph of power vs time for whole burst or for ramp up and ramp down periods only
Tabular result presentation

Unwanted Output Power in Nonactive Transmit State

The 2310 measures unwanted power in each of the 3 nonactive timeslots following the transmitter burst through a TETRA filter.

Accuracy
±0.2 dB ± residual error

Residual noise floor
<-80 dBc

Measurement Time
200 bursts measured and displayed in
<45 seconds - 1 slot
<60 seconds - 2 slots
<70 seconds - 3 slots

Display Mode
Tabular result presentation

Adjacent Channel Power due to Modulation

The 2310 measures the average power appearing in the adjacent channels at frequency offsets of ±25 kHz, ±50 kHz and ±75 kHz from the nominal center frequency of the allocated channel.
The measurements are performed over the useful part of a burst through the TETRA filter.

Accuracy

Channel ±25 kHz	±0.2 dB ± residual error
Channel ±50 kHz	±0.2 dB ± residual error
Channel ±75 kHz	±0.2 dB ± residual error

Residual noise floor
<-80 dBc

Measurement Time
For one adjacent channel; 200 bursts measured and displayed in <60 seconds
For three adjacent channels; 60 bursts measured and displayed in <115 seconds

Display Mode
Tabular result presentation
Spectrum display of adjacent channel power.

Adjacent Channel Power due to Switching Transients

The 2310 measures the adjacent channel power due to switching transients of the ramp-up (t1) and ramp-down (t3) period of a discontinuous burst. The peak power for each burst is measured. The average peak power over 200 bursts is calculated and displayed.
The measurement is performed at frequency offsets of ±25 kHz from the nominal frequency of the allocated channel through the TETRA filter.
In addition, 2310 can display the peak power of the highest 20 bursts measured.

Accuracy
±0.2 dB ± residual error

Residual noise floor
<-70 dBc

Measurement Time
200 bursts measured and displayed in <85 seconds

Display Modes
Tabular result presentation.
Graph of power vs time for the on-channel and ± 25 kHz adjacent channels.

Modulation Accuracy

The 2310 measures the difference between the actual transmitted waveform and the ideal signal waveform.

RMS Vector Error	<0.01 (1% in any burst)
Peak Vector Error	<0.03 (3% for any symbol)
Residual Carrier Magnitude	<0.01%

Measurement Time
20 bursts measured and displayed in <10 seconds

DISPLAY MODES

Constellation
Samples displayed at symbol times. Updated 3 times per second. All symbols within the t2 period are displayed.

Vector
Display of trajectory between symbol times.

Rotated Vector
Display of all symbol points super imposed onto a single symbol point.

Symbol table
The detected bits of a single TETRA burst are displayed and grouped by symbol.

Tabular result presentation
RMS Vector Error
Peak Vector Error
Residual Carrier Magnitude

Carrier Frequency Accuracy

The difference between the actual transmitted carrier frequency and its nominal value.

Accuracy
±0.01 ppm + frequency standard error

Measurement Time
20 bursts measured and displayed in <10 seconds

Display Mode
Numeric display

Wideband Noise

The 2310 measures the wideband noise level at selected frequency offsets from the on-channel. For each offset, the average power over 20 bursts is calculated and displayed. The measurement is timed to occur during the useful part of the burst (and covering at least 200 symbols in each burst) and is made through the TETRA filter. The average transmitter output power is also measured and is used as the 0 dB reference.

Accuracy
±0.2 dB ± residual noise floor error.

	Residual Noise Floor (18 kHz b/w)	
Offset Frequency	***CW <=520 MHz***	***CW <1 GHz***
100 kHz to 250 kHz	-88.0 dBc	-88.0 dBc
250 kHz to 500 kHz	-98.0 dBc	-98.0 dBc
500 kHz to frb	-100.0 dBc	-99.0 dBc
>frb	-105.0 dBc	-103.5 dBc

Where frb denotes the frequency offset corresponding to the near edge of the received band or 5 MHz whichever is greater.

Measurement Time
Average Transmitter Power (bursts to average =20) and 8 frequency offsets measured and displayed in <40 seconds.

Display modes
Tabular result presentation
Spectrum display of selected frequency offset

Adjacent Channel Power during the Initial Linearization Burst

The 2310 measures the peak power appearing in the adjacent channels during the first linearization period. The measurement is performed at frequency offsets of ±25 kHz from the nominal center frequency of the allocated channel through the TETRA filter.

Accuracy
±0.2 dB ± residual error

Residual Noise Floor
<-70 dBc

Measurement Time
Initial linearization burst followed by 200 normal bursts (for average transmitter output power calculation) measured and displayed in <35 seconds

Display Mode
Tabular results presentation
Graphs of power vs time for on-channel and ±25 kHz adjacent channels.

FFT Spectrum Analyzer

Frequency

Frequency range
100 MHz to 2.4 GHz

Total span
10 Hz to 300 kHz in a 1, 2, 5 sequence or continuously variable.

Equivalent noise bandwidth (digital)
Window:-
5 term Blackman Harris ENBW 0.22% to 0.44% of set span
Gaussian ENBW 0.5% to 17.5% of set span.

Phase noise (at 470 MHz)

10 kHz offset	<-115 dBc/Hz
20 kHz offset	<-121 dBc/Hz
25 kHz offset	<-122 dBc/Hz
50 kHz offset	<-124 dBc/Hz

Display resolution
501 points per trace

Display update rate
5 updates/second

Amplitude

Accuracy (for input attenuation >10 dB)
±0.5 dB (following self calibration, 100 MHz to 1 GHz, 25°C ±5°C). ±1.0 dB all other conditions.

Maximum input
(See Inputs)

Dynamic range
Harmonic distortion <-70 dBc
(for a single CW signal of -20 dBm at input mixer).

Third order intermodulation free dynamic range <-90 dBc for 2 tones of -26 dBm at mixer.

Third order intercept point (TOI) +25 dBm at input mixer.

Maximum sensitivity -150 dBm in 1 Hz bandwidth (low power input)

Spurious responses @ off sets <= ± 1 MHz <-80 dBc

Residual response <-110 dBm, (0 dB RF attenuation, input terminated)

Linearity ±0.01 dB per 10 dB plus Thermal Linearity Factor (TLF). Where TLF = 0.00 dB up to +30 dBm and 0.04 dB from +30 to +47 dBm per 10 dB.

Reference level setting
High power input
+50 dBm to -200 dBm in 0.001 dB steps
Low power input
+30 dBm to -200 dBm in 0.001 dB steps

Input attenuator
0 to 65 dB in 5 dB steps

Display resolution
0.01 dB to 20 dB/division in a 1, 2, 5, 10 sequence

Display units
dBm, dBµV, dBmV

Features

Display
10 x 10 graticule

Traces
Max/Min hold
Max hold
Outline
Infill

Marker Resolution
0.001 dB

Averaging
User settable 1 to 200 sweeps (repeat)
User settable 1 to 20000 sweeps (single)

Markers
Frequency and level readout
2 markers
Delta marker
Peak find
Delta marker sets span
Marker sets reference level
Marker sets reference frequency
Marker to centre frequency

RF Inputs (TETRA and FFT Spectrum Analyzer Modes)

High Power Input

Maximum Input
40 W (+46 dBm) continuous
50 W (+47 dBm) 50% duty cycle
50 W continuous for 30 seconds after a minimum interval of 30 seconds with <5 W applied.

Connector
Type N (f)

Impedance
50 Ω DC coupled

Input VSWR
<1.1:1, 100 MHz to 500 MHz
<1.22:1, 500 MHz to 1 GHz
<1.43:1, >1 GHz

Low Power Input

Maximum Input
0.5 W (+27 dBm)
(overload protection to 10 W)

Connector
Type N (f)

Impedance
50 Ω DC coupled

Input VSWR (>10 dB input attenuation)
<1.22:1, <1 GHz
<1.43:1, >1 GHz

Input VSWR (no attenuation)
<1.92:1 all frequencies

Display

6.5 in VGA TFT active matrix color LCD. External VGA monitor supported via rear panel connector.

Frequency Standard

Internal OCXO
10 MHz Ageing
$\pm 0.8 \times 10^{-7}$ per year after 30 days
$\pm 2.5 \times 10^{-8}$ per month after 30 days
$\pm 2.0 \times 10^{-8}$ per month after 60 days
$\pm 1.5 \times 10^{-9}$ per day after 30 days
$\pm 1.0 \times 10^{-9}$ per day after 60 days

Temperature stability
$\pm 5 \times 10^{-8}$ over the temperature range 5 to 55°C

Warm up time
Output frequency within 2×10^{-7} of final frequency after switch-on at a temperature of 20°C.

Rear Panel Connectors

IF input*
10.7 MHz, BNC (f), 50 Ω
Frequency standard
Output: BNC(f), 10 MHz, 2V pk-pk into 50 Ω
Input: BNC(f), 1 MHz or 10 MHz
Requires an input signal of 350 mV to 1.8 V RMS into 1 kΩ.

Printer interface
Parallel (Centronics compatible)
25 way D-type female

Auxiliary data I/O*
25 way D-type female

External VGA monitor
15 way compact D-type female

LO In
(SMA)

LO Out
(SMA)

RS-232
Connector is 9-way D-type (male), baud rate 300 to 9600 bits per second.

GPIB
See remote control

External Trigger*
BNC Female

Instrument Storage

Internal memory
10 non volatile instrument setting stores

3.5 in disk drive
1.44 MB floppy disk drive (MS-DOS compatible)

Remote Control

GPIB
All major functions except power supply switch control and auto pre-scan are remotely programmable.

Capabilities
Designed in accordance with IEEE488.2
Complies with the following subsets as defined in IEEE std 488.1.
SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

General Characteristics

Electromagnetic compatibility
Conforms with the protection requirements of EEC council directive 89/336/EEC.
Conforms with the limits specified in the following standards.

EN55011:	1991 (emissions) Class A
EN50082-1:	1992 (immunity)
EN60555-2:	1987 (mains harmonics)

CISPR 11 1990 Class A
IEC1000-4-2
IEC1000-4-3
IEC1000-4-4
IEC60555-2

Safety
Complies with IEC1010-1 EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.

Rated range of use
Full specification is met over the temperature range +5°C to +40°C (unless otherwise stated).
Humidity up to 93% over specified operating range and elevation up to 3,050 m (10,000 ft) (excluding 3.5 in disk drive).
3.5 in disk drive - Humidity up to 80% @ 30°C

Conditions of storage

Temperature	-40 to +70°C
Humidity	90% at +40°C
Altitude	<4,570 m

Calibration interval
Recommended 2 years.
Re-alignment can be accomplished from the front panel or by GPIB control. There are no mechanical adjustments required for re-alignment

Power requirements

Mains frequency	47 Hz to 63 Hz
Voltage range	100 V to 240 V ±10%
Power consumption	120 VA maximum

Dimensions
Width: 419 mm, Height: 177 mm, Depth: 488 mm.

Weight
<17 kg.

Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2310	100 MHz to 2.4 GHz TETRA Signal Analyzer
	Supplied with
	AC Supply lead
46882-329	Operating Manual
	Optional Accessories
46880-081	Service Manual
52388-900	1 GHz Active Probe
59000-327	MIPlot Measurement Presentation Software (Version 2.1)
43126-012	RF connector cable, TM 4969/3, 50 Ω, 1.5 m, BNC
54311-092	Coaxial adapter N-type male to BNC female
54311-095	RF connector cable, 1 m, N-type connectors
43129-189	GPIB lead assembly, 1.5 m
46884-649	RS-232 cable, 9 way D-type female to 25 way D-type female, 1.5 m
46884-650	RS-232 cable, 9 way D-type female to 9 way D-type female, 1.5 m
46884-648	Cable assembly, serial port to printer 9 way D-type female to 25 way D-type male, 1.5 m
46884/560	Cable assembly, parallel port to printer Centronics socket, 2 m
46884-293	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm
46884/294	Rack mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm
46884/931	Rack mounting kit containing front brackets only
54112/164	Soft carrying case

* Not supported in Phase 2.2 release

Avionics and Defense

IFR avionics test solutions provide the stimulus necessary to allow certification and verification of airborne avionics systems for Transponder Modes A, C, S and 4, DME (Distance Measuring Equipment), TACAN (Tactical Air Navigation), TCAS (Traffic Alert and Collision Avoidance Systems), VOR (Very High Frequency Omnidirectional Range), G/S (Glide Slope), LOC (Localizer), M/B (Marker Beacon), Communications, Weather Radar, and GPS (Global Positioning System).

Ramp equipment provides flight line test capabilities for installed avionics systems. Bench test solutions provide a means for comprehensive testing and trouble shooting for avionics systems in the laboratory environment.



AVIONICS AND DEFENSE

GPS-101 3.2
GPS Satellite Simulator

TCAS-201 3.4
TCAS Ramp Test Set

RD-301A 3.6
Weather Radar Test Set

NAV-402AP 3.8
MKR/NAV/COMM Ramp Test Set

ATC-600A 3.10
Portable Transponder/DME Test Set

ATC-601 3.12
Mode S/A/C Transponder Ramp Test Set

IFF-701 3.14
IFF Transponder Test Set

NAV-750C 3.18
2030/40/50 Option 6
Avionics Signal Generator

ATC-1400A 3.20
Transponder/DME Test Set

T-1401 3.23
TACAN Accessory Unit

I-1402 3.25
Mode 4 Accessory Unit

S-1403DL 3.27
Mode S Accessory Unit

SI-1404 3.29
MK12/Mode S IFF Accessory Unit

WRX and WRC-7708 3.34
Weather Radar Test Set

2946A 3.36
Avionics Communications Service Monitor

2030 3.37
DME Avionics Option 10

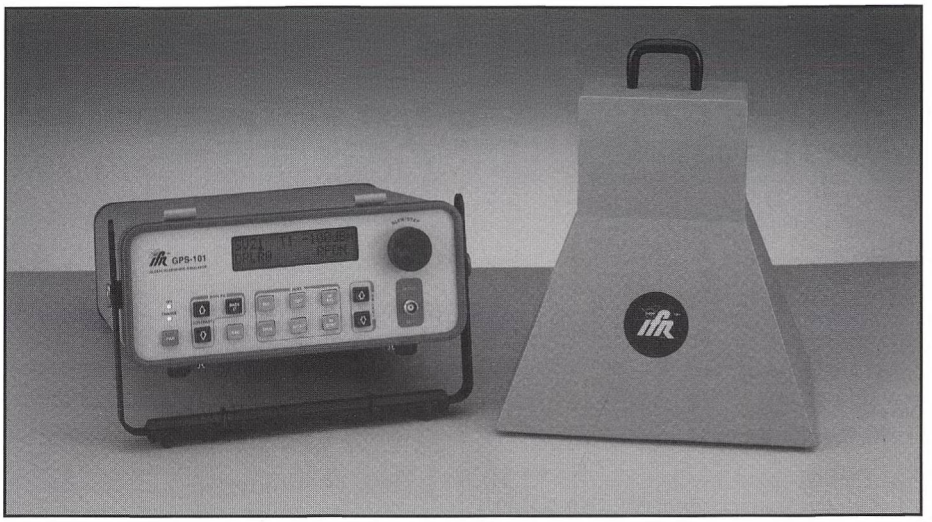
2030 3.39
ILS Monitor Software

DEFENSE

See page 1.61 for TS-4317-X Frequency Agile Communications Test Set

GPS-101
GPS Satellite Simulator

An innovative approach for verifying the operational integrity of installed Global Positioning Satellite (GPS) systems



- Verify operational integrity of GPS receivers quickly
- Selectable Satellite Vehicle (SV) and Navigation (NAV) Data
- Adjustable RF levels from -85 dBm to -145 dBm in 1 dB steps
- Doppler control allows the operator to select a positive or negative carrier frequency shift of approximately 4 kHz
- Stored GPS Almanac with real time clock
- Direct connect to receiver or via antenna coupler
- Battery operated portability

The IFR GPS-101 Global Positioning Simulator provides accurate and repeatable testing of Global Positioning Satellite (GPS) receivers. The GPS-101 achieves this testing capability by simulating a Global Positioning Satellite and generating a specific Satellite Vehicle (SV) and Navigation (NAV) data pattern. Coupled with remotely loaded GPS almanac information and RF levels/frequency control, the GPS-101 provides a portable test solution for verifying the operational integrity of GPS systems.

The GPS-101 verifies the operational integrity of:

- An integrated GPS receiver - antenna system (e.g. a hand held unit) with built-in test modes accessible by transmitting special satellite (SV) numbers and navigational (NAV) data word that will cause an indication or received signal strength.
- An installed GPS receiver with remote antenna system.
- Any GPS receiver or installation capable of indicating that a single satellite with appropriate navigation data was detected.

Operation

The GPS-101 provides dedicated front panel keys for all primary functions. Selected parameters are displayed on a wide viewing angle, high contrast, backlit LCD display.

Mode Keys

RF LVL:
The RF level can be adjusted from -85 dBm to -145 dBm in 1 dB steps via slew wheel control to verify GPS.

DPLR:
The doppler control allows the operator to select a positive or negative carrier frequency shift of approximately 4 kHz to verify receiver acquisition and lock performance.

SV:
Selects the satellite vehicle to be simulated 1 through 37. The almanac data is utilized to display an asterisk alongside the selected satellite vehicle if the satellite is unhealthy or not available.

RF CONT:
The RF control selects the modulating source for the 1575.42 MHz generator. The selections are RFOFF: Turns carrier off, RFCW: Unmodulated carrier, RFON: C/A code and NAV data (spread spectrum signal), RFEXT external BPSK modulation through AUX I/O connector, RFSQR: 511.5 kHz square wave modulation (maintenance purposes).

SETUP:
Provides access to menus for setting RS-232/422 communications port parameters, test set operational characteristics and self test.

TEST:
Selects one of three stored NAV data patterns. (Three data patterns reserved for future use)

1. T_1: NAV data that contains programmable almanac information and GPS week and time of week fields. The almanac data is valid for a 30 day period and may be downloaded in 'YUMA' ASCII text format via the RS-232 port. Current almanac data is available from the U.S. Coastguard Internet Web Site. The GPS-101 has an internal real time clock that keeps UTC time and is programmable by the user.
2. T_2: NAV data pattern that contains fixed GPS week and time of week.
3. T_3: Fixed 11001100.. repeating test pattern.

Select Keys: Moves cursor to selected field/parameter.

Display Keys: Contrast setting keys and display backlight on/off key.

ESC Key: Returns to main operation screen.

Slew Wheel: Allows rapid data slewing.

Specification

Generator

Frequency
1575.42 MHz

Accuracy
Same as Master Timebase

Doppler
Selectable frequency offset ±4.0 kHz

Offset Accuracy
See Master Oscillator

Channels
Single SV simulation, selectable from 1 to 37

Phase Modulation
BPSK

PRN Code
C/A code = 1.023 MHz, 1023 bit gold code

NAV Data
50 Hz, Programmable test pattern, built-in patterns

Output Level
-85 dBm to -145 dBm in 1 dB steps, ±2 dB accuracy into 50 Ω (AC Coupled) Standard Cable, 4 dB loss

Spurious
<-40 dBc over the bandwidth (20 MHz)

External Modulation Input
TTL

Master Oscillator

Standard Timebase

Frequency
10 MHz nominal (see note)

Temperature Stability
±1 ppm

Ageing Rate
±1 ppm/yr, ±5 ppm/10 yr

Uncertainty
±1 ppm

Option Timebase

Frequency
10 MHz nominal (see note)

Temperature Stability
±0.1 ppm

Ageing Rate
±0.1 ppm/yr

Uncertainty
±0.1 ppm

Note: Internal timebase frequency is a function of timebase calibration, ageing rate, temperature stability and uncertainty.

External Reference Input

Input Level
0.25 to 6.0 Vp-p

Input Impedance
150 Ω nominal

Input Frequency
10.0 MHz

External Reference Output

Output Level
1.5 Vp-p nominal into 50 Ω

Output Frequency
10.0 MHz nominal

Coupler

Coupling
-20 dB typical at 1575.42 MHz

Assumes
4.77 dB patch antenna gain and 4 dB cable loss

Isolation
>25 dB at 1575.42 MHz
>30 dB typical at 1575.42 MHz

General

Calibration Interval
1 year

AC Input
90 to 120 VAC, 50 to 400 Hz
200 to 240 VAC, 50 to 60 Hz

Battery Operation Time
120 minutes minimum, 360 minutes nominal

AC Power Consumption
<50 W maximum, <40 W typical

Battery Charge Time

Unit Operating
8 hours for full charge @ 115 VAC, 60 Hz

Unit non-operating
6 hours for full charge @ 115 VAC, 60 Hz

Operating Temperature
-20 to +55°C

Storage Temperature
-20 to +70°C

Humidity
95% ±5%, non-condensing
+10 to +30°C

Dimensions
292 mm (11.4 in) wide; 131 mm (5.1 in) high; 412 mm (16.1 in) deep, does not include handle.

Weight
9 kg (20 lb) maximum (with battery) does not include lid and lid contents

Connector Types

RF Output
TNC, Female

Auxiliary Port
25-pin D-Sub, Male

RS-232 "REMOTE" (COMM 1)
9-pin D-Sub, Male, PC compatible

RS-232/422 "RECEIVER" (COMM 2)
25-PIN D-Sub, Male, PC compatible

FCC Type Accepted, CFR47 Part 87.

Complies with UL/CSA/EU Product Safety Standards

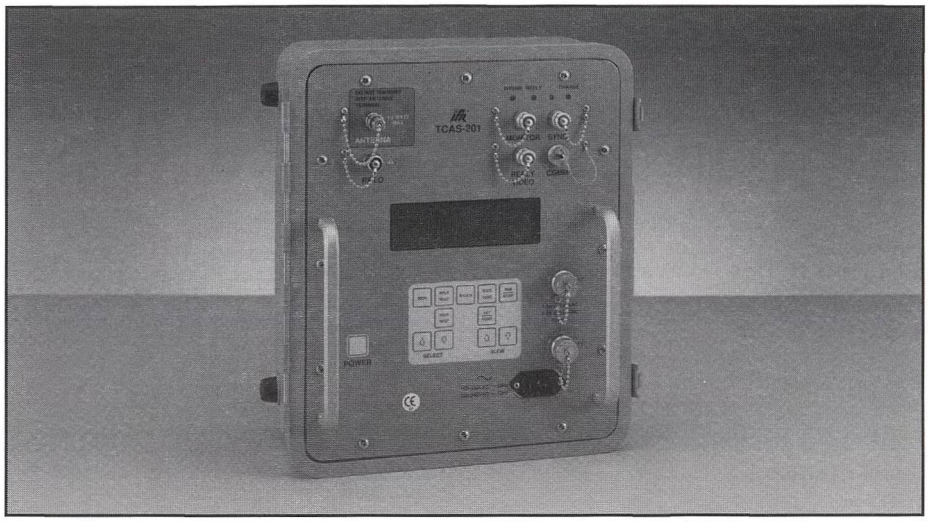
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
101-110	GPS-101 Global Positioning System Ramp Test Set, 110 VAC operation
101-110-C	GPS-101 Global Positioning System Ramp Test Set, 110 VAC operation with Certificate of Calibration
101-220	GPS-101, 220 VAC operation
101-220-C	GPS-101, 220 VAC operation with Certificate of Calibration
	Accessories
AC101	0.1 ppm High Stability Time Base

TCAS-201
TCAS Ramp Test Set

The TCAS-201 simulates the airborne environment necessary for verification/certification for TCAS installations



- Programmable intruder simulation parameters
- Surveillance monitor displays ATCRBS or Mode S interrogations
- 10 selectable programmable scenarios
- Measures interrogator power and frequency
- Built-in self test
- LCD display with automatic backlight
- 1.5 hour battery operation
- Two-year limited warranty

TCAS-201

The TCAS-201 allows verification and certification of an aircraft's TCAS installation, performing many of the required tests for Supplemental Type Certification (STC), during initial installation and subsequent routine maintenance.

The TCAS-201 includes the capability to monitor TCAS interrogations (displaying decoded information/communication data) and generating ATCRBS or Mode S replies that simulate threat aircraft for bearing accuracy checks.

Programming flexibility of the TCAS-201 allows the operator to exercise and generate Traffic Advisory (TA) and Resolution Advisory (RA) alerts. The TCAS-201 is environmentally packaged to operate in all weather conditions and is protected against the shock and vibration encountered during ramp use.

Operation

The TCAS-201 uses four basic test functions. Power and frequency, monitor, reply, scenario and one configuration function. Set up is for the gathering and verification of TCAS system data.

The Set up Menu is used to program parameters for Scenario Tests and additional control of test set functions.

The Power and Frequency screen displays interrogator Effective Radiated Power (ERP) and Frequency.

The Surveillance and Broadcast Monitor screens displays the contents of the major interrogation fields incorporated in UF0 and UF16 and verifies the TCAS Broadcast is transmitted in UF16 approximately every ten seconds.

In the ATCRBS Reply Test the TCAS-201 simulates a Mode C transponder with programmable percentage reply, altitude and range parameters.

Scenario Test

Running the Scenario Test enables the user to simulate an approaching intruder with constant closing rate and constant altitude change rate. Up to 10 user programmed scenarios can be stored and later recalled. Scenario test time and total elapsed test time enable the user to monitor times for TCAS Traffic and Resolution Advisories.

```
** SCENARIO TEST - RUNNING **
INTRUDER TYPE: MODE-S    TIME: 0:23;1:02
   RANGE: 3.49 nm        RATE: +540 kt
     ALT: 9552 ft        RATE: +1500 fpm
STATUS: RESOLUTION
   SURVEILLANCE INTERVAL: 1.00 sec
```

```
** SCENARIO TEST - RUNNING **
INTRUDER TYPE: ATCRBS    TIME: 0:23;1:02
   RANGE: 3.95 nm        RATE: +350 kt
     ALT: 10,000 ft      RATE: +0 fpm
STATUS: PROXIMITY
   W-S SEQUENCE INTERVAL: 1.00 sec
```

Mode S Reply Test

The Mode S Reply Test can be used to evaluate the ability of the TCAS interrogator to receive, decode and respond to Mode S replies. In this mode the TCAS-201 simulates a Mode S transponder replying with formats DF0, DF11 and DF16. The message fields allow the user to program capability information and various advisories into the replies.

```
** MODE S REPLY TEST - RUNNING **
RANGE: 11.00 nm  ALTITUDE: 8300 ft
 VS:0   SL:0  RIa:8    RIt:3   CA:0
ARA:0000      RAC:0    CLI:0  VDS:30
 AA:01FF37
  SURVEILLANCE INTERVAL: 1.00 sec
```

Whisper-Shout Monitor

The Whisper-Shout Monitor screen provides information used to verify whisper-shout steps and Side Lobe Suppression (SLS). By conducting several tests from different points around the aircraft, the TCAS coverage (directional and/or omni-directional), whisper-shout sequence operation and interrogation timing may be evaluated.

```
** WHISPER SHOUT MONITOR - RUNNING **
                      - MONITOR ONLY -
 ATTEN: 0.0 dB          NO SUPP: 1
 S1: 0   P2: 0     BOTH: 0
 SPACING: 4.3 ms
  W-S SEQUENCE INTERVAL: 1.01 sec
```

Specification

Reply Generator

Output
1090 MHz DCXO controlled ±10 kHz

Level
Set for operation over an antenna to antenna distance of 5 to 500 feet (1.5 to 152.4 meters)

Test Antenna
Remote antenna
VSWR <1.5:1, 9.5 gain typical

Output Test Signals

Reply Modes
Mode C (with altitude reporting) Mode S (Formats 0, 11, 16)

Pulse Spacing
Accuracy ±50 ns

Pulse Widths
Accuracy ±50 ns

Pulse Characteristics

All Pulses
±1 dB relative to P_1

Percent Reply
Range 0 to 100%
Resolution 10%
Accuracy ±1%

Range Delay
Range 0.3 to 30 nautical miles
Resolution 50 ns steps
Accuracy ±0.02 nautical miles

Altitude
Range -1000 to +126,000 feet
Resolution 100 feet

Mode S Address
Selectable

Reply Delay
ATCRBS 3.0 µs ± 50 ns
Mode S 128.0 µs ± 50 ns

Range Rate
Range -1200 to +1200 kts
Resolution 10 kts
Accuracy ±10%

Altitude Rate
Range -10,000 to +10,000 fpm
Resolution 100 fpm
Accuracy ±10%

Squitter
Control ON/OFF
Rate 1.0 seconds ±10 ms

UUT Measurements

Effective Radiated Power (Mode S Interrogations)
Range +43 to +57 dBm (20 to 500 W)
Accuracy ±2 dBm

Frequency
Range 1029.9 to 1030.1 MHz
Accuracy ±10 kHz
Resolution 1 kHz

Detectable Modes
ATCRBS only All Call (Mode C)
Mode S Downlink (Formats 0, 11, 16)

General

Calibration Interval
1 Year

Battery Operation
Duration: 1.5 hours before recharge at 25°C
Automatic shut off after 10 minutes of non-use

AC Supply
103.5 to 129 VAC, 207 to 253 VAC, 47.5 to 420 Hz, 45 W (used to recharge battery)

ENVIRONMENTAL

Temperature
-20 to +55°C

Relative Humidity
≤80% for temperatures up to 31°C decreasing linearly to 50% at 40°C (Non-condensing)

Altitude
≤4000 m (13,124 feet)

Dimensions
284 mm (11.2 in) W; 361 mm (14.2 in) D;
279 mm (11 in) H

Weight
13.7 kg (30 lb)

Electromagnetic Compatibility
Complies with the limits in the following standards:
EN 55011 Class B
EN 50082-1

Safety
Complies with EN 61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Versions and Accessories

When ordering please quote the full ordering number information

Ordering Number	*Versions*
201-110	TCAS-201 Traffic Alert & Collision Avoidance, 110 VAC operation
201-110-C	TCAS-201 Traffic Alert & Collision Avoidance, 110 VAC with Certificate of Calibration
201-220	TCAS-201, 220 VAC operation
201-220-C	TCAS-201, 220 VAC with Certificate of Calibration
	Accessories
201B	AC-201B TCAS Coupler B (Bendix TCAS II)
	Accessories (Supplied)
	Line Cord
	RF Coax Cable
	Antenna Shield
	Operators Manual
	Operators Guide
	Directional Antenna
	Tripod
	Omni-Directional Antenna

AC-201B TCAS ANTENNA COUPLER



The AC-201B provides an alternate means of testing Allied Signal TCAS installations.

When used with the TCAS-201, the coupler eliminates errors due to multipath or reflected signals, allowing the TCAS system to be tested within the hangar environment.

Features

- Provides isolation by attenuating TCAS interrogations and airborne transponder replies, reducing the number of airborne targets displayed. This allows the operator to easily identify and control the TCAS-201 generated target.
- Absorbs TCAS interrogation RF power, without presenting an excessive VSWR mismatch.
- Target bearing angles can be varied in 30 degree increments by rotating the bearing selector on the coupler.
- Supplied with carrying case complete with coax cable and multi-section gas spring monopole allowing the coupler to be mounted over the bottom TCAS antenna.

RD-301A
Weather Radar Test Set

The RD-301A Weather Radar Test Set satisfies simulation requirements for new generation non-coherent radar systems



- Automatic transmitter magnetron frequency tracking and digital readout
- Internal/external modulation for simulating target scintillation for turbulence detection radars
- Transmitter peak pulse measurements
- Built-in IF sweep generator from 20 to 70 MHz and marker generator for IF and AFC testing
- Radar UUT sensitivity testing
- Two-year limited warranty

Performance Features

The RD-301A will respond to radar transmitter pulse widths of 50 ns to 30 µs in a frequency range of 9295 MHz to 9500 MHz. All RF tests and measurements can be accomplished by connecting the RD-301A to the unit under test with the use of the supplied calibrated coaxial cable, waveguide coupler and dummy load.

Tracking System

The RD-301A tracking system enables the test set to automatically acquire and track the transmitter frequency. This basic feature eliminates the need for constant retuning to compensate for transmitter or signal generator drift.

Heterodyne Monitor Output

The Heterodyne Monitor Output provides a convenient oscilloscope display of the frequency and duration of modes, identifying the location and magnitude of phase pulling within the magnetron pulse.

Effective Peak Power (EFF)

Effective Peak Power (EFF), displayed on the Panel Meter located on the front panel, quantifies the effects of phase modulation in the magnetron replacing the requirement for the use of a spectrum analyzer. The EFF function allows the operator to choose the optimum tracking frequency in the presence of modes and phase pulling in the magnetron pulse. Using the EFF meter function in conjunction with the heterodyne monitor output verifies the frequency tracking accuracy of the test set, replacing the need for the echo box which is used for AFC centering.

Contour Mode

The Contour Mode provides for rapid calibration and checking of contour threshold circuits, receiver color and intensity response, and sensitivity by means of an additional 0 to 20 dB amplitude boost above the selected output level.

Other Features

- Heterodyne monitor output
- (EFF) Transmitter effective peak pulse power measurements
- Built-in PRF generator and digital readout
- Contour boost capabilities for testing contour threshold circuits
- Video detector, frequency discriminator and spectrum analyzer outputs
- Respond to radar transmitter pulse widths of 50 ns to 30 µs

Specifications

Variable Mode Frequency
Continuously variable from 9.295 to 9.500 GHz

Tracking Mode
Tracks radar transmitter frequencies 9.295 to 9.500 GHz and transmitter power from 0.1 to 12 kW

Tracking Accuracy
Radar Transmitter

Pulse Width	*Maximum Error*
30 to 2 µs	25 kHz*
<2 to 0.5 µs	60 kHz
<0.5 to 0.1 µs	600 kHz
<0.l to 0.05 µs	2 MHz

(* 10 kHz typical)

Output Power
-50 to -127 dBm in 1 and 10 dB steps calibrated at R/T. Accuracy is ± 2 dB.

RF Pulse Width
0.05 µs to 500 µs continuously variable

RF ON/ OFF Ratio
70 dB minimum

1 kHz AM
30% AM nominal (1 kHz ± 100 Hz)

Source VSWR at Waveguide Coupler
1.25:1 maximum

Modulation Mode

Track
PRF same as Radar-Under-Test (50 Hz to 20 kHz)

INTL (internal)
PRF continuously variable from 50 to 5000 Hz

CW
Continuous wave output

INTL/EXT AM
50 Hz to 50 kHz

Resolution
1 dB or 10 dB steps

Range

Range 1
0.1 to 999.9 µs or nautical miles (NM). Time referenced to the 50% point of leading edge of detected radar transmitter pulse.
Residual delay: 0.1 to ± 0.05 µs

Range 2
0.2 to 999.9 µs or nautical miles (NM). Time referenced to the 50% point of the leading edge of detected radar transmitter pulse.
Residual delay: 0.4 to 0.05 µs.

Range Accuracy
Residual delay ± 0.01% of selected range delay. Range delay is referenced to 12.3589 µs/NM.

Range Rings 1, 2, 3, 4, 5
Selectable multiples of Range 1

Frequency Counter

RF

Resolution
10 kHz

Accuracy
±250 kHz

IF

Resolution
±1 kHz

Accuracy
0.01%

PRF

Resolution
1 Hz

Accuracy
±1 Hz plus 0.01%

Power Meter

Range
0.1 kW to 12 kW peak standard
(1.0 kW to 120 kW optional)*
(10 W to 1200 W optional)*
*Optional power ranges include an external 10 dB attenuator not calibrated in the system

Accuracy
Calibrated at R/T ±0.6 dB from 1 kW to 12 kW peak standard

Load VSWR
1.25:1 maximum

Outputs

HET Monitor
Oscilloscope display of magnetron pulse

DET (Detector)
Detected radar transmitter signal (into 50 Ω load)

Spectrum Analyzer
Attenuated RF sample of radar transmitter signal (Back Panel)

DSCRM (Discriminator)
Frequency discriminator output. 0.1 V/MHz ±10% (into 50 Ω load)

SYNC (Scope Sync)
Positive polarity pulse simultaneous with radar transmitter pulse in Track Mode, Internal PRF Generator in Internal Mode, or External Trigger in EXT (+) or EXT (-) Mode.

DLYD SYNC (Delayed Sync)
Simultaneous with Range 1 and Range 2 generator pulses

SCOPE SWEEP
100 Hz ramp output approximately 5 volt peak-to-peak

AUX RF OUT (Back Panel)
Auxiliary RF output from X-Band front end

VCO OUT (Back Panel)
Sample L-Band signal from VCO

General

Power
105 to 125 VAC or 210 to 250 VAC, 50 to 460 Hz, 150 watts

Dimensions
422 mm (16.7 in) wide, 185 mm (7.311 in) high, 467 mm (18.4 in) deep

Weight
19 kg (42 lb)

Waveguide Accessories
1.4 kg (3 lb)

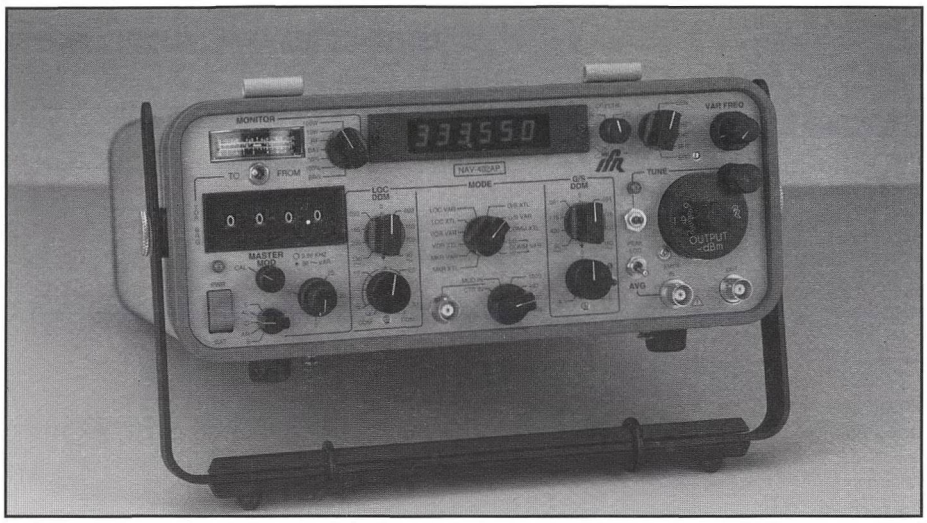
Versions and Accessories

When ordering please quote the full ordering number information

Ordering Number	*Version*
RD-301A	Weather Radar Bench Test Equipment
RD-301A-C	Weather Radar Bench Test Equipment with Certificate of Calibration
	Accesssories
	Calibrated Coaxial Cable
	Dummy Load
	Waveguide Directional Coupler

NAV-402AP
MKR/NAV/COMM Ramp and Bench Test Set

The NAV-402AP is a completely self-contained unit designed for functional testing and calibration of MKR, VOR, LOC, G/S and COMM avionics



- Signal generator for MKR, VOR, LOC, G/S and COMM systems with both XTAL and VAR frequency modes
- Simultaneous LOC-G/S output
- Sweep LOC DDM to test autopilot capture mode
- Built-in counter for display of generator frequency, COMM XMTR frequency, or 0 dBm external frequencies from 1 MHz to at least 300 MHz
- Compact size for flight deck operation
- Two-year limited warranty

The NAV-402AP Test Set is designed to meet the functional testing requirements of CAT I, CAT II and CAT III ILS systems. It includes a modulated signal generator for MKR, VOR, LOC, G/S and VHF COMM tests and a variable output attenuator. Maximum output on any band is -7 dBm (0.1 V) output range is from -7 dBm to -110 dBm.

The VOR and G/S bands are each supplied with two crystals, and the LOC, MKR and VHF COMM bands are supplied with one crystal each. Variable frequency modes allow all frequencies of all bands to be used. All bands are frequency phase-locked at 25 kHz intervals except G/S. G/S is phase-locked at 50 kHz intervals.

Two independent internal localizer transmitters with outputs of approximately -18 dBm at the generator output jack are provided for simultaneous radiation of LOC and G/S signals in G/S XTL mode with LOC switch on.

The test set includes a counter to measure the RF frequency of the signal generator in any band, the frequency of any VHF COMM transmitter, any 0 dBm external frequency from 1 MHz to 300 MHz, or display the selected VOR bearing as a check on the VOR BRG. The counter time base is derived from a 10 MHz oscillator with an accuracy of ±0.002% from 0 to 50°C.

A power meter is included to measure COMM transmitter power 0 - 10 W or 0 - 100 W. A peak or average power switch allows COMM XMTR modulation checks, and a rear panel jack permits monitoring of the modulation.

A percentage modulation meter accurately indicates modulation levels on any band 0 - 30% or 0 - 100%.

The NAV tones for modulation are digitally derived from a 2.16 MHz crystal oscillator. The 90 Hz and 150 Hz tones utilized for LOC and G/S modulation are phased-locked with an accuracy of 0.1 degree.

By pressing a front panel switch the relative phases between the 90 and 150 Hz tones can be varied in 5 degree steps, relative to the 30 Hz reference signal, for a 1 degree selected step on the VOR BRG selector.

LOC and G/S centering may be calibrated from the front panel.

The battery charging system will permit continuous charging without damage to the battery.

Added Features

- VOR bearing selectable in 0.1 degree steps, accuracy ±0.1 degree
- Built-in 90 degree bearing monitor of VOR output
- RF Power meter for COMM XMTR power 0-10 W and 0-100 W
- Extended phase-locked loop circuit
- Built-in battery and charger supply

Specifications

Signal Generator

Frequency Ranges
72-78 MHz, 107-156 MHz, 327-337 MHz

Signal Output
0.7 µV to 100,000 µV. (-7 to -110 dBm)

Crystal Control*
75.0 MHz, 108.0 MHz, 108.1 MHz, 112.8 MHz, 126.9 MHz, 329.6 MHz, 334.7 MHz.
Frequency Accuracy ±0.005%
*Note: Any frequency may be chosen in each band at time of test set order

Variable Mode
Continuously tunable on all bands or phase-locked at 25 kHz intervals on each band except G/S. (50 kHz G/S phase-lock) ±0.002%

Modulating Signal
1020, 400, 1300, 3000 Hz Tones, ±1% accuracy
95% modulation on MKR ±5%; VOR Signal, see below; 30% modulation on LOC, VOR, COMM ±2%; LOC and G/S signals, see below
(These are modulation levels with the Master Mod control in Cal position).

Test Signal Accuracy

VOR
359.9 digitally derived courses, selectable in 0.1 degree increments. Course accuracy better than ±0.1 degree. 30 Hz ±0.02%, 9.96 kHz ±0.02% (Deviation ±480 Hz ±25 Hz). Modulation % of each signal 30 (±2)%. TO-FROM switch added for convenience.

LOC-G/S
90, 150 Hz ±0.02%
Modulation LOC - 20 (±2)% each tone G/S - 40 (±2)% each tone

DDM-LOC
0.093, 0.155, 0.200 DDM and tone delete for flag tests
Accuracy ±0.0013 DDM (±3 µA)
Variable Control ±0.4 DDM
Sweep Control from 0 to ±30 µA

DDM-G/S
0.091, 0.175, 0.400 DDM and tone delete for flag tests
Accuracy ±0.0024 DDM (±2.0 µA)
Variable Control ±0.8 DDM

Auxiliary LOC Signal
108.1 MHz Paired with G/S 334.7 MHz
110.5 MHz Paired with G/S 329.6 MHz
Frequency Accuracy ±0.005%
Fixed RF output typically -18 dBm
0.093, 0.155, 0.200 DDM and tone delete for flag tests
Accuracy ±0.0013 DDM (±3 µA)
Variable Control ±0.4 DDM

Power Meter & Counter

POWER METER

Range
0 to 100 W

Scales
0 to 10 W , 0 to 100 W

Accuracy
±3% of full scale + ±5% of meter indication

Input Power
≤20 W CW Continuous Duty

COUNTER

Accuracy
±0.002%

Resolution
Four selections 1 Hz, 10 Hz, 100 kHz, 1 kHz

External Input Range
1 to 300 MHz

Impedance
50 Ω AC terminated

Sensitivity
-9 dBm at 10 MHz, -3 dBm at 200 MHz, 0 dBm at 300 MHz

Maximum Input Power
+24 dBm (250 mW)

General

Calibration Interval
1 year

Power Requirements
102 to 120 VAC, 220 to 240 VAC, 50 to 400 Hz, ≤±10% of the nominal voltage, 38 W maximum. Internal 2.0 AH NICAD battery operation for approximately 1.5 hours of continuous operation

Temperature
-20 to +55°C

Relative Humidity
≤80% for temperatures up to 31°C decreasing linearly to 50% at 40°C (Non-condensing)

Altitude
≤4000 m (13,124 ft)

Dimensions and Weight
Housed in a portable case 289 mm (11.375 in) wide, 130 mm (5.125 in) high, 410 mm (16.125 in) deep

Weight
7.7 kg (17 lb)

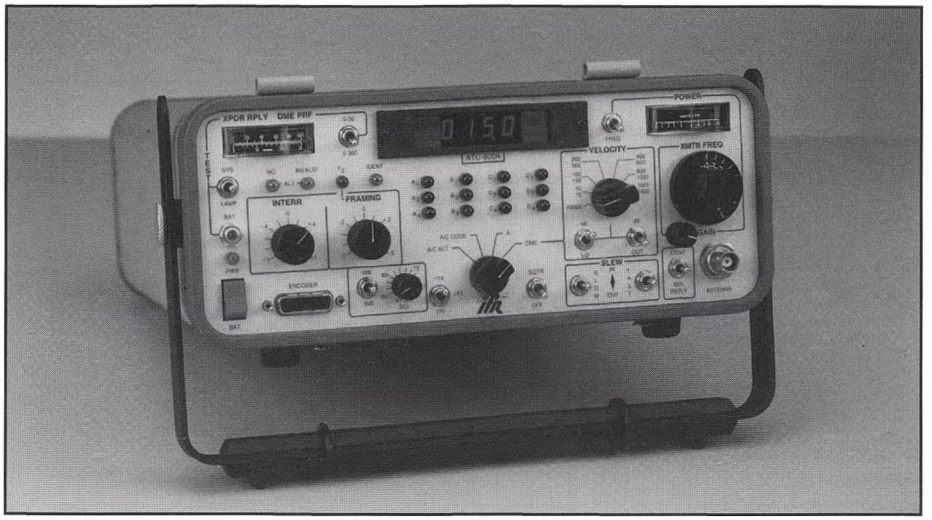
Versions and Accessories

When ordering please quote the full ordering number information

Ordering Numbers	*Versions*
402-110	NAV-402AP VOR/LOC/GS/COMM/MKR Ramp Test Equipment, 110 VAC operation
402-110-C	NAV-402AP, 110 VAC operation with Certificate of Calibration
402-220	NAV-402AP, 220 VAC operation
402-220-C	NAV-402AP, 220 VAC operation with Certificate of Calibration
	Accessories
AC100	20 dB RF Amplifier

ATC-600A
Portable Transponder/DME Test Set

A portable transponder/DME ramp test set, the rugged ATC-600A is the ideal solution for both ramp or bench use



- Read XPDR code and altitude numerically
- Measure transponder frequency and check for correct DME channel
- Measure transponder receiver sensitivity
- Performs all tests required by the revised Federal Aviation Regulations (91.177 and 43 appendix F)
- Two-year limited warranty

A portable transponder/DME ramp test set, the rugged ATC-600A is the ideal solution for both ramp or bench use. Providing simulation of the ground station or airborne environment, the ATC-600A meets the latest ARINC specifications and FAA regulations concerning transponder receiver sensitivity and SLS tests.

Transponder tests allow quick determination of transmitter power, frequency, percent reply, pilot's code and encoded altitude. For DME testing, the unit includes accurate range and velocity simulation, power and frequency and PRF measurements.

Performance Features

The ATC-600A will perform, with radiated signals, all the tests required by the revised Federal Aviation Regulations (91.177 and 43 appendix F, as amended December 19, 1973).

- Reads out XPDR code and altitude numerically and also displays binary pulse information for code and altitude
- Measures transponder frequency and checks for correct DME channel
- Front panel connector provided to directly check the output of altitude encoders
- Capable of checking XPDR input pulse decoder gate for marginal operation
- Checks position of XPDR second framing pulse relative to F_1
- Measures transponder receiver sensitivity and SLS tests
- Precision DME range and velocity signals, both X and Y channel
- Uses remote tripod mounted antenna - can be accurately spaced from aircraft antenna for power measurements

Specification

Transponder

Interrogations Output

Frequency
1030 MHz, ±0.006%

Level
Variable from -66 dBm to -79 dBm, ±1.5 dBm with 34 dB pad or radiated with properly spaced antenna

Modes
A/C, Altitude or Pilot Code, 2:1 interlace, or mode A, (B mode available on request)

Pulse Spacing
Mode A P_1 to P_3 8 µs, ±0.1 µs
Mode C P_1 to P_3 21 µs, ±0.1 µs
(In A/C Modes)
Mode C P_1 to P_3 17 µs, ±0.1 µs
SLS P_1 to P_2, ±0.1 µs

Variable Spacing
P_2 and P_3 variable with respect to P_1 ±1 µs, ±1 µs from nominal for input decoder gate tests

PRF
235 Hz ±10%

SLS Test
±1.0 dB P_2 inserted at 0 dB or -9 dB relative to P_1

Reply Measurements

Power (UUT)
10 W to 1.5 kW peak, ±20%; direct with 34 dB pad.
±3 dB radiated with properly spaced antenna

Frequency Check
1086 to 1093 MHz, ±0.3 MHz

Altitude Code
Binary and Numerical Readout, -1.0 to 126.7 thousand feet

Pilot Code
Binary and Numerical Readout, 0000 to 7777

Percent Reply
0-100%, either A/C or A(B) modes

F_2 Pulse Position
Measurement of rising and falling edge ±0.5 µs from nominal, ±0.05 µs

Status Lamps
Ident Pulses, Invalid Altitude Code and No Altitude Code

Encoder Test
Direct connection accepts altitude encoder

DME

Interrogations Measurements

PRF
Track PRF 0 to 30 Hz, ±5% full scale
Search PRF 0 to 300 Hz, ±5% full scale

Power (UUT)
10 W to 1.5 kW peak, ±20%; direct with 34 dB pad. ±3 dB radiated with properly spaced antenna

Frequency Check
1038 to 1045 MHz, ±0.3 MHz

Reply Output

Frequency
17X-channel: 978 MHz
±0.006% (108.00 MHz paired)

17Y-channel: 1104 MHz
±0.006% (108.05 MHz paired)

18X-channel: 979 MHz
±0.006% (108.10 MHz paired)

Level
Approximately -45 dBm direct with 34 dB pad or radiated with properly spaced antenna

Reply Pulses
3.5 µs wide, ±0.5 µs

Pulse Spacing
X channel: 12 µs wide, ±0.2 µs
Y channel: 30 µs wide, ±0.2 µs

Range
0 to 399 NM in 1 NM steps. Accuracy ±0.07 NM ±0.02%

Velocity
Crystal-controlled digital velocity with rates of 50, 75, 100, 150, 200, 300, 400, 600, 800, 1200, 1600 and 2400 knots, ±0.02% of setting. Inbound or outbound starting from any selected range. Range steps in velocity mode are 0.025 NM (system) 0.1 NM displayed

Percent Reply
100% or 50%

Squitter
2700 PRF, ±50 Hz

Ident Tone
1350 Hz (±8 Hz) with equalizing pulses

General

ENVIRONMENTAL

Temperature
-20 to 55°C

Relative Humidity
≤80% for temperature up to 31°C decreasing linearly to 50% at 40°C (Non-condensing)

Altitude
≤4000 meters (13,124 feet)

GENERAL

Calibration Interval
1 year

Power
102 to 120 VAC, 220 to 240 VAC, 50 Hz to 400 Hz, ≤±10% of the nominal voltage, 24 W maximum.
Internal 2.0 AH NICAD battery operation for approximately

Dimensions
Housed in a portable case 290 mm (11.4 in) wide, 130 mm (5.1 in) high, 410 mm (16.1 in) deep

Weight
8.1 kg (18 lb) approximately

Electromagnetic Compatibility
Complies with the limits in the following standards:
EN 55011 Class B
EN 50082-1

Safety
Complies with EN 61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

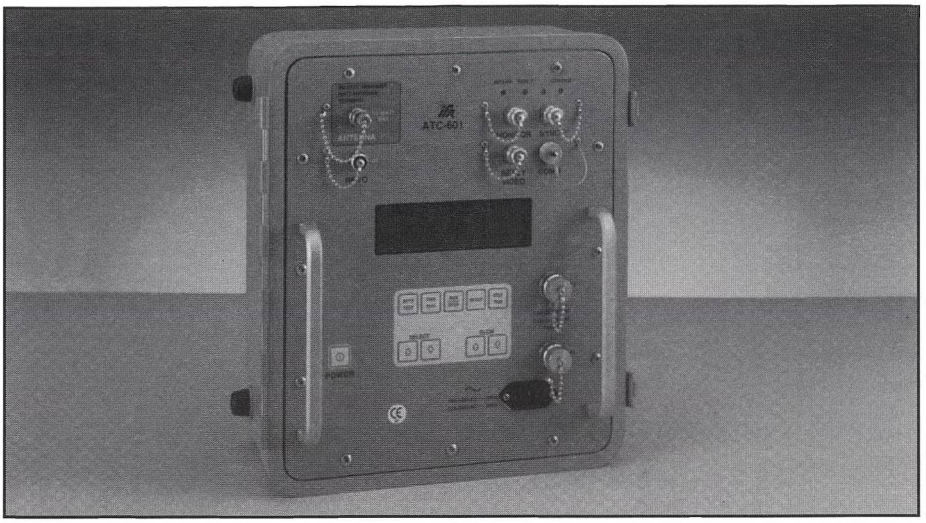
Versions and Accessories

When ordering please quote full ordering number information

Ordering Numbers	*Versions*
600-110	ATC-600A Transponder/DME Ramp Test Equipment, 110 VAC operation
600-110-C	ATC-600A Transponder/DME Ramp Test Equipment, 110 VAC operation, with Certificate of Calibration
600-220	ATC-600A Transponder/DME Ramp Test Equipment, 220 VAC operation
600-220-C	ATC-600A Transponder/DME Ramp Test Equipment, 220 VAC operation, with Certificate of Calibration

ATC-601
Mode S/A/C Transponder Ramp Test Set

The ATC-601 performs Mode S/A/C transponder tests required by Federal Aviation Regulations



- Accurate measurement of transponder transmitting frequency, power and receiver sensitivity
- AUTO TEST minimizes test time
- Tests include Flight ID, Tail Number decode and UELM/DELM data link
- Non volatile storage for two sets of test data
- Operating range of 0 to 300 feet from the aircraft under test
- Dump test data to printer via RS-232
- Built-in self test
- LCD display with automatic backlight
- Tripod mountable directional antenna
- 2 hour battery operation
- FCC Type Acceptance approved
- Two-year limited warranty

ATC-601

The ATC-601 performs the ATC transponder test required by the revised Federal Aviation Regulations (91.172 and Part 43, Appendix F as amended August 18, 1990) for Mode S, A, and C transponders.

The ATC-601 provides a comprehensive 'AUTO TEST' function which allows the operator to verify and certify the operation of Mode S/A/C transponders with little or no intervention once the test has been commanded.

Tests may be individually run for diagnostic fault finding purposes during routine maintenance.

The ATC-601 is environmentally packaged to operate in all weather conditions and protected against the shock and vibration encountered during ramp use.

OPERATION

Setup Menu

The set up menus are used to program parameters for power and sensitivity measurements, RS-232 parameters, test data storage, recall and data dump.

```
          ** SETUP#1 MENU **
   UUT ANTENNA: RANGE HEIGHT
          TOP = 63      18
       BOTTOM = 55       8
     SELECTED = BOTTOM
GAIN_1030=11.5 GAIN_1090=12 LOSS=1.0
```

Auto Test

The AUTO TEST screen is selected with the 'AUTO TEST' key. When initiated with the 'RUN/STOP' key, this test runs through 23 discrete tests in approximately 30 seconds.

If the required operating modes pass, this completes the 'Part 43, Appendix F' requirements. The detailed results of individual tests conducted during AUTO TEST are stored in memory and may be reviewed by using the 'SELECT' keys. Once selected the test may be initiated by the 'RUN/STOP' key, and will continue to run until the 'RUN/STOP' key is pressed again.

```
        ** AUTO TEST - PASSED **
MODE TESTED - A,C,S  FREQ: 1090.00 MHz
MODE PASSED - A,C,S   ERP:  53 dBm
MODE FAILED -         MTL: -73 dBm
DIVERSITY ISOLATION: 25 dBm
         Press RUN TO start
```

Reply Delay Test

```
    ** REPLY DELAY TEST - PASSED **

  MODE S: 128.00 uS
   ITM A: 128.00 uS  C: 128.00 uS
   ATC A:   3.02 uS  C:   3.10 uS
       Press RUN to start
```

ATCRBS Reply Test

```
    ** ATCRBS REPLY TEST - PASSED **
F1 TO F2 SPACING A:20.30 uS  C:20.30 uS
F1 PULSE WIDTH   A: 0.45 uS  C: 0.45 uS
F2 PULSE WIDTH   A: 0.45 uS  C: 0.45 uS
CODE= 7777       ALT= 10,700 FT [6140]
         Press RUN to start
```

Mode S UF0 Test

```
    ** MODE S UF0 TEST - PASSED **

 DF 0  VS=1    RI=C    AC= 10,700 FT
 ADDRESS=3AC421

        Press RUN to start
```

Mode S UF11 Test

```
    ** MODE S UF11 TEST - PASSED **

 DF11   CA=0  AA=3AC421 PI=000000


        Press RUN to start
```

Mode S UF20 Test

```
    ** MODE S UF20 TEST - PASSED **

 DF20 FS=0  DR=00 UM=00 AC= 10,700 FT
MB=00000000000000 ADDRESS=3AC421

        Press RUN to start
```

Squitter Test

```
** SQUITTER TEST - PASSED **
PERIOD = 1.00 SECONDS
TAIL NUMBER = N12345
SQUITTER ADDRESS = 3AC421 [1654201]

Press RUN to start
```

Flight ID Test

```
** FLIGHT ID TEST - PASSED **

DF20  BDS1=02  BDS2=00
AIS=20420CCB9C1041  FLIGHT ID=BA349
ADDRESS=3AC421
Press RUN to start
```

Mode S UELM Test

```
** MODE S UELM TEST - PASSED **
RES: DF20  DR=15  IIS=F  IDS=2
ACK: DF24  KE=1   ND=0   TAS=000F
CLO: DF20  DR=15  IIS=F IDS=2
ADDRESS=3AC421  ERROR=
Press RUN to start
```

Power

```
** POWER TEST - PASSED **
                ERP     MTL
TOP AVG (dBm) = 53.0  -73.4 PASSED
•BOT AVG (DBM) = 52.0  -74.3 PASSED
INSTANTANEOUS = 47.0  -73.4
Press RUN to start
```

Individual Tests

V2.1 Firmware

1. REPLY DELAY
2. REPLY JITTER
3. ATCRBS REPLY
4. SLS LEVEL
5. ATCRBS ONLY ALL-CALL
6. MODE S ALL-CALL
7. INVALID MODE S ADDRESS
8. SPR ON/OFF
9. MODE S UF0
10. MODE S UF4
11. MODE S UF5
12. MODE S UF11
13. MODE S UF16
14. MODE S UF20
15. MODE S UF21
16. SQUITTER
17. FREQUENCY
18. DIVERSITY
19. MTL DIFFERENCE
20. POWER
21. FLIGHT ID
22. UELM
23. DELM

Specification

Signal Generator

Output
1030 MHz ±10 kHz DCXO controlled

Level
-57 to -7 dBm typically, into 50 Ω (Automatically controlled to determine receiver sensitivity [MTL] for the selected range and 4 dB typically, higher than MTL for test interrogations)

TEST ANTENNA

VSWR
1.5:1

Gain
10 dB typical, specified on the antenna
Range 1.83 meters (6 feet) to 91.44 (300 feet)

Interrogation Test Signals

Rate
Modes A, C 235 Hz PRF (±5 Hz)
Mode S 47 Hz PRF (±5 Hz)

Interlace Ratio
MTL Interrogations to test interrogations
ATCRBS 2:1
Mode S 8:1
Modes A, C, S, Intermode

NOTE: The ATC-601 Interrogates with the mode(s) necessary to run selected test.

Pulse Characteristics

ATCRBS/Mode S Pulse Spacing
Mode A
P_1 to P_2 2.00 s (± 50 ns)
P_1 to P_3 8.00 s (± 50 ns)
Mode C
P_1 to P_2 2.00 s (± 50 ns)
P_1 to P_3 21.00 s (± 50 ns)
Mode S
P_1 to P_2 2.00 s (± 50 ns)
P_1 to P_3 21.00 s (± 50 ns)

Intermode Pulse Spacing
Mode A
P_1 to P_3 8.00 s (± 50 ns)
P_1 to P_4 10.00 s (± 50 ns)
Mode C
P_1 to P_3 21.00 s (± 50 ns)
P_1 to P_4 23.00 s (± 50 ns)

Pulse Widths
Mode A, C, S, Intermode
P_1, P_2, P_3 0.80 s
Mode S
P_6 (Short) 16.25 s
P_6 (Long) 30.25 s
Intermode
P_4 (Short) 0.80 s
P_4 (Long) 1.60 s
All Modes
Accuracy ± 50 ns
Rise Time 50 to 100 ns
Fall Time 50 to 200 ns

PHASE MODULATION

Transition time
≤80 ns

Phase Shift
180 (±10)

AMPLITUDE LEVELS

SLS Level (P_2)
-9 dB (±1 dB) and 0 dB relative to P_1 level

NOTE: SLS Level is automatically controlled in the SLS LEVEL Test.

UUT Measurements (replies)

XMTR POWER (AT 1090 MHz)

EFFECTIVE RADIATED POWER (ERP)

Range
+48.5 to +57 dBm (71 to 500 watts)

Accuracy
±2 dBm

DIRECT CONNECTION - PEAK PULSE POWER

Range
+46.5 to +59 dBm (45 to 800 watts)

Accuracy
1 dB

Resolution
0.1 dB

XMTR FREQUENCY

Range
1087 to 1093 MHz

Accuracy
50 kHz

Resolution
10 kHz

RECEIVER SENSITIVITY

Direct Connection - Minimum Triggering Level (MTL)

Range
-67 to -79 dBm

Accuracy
±2 dB

RADIATED FIELD STRENGTH (MTL)

Range
-69 to -77 dBm into 0 dBm antenna (-77 dB W/m² to -85 dB W/m²)

SQUITTER PERIOD

Range
0.10 to 4.88 sec
Accuracy
±10 ms

REPLY DELAY

ATCRBS

Range
1.80 to 7.00 µs

Accuracy
±100 ns

MODE S AND ATCRBS/MODE S ALL CALL

Range
125.00 to 131.00 µs

Accuracy
±100 ns

DIVERSITY ISOLATION

Range
0 to >20 dB (depending on Antenna range)

Antenna Range
1.83 m (6 feet) to 28.96 m (95 feet)

Accuracy
± 3 dB

General

CALIBRATION INTERVAL
1 year

BATTERY OPERATION
Duration 2 hours before recharge at 25°C
Automatic Shutoff After 15 minutes of non-use

AC SUPPLY
103.5 to 129 VAC, 207 to 253 VAC, 47.5 to 420 Hz, ≤+10% of the nominal voltage
30 watts (used to recharge battery)

ENVIRONMENTAL

Temperature
-20 to 55°C

Relative humidity
≤80% for temperatures up to 31°C decreasing linearly to 50% at 40°C (Non-condensing)

Altitude
≤4000 meters (13,124 feet)

ELECTROMAGNETIC COMPATIBILITY
Complies with the limits in the following standards:
EN 55011 Class B
EN 50082-1

SAFETY
Complies with EN 61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

DIMENSIONS
284 mm (11.2 in) W; 361 mm (14.2 in) D;
279 mm (11 in) H

WEIGHT
13.7 kg (30 lb)

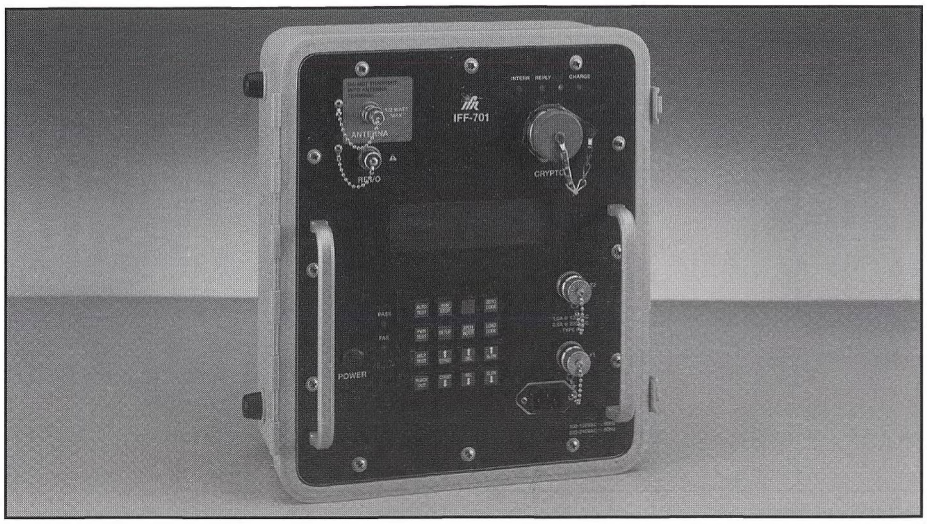
Versions and Accessories

When ordering please quote the full ordering information

Ordering Number	*Versions*
601-110	ATC-601 Transponder Mode S Ramp Test Equipment
601-110-C	ATC-601 Transponder Mode S Ramp Test Equipment with Certificate of Calibration
601-220	ATC-601, 220 VAC operation
601-220-C	ATC-601, 220 VAC with Certificate of Calibration
	Accessories (Supplied)
	RF Coax Cable
	Antenna Shield
	Operators Manual
	Operators Guide
	Line Cord
	Directional Antenna
	Tripod
	Omni-Directional Antenna

IFF-701
IFF Transponder Test Set

IFF-701 provides pre-mission verification of next generation MK12/Mode S IFF transponders



- Accurate measurement of transponder transmitting frequency, power and receiver sensitivity
- AUTO TEST minimizes test time
- Configuration control provides user selectable predetermined test limits
- GO/NOGO or diagnostic operation
- Mode 4 Stored Code operation
- Built-in self test
- LCD display with automatic backlight
- Hand held directional antenna
- 2 hour battery operation
- Compliant with test requirements of FAR Part 43 Appendix 'F'
- Two-year limited warranty

IFF-701

The IFF-701 is an organizational level/1ST Line, portable battery operated test set for testing IFF transponders installed in airborne, naval or land based platforms. The IFF-701 may also be used at intermediate level/2ND Line.

The IFF-701 provides a comprehensive 'AUTO TEST' function which allows the operator to verify and certify the operation of MK10A, MK12, MK12/Mode S IFF transponders with minimal intervention once the test has been commanded.

Testing may be conducted 'over the air' or by direct connection to the transponder.

Tests may be individually run for diagnostic fault finding purposes during routine maintenance.

The IFF-701 is environmentally packaged to operate in all weather conditions.

OPERATION

Set up Menu

Three set up menus are used to program parameters for power and sensitivity measurements, test set operational modes, test data storage and recall.

```
          ** SETUP#1 MENU **
UUT ANTENNA: RANGE HEIGHT  PWR UP=1ST/L
      TOP:     20     15
   BOTTOM:     20      3
  SELECTED: BOTTOM
GAIN_1030=11.5 GAIN_1090=12.0 LOSS=1.0
```

```
          ** SETUP#2 MENU **
STORED CODE:LOADED       ERP UNITS= WATTS
STORE= 0 RECALL= 1       DIVERSITY= ON
CONFIG= MK12/M_S  XPDR MODES:C,S,1,2,3,4
CODE SOURCE= STORED A(VB)  INTERR= BURST
Change store/recall field then press RUN
```

1ST Line Auto Test

The 'PWR UP' field in set up #1 menu is used to determine which autotest mode is available after power up. If '1st/L is selected, the 1ST LINE AUTO TEST screen is displayed when the 'AUTO TEST' key is pressed.

The 1ST Line mode is used to provide simple 'point and press' testing using a hand held directional antenna. A ratiometric test is used to confirm that ERP (Effective Radiated Power) and MTL (Minimum Trigger Level) are within pass limits. This test is independent of distance from the transponder antenna, over a 6 ft to 250 ft range.

When initiated with the 'RUN/STOP' key, this test runs through 31 discrete tests. The 'RUN/STOP' button mounted on the directional antenna handle may also be used for 'single handed' operation.

The modes tested, specific tests and PASS/FAIL limits are determined by the configuration selected in the 'CONFIG' field.

During the Mode 4 reply tests the operator is prompted to change transponder control panel settings to verify the crypto A/B code select and verify bit 1 functions. The test may be configured to only use the A code without operator prompt.

Upon completion the 1ST LINE AUTO TEST screen displays the modes tested, the modes passed, the modes failed, ERP/MTL pass or fail, and lobing Ant pass or fail (if enabled in the selected configuration). The 'LOBING ANT' field is used to display correct operation of a lobing antenna RF switch, typically used with MK10A transponders. The 'DIST' field is used by the operator to confirm the approximate distance from the antenna under test.

The detailed results of individual tests conducted during AUTO TEST are stored in memory and may be reviewed by using the 'SELECT' keys. Once selected the test may be initiated by the 'RUN/STOP' key and will continue to run until the 'RUN/STOP' key is pressed again.

```
   ** 1st LINE AUTO TEST - PASSED **
MODE TESTED-C,S,1,2,3,4   FRQ:1090.00 MHz
MODE PASSED-C,S,1,2,3,4   ERP/MTL: PASS
MODE FAILED-              DIST: 16-32 ft
CONFIG: MK10A             LOBING ANT: PASS
          Press RUN TO start
```


http://www.ifrinternational.com

Access to a direct connect POWER TEST is provided in 1ST Line mode and is used for testing feeder and lobing switch losses. Access to the set up menus is prevented in 1ST Line mode.

The 2ND Line mode may be entered when the IFF-701 is in 1st Line mode, by a twin key press on power up.

2nd Line Auto Test

If '2ND/L' is selected in set up menu #1, the IFF-701 will power up in 2ND line mode. The 2ND LINE AUTO TEST screen is displayed when the 'AUTO TEST' key is pressed. Pressing the 'SET UP' key provides access to the set up menus.

The 2ND Line mode provides precise 'over the air' ERP and MTL testing using the directional antenna. Range and height parameters are entered in set up #1 menu.

This mode may be used periodically to confirm specific installation performance and monitor feeder/antenna deterioration. Direct connection via the RF I/O port is also selectable for bench operation.

The 2ND LINE AUTO TEST operation is identical to the 1ST LINE AUTO TEST mode except ERP and MTL measurements are displayed. LOBING ANT and DIST are not displayed. LOBING Configuration files are selected in set up #2 menu.

Two sets of test results may be stored in non volatile memory stores and the last set of results are held in current memory. Test results may be down loaded to a PC or printer for hardcopy.

```
** 2nd LINE AUTO TEST - PASSED **
MODE TESTED-C,S,1,2,3,4   FRQ:1090.00 MHz
MODE PASSED-C,S,1,2,3,4   ERP: 55 dBm
MODE FAILED-              MTL: -74 dBm
DIVERSITY ISOLATION: NOT RUN
          Press RUN TO start
```

Reply Delay Test

```
** REPLY DELAY TEST - PASSED **

  MODE S: 128.00 uS
   ITM 3: 128.00 uS  C: 128.00 uS
   ATC 3:   3.02 uS  C:   3.10 uS
       Press RUN to start
```

ATCRBS Reply Test

```
** ATCRBS REPLY TEST - PASSED **
F1 TO F2 SPACING 3:20.30 uS  C:20.30 uS
F1 PULSE WIDTH   3: 0.45 uS  C: 0.45 uS
F2 PULSE WIDTH   3: 0.45 uS  C: 0.45 uS
CODE=EM7777      ALT= 10,700 FT [6140]
         Press RUN to start
```

ATCRBS Decoder Test

```
** ATCRBS DECODER TEST - PASSED **
MODE A:7.90uS: REPLY    8.10uS: REPLY
       7.20uS: NO REPLY 8.80uS: NO REPLY
MODE C:20.9uS: REPLY    21.1uS: REPLY
       20.2uS: NO REPLY 21.8uS: NO REPLY
         Press RUN to start
```

Mode 4 Reply Test

Verifies correct Mode 4 replies to Mode 4 interrogation challenges derived from one of three selectable code sources.

1. Test A/B
2. Crypto A/B or A/B with verify bit 1
3. Stored A/B or A/B with verify bit 1

```
** MODE 4 REPLY TEST - PASSED **
CODES TESTED:  :A  :B  :A(VB)  :B(VB)
CODE SOURCE= STORED A(VB) T1 PW: 0.45 uS
T1 TO T2 SP: 1.800 uS     T2 PW: 0.45 uS
T1 TO T3 SP: 1.750 uS     T3 PW: 0.45 uS
          Press RUN to start
```

Mode 1, 2, 4 Reply Delay Test

```
** 1,2,4 REPLY DELAY TEST - PASSED **
  MODE  1: 3.02 uS
  MODE  2: 3.02 uS
  MODE  4: TDV:268.20 uS
  CODE SOURCE: STORED A
        Press RUN to start
```

Mode 1, 2, 4 SLS Level Test

```
** 1,2,4 SLS LEVEL TEST - PASSED **
MODE 1: -9 dB: REPLY  0 dB: NO REPLY
MODE 2: -9 dB: REPLY  0 dB: NO REPLY
MODE 4: -9 dB: REPLY  0 dB: NO REPLY

          Press RUN to start
```

Mode 1, 2, Reply Test

```
** MODE 1,2 REPLY TEST - PASSED **
F1 TO F2 SPACING 3: 20.30 uS C: 20.30 uS
F1 PULSE WIDTH   3:  0.45 uS C:  0.45 uS
F2 PULSE WIDTH   3:  0.45 uS C:  0.45 uS
M1_CODE=EM7777   M2_CODE=EM7120
          Press RUN to start
```

MTL Difference Test

```
** MTL DIFFERENCE TEST - PASSED **
A-C = 1.0 dB  A-4 = 2.0 dB  A-4 = 2.0 dB
A-S = 1.0 dB  C-S = 1.0 dB  1-2 = 1.0 dB
A-1 = 1.0 dB  C-2 = 1.0 dB  1-4 = 2.0 dB
A-2 = 1.0 dB  C-2 = 1.0 dB  2-4 = 2.0 dB
          Press RUN to start
```

Power Test

```
** POWER TEST - PASSED **
                  ERP    MTL
  TOP AVG (dBm) = 53.0  -73.4 PASSED
  BOT AVG (dBm) = 52.0  -74.3 PASSED
  INSTANTANEOUS = 47.0  -73.4
        Press RUN to start
```

Mode S Tests (General)

The discrete address reported in each individual DF reply content is verified against the address reported in the All-Call DF11 replies. Where altitude is displayed, the Mode S reported altitude is verified against Mode C reported altitude.

Downlink data is displayed in RTCA DO-181A format.

Squitter Test

This test displays the squitter address (aircraft's discrete address) in Hexadecimal and Octal numeric formats. The Squitter period is also displayed.

```
** SQUITTER TEST - PASSED **
PERIOD = 1.00 SECONDS
TAIL NUMBER = N12345
SQUITTER ADDRESS = 3AC421 [1654201]

        Press RUN to start
```

Mode S UF0 Test

This test displays the DF0 (Short Special Surveillance) reply content.

```
** MODE S UF0 TEST - PASSED **

DF 0  VS=1    RI=C    AC= 10,700 FT
ADDRESS=3AC421

        Press RUN to start
```

Mode S UF4 Test

Displays the DF4 (Surveillance Altitude) reply content.

```
** MODE S UF4 TEST - PASSED **

DF 4 FS=1  DR=00 UM=00 AC= 10,700 FT
ADDRESS=3AC421

        Press RUN to start
```

Mode S UF5 Test

Displays the DF5 (Surveillance Identity) reply content.

```
** MODE S UF5 TEST - PASSED **

DF 5 FS=1  DR=00 UM=00  ID= 3247
ADDRESS=3AC421

        Press RUN to start
```

Mode S UF11 Test

Displays the DF11 (All-Call Reply) content.

```
** MODE S UF11 TEST - PASSED **

DF11   CA=0  AA=3AC421 PI=000000


        Press RUN to start
```

Mode S UF16 Test

Displays the DF16 (Long Special Surveillance) reply content.

```
** MODE S UF16 TEST - PASSED **

DF16 VS=0  SL=0 RI=0 AC= 10,700 FT
MV=00000000000000 ADDRESS=3AC421

        Press RUN to start
```

Mode S DF20 Test

Displays the DF20 (Comm-B Altitude) & AIS reply content.

```
** MODE S DF20 TEST - PASSED **

DF20 FS=0  DR=00 UM=00 AC= 10,700 FT
MB=00000000000000 ADDRESS=3AC421

        Press RUN to start
```

IFF-701

Mode S DF21 Test

Displays the DF21 (Comm-B Identity) and AIS reply content.

```
** MODE S DF21 TEST - PASSED **

DF21 FS=0  DR=00 UM=00 ID= 3247
MB=00000000000000 ADDRESS=3AC421

        Press RUN to start
```

Flight ID Test

Displays the Flight Identity information encoded in the AIS subfield contained in the MB message field within DF20.

```
** FLIGHT ID TEST - PASSED **

DF20  BDS1=02  BDS2=00
AIS=20420CCB9C1041  FLIGHT ID=BA349
ADDRESS=3AC421
        Press RUN to start
```

Individual Tests

1. REPLY DELAY
2. REPLY JITTER
3. ATCRBS REPLY
4. SLS LEVEL
5. ATCRBS ONLY ALL-CALL
6. MODE S ALL-CALL
7. INVALID MODE S ADDRESS
8. SPR ON/OFF
9. MODE S UF0
10. MODE S UF4
11. MODE S UF5
12. MODE S UF11
13. MODE S UF16
14. MODE S UF20
15. MODE S UF21
16. SQUITTER
17. FREQUENCY
18. FLIGHT ID
19. MODE S UELM
20. MODE S DELM
21. DIVERSITY
22. MTL DIFFERENCE
23. MODE 1, 2, 4 REPLY DELAY
24. MODE 1, 2, 4 REPLY JITTER
25. MODE 1, 2, REPLY
26. MODE 1, 2, 4 SLS LEVEL
27. ATCRBS DECODER
28. MODE 1, 2 DECODER
29. MODE 4 DECODER
30. MODE 4 REPLY
31. POWER

Specification

Signal Generator

Frequency
1030 MHz DCXO controlled ±10 kHz

Level
-57 to -7 dBm typically, into 50 Ω (Automatically controlled to determine receiver sensitivity [MTL] for the selected range and 4 dB typically, higher than MTL for test interrogations)

Test Antenna
VSWR <1.5:1
Gain 10 dB typical, specified on the antenna
Range 6 feet (1.83 meters) to 250 feet (76.20 meters)

Interrogation Test Signals

Rate
Modes 1, 2, 3/A, C 235 Hz PRF (±5 Hz)
Mode S 47 Hz PRF (±5 Hz)

Interlace Ratio
MTL Interrogations to Test interrogations
Mode 1, 2, 3/A, 4, C 2:1
Mode S 8:1
Mode 1, 2, 3/A, 4, C, S, Intermode

NOTE:
The IFF-701 Interrogates with the mode(s) necessary to run selected test.

Pulse Spacing (Nominal)
Mode 1
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 3.00 µs (± 50 ns)

Mode 2
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 5.00 µs (± 50 ns)

Mode 3/A
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 8.00 µs (± 50 ns)

Mode 4
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 4.00 µs (± 50 ns)
P_1 to P_4 6.00 µs (± 50 ns)
P_1 to P_5 8.00 µs (± 50 ns)
P_1 to P_6 10.00 µs (± 50 ns) (Test Code A & B)

Mode C
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 21.00 µs (± 50 ns)

Mode S
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_6 3.50 µs (± 50 ns)
P_1 to SPR 4.75.µs (± 50 ns)

Intermode Pulse Spacing
Mode 3/A
P_1 to P_3 8.00 µs (± 50 ns)
P_1 to P_4 10.00 µs (± 50 ns)

Mode C
P_1 to P_3 21.00 µs (± 50 ns)
P_1 to P_4 23.00 µs (± 50 ns)

Pulse Spacing Deviation
Decoder Tests 1, 2, 3/A, 4, C
Range 1 to 23.00 µs
Accuracy ±50 ns

Pulse Widths
Mode 1, 2, 3/A, C, S, Intermode
P_1, P_2, P_3 0.80 µs

Mode 4
P_1, P_2, P_3, P_4 0.50 µs
ISLS P_5 0.50 µs
P_6 to P_{37} 0.50 µs

Mode S
P_6 (Short) 16.25 µs
P_6 (Long) 30.25 µs

Intermode
P_4 (Short) 0.80 µs
P_4 (Long) 1.60 µs

All Modes
Accuracy ±50 ns
Rise Time 30 to 100 ns
Fall Time 30 to 100 ns

Mode 4 Code Sources
Test Codes A/B selectable
Live Crypto A/B selectable
Stored Code
32 A Codes
32 B Codes
32 A (Verify Bit 1) Codes
32 B (Verify Bit 1) Codes

Phase Modulation
Transition time ≤80 ns
Phase Shift 180° (±10°)

Amplitude Levels
SLS Level (P_2/ P_5) -9 dB (±1 dB) and 0 dB relative to P_1 level
NOTE : SLS Level is automatically controlled in the SLS LEVEL Test.

UUT Measurements (Replies)

XMTR Power (at 1090 MHz)

Effective Radiated Power (ERP)
Range +48.5 to + 57 dBm (71 to 500 W)
Accuracy ±2 dBm

Direct Connection - Peak Pulse Power
Range +46.5 to +60 dBm (45 to 1000 W)
Accuracy ±1 dB
Resolution 0.1 dB

XMTR Frequency
Range 1087 to 1093 MHz
Accuracy ±50 kHz
Resolution 10 kHz

Receiver Sensitivity
Direct Connection - Minimum Triggering Level (MTL)
Range -67 to -79 dBm
Accuracy ±2 dB

Radiated Field Strength (MTL)
Range -69 to -77 dBm into 0 dBi antenna
(-77 dB W/m² to -85 dB W/m²)

Squitter Period
Range 0.10 to 4.88 seconds
Accuracy ±10 ms

Reply Delay
Mode A, C, 1, 2
Range 1.80 to 7.00 µs
Accuracy ±100 ns

Mode 4 Triplet
Range 195.00 to 265.00 µs
Accuracy ±250 ns

Mode 4 TDV
Range 194.00 to 819.00 µs
Accuracy ±250 ns

Reply Jitter
Mode 1, 2, 3/A, C
Range 0.00 to 2.30 µs
Accuracy ±90 ns

Mode 4 TDV
Range 0.00 to 10.50 µs
Accuracy ±90 ns

Mode S and ATCRBS/Mode S All Call
Range 0.00 to 6.00 µs
Accuracy ±90 ns

Pulse Spacing
F_1 to F_2
Range 19.70 to 21.60 µs
Accuracy ±50 ns

Mode 4 Triplet
Range
T_1 to T_2 1.30 to 2.00 µs
T_1 to T_3 3.05 to 3.75 µs
Accuracy ±50 ns

Pulse Widths
F_1 to F_2
Range 0.20 to 1.00 µs
Accuracy ±50 ns

Mode 4 Triplet
Range 0.350 to 0.600 µs
Accuracy ±50 ns

Diversity Isolation
Range 0 to >20 dB (depending on Antenna range)
Antenna Range 1.83 meters (6 feet) to 28.96 meters (95 feet)
Accuracy ±3 dB

General

Calibration Interval
1 year

Temperature
-20 to +50°C (functional)

Battery Operation
Duration 2 hours before recharge at 25°C
Automatic Shutoff after 15 minutes of non-use

AC Supply
103.5 to 129 VAC, 207 to 253 VAC, 47.5 to 420 Hz, 30 watts (used to recharge battery)

Dimensions
284 mm (11.2 in) W; 361 mm (14.2 in) D;
279 mm (11 in) H

Weight
13.7 kg (30 lb)

Supplied Accessories

RF Coax Cable
Connects Directional Antenna to IFF-701

Directional Antenna
Used for all 'over the air' tests

TNC-BNC Adapter
For direct connection to antenna feeders, lobing switches and transponder

Crypto Umbilical Cable Length 3 ft
Connects IFF-701 to KIR-1C-TSEC Crypto, for stored code loading. Provided with 4 ft power leads for +28 VDC aircraft battery connection

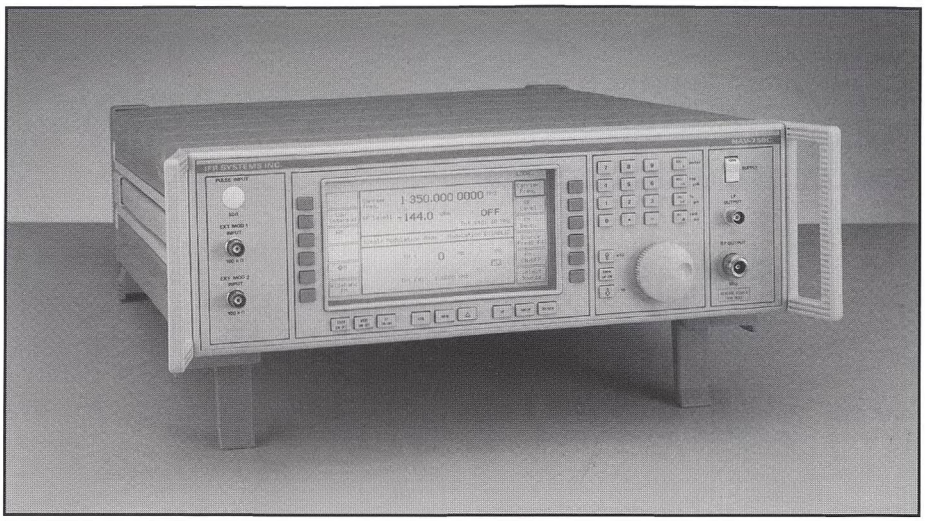
Versions and Accessories

When ordering please quote full ordering number information

Order Number	*Versions*
701-110	IFF-701 Transponder Mode 4 Test Equipment, 110 VAC operation
701-110-C	IFF-701 Transponder Mode 4 Test Equipment, 110 VAC with Certificate of Calibration
701-220	IFF-701, 220 VAC operation
701-220-C	IFF-701, 220 VAC operation with Certificate of Calibration
	Accessories (supplied)
	Line Cord
	RF Coax Cable
	Operators Manual
	Directional Antenna
	TNC-BNC Adapter x 2
	Crypto Umbilical Cable

NAV-750C and 2030/40/50 Option 6 Avionics Signal Generator

Accurate ILS, VOR, ADF, marker beacon and SELCAL signals for testing avionics receivers



- Accurate ILS and VOR RF waveforms
- Wide frequency coverage
- SELCAL calling tones
- Internal ILS and VOR waveform generators
- 0.0001 DDM resolution
- 0.01% bearing resolution
- Marker beacon
- Optional pulse modulation
- Automatic direction finder testing
- Comprehensive memory facilities

The IFR family of Avionics Signal Generators provides internal generation of waveforms suitable for testing Instrument Landing Systems (ILS), VHF Omni-directional Radio Range (VOR) systems, Marker Beacons and SELCAL radio receivers. Avionics parameters are presented in the same form as described in the ICAO standards. The family offers an ideal single instrument solution for the testing of avionics receivers and alarm monitors. The use of Direct Digital Synthesis techniques ensures excellent accuracy and stable performance under all operating conditions.

ILS

In ILS mode, the Sum of Depth of Modulation (SDM) of the 90 Hz and 150 Hz tones can be entered to a resolution of 0.1% AM depth. The Difference in Depth of Modulation (DDM) is entered to a resolution of 0.01% depth for a DDM up to 20% and 0.1% for higher DDM settings. A choice of which tone is dominant is available to the user.

The 30 Hz repetition frequency of the ILS waveform can be adjusted in 0.1 Hz steps. For 0% DDM, additional modulation signals can be added to the ILS waveform.

Changing between localizer and glide-slope operation is accomplished with a single key stroke.

Marker Beacons

In the Marker Beacon mode, signals are generated simulating the outer, middle and inner marker beacons. A single key press selects which marker beacon is simulated. Carrier frequency, modulation depth and modulation frequency can be varied from the default settings. Using the normal calling tones menu enables pulsed marker beacon modulation signals to be generated.

VOR

In VOR mode, the AM depth of the subcarrier and 30 Hz tone can be independently set and the relative phase of the 30 Hz tone and the modulation tone on the subcarrier is set by directly entering the bearing information in degrees. The VOR repetition rate of 30 Hz can be adjusted in 0.1 Hz steps. For a fixed bearing, additional modulation can be applied to simulate voice/identity signal. A To/From Beacon key provides a rapid means of reversing a bearing entry and accounting for different bearing conventions.

SELCAL

SELCAL selective calling tone signals are used on the radios providing communication between the aircraft operator and the flight crew. The Avionics Signal Generator provides facilities for generating the SELCAL codes and the modulation signals to test the radio receiver.

Simple Operation

Major parameters can be adjusted by keyboard entry of data, using the UP/DOWN keys or using the rotary control. The use of a large screen dot matrix display ensures clear and unambiguous readout of the avionics parameters.

Instrument settings can be stored in nonvolatile memories. A sequence of test settings can be stored and, using the external trigger facility, the currently recalled memory can be incremented to step through the stored test sequence.

Specification

ILS Mode

Tone Frequencies
90 Hz, 150 Hz nominal. Tone frequency may be changed by varying the ILS repetition rate of 30 Hz in 0.1 Hz steps. Tone frequencies maintain 3:1 and 5:1 relationships with the ILS rate.

Frequency Accuracy
As frequency standard

Tone Suppression
Either tone can be suppressed

Additional Modulation
Available for 0% DDM from an internal or external modulation source

Sum of Depth of Modulation (SDM)

SDM Range
0 to 99.9% in 0.1% steps representing the arithmetic sum of each tone depth

SDM Selection
By keyboard entry of data and variation by UP/DOWN keys or rotary control

RF Accuracy of SDM
±2% of SDM setting for carrier frequencies up to 400 MHz

At 40% SDM accuracy is ±0.8% depth
At 80% SDM accuracy is ±1.6% depth

Difference in Depth of Modulation (DDM)

DDM Range
0 to 20% in 0.01% steps
20 to 99.9% in 0.1% steps

DDM Selection
By keyboard entry of depth in %, mA or index and variation by UP/DOWN keys or rotary control

RF Accuracy of DDM
±0.02 of DDM setting ±0.0003 DDM (0.03% depth)
At 0 DDM (on course) accuracy is ±0.0003 DDM (0.03% depth)
At 0.155 DDM accuracy is ±0.0034 DDM (0.34% depth)

LF Output
Available from the LF Output connector

LF Accuracy of DDM
Equivalent to ±0.0003 DDM ±0.005 of setting
At 0 DDM (on course) accuracy is ±0.0003 DDM

Marker Beacon Mode

Provides default carrier of 75 MHz, 95% AM depth and a modulation frequency of 400 Hz, 1.3 kHz or 3 kHz corresponding to Outer, Middle and Inner Markers. Carrier frequencies, AM depth and modulation frequency can be adjusted from the default values.

VOR Mode

Selection
By keyboard entry of depth and variable by UP/DOWN keys and rotary control

Bearing Control
Relative phase of 30 Hz tone and subcarrier modulation adjustable from 0° to 359.9° in 0.01° steps by entering VOR bearing. Bearing can be entered as TO or FROM the beacon.

Bearing Accuracy
±0.05°

Additional modulation
Available on 0° bearing from an internal or external modulation source

AM Depth Accuracy
±3% of setting ±0.5% for carrier frequencies up to 400 MHz

Frequency
The VOR repetition frequency of 30 Hz may be varied in 0.1 Hz steps. The subcarrier frequency and deviation maintain a fixed relationship with the VOR repetition rate

Frequency Accuracy
As frequency standard
9.96 kHz subcarrier

AM Range
0 to 49.9% depth in 0.1% steps

Modulation
Frequency modulated by a 30 Hz tone with settable deviations of 420 Hz, 450 Hz, 480 Hz, 510 Hz and 540 Hz

30 Hz Tone

AM Range
0 to 49.9% depth in 0.1% steps
Arithmetic sum of 30 Hz tone and sub carrier limited to 99.8%

ADF Mode

Provides default carrier of 190 kHz with 30% AM depth at 1 kHz rate. Carrier frequency, AM depth, modulation rate and RF level can be varied from the default values.

SELCAL Mode

Provides a facility for modulating the RF carrier with sequential calling tones defined by the SELCAL protocol. Allows the entry of two character pairs to define the SELCAL code generated to open the audio path of aircraft radios. Default tone duration and gap are 1 s and 250 ms respectively and can be varied from nominal values.

Versions and Accessories

The NAV-750C is functionally identical to 2030 1.35 GHz Signal Generator fitted with Option 1 and 6.

For the full Signal Generator performance specifications please refer to Section 2.

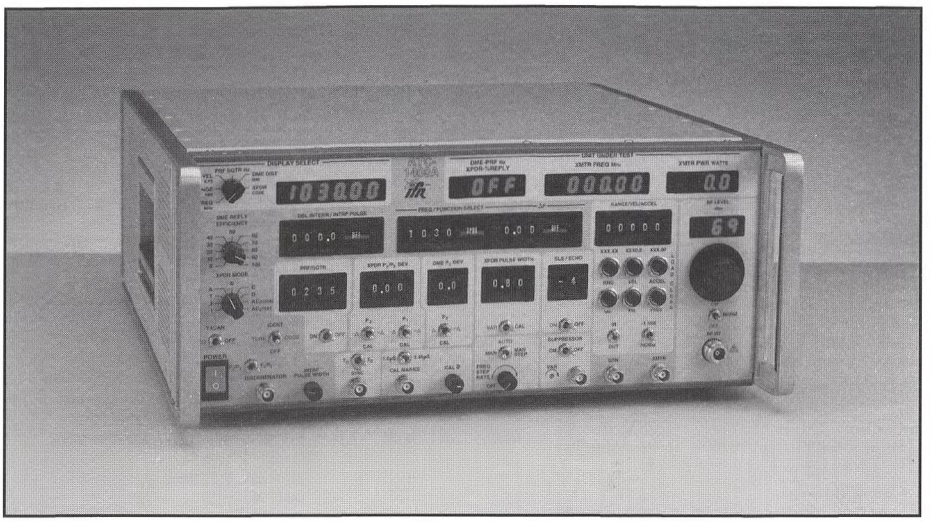
When ordering please quote the full ordering number information.

NAV-750C Ordering Numbers	***Versions***
750C	NAV-750C VOR/LOC/GS/COMM/MKR Bench Test Equipment
750C-C	NAV-750C VOR/LOC/GS/COMM/MKR Bench Test Equipment with Certificate of Calibration

2030/40/50 Option 6 Ordering Numbers	***Versions***
2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
2040	10 kHz to 1.35 GHz Low Noise Signal Generator
2041	10 kHz to 2.7 GHz Low Noise Signal Generator
2042	10 kHz to 5.4 GHz Low Noise Signal Generator
2050	10 kHz to 1.35 GHz Digital and Vector Signal Generator
2051	10 kHz to 2.7 GHz Digital and Vector Signal Generator
2052	10 kHz to 5.4 GHz Digital and Vector Signal Generator
Option 001	Second Internal Modulation Oscillator
Option 006	Avionics (must be ordered with Option 001)
	Supplied with
	AC Power Lead
	Operating Manual
	Options
Option 002	Pulse Modulation
Option 008	RF Profile and complex sweep
Option 009	Internal Pulse Generator (cannot be used with Option 005) only available on 2030 Series
Option 010	DME (requires Option 001 and 006, only available on 2030 Series, cannot be fitted with Option 005)
Option 105	Modifies the pulse modulation Option for slower rise time (order with Option 002)
Option 112	Ext. mod 2 Input 600 Ω

ATC-1400A
Transponder/DME Test Set

The ATC-1400A is a microprocessor-based test set designed to accomplish comprehensive testing of modern ATC transponder and DME equipment



- Continuous display of UUT, PRF, % reply, transmitter frequency and power
- Variable SLS and Echo Pulse Level
- Digital display of decoded transponder reply pulses
- Acceleration, velocity and range DME Modes
- TACAN modulation and reference bursts
- Two year limited warranty

IFR is a leader in the design, manufacture and marketing of Avionics test systems.

The ATC-1400A is a microprocessor-controlled test set designed to accomplish complete testing of modern ATC Transponder and DME equipment.

SIGNAL GENERATOR

Frequency Select Modes
User selectable L-Band Output Frequency can be selected by direct MHz, VOR paired and TACAN channel designation.

ΔF Capability
The selected frequency can be varied ±9.99 MHz in 0.01 MHz increments.

Manual/Automatic Stepping
The selected frequency can be automatically varied in 1 MHz increments.

Suppressor ON/OFF
The suppressor pulse output may be switched ON or OFF and the level adjusted from the front panel.

DME MODE

Range Delay
Switch selectable 0 to 399.99 NM.

Velocity
Select inbound or outbound. Inbound and outbound velocity decrements range to 0 NM, then increments range to maximum.

Acceleration
Non zero acceleration decrements the selected velocity to 0 KTS, then increments velocity to 3990 KTS.

Squitter
Digitally implemented to provide stable rate distribution and repeatability.

TACAN Simulation
When TACAN/On is selected, output pulses are AM modulated with 15 and 135 Hz signals.

Echo Pulses
Front panel selectable.

Ident Pulses
Select continuous pulse or Morse code from front panel.

Pulse Characteristics
DME Pulses are formed by filtering, which provides superior representation of Gaussian shaped pulses.

DME Serial Data Interface
The serial BCD distance word is generated to correspond to the range distance programmed in the test set. This serial BCD word is available at the back panel through a 25 pin D type connector.

Frequency Channelling
The 2-out-of-5 VOR Paired Channel Frequency is available for control of the DME UUT when the test set is in the automatic frequency stepping mode.

ARINC 568 compatible.

TRANSPONDER MODE

Modes 1, 2 T, A, B, C, D, AC_1 and AC_2 are available.

Variable Pulse Spacing
P_2 and P_3 pulse spacing may be varied in the + or - direction or may be selected to the calibrated spacing from individual switches on the front panel.

Pulse Width
The generated pulse width may be varied or selected for a calibrated width by a front panel switch.

Side Lobe Suppression
On/Off selectable P_2 pulse.

Interference/DBL Interrogation
The Interference pulse and double interrogation functions are combined in a single switch and are exclusively selectable.

UUT Pulse Spacing Detector
Transponder reply pulses are verified for proper position by selection of a narrow window. A wide window is provided when pulse position accuracy verification is not desired.

Suppression Recovery
Selection of double interrogation and suppressor pulse provides a single interrogation after suppressor pulse spacing. May be varied by interference/DBL interrogation switch.

UUT MEASUREMENTS

Transmitter Frequency Counter
The average frequency of one pulse in a reply (XPDR Mode) or an interrogation (DME Mode) is counted and continuously displayed. In the DME Mode either P_1 or P_2 may be selected to be counted. In XPDR Mode F_1 or F_2 may be counted.

http://www.ifrinternational.com

Transmitter Frequency Discriminator
View frequency variation within the measured pulse.

Transmitter Power Meter
Transmitter power of P_1 or P_2 in DME Mode, F_1 or F_2 in XPDR Mode may be selected and displayed on the front panel.

ADDED FEATURES

- IEEE-488-1978 GPIB
- Automatic frequency stepping
- TACAN Channel: VOR pairing, or direct UHF frequency selection
- Variable interference and double interrogation pulse position
- DME serial data output
- DME serial data input
- 2-out-of-5 code frequency channeling outputs

ATC-1400A

Accessory units

When interfaced with the T-1401, I-1402, SI-1404 or S-1403DL accessory units, the ATC-1400A becomes a comprehensive test system for TACAN, Mode 4 XPDR/RADAR and Mode S XPDR avionics equipment. For more information see separate data sheets.

Non Coherent SLS Option

P_2 provided on separate 1030 MHz carrier, phase unsynchronized. Factory or factory service center installed option.

Specifications

Frequency Characteristics

Range
952.01 MHz to 1222.99 MHz selectable in 0.01 MHz increments

Accuracy
(See frequency counter)

ΔF
±9.99 MHz in 0.01 MHz increments from the selected frequency

Generator Frequency Counter

Range
950 to 1225 MHz

Accuracy
±15 kHz

Output Characteristics

Range
0 dBm to -110 dBm (into 50 Ω) in 1 dB increments

Attn Accuracy
±0.3 dB or 1%

Leveller Accuracy
±0.3 dB

ON/OFF Ratio
80 dB minimum

Impedance
50 Ω, VSWR < 1.2:1 measured at the RF output jack

Spectral Purity

Residual FM
5 kHz peak to peak maximum

Phase Noise
> 90 dBc/Hz measured at 150 kHz from the carrier

Spurious
>60 dBc from 350 MHz to 1800 MHz

Suppressor Pulse Output Characteristics

Pulse Width
33 µs ± 3 µs (Transponder Mode)
Continuous high level (DME Mode)

DME Mode Characteristics

RANGE DELAY
Range
0 to 399.99 NM. Selectable in 0.01 NM increments. -1 NM selected by individual switch
Accuracy
±0.02 NM plus ±0.005% of selected range

VELOCITY
Range
0 to 9990 KT selectable in 10 KT increments
Accuracy
±0.05%

ACCELERATION
Range
0 to 399 ft/sec² selectable in 1 ft/sec² increments
Accuracy
±0.5 ft/sec²

SQUITTER
Range
Selectable from 10 Hz to 5999 Hz in 1 Hz increments (Average rates)
Accuracy
±2% from 200 to 5000 Hz
Dead Time
60 µs (±10 µs)
Distribution
At 2700 Hz the distribution is in compliance with the requirements presented in ARINC characteristics 568

TACAN Simulation Characteristics (Int)

AM Modulation Frequencies
15 Hz and 135 Hz ±0.02%

AM Modulation %
21% ±3% each component

Bearing Output
180 degrees (approx)

Echo Pulse Characteristics

Position
30 NM ±1 NM after the interrogation is received in X channel

Amplitude
-19 to +6 dB, ref to the desired reply, selectable in 1 dB increments

Accuracy
-10 to + 3 dB ±0.2 dB

REPLY EFFICIENCY

Range
0% to 100% selectable in 10% increments (1% under GPIB control)

Accuracy
±0.5%

Pulse Characteristics

Spacing
12 µs ±0.1 µs (X channel), P_1, to P_2, 50% pk
30 µs ±0.1 µs (X channel), P_1, to P_2, 50% pk

P_2 Deviation
± 7.0; + 0.05 µs, -0.00 µs, ±7.9 ms from nominal in 0.1 µs increments

Rise Time
2.0 ±0.25 µs (10% to 90%)

Fall Time
2.5 ±0.25 µs (90% to 10%)

Width
3.5 ±0.5 µs (50% to 50%)

Spectrum
55 dB down at f_o ±800 kHz

R-NAV Characteristics

Spacing
50 µs ±0.25 µs at 0 NM (X Channel) 56 µs ±0.25 µs at 0 NM (Y Channel)
P_1 at time of interrogation
P_2 at time of reply

Width
7 µs ±1 µs

Transponder Mode Characteristics

INTERROGATION RANGE

Range
10 Hz to 7999 Hz selectable in 1 Hz increments

Accuracy
±0.005%

PULSE CHARACTERISTICS

Mode Spacing
3.0 µs ±5 ns (Mode 1)
5.0 µs ±5 ns (Mode 2)
6.5 µs ±5 ns (Mode T)
8.0 µs ±5 ns (Mode A)
17.0 µs ±5 ns (Mode B)
21.0 µs ±5 ns (Mode 1)
25.0 µs ±5 ns (Mode 1)

Variable Pulse Spacing
±1.85 µs selectable in 0.05 µs increments for P_1, to P_2, P_1, to P_2, independently variable in direction relative to P_1

Width
0.8 ±5 ns (CAL switch position)
0.20 µs to 1.85 µs selectable in 0.05 µsec increments (VAR Switch Position)

Rise Time
70 ns +10, -20 (10% to 90%)

Fall Time
70 ns +10, -20 (90% to 10%)

SIDE LOBE SUPPRESSION (SLS)

Amplitude
-19 to +6 dB, relative to P_1 selectable in 1 dB increments

Accuracy
±0.2 dB for -10 dB to +3 dB

INTERFERENCE PULSE CHARACTERISTICS

Position Range
-17.5 µs to +399.0 µs referenced to P_1, selectable in 0.1 µs increments

Accuracy
±0.05 µs

Width
Continuously adjustable from 0.2 µs to 5 µs by front panel control

DOUBLE INTERROGATION CHARACTERISTICS

Range
Measured from P_1 first interrogation, selectable to 0.1 µs

Accuracy
±5 ns plus 0.05%

UUT PULSE SPACING DETECTOR

Window Width
Narrow: 220 ns nominal, referenced to P_1
Wide: 750 ns nominal, referenced to P_1

UUT Measurement Characteristics

TRANSMITTER FREQUENCY COUNTER CHARACTERISTICS

Range
1020 MHz to 1155 MHz

Accuracy
±20 kHz (DME Mode)
±50 kHz (XPDR Mode)

TRANSMITTER FREQUENCY DISCRIMINATOR OUTPUT

Response
1 MHz/volt ±10% into open load
2 MHz/volt ±10% into a 50 Ω load

Bandwidth
10 MHz min

TRANSMITTER POWER METER CHARACTERISTICS

Frequency Range
1020 MHz to 1155 MHz

Amplitude Range
10 W to 3999 W pk

Accuracy
±0.5 dB (from 50 Ω source)

ATC-1400A

General

Power
105 to 120 VAC or 220 to 250 VAC, 50 to 400 Hz.
Power consumption is less than 100 watts

Electromagnetic Compatibility
Complies with the limits specified in the following standards:
EN 55011:1991 Class B
EN 50082-1

Safety
Conforms with EN 61010-1 for class 1 portable equipment.

Temperature
5 to 40°C

Relative Humidity
≤80% for temperatures upto 31°C decreasing linearly to 50% at 40°C

Altitude
≤4000 m (13,124 feet)

Mains Supply Fluctuations
≤±10% of the nominal voltage

Transient Overvoltages
According to installation category II

Pollution Degree
2

Dimensions
426 mm (16.8 in) wide, 185 mm (7.3 in) high, 467 mm (18.4 in) deep

Weight
20 kg (44 lb) approximately

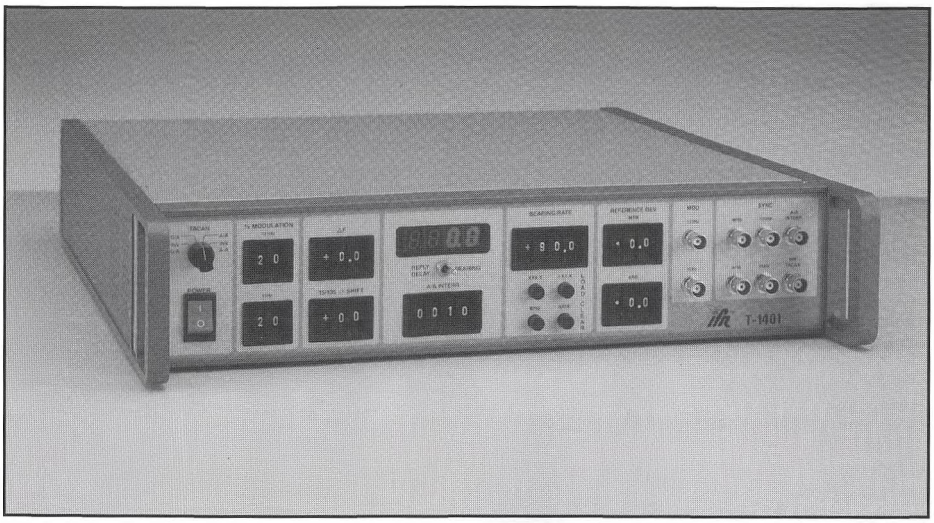
Versions and Accessories

When ordering please quote the full ordering number information

Ordering Numbers	*Versions*
1400-110	ATC-1400A Transponder/DME Bench Test Equipment, 110 VAC operation
1400-110-C	ATC-1400A Transponder/DME Bench Test Equipment, 110 VAC with Certificate of Calibration
1400-220	ATC-1400A, 220 VAC operation
1400-220-C	ATC-1400A, 220 VAC with Certificate of Calibration
	Accessories
1401-110	T-1401 TACAN Bearing and DME Simulation, 110 VAC operation
1401-110-C	T-1401 TACAN Bearing and DME Simulation, 110 VAC operation with Certificate of Calibration
1401-220	T-1401, 220 VAC operation
1401-220-C	T-1401, 220 VAC operation with Certificate of Calibration
1402-110	I-1402 Mode 4 Transponder/Interrogator, 110 VAC operation
1402-110-C	I-1402 Mode 4 Transponder/Interrogator, 110 VAC operation with Certificate of Calibration
1402-220	I-1402, 220 VAC operation
1402-220-C	I-1402, 220 VAC operation with Certificate of Calibration
1403-110	S-1403DL Mode S Transponder, 110 VAC operation
1403-110-C	S-1403DL Mode S Transponder, 110 VAC operation with Certificate of Calibration
1403-220	S-1403DL, 220 VAC operation
1403-220-C	S-1403DL, 220 VAC with Certificate of Calibration
1403MLD-110	S-1403DL/MLD Mode S with Level Diversity, 110 VAC operation
1403MLD-110-C	S-1403DL/MLD Mode S with Level Diversity, 110 VAC operation with Certificate of Calibration
1403MLD-220	S-1403DL/MLD, 220 VAC operation
1403MLD-220-C	S-1403DL/MLD, 220 VAC operation with Certificate of Calibration
1404-110	SI-1404 Modes S & 4 Transponder with MLD, 110 VAC
1404-110-C	SI-1404 Modes S & 4 Transponder with MLD, 110 VAC with Certificate of Calibration
1404-200	SI-1404 Modes S & 4 Transponder with MLD, 220 VAC
1404-200-C	SI-1404 Modes S & 4 Transponder with MLD, 220 VAC with Certificate of Calibration
	Options
	Non coherent SLS option

T-1401
TACAN Accessory Unit

The T-1401 provides a user friendly test solution for TACAN receiver/transmitters



- NATO codified
- Easy to operate
- IEEE-488 GPIB via ATC-1400A
- Complete air-to-air and ground-to-air and inverse MODES of operation
- Two year limited warranty

T-1401

The T-1401 TACAN accessory unit interfaces with the ATC-1400A Transponder/DME Test Set to form the TACAN Test System. The TACAN Test System simulates a TACAN transmitter for testing TACAN receivers and transmitters. The TACAN Test System can be operated manually using external controls or remotely by ATE control through the GPIB bus.

Operation

The T-1401 provides a full range of TACAN bearing and DME simulation required to test and service air-to-air and ground-to-air airborne equipment in both normal and inverse modes. The control settings on the T-1401 front panel determine the mode of operation. In the absence of an ATC-1400A, the T-1401 operates with X Mode pulse spacing. Selecting Ground-to-Air (G/A) Mode enables the Identification and Equalizer pulse pairs. The ATC-1400A also sends mode information when connected to the T-1401 through the IFR Bus. ATC-1400A mode information includes Identification On/Off, Equalizer On/Off, X/Y Mode and P_1 and P_2 pulse spacing.

Interconnect

The T-1401 may be hard mounted to the ATC-1400A using supplied hardware. Electrical interface to the ATC-1400A is via the IFR and AUX busses using two 25 way interconnect cables and 2 SMB-to-SMB coaxial cables. Line power is switched through the T-1401 for synchronized power up of both test sets.

Features

- Programmable air-to-air interrogation rate
- Variable 15 Hz modulation
- Variable 135 Hz modulation
- Phase shift selection between 15 and 135 Hz
- Simulated bearing selection and display
- Programmable bearing/rate selection
- Identifies air-to-air replies from UUT

T-1401 Specifications

Modulation
15 Hz and 135 Hz independently adjustable from 0% to 39% in 1% steps, ±1% of selected value, distortion ± 2%

Bearing
0 to 359.9 degrees per second 0.1 degree increments, ±0.05 degree

Bearing Rate
0 to ±39 degrees in 1.0 degree increments, ±0.02 degree

15/135 Hz Phase Shift
0 to ±39 degrees in 1.0 degree increments, ±0.2 degree

ΔF
±3.9% of nominal in 0.1% steps, ±0.01%

Main Reference Burst

Length
12 pulse pairs nominal in G/A X Mode
13 single pulses nominal in G/A Y Mode
10 single pulses nominal in A/A X or Y Mode
Adjustable +1, +2, -1 or -2

Spacing
30.0 µs nominal, adjustable ±3.9 µs in 0.1 µs increments, ±0.1 µs

Auxiliary Reference Burst

Length
6 pulse pairs nominal in G/A X Mode
13 single pulses nominal in G/A Y Mode
Adjustable +1, +2, -1 or -2

Spacing
24.0 µs nominal in G/A X Mode
15.0 µs nominal in G/A Y Mode
Adjustable ±3.9 µs in 0.1 µs increments, ±0.1 µs

Position
The first ARB following the MRB may be disabled

A/A Interrogations
0 to 3999 per second, selectable in 1 Hz steps

Pulse Characteristics

Spacing
12 µs ±0.1 µs (X channel DME and TACAN replies)
30 s ±0.1 µs (Y channel DME and TACAN replies)
12 µs ±0.1 µs (X channel A/A TACAN interr)
24 µs ±0.1 µs (Y channel A/A TACAN interr)

P_2 Deviation
±7.9 µs in 0.1 µs increments (X channel)
±7.9 µs in 0.1 µs increments (Y channel)

Spectrum
55 dB down from center frequency measured at ±800 kHz

UUT Pulse A/A Reply

Spacing Detector
Centered at 62 µs for X channel, 74 ms for Y channel

UUT Pulse Interrogation Spacing Detector
Centered at 12 µs for X channel DME, G/A, A/A; 36 µs for Y Channel DME and G/A; and 24 µs for Y channel A/A

T-1401

Calibration Interval
1 year

AC Supply
100 to 120 VAC, 220 to 240 VAC, 50 Hz to 60 Hz, ≤+10 % of the nominal voltage
43 watts maximum (163 watts maximum with 1400-A)

AC Output
Line output, fused at 3 amps and switched

ENVIRONMENTAL

Temperature
5 to 40°C

Relative Humidity
≤80% for temperatures upto 31°C decreasing linearly to 50 % at 40°C

Altitude
≤4000 m (13,124 feet)

Electromagnetic Compatibility
Complies with the limits in the following standards:
EN 55011 Class B
EN50082-1

Safety
Complies with EN 61010-1:1993 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Dimensions
425 mm (16.8 in) W, 467 mm (18.4 in) D, 89 mm (3.5 in) H

Weight
8.1 kg (18 lb)

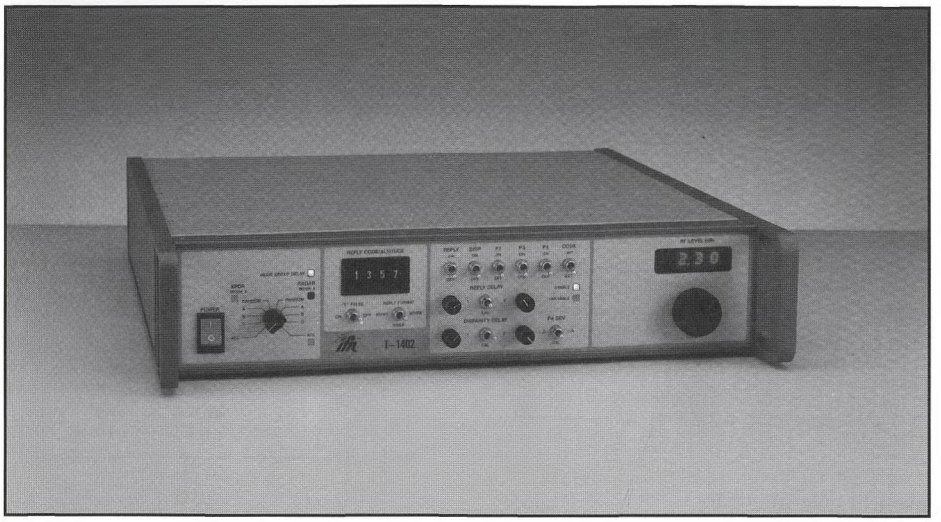
Versions and Accessories

When ordering please quote the full ordering number information

Ordering Numbers	*Versions*
1401-110	T-1401 TACAN Bearing and DME Simulation, 110 VAC operation
1401-110-C	T-1401 TACAN Bearing and DME Simulation, 110 VAC operation with Certificate of Calibration
1401-220	T-1401, 220 VAC operation
1401-220-C	T-1401, 220 VAC operation with Certificate of Calibration
	Accessories (Supplied)
	Line Cord
	Aux Bus Interface Cable
	IFR bus Interface Cable
	Operators Manual
	1 x RF Coax Interface Cable
	Line Cord to ATC-1400A to T-1401

I-1402
Mode 4 Accessory Unit

The I-1402 provides a friendly test solution for Mk10A and Mk12 IFF transponders and interrogators



- NATO codified
- Easy to operate
- IEEE-488 GPIB via ATC-1400A
- KIT/KIR crypto simulation
- External KIT/KIR crypto interface
- 4096 code & altitude encoder
- Two year limited warranty

I-1402

The I-1402 Mode 4 accessory unit is designed to interface with the ATC-1400A Transponder/DME Test Set. The I-1402 provides additional pulse code modulation for testing ATC, Mode 4 transponders extending the ATC-1400A test capability to include Modes 1, 2, 3/A, C & 4. The I-1402 also provides the ATC-1400A with Interrogator test capability for Modes 1, 2, A, C & Mode 4.

Operation

The I-1402 can provide a fixed simulation of a KIT/KIR TSEC-1A/1C cryptographic computer, utilizing the NATO assigned A, B & O Mode 4 test codes. The I-1402 provides the necessary signals to the unit under test to simulate operation in an installed environment, allowing maintenance procedures to be performed without using security classified hardware or encryption keys. The I-1402 may also be interfaced with KIT/KIR TSEC-1A/1C cryptographic computers for live system performance testing.

Interconnect

The I-1402 may be hard mounted to the ATC-1400A using supplied hardware. Electrical interface to the ATC-1400A is via the IFR and AUX busses using two 25 way interconnect cables. A coax cable is provided for RF vernier control. Line power is switched through the I-1402 for synchronized power up of both test sets.

Additional Features

- Mode 4 A, B, O and random codes
- Vernier level, controls the ATC-1400A RF level in 0.1 dB steps
- ON-OFF control reply, disparity, P_2, P_3, P_4 and P_5 pulses
- Position control of reply, disparity, P_2, P_3, and P_4 pulses
- Rear panel BNC interconnects for control and signal monitoring
- Normal, ident, and emergency replies

I-1402 Specifications

XPDR ATC Test Function

Modes
1, 2, 3/A, B, C and D

Generator Code Output
0000 to 7777 (octal) for Mode A
0000 to 1267 (decimal) Altitude in hundreds of feet for Mode C

Reply Format
IDENT, NORM or EMER

Generator Code Delay
Two setting adjustable from 0 to 12 µs. One calibrated setting of 3 µs following P_3 (CAL) of the interrogation

Level
+3 V to +27 V (selectable)

UUT Reply Delay
Measurement taken from P_3 of interrogation to F_1 of the first reply pulse (GPIB)

XPDR Mode 4 Test Function

RF Output Interrogation Pulses

P_2, P_3 and P_4 Pulses
Period
2 µs nominal
Width
0.5 µs (variable 0.2 µs to 1.95 µs)
P_5 Pulse
Delay fixed at 8.0 ms following P_1 (CAL).
Information pulses: Selectable as either internal or external modulation, by code switch.
Amplitude
Variable from -19 dB to +6 dB in 1 dB steps or off
Width
0.5 µs fixed
Delay
Fixed at 8.0 µs following P_1 (cal)
Information pulses
Selectable as either internal or external modulation, by code switch

Internally Generated CODE
O, A, B or Random format
Interrogation
0.5 µs pulse width fixed: even µs spacing intervals for information pulses, odd µs spacing intervals for anti-interference pulses Random Format)
Reply
Output to the UUT to provide modulator drive Delay Pulses in lieu of encryption devise. Three pulses at 1.75 µs fixed spacing, 0.45 µs width, and +3 to +27 volts (internally adjustable)

Double Interrogation
Spacing
92.5 µs to 399.9 µs in 1 µs steps following P_4 (CAL)

Random Pulse
(ATC-1400A Interface Pulse)(CODE=INT)
Position
Variable from -25.0 µs to +399.9 µs relative to P_1 in 0.1 µs steps
Amplitude
Variable from -19 dB to +6 dB in 1 dB steps
Scope Trigger
1.0 µs fixed. Positive TTL output

Externally Generated CODE
UUT Reply Delay
Measurements are taken from P_4 (CAL) of interrogation to the first reply pulse of the decoded video. Resolution: 25 ns, Accuracy: ±50 ns (GPIB)
Time Decoded Video

I-1402

Input from optional encryption device used for stable/unstable determination

Radar ATC Test Function

Modes
1, 2, 3/A and C

Range Delay
Variable from 0.00 to 200 nautical miles (NM) in 1.0 NM steps

Echo
Enabled by SLS/ECHO Switch on ATC-1400A

Indent
Range delay, 15 NM fixed, RF level is -19 to +6 dB

Reply Codes
0000 to 7777 (octal) for modes 1,2, and 3/A.
-0010 to 7777 (decimal) altitude in hundreds of feet for Mode C

F_2 Reply Pulse
20.3 µs from F_1 in CAL

Deviation
± 1.95 µs selectable in 0.05 increments from CAL

Width
CAL = 0.45 µs. Variable = 0.20 µs to 1.95 µs selectable in 0.05 µs increments

Radar Mode 4 Test Function

Range Delay
Variable from 0.00 to 200 NM in 1.0 NM steps
Echo
Enabled by SLS/ECHO Switch on ATC-1400A. Causes a fixed range delay of 15 NM at selected SLS levels
Level
-19 dB to +6 dB

Internally Generated CODE
Disparity Delay
Two variable and one calibrated setting (0.5 ms, +TTL)
CAL
5.9 µs following P_1 CAL
Delay 1
-6.1 µs to 17.9 ms following P_1
Delay 2
Variable from 360 µs to 384 µs following pre-trigger input
Reply
At 0 NM range, output to the UUT to provide modulator drive Delay Pulses in lieu of encryption device. Three pulses at 1.75 µs fixed spacing, 0.45 µs width, and +3 to +27 volts (internally adjustable)

Externally Generated CODE
Reply
Input from optional encryption device used to modulate ATC-1400A RF Generator
Level
+2.5 to +15 V
Enable Trigger
1.0 µs, Positive TTL output
Delay
0.45 µs after P_4 challenge video

General

Calibration Interval
1 year

AC Supply
100 to 120 VAC, 220 to 240 VAC, 50 Hz to 60 Hz, ≤+10 % of the nominal voltage
43 watts maximum (163 watts maximum with 1400-A)

AC Output
Line output, fused at 3 amps and switched

ENVIRONMENTAL

Temperature
5 to 40°C

Relative Humidity
≤80% for temperatures upto 31°C decreasing linearly to 50 % at 40°C

Altitude
≤4000 m (13,124 feet)

Electromagnetic Compatibility
Complies with the limits in the following standards:
EN 55011 Class B
EN50082-1

Safety
Complies with EN 61010-1:1993 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Dimensions
425 mm (16.8 in) W, 467 mm (18.4 in) D, 89 mm (3.5 in) H

Weight
7.94 kg (17.5 lb)

Versions and Accessories

When ordering please quote the full ordering number information

Ordering Numbers	*Versions*
1402-110	I-1402 Mode 4 Transponder/Interrogator, 110 VAC operation
1402-110-C	I-1402 Mode 4 Transponder/Interrogator, 110 VAC operation with Certificate of Calibration
1402-220	I-1402, 220 VAC operation
1402-220-C	I-1402, 220 VAC operation with Certificate of Calibration
	Accessories (Supplied)
	Line Cord
	Aux Bus Interface Cable
	IFR Bus Interface Cable
	Operators Manual
	1 x RF coax Interface Cable
	Line Cord ATC-1400A to I-1402

S-1403DL
Mode S Accessory Unit

The S-1403DL provides a complete test solution for Mode S and Mode S "Datalink" capable transponders



- Easy to operate
- Control via IEEE.488 GPIB v13 or ATC-1400A
- Support for MTL, COMM C and COMM D
- User defined screens for user specific tests
- Two year limited warranty

S-1403DL

The S-1403DL Mode S accessory unit is designed to interface with the ATC-1400A Transponder/DME Test Set. The S-1403DL/ATC-1400A (Mode S Test System) simulates an ATCRBS/Mode S equipped Secondary Surveillance Radar (SSR) ground station. The Mode S Test System provides pulse and Differrential Phase Shift Keying (DPSK) modulated signals for testing Air Traffic Control Radar Beacon Systems (ATCRBS) and Mode Select (Mode S) transponders.

Operation

The S-1403DL Mode S accessory unit supports the new Mode S Data Link and ADS-B (extended DF17 squitter). The "DL" is backward compatible with the "C" model, current ATE programs implemented on the S-1403C will operate with the S-1403DL without program changes. The unit provides additional pulse code modulation, as specified by RTCA/DO-181 to the ATC-1400A for testing ATCRBS and Mode S transponders, including Data Link and ADS-B. The optional MLD (Multi Level Diversity) function is available for testing Mode S transponders with MLD requirements. The S-1403DL may also be used as a stand-alone unit to perform limited Mode S tests

Interconnect

The S-1403DL may be hard mounted to the ATC-1400A using supplied hardware. Electrical interface to the ATC-1400A is via the IFR and AUX buses using two 25 way interconnect cables and three SMB-to-SMB coaxial cables. Line power is switched through the S-1403DL for synchronized power up of both test sets.

Standard Features

- Over 30 new screens, including support for MTL, Comm C and Comm D formats
- Remote Operation via IEEE 488.2-1987 or RS-232
- Rapid updating of data fields using continuous rotation "SLEW" knob or keypad
- Rear panel interconnects for control and signal monitoring
- Control of P_2, P_3, P_4 and P_6 width, offset and amplitude
- Fixed frequency/fixed level RF output for diversity antenna testing
- Mode S interrogation rates up to 2500 PRF burst
- Onboard GPIB interface to increase the speed of ATE test routines
- Battery back-up memory for storage of additional test data
- PRF generator from 99.999 sec to 2600 Hz
- Flash memory for easy firmware upgrades

S-1403DL Specifications

Control Menu Functions

Mode Select (Pulse Variable)

ATC
ATC-1400A only provides the pulse modulation (A, C, etc.). The Accessory unit will measure and display Reply Delay for ATC modes.

SEQ
Mode S interrogations are provided from the Accessory unit. (outputs the stored sequence). PRF selection is made from the 1400A front panel switches. The 1400A transponder mode select switch is overridden.

ACS
ATCRBS All-Call short.
PRF selection is made from the 1400A front panel switches.

ACL
ATCRBS/Mode S All-Call long.
PRF selection is made from the 1400A front panel switches.

INTLCE
Set ratio of Mode S interrogations (from the seq. menu) to ATCRBS interrogations.
NOTE: Mode S interrogations are interlaced with a fixed delay of 400 ps following P_1.

DI
Set double interrogation modes (Any combination of ATCRBS, All-Call and Mode S).
NOTE: Enable and DI delay are controlled by the 1400A front panel switches.

BURST
Program the BURST key to output ATC, ACS, ACL or SEQ formats, followed by the BURST number value of 1 to 999.

P_4/P_6 Control

All-Call modes (P_4)

Width
Calibrated at 0.8 µs for P_4 (short) and 1.6 µs for P_4 (long). Variable independent of P_1, P_2 and P_3 from 0.2 µs to 2.75 µs in 0.05 µs steps for P_4 (short) and from 0.2 µs and 3.55 µs for P_4 (long).

Deviation
Independently variable ±1.95 µs relative to CAL position in 0.05 µs steps

S-1403DL

Amplitude
Variable from -19 to +6 dB in 1 dB increments
NOTE: SLS control "ON" on the ATC-1400A overrides the variable amplitude.
Accuracy: ±0.3 dB for -10 dB to +3 dB

Rise Time
50 to 90 ns

Fall Time
50 to 200 ns

Mode S (P_6)

Width
Calibrated at 16.25 µs or 30.25 µs (56 or 112 phase reversals), variable ±1.5 µs in 0.05 µs steps

Deviation
CAL at 3.5 µs following P_1. Variable ±1.95 µs in 0.05 µs steps

SYNC Phase Reversal

Control
ON / OFF

Deviation
Calibrated at 2.75 µs after the rising edge of P_2 (CAL). Variable from + 1.75 to + 3.75 µs relative to the rising edge of P_6 in 50 ns steps. (All DPSK data will deviate accordingly).

SLS
SLS control on the ATC-1400A disables all other pulse amplitude control and enables the SLS pulse.

Width
Fixed at 0.8 µs Accuracy: ±100 ns

Position
For ATC and ALL CALL functions, 2.0 µs. For Mode S, fixed relationship to Sync Phase Reversal from -0.4 µs before SPR to +0.4 µs following SPR.

Amplitude
Variable from -19 to +6 dB in 1 dB increments
Accuracy: (Same as P_4)

Relay Delay

ATCRBS
Measures delay from P_3 to F_1 to a resolution of 25 ns
Accuracy: ±100 ns

Mode S
Measures delay from the SYNC phase reversal to the first preamble pulse of the reply to a resolution of 25 ns.
Accuracy: ±50 ns

% Reply

ATC
0 to 127% in 1% steps. Displays percent of valid replies that are ATCRBS only

SEQ
0 to 127% in 1% steps. Displays percent of valid replies that are Mode S only

Ant. A
Displayed on 1400A front panel

Ant. B
0 to 127% in 1% steps. Displays percent of valid replies that return through antenna B
Accuracy: +1, -0 counts

Decoder
Decodes downlink data and generates parity information which is compared to the "AP" field to check errors.

Squitter
Indicates Squitter period from 0 to 9.99 seconds in 10 ms steps. Accuracy: ±0.5 ms

Address
Mode S address selectable from 1 to 2 to the 24th Power

Sequence Menu

Sequence Menu
The Sequence Menu allows the input of Uplink Formats in a programmable sequence of up to 16 items. Downlink Formats are read-only

Uplink Format
UF00, UF04, UF05, UFll, UF16, UF20 and UF21 are predefined field locations per Table B-3 of the Operators/Maintenance Manual. Formats "S" and "L" are user defined 56-bit and 112-bit words consisting of 5 bits octal formatted data, 27 and 83 bits (S/L) of octal information data, and 24 bits of octal UUT data.

Downlink Format
DF00, DF04, DF05, DF11, DF16, DF20 and DF21 are predefined field locations per Table B-3 of the Operators/Maintenance Manual. Formats "S" and "L" are three fields of generic data consisting of 5 bits of octal formatted data; 27 or 83 bits of octal information data and 24 bits of octal address data.

Additional Functions

RF Level
"RFLvl" key followed by a number will raise or lower the ATC-1400A RF level by 3.0 dB in 0.1 dB steps. Accuracy: ±10%

Ant. B
Used to enable or disable the second RF output for diversity testing.

Frequency
1030 MHz Accuracy: 0.001%

RF Level
-50 dBm

Accuracy
±1 dB relative to the 1400A output at -50 dBm

General

Calibration Interval
1 year

AC Supply
100 to 120 VAC, 220 to 240 VAC, 50 Hz to 60 Hz, ≤+10 % of the nominal voltage
48 watts maximum (163 watts maximum with 1400A)

AC Output
Line output, fused at 3 amps and switched

ENVIRONMENTAL

Temperature
5 to 40°C

Relative Humidity
≤80% for temperatures upto 31°C decreasing linearly to 50 % at 40°C (Non condensing)

Altitude
≤4000 m (13,124 feet)

Electromagnetic Compatibility
Complies with the limits in the following standards:
EN 55011 Class B
EN50082-1

Safety
Complies with EN 61010-1:1993 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Dimensions
425 mm (16.8 in) W, 467 mm (18.4 in) D, 89 mm (3.5 in) H

Weight
6.75 kg (15 lbs)

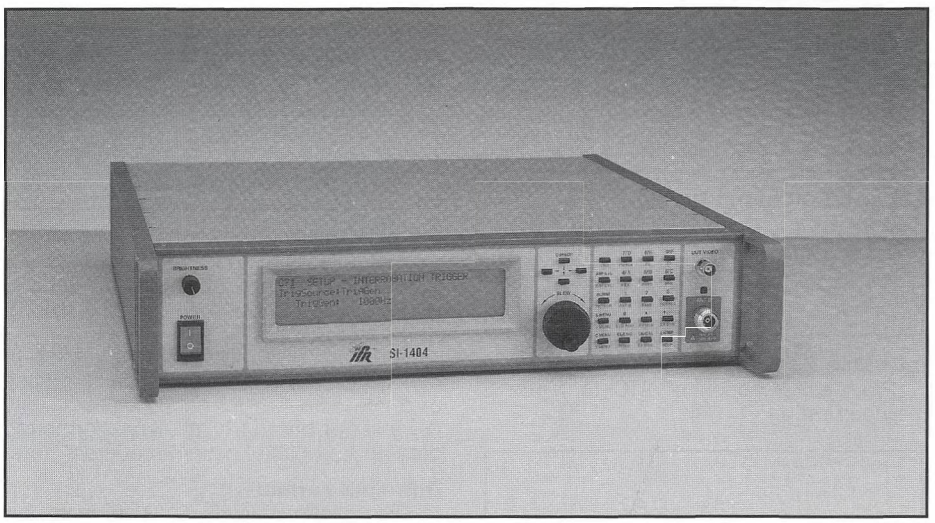
Versions and Accessories

When ordering please quote the full ordering number information

Ordering Numbers	*Versions*
1403-110	S-1403DL Mode S Transponder, 110 VAC operation
1403-110-C	S-1403DL Mode S Transponder, 110 VAC operation with Certificate of Calibration
1403-220	S-1403DL, 220 VAC operation
1403-220-C	S-1403DL, 220 VAC with Certificate of Calibration
1403MLD-110	S-1403DL/MLD Mode S with Level Diversity, 110 VAC operation
1403MLD-110-C	S-1403DL/MLD Mode S with Level Diversity, 110 VAC operation with Certificate of Calibration
1403MLD-220	S-1403DL/MLD, 220 VAC operation
1403MLD-220-C	S-1403DL/MLD, 220 VAC operation with Certificate of Calibration
	Accessories (Supplied)
	Line Cord
	Aux Bus Interface Cable
	IFR Bus Interface Cable
	Operators Manual
	3 x RF Coax Interface Cable
	Line Cord ATC-1400A to S-1403DL

SI-1404
MK12/Mode S IFF Accessory Unit

SI-1404 provides a comprehensive 3rd line/ depot level test solution for next generation MK12/Mode S IFF transponders



- Comprehensive Mode S (level 4) and Mode 4 interrogator simulation
- Accurate measurement of transponder reply pulse parameters
- Configuration memory stores five complete SI-1404 configurations
- Extended squitter UF/DF17 capability
- Mode 4 crypto simulation plus external crypto interface
- Built-in self test
- LCD display with adjustable backlight
- IEEE-488.2 GPIB & RS-232 interface
- Two year limited warranty

SI-1404

The SI-1404 is a Depot Level/3rd Line test accessory, used in conjunction with the ATC-1400A Transponder/ DME test set, for testing IFF transponders in a maintenance or production environment.

The SI-1404/ATC-1400A may also be utilized by OEMs to perform most of the MOPs (Minimum Operational Performance) tests defined in RTCA/DO-181A, required in the Mode S transponder certification process.

The SI-1404 and ATC-1400A form a comprehensive SSR ground station simulator capable of parametric and protocol testing MK10A, (Mode 1, 2, 3/A, C), MK12 (Mode 1, 2, 3/A, 4, C) and MK12/Mode S transponders.

OPERATION

Display

Operation of the SI-1404 is via a menu system displayed on a 40 column x 4 row alphanumeric LCD display. The display has an adjustable illumination backlight which provides viewable screens under all ambient lighting conditions.

Keypad

Menu selection and data entry is provided via a 4 x 5 main key pad, four directional cursor keys and a slew knob. Dedicated keys are provided for commonly used functions.

SI-1404/ATC-1400A Interface

The SI-1404 is interfaced to the ATC-1400A via two rear panel bus cables and three RF coax cables.

The SI-1404 provides the ATC-1400A with Mode S DPSK modulation and monitors replies on Ant A (ATC-1400A).

The ATC-1400A provides UUT power and frequency measurement and has a fully synthesized RF generator for performing receiver bandwidth and selectivity tests.

ATC mode selection and SLS testing is provided via the ATC-1400A controls.

Remote Control

The SI-1404 may be controlled via the ATC-1400A IEEE-488 GPIB interface as an integrated system, or via a separate high speed GPIB interface available on the SI-1404 rear panel.

A RS-232 interface is provided for a screen dump to an external printer.

Test Menus and Screens

Testing under manual control is via a series of menus. Menu types are 'C' (Control), 'S' (Sequence) and 'T' (Test). C10 menus relate to control and monitoring of the 'A' antenna RF I/O port (ATC-1400A) and C20 menus relate to the control and monitoring of the 'B' antenna RF I/O port (SI-1404).

The C10 and C20 menus contain a number of 'f' or function screens. The function screens are structured for manual testing.

Control fields are provided for Ant A RF level vernier and Ant A to Ant B diversity time delay.

Measured parameters displayed are, percent reply for Ant A (ATC and Mode S), Ant B (all replies), reply delay and Mode S squitter period.

Main C Menu

Access to all menus and screens is provided via the main 'C' control menu.

```
C00              MAIN CMENU
1) FUNCT A    4) REPLY DELAY   7) SETUP MENU
2) FUNCT B    5) SQTR 1of2     8) SYSTEM MENU
3) %REPLY     6) SQTR 2of2     9) CAL MENU
```

ATC Screen

Displays Mode 1,2,3/A code or Mode C altitude and provides P_3 control field.

```
C10 f01:ATC (ATCRBS)                    Arf:+1.2
                                        P3:CAL
Code=ID7777X      Dly=  3.0125 Sqtr= 2.10
AntA%:ATC=100,S=  0  AntB%=  0 AntB:+.95
```

Mode S Sequence Screen

Provides selection of P_6 control, pulse width and deviation, P_2 control, SPR control and deviation.

SI-1404

Mode S formats are configured in the sequence menu.

```
C10 F02:SEQ (ModeS)                    Arf:+1.2
P6:CAL,Wd: CAL ,Dv: CAL    P2:CAL
SPR:ON ,Dv: CAL  Dly=  128.00  Sqtr= 2.10
AntA%:ATC=  0,S=100  AntB%=  0 AntB:+.95
```

ACS (All-Call Short) Screen

Provides selection of P_4 control, pulse width and deviation. Displays DF11 all-call reply and transponders discrete address.

```
 C10 F03:ACS (ALL CALL SHORT)     ARF:+1.2
P4:CAL,Wd: CAL ,Dv: CAL             P3:CAL
DF=11              Dly=  128.00 Sqtr= 2.10
AntA%:ATC=100,S=  0  AntB%=  0 AntB:+.95
```

ACL (All-Call Long) Screen

```
C10 f04:ACL (All Call Long)      Arf:+1.2
P4:CAL,Wd: CAL ,Dv: CAL             P3:CAL
DF=11,AA=123456  Dly=  3.0125 SQTR= 2.10
AntA%:ATC=  0,S=100  AntB%=  0 AntB:+.95
```

Interlace Screen

Provides selection of ATC to Mode S interlace ratio.

```
C10 f05:INTLCE;Ratio:1to999      Arf:+1.2

                    Dly=  3.0125 Sqtr= 2.10
AntA%:ATC=100,S=100  ANTB%=  0 ANTB:+.95
```

Double Interrogation Screen

Provides selection for 1st and 2nd interrogation modes. Interrogation spacing control is provided by the ATC-1400A.

```
C10 f06:DI;1st:ATC,2nd:ATC       Arf:+1.2
                              P3:CAL
Code=ID7777X      Dly=  3.0125 SQTR= 2.10
AntA%:ATC=100,S=  0  AntB%=  0 ANTB:+.95
```

Burst Screen

Select desired burst format ATC, ASC, ACL or SEQ. Select burst number 1 to 9999. Press burst key to send burst.

```
C10 f07:BURST;SEQ:9999           Arf:+1.2
P6:CAL,Wd: CAL ,Dv: CAL    P2:CAL
SPR:ON ,Dv: CAL  Dly=  3.0125 SQTR= 2.10
AntA%:ATC=  0,S=100  AntB%=  0 AntB:+.95
```

ATC Monitor Screen

Displays the same parameters as the f01 ATC screen plus F_1/F_2 framing pulse spacing and pulse width, reply jitter and emergency replies.

```
 C10 F08:ATC MON;MODE:1          ARF:+1.2
F1toF2=20.3000, F1WD=0.4500, F2WD=0.4500
Code=ID7777X EM  Dly=  3.0125 Jtr=0.1500
AntA%:ATC=100,S=  0  ANTB%=100 ANTB:+.95
```

Mode 4 Screen

Displays TDV jitter (from external crypto), triplet reply delay and jitter. Provides selection of Mode 4 P_2, P_3, P_4 control and P_4 deviation.

```
C10 f10:Mode4;Code:CRYPTO        Arf:+1.2
P2:CAL  P3:CAL  P4:CAL,DV:+0.00
TDV Jtr=0.0000   Dly=202.0125 JTR=0.0500
A%:ATC= 10,S=  0,M4= 90 B%=  0 ANTB:+.95
```

Mode 4 Monitor Screen

Displays P_4 to Enable trigger spacing, Enable trigger width, Triplet T_1 to T_2 spacing, T_1 to T_3 spacing and T_1, T_2, T_3 widths.

```
C10 f11:Mode4 Mon;Code:EXT       Arf:+1.2
P4toEnaTrg=0.2000, EnaTrgWd=0.4500
T1Wd=0.4625, T2Wd=0.4475, T3Wd=0.4625
T1toT2=1.7500, T1toT3=3.5000   AntB:+.95
```

S Menu

Allows the input of Uplink Formats in a programmable sequence of up to 1000 items. Downlink Formats are read-only.

```
 S000:D;UF11,PR=0, IC=0, CL=0,
 +                        ADDR=FFFFFF
 RPLY:D;DF11,CA=5,AA=292492,
                          ADDR=000000
```

Uplink Format

The following Mode S 'D' formats are provided with predefined data fields... UF00, UF04, UF05, UF11, UF16, UF20, UF21 and UF24.

Formats 'S' & 'L' allow the user to define 56-bit and 112-bit words consisting of 5 bits octal/hex formatted data, 27 bits (S) and 83 bits (L) of octal/hex formatted data and 24 bits of octal/hex address data.

Downlink Format

The following Mode S 'D' formats are provided with predefined data fields... DF00, DF04, DF05, DF11, DF16, DF20, DF21 and DF24.

Formats 'S' & 'L' are three fields of generic data consisting of 5 bits octal/hex formatted data, 27 bits (S) and 83 bits (L) of octal/hex formatted data and 24 bits of octal/hex address data.

Percent Reply Screen

Displays Ant A and Ant B, statistical percent replies for ATC, Mode S Mode 4 groups, plus Bad or No Replies.

```
C30          PERCENT REPLY
       ATC  ModeS  Mode4  BAD  NOREPLY
AntA%=  70    10     10    5      5
AntB%=  60    10     20    5      5
```

Reply Delay Screen

Displays Min and Max reply delays for ATC, Mode S and Mode 4 replies.

```
C40           REPLY DELAY
  ATC:  3.0125,Min=  3.0100,Max=  3.0250
ModeS:128.0125,Min=128.0100,Max=128.0250
Mode4:202.0125,Min=202.0100,Max=202.0250
```

Set up Mode 4 Menu

Provides selection of Mode 4 disparity pulse control, sync source, delay, deviation and pulse width. Also provides selection of Mode 4 reply type, sync source, delay, deviation and triplet pulse width.

```
C78          SETUP - MODE 4
             Sync  Var   Dv    Wd
 DispOut:VAR, INT, 198, +0.95, 1.50 (US)
ReplyOut:RND, INT, 202,  CAL , CAL  (US)
```

Set up PPMG Menu

Provides Peak Power Measurement Gate pulse selection for ATC, Mode S, DELM and Mode 4 replies.

```
C74        SETUP - PPMG (POWER)
       ATC  ModeS  DELM  MODE4
Enable:OFF   OFF    OFF   OFF
 PULSE:A1   P116    16    T1
```

Squitter Screen 1

Displays squitter address in hex/octal, tail number and country (if algorithm available), squitter type DF11 (all-call), DF17 (extended squitter).

```
C50          SQUITTER (1 of 2)
Addr:h=A07613,o-50073023,Tail=N129KS
    COUNTRY=UNITED STATES
Counts/120s:DF11=110,DF17= 36,DF17S=24
```

Squitter Screen 2

Displays DF11 and selected DF17 (A, I, O, P, S or T), content, Ant and squitter period.

```
C60          SQUITTER (2 of 2)
DF CA   AA          ME          II ANT TIME
11  4 A07613                   0  A  1.00
17I 4 A07613  1A8C9A3124BA53   0  A 10.05
```

Set up Screen

Provides selection of S menu data type in octal or hex. A factory set of default formats may also be selected plus the discrete address utilized in the S menus can be selected as User defined or Xpdr (obtained from DF11/DF17 squitters).

```
C76          SETUP - SMENU
SmenuRadix:OCTAL   SetAllSmenu:XPDR
GlobalAddr:Xpdr=17725762,AP XOR=00000000
GlobalAddr:User=10273645,AP XOR=00000001
```

MISC - MTL Screen

Displays pre-programmed MTL test

```
T23           MISC - MTL              PASS
 Reply%:100  Time:10Sec    MTL:-65.3DBM
Antenna: A   Error: 2=PASS
       Press BURST to start test
```

Specification

NOTE: These specifications supersede ATC-1400A specifications when the ATC-1400A is connected with the SI-1404. Refer to 1-3-1 in the ATC-1400A Operation Manual for specifications not outlined in this section.

RF

Antenna A (ANT A), RF I/O Connector

Frequency:	Per ATC-1400A Specifications
Level:	Per ATC-1400A Specifications
Vernier Control	
Range:	±3.0 dB
Step:	0.1 dB
Accuracy:	±0.05 dB or ±10%

Antenna B (ANT B), RF I/O Connector

Frequency:	1030 MHz
Accuracy:	0.001%
Level:	
Range:	-20 to -83 dBm
Step:	1 dB
Accuracy:	±0.5 dB relative to ATC-1400A at -20 dBm into 50 Ω

Attenuator Accuracy:

Level	*Accuracy*
-30 dBm	±0.4 dB
-40 dBm	±0.4 dB
-50 dBm	±0.4 dB
-60 dBm	±0.5 dB
-70 dBm	±0.61 dB
-80 dBm	±0.72 dB

Vernier Control
Range: ±3.0 dB
Step: 0.1 dB
Accuracy: ±0.05 dB or ±10%

Pulse Characteristics

NOTE: Pulse characteristics are verified from the RF I/O or ANT B Connectors using a Heterodyne Monitor.

General

ANT A
Rise and Fall times: Per ATC-1400A Specifications

ANT B
Rise Time: 50 to 90 ns
Fall Time: 50 to 200 ns
On/Off Ratio: >80 dB
P_1 Position (CAL): Relative to ANT A P_1
Deviation: Variable from CAL (±0.95 µs)
Step: 0.05 µs

ANT A to ANT B Tracking Accuracy
±15 ns

PRF Limitations
ATC Function: 7999 Hz
SEQ Function: 2500 Hz
ACS Function: 2500 Hz
ACL Function: 2500 Hz
INTLCE Function: 1250 Hz
DI Function: 1250 Hz
BURST Function: 7999 Hz (ATC)
2500 Hz (All others)
ATCRBS Monitor Function: 4000
Mode 4/Mode 4 Monitor Functions: 2500

PRF Accuracy (TrigGen)

Range (Hz)
1 to 2500 Hz (All functions except INTLCE and DI)
1 to 1250 Hz (INTLCE and DI)
Step Size: 1 Hz
Accuracy: ±1 Hz, ±0.0035%
Range (Sec): 0.0004 to 99.9999 Sec (All functions except (INTLCE and DI)
0.0008 to 99.9999 Sec (INTLCE and DI)
Step Size: 0.1 ms
Accuracy: ±100 ns, ±0.0035%

External Sync Input, EXT SYNC IN Connector

Maximum Input Frequency
ATC Function: 7999 Hz
SEQ Function: 2500 Hz
ACS Function: 2500 Hz
ACL Function: 2500 Hz
INTLCE Function: 1250 Hz
DI Function: 1250 Hz
BURST Function: 7999 Hz (ATC)
2500 Hz (All others)
Minimum Input Low Time: 200 ns

ATC Function

P_2 SLS
Amplitude (CAL) (ANT A) 0 dB, relative to P_1
Range: Variable from -19 to +6 dB
Step: 1 dB
Accuracy: ±0.3 dB for -10 to +3 dB
Width (CAL) (ANT A) 0.8 µs
Range: Variable from 0.2 to 1.85 µs
Step: 0.05 µs
Accuracy: ±10 ns
Width (CAL) (ANT B) 0.8 µs
Range: Variable from 0.2 to 1.85 µs
Step: 0.05 µs
Accuracy (CAL): ±10 ns
(Variable ≤0.8 µs): ±20 ns
(Variable >0.8 µs): ±10 ns
Position (CAL) (ANT A and ANT B) 2.0 µs following leading edge of P_1
Deviation: Variable from CAL (±1.85 µs)
Step: 0.05 µs
Accuracy: ±10 ns

P_3
Amplitude (CAL) (ANT A) 0 dB, relative to P_1
Range: Variable from -19 to +6 dB
Step: 1 dB
Accuracy: ±0.3 dB for -10 to +3 dB
Width (CAL) (ANT A) 0.8 µs
Range: Variable from 0.20 to 1.85 µs
Step: 0.05 µs
Accuracy: ±10 ns
Width (CAL) (ANT B) 0.8 µs
Range: Variable from 0.20 to 1.85 µs
Step: 0.05 µs
Accuracy (CAL): ±10 ns
(Variable <0.8 µs): ±20 ns
(Variable ≥0.8 µs): ±10 ns
Position (CAL) (P_1 to P_3)
3.0 µs (Mode 1)
5.0 µs (Mode 2)
6.5 µs (Mode T)
8.0 µs (Mode 3/A)
17.0 µs (Mode B)
21.0 µs (Mode C)
25.0 µs (Mode D)
Deviation: Variable from CAL (±1.85 µs)
Step: 0.05 µs
Accuracy: ±10 ns

Interference Pulse (PrePulseOut OFF or 0) (<1200 PRF)
Amplitude: 0 dB, relative to P_1
Range: Variable from -19 to +6 dB
Step: 1 dB
Accuracy: ±0.3 dB for -10 to +3 dB
Width: Variable from 0.2 to 5 µs
Position: Variable from 17.5 µs prior to P_1 to 399.9 µs following P_1
Step: 0.1 µs
Accuracy: ±0.1 µs, ±0.005% of pulse position selected on the ATC-1400A

Suppressor Pulse (PrePulseOut OFF or 0) (<1200 PRF) through SUPPRESSOR OUTPUT Connector
Amplitude: Per ATC-1400A Specifications
Width: Per ATC-1400A Specifications
Position: 0.8 µs prior to leading edge of P_3
Range: Variable from 17.5 µs prior to P_1 to 399.9 µs following P_1
Step: 0.1 µs
Accuracy: ±0.1 µs, ±0.005% of pulse position selected on the ATC-1400A
Prepulse through PREPULSE OUT Connector
Position: Variable from 0 to 260 µs prior to leading edge of P_1
Step: 1 µs
Accuracy: ±50 ns ±0.005%
External Sync Output through EXT SYNC OUT Connector
Position: Variable from -9.95 to +9.95 µs from rising edge of P_1
Step: 0.05 µs
Accuracy: ±50 ns
ATCRBS Discrete Pulse through ATCRBS OUT Connector
Width: 3.0 µs
Accuracy: ±50 ns
Position: 1.0 µs prior to leading edge of P_1
Accuracy: ±50 ns

SEQ Function

P_2
Amplitude (CAL) (ANT A): 0 dB, relative to P_1
Range: Variable from -19 to +6 dB
Step: 1 dB
Accuracy: ±0.3 dB for -10 to +3 dB
Width (CAL) (ANT A): 0.8 µs
Range: Variable from 0.20 to 1.85 µs
Step: 0.05 µs
Accuracy: ±10 ns
Width (CAL) (ANT B): 0.8 µs
Range: Variable from 0.20 to 1.85 µs
Step: 0.05 µs
Accuracy (CAL): ±10 ns
(Variable <0.8 µs): ±20 ns
(Variable ≥0.8 µs): ±10 ns
Position (CAL) (ANT A and ANT B): 2.0 µs following leading edge of P_1
Deviation: Variable from CAL (±1.85 µs)
Step: 0.05 µs
Accuracy (CAL): ±10 ns

P_5 SLS
Amplitude (CAL) (ANT A): 0 dB, relative to P_1
Range: Variable from -19 to +6 dB
Step: 1 dB
Accuracy: ±0.5 dB for -10 to +3 dB
Width (CAL) (ANT A):0.8 µs
Accuracy: ±100 ns
Position (CAL) (ANT A): 0.4 µs before Sync Phase Reversal (SPR)
Deviation: Controlled by SPR deviation
Accuracy: ±100 ns

P_6 (ANT A and ANT B)
Width (CAL): 16.25 µs for short formats
30.25 µs for long formats
Range: Variable from CAL (±1.5 µs)
Step: 0.05 µs
Accuracy: ±10 ns
Position (CAL): 3.5 µs following leading edge of P_1
Deviation: Variable from CAL (±1.95 µs)
Step: 0.05 µs
Accuracy: ±10 ns

SPR (ANT A and ANT B)
Position (CAL): 2.75 µs following leading edge of P_2 (CAL)
Deviation: Variable from CAL (±1 µs)
(DPSK data deviates accordingly.)
Step: 0.05 µs
Accuracy: ±10 ns
DPSK
Phase Reversal Time: <80 ns (10° to 170°)

Interference Pulse
Same as in ATC Function

Suppressor Pulse (PrePulseOut OFF or 0) (<1200 PRF) through SUPPRESSOR OUTPUT Connector:
Amplitude: Per ATC-1400A Specifications
Width: Per ATC-1400A Specifications
Position: 0.8 µs prior to SPR (CAL)
Deviation: Variable from 17.5 µs prior to P_1 to 399.9 µs following P_1
Step: 0.1 µs
Accuracy: ±0.1 µs, ±0.005% of pulse position selected on the ATC-1400A

Prepulse through PREPULSE OUT Connector
Same as in ATC Function

External Sync Output through EXT SYNC OUT Connector
Same as in ATC Function

ACS/ACL Functions
P_2 SLS Same as in ATC Function
P_3 (ANT A and ANT B) Same as in ATC Function
P_4:
Amplitude (CAL) (ANT A): 0 dB, relative to P_1
Range: Variable from -19 to +6 dB
Step: 1 dB
Accuracy: ±0.3 dB for -10 to +3 dB
Width (CAL) (ANT A) 0.8 µs for short P_4 (ACS) or 1.6 µs for long P_4 (ACL)
Range: Variable (independent of P_1, P_2 and P_3) from 0.2 to 3.55 µs
Step: 0.05 µs
Accuracy: ±10 ns
Width (CAL) (ANT B) 0.8 µs for short P_4 (ACS) or 1.6 µs for long P_4 (ACL)
Range: Variable (independent of P_1, P_2 and P_3) from 0.2 to 3.55 µs
Step: 0.05 µs
Accuracy (CAL): ±10 ns
(Variable <0.8 µs): ±20 ns
(Variable ≥0.8 µs): ±10 ns
Position (CAL) 2.0 µs following leading edge of P_3
Deviation: Variable from CAL (±1.95 µs)
Step: 0.05 µs
Accuracy: ±10 ns
Interference Pulse
Same as in ATC Function
Suppressor Pulse through SUPPRESSOR OUTPUT Connector
Same as in ATC Function
Prepulse through PREPULSE OUT Connector
Same as in ATC Function
External Sync Output through EXT SYNC OUT Connector
Same as in ATC Function

INTLCE Function

ATC Interrogations: Same as in ATC Function (CAL settings)
SEQ Interrogations: Same as in SEQ Function (CAL settings)
Position: 200 µs from ATC interrogation P_1 leading edge to SEQ interrogation P_1 leading edge
Accuracy: ±100 ns

DI Function

First Interrogation
Refer to applicable function

Second Interrogation
Refer to applicable function (CAL settings).

DI Spacing (P_1 leading edge of 1st interrogation to P_1 leading edge of 2nd interrogation)
ATC, ACS or ACL (either interrogation):
Range: 0 to 399.9 µs
Step: 0.1 µs

Accuracy: ±50 ns, ±0.005%
SEQ (both interrogation):
Range: 40.0 to 399.9 µs
Step: 0.1 µs
Accuracy: ±50 ns, ±0.005%

BURST Function
Interrogations: Refer to applicable function.

ELM Function
SEQ Interrogations: Refer to applicable function (CAL settings).

Mode 4 (Internal) Function

P_2 - P_4:
Amplitude: 0 dB, relative to P_1
Width (CAL) (ANT A) 0.5 µs
Range: P_1, P_2 and P_3 are variable from 0.2 to 1.85 µs (P_4 is fixed.)
Step: 0.05 µs
Accuracy: ±10 ns (for pulse widths from 0.2 to 1.5 µs)
Width (CAL) (ANT B) 0.5 µs
Range: P_1, P_2 and P_3 are variable from 0.2 to 1.85 µs (P_4 is fixed.)
Step: 0.05 µs
Accuracy:
(CAL): ±20 ns
(Variable) at <0.8 µs: ±20 ns
(Variable) at ≥ 0.8 µs: ±10 ns (for pulse widths from 0.2 to 1.5 µs)
Position (CAL) (P_1 to P_2) 2.0 µs ±10 ns
Position (CAL) (P_1 to P_3) 4.0 µs ±10 ns
Position (CAL) (P_1 to P_4) 6.0 µs ±10 ns
Deviation:
P_2 and P_3: Variable from CAL (±1.85 µs)
P_4: Variable from CAL (-1.85 µs to +1.0 µs)
Step: 0.05 µs
Accuracy: ±10 ns

P_5 (SLS)
Amplitude -19 to +6 dB
Step: 1 dB
Accuracy: ±0.3 dB for -10 to +3 dB
Width 0.5 µs
Accuracy: ±10 ns

P_6 - P_{37}
Amplitude (ANT A) 0 dB, relative to P_1
Width (ANT A) 0.5 µs
Accuracy: ±10 ns
Position (P_1 to P_N) 9.0 to 72.0 µs
Deviation: Pulses are distributed throughout the 9 to 72 µs range at 1, 2 or 3 µs increments. Some pulses are shut off.
Accuracy: ±10 ns

Reply Out through REPLY (TTL) OUT and REPLY (3-27 V) OUT Connectors
Amplitude
REPLY (TTL) OUT Connector: Positive TTL into 90 Ω
REPLY (3-27 V) OUT Connector: Nominal 4.5 V, Internally adjustable +3 to +27 V into 1 kΩ
Width
CAL: 0.45 µs
Range: Variable from 0.10 to 1.25 µs
Step: 0.05 µs
Accuracy:
REPLY (TTL) OUT Connector: ±10 ns
REPLY (3-27 V) OUT Connector: ±100 ns
Pulse Spacing
T_1 to T_2 Spacing: 1.75 µs
Accuracy: ±10 ns
T_1 to T_3 Spacing: 3.5 µs
Accuracy: ±10 ns

Reply Out through REPLY (TTL) OUT and REPLY (3-27 V) OUT Connectors (Cont)
Position (CAL ReplyOut)
Mode 0 (ZERO Code): 232.0 µs following Sync Source leading edge
Mode A (A Code): 202.0 µs following Sync Source leading edge
Mode B (B Code): 262.0 µs following Sync Source leading edge
All (ALL Code): 250.0 µs following Sync Source leading edge
Random (RND Code): 218.0 µs following Sync Source leading edge
Mode Accuracy: ±50 ns
Sync Source: P_4 or Enable Trigger pulse input through ENABLE TRIG IN Connector (Enable Trigger leading edge must occur within P_4 time period).
Position (RND ReplyOut) 202.0 to 262.0 µs (16 different positions) following Sync Source leading edge in a quasi-random fashion
Position (VAR ReplyOut)
2 to 270 µs
Step: 1 µs
Accuracy: ±50 ns
Deviation Variable from CAL (±0.95 µs)
Disparity Pulse through DISPARITY OUT Connector
Width
CAL: 0.5 µs
Range: 0.10 to 1.50 µs
Accuracy: ±10 ns
Position (CAL) 198.0 µs following Sync Source leading edge Sync Source: P_4 or Enable Trigger pulse input through ENABLE TRIG IN Connector (Enable Trigger leading edge must occur within P_4 time period).
Accuracy: ±50 ns
Position (VAR) Variable from 2 to 275 µs following leading edge of Sync Source.
Step: 1 µs
Accuracy: ±50 ns
Deviation Variable from CAL (±0.95 µs)

Mode 4 (External) function

Trigger Pulse through SCOPE TRIG OUT Connector
Width: 1.0 µs
Accuracy: ±50 ns

External Modulation input through EXT MOD IN Connector
Polarity: Positive
Amplitude: 2.5 to 15 V

UUT Measurements

Reply Delay

ANT A
ATC (leading edge of P_3 [CAL] to leading edge of F_1)
Range: 2 to 4 µs
Resolution: 12.5 ns
Accuracy: ±50 ns
SEQ (SPR to leading edge of reply P_1)
Range: 126 to 130 µs
Resolution: 12.5 ns
Accuracy: ±50 ns, ±1 count
ACS/ACL
ATCRBS Reply (leading edge of P_3 [CAL] to leading edge of F_1):
Range: 2 to 4 µs
Resolution: 12.5 ns
Accuracy: ±50 ns, ±1 count
Mode S Reply (leading edge of P_4 [CAL] to leading edge of reply P_1):
Range: 126 to 130 µs
Resolution: 12.5 ns
Accuracy: ±50 ns, ±1 count
Mode 4 Reply (leading edge of P_4 to leading edge of T_1)
Range: 202 to 270 µs
Resolution: 12.5 ns
Accuracy: ±50 ns

ANT B:
ATC (leading edge of P_3 [CAL] to leading edge of F_1)
Range: 2 to 4 µs
Resolution: 12.5 ns
Accuracy: ±100 ns, ±1 count (UUT VIDEO Connector unterminated)
±200 ns, ±1 count (UUT VIDEO Connector terminated into 50 Ω)
SEQ (SPR to leading edge of reply P_1)
Range: 126 to 130 µs
Resolution: 12.5 ns
Accuracy: ±100 ns, ±1 count (UUT VIDEO Connector unterminated)
±200 ns, ±1 count (UUT VIDEO Connector terminated into 50 Ω)
ACS/ACL
ATCRBS Reply (leading edge of P_3 [CAL] to leading edge of F_1):
Range: 2 to 4 µs
Resolution: 12.5 ns
Accuracy: ±100 ns, ±1 count (UUT VIDEO Connector unterminated)
±200 ns, ±1 count (UUT VIDEO Connector terminated into 50 Ω)
Mode S Reply (leading edge of P_4 [CAL] to leading edge of reply P_1)
Range: 126 to 130 µs
Resolution: 12.5 ns
Accuracy: ±100 ns, ±1 count (UUT VIDEO Connector unterminated)
±200 ns, ±1 count (UUT VIDEO Connector terminated into 50 Ω)
Mode 4 Reply (leading edge of P_4 to leading edge of T_1)
Resolution: 12.5 ns
Accuracy: ±50 ns

% Reply

ATCRBS Valid Reply (ANT A and ANT B)
Range: 0 to 100%
Resolution: 1%
Accuracy: ±1 step

Mode S Valid Reply (ANT A and ANT B)
Range: 0 to 100%
Resolution: 1%
Accuracy: ±1 step

Mode 4 Valid Reply (ANT A and ANT B)
Range: 0 to 100%
Resolution: 1%
Accuracy: ±1 step

Pulse Characteristics

ATCRBS Monitor Pulse Function (ATC Mon):
Reply Pulse F_1 and F_2 Width (into ANT A or ANT B at 500 W)
Resolution: 12.5 ns
Accuracy:
(ANT A): ±50 ns
(ANT B): ±100 ns
Reply Pulse F_1 to F_2 Spacing (into ANT A or ANT B at 500 W)
Resolution: 12.5 ns
Accuracy:
(ANT A): ±50 ns
(ANT B): ±100 ns

Mode 4 Monitor Pulse Function (Mode 4 Mon)
Enable Trigger Pulse (into ENABLE TRIG IN Connector) Delay from leading edge of P_4
Range: Enable Trigger Pulse must occur within P_4 time period.
Resolution: 12.5 ns
Accuracy:
(ANT A): ±50 ns
(ANT B): ±100 ns
Enable Trigger Pulse Width (into ENABLE TRIG IN Connector)
Resolution: 12.5 ns
Accuracy: ±50 ns
Reply Pulse T_1, T_2 and T_3 Width (into ANT A or ANT B at 500 W)
Resolution: 12.5 ns
Accuracy:
(ANT A): ±50 ns
(ANT B): ±100 ns
Reply Pulse T_1 to T_2 and T_2 to T_3 Spacing (into ANT A or ANT B at 500 W):
Resolution: 12.5 ns
Accuracy:
(ANT A): ±50 ns
(ANT B): ±100 ns

Mode 4 TDV Jitter

TDV Jitter (peak to peak jitter in delay from leading edge of P_1 to leading edge of Time Decoded Video pulse input through DECODED VIDEO IN Connector)
Range: 0 to 9.999 µs
Resolution: 12.5 ns
Accuracy:
(ANT A): ±50 ns
(ANT B): ±100 ns

Input/Output Drive Levels

Miscellaneous Outputs

SIGNAL NAME (CONNECTOR)	*LEVEL Voh (Min)*	*Vol (Max)*	*LOAD IMPEDANCE*
ANT B GEN OUT (J22)	2.4 V	0.6 V	≥90 Ω
ANT B VIDEO OUT (J6)	2.4 V	0.6 V	≥90 Ω
ATCRBS OUT (J5)	2.4 V	0.6 V	≥90 Ω
DISPARITY OUT (J23)	2.4 V	0.6 V	≥90 Ω
EXT PRF OUT (J17)	2.4 V	0.6 V	≥90 Ω
EXT SYNC OUT (J8)	2.4 V	0.6 V	≥90 Ω
PPMG (J14)	2.4 V	0.6 V	≥90 Ω
PREPULSE OUT (J9)	2.4 V	0.6 V	≥90 Ω
REPLY (TTL) OUT (J25)	2.4 V	0.6 V	≥90 Ω
SCOPE TRIG OUT (J7)	2.4 V	0.6 V	≥90 Ω

Miscellaneous Inputs

SIGNAL NAME (CONNECTOR)	*LEVEL*		*INPUT IMPEDANCE*
	Vih (Min)	*Vil (Max)*	
DECODED VIDEO IN (J20)	+2 to +15 V	0.0 to 0.7 V	≥1 kΩ (Typical)
ENABLE TRIG IN (J24)	+2 to +15 V	0.0 to 0.7 V	≥1 kΩ (Typical)
EXT MOD IN (J3)	+2 to +15 V	0.0 to 0.7 V	≥1 kΩ (Typical)
EXT SYNC IN (J4)	+2 to +15 V	0.0 to 0.7 V	≥1 kΩ (Typical)
MODE GRP TRIG IN (J18)	+2 to +15 V	0.0 to 0.7 V	≥1 kΩ (Typical)
REPLY GRP TRIG IN (J19)	+2 to +15 V	0.0 to 0.7 V	≥1 kΩ (Typical)

Power Requirements

Source Voltage and Frequency
100 to 120 VAC, 60 Hz.
220 to 240 VAC, 50 Hz.

Power Consumption
48 W Maximum
180 W Maximum with ATC-1400A
40 W Nominal at 115 VAC
136 W Nominal at 115 VAC with ATC-1400A
33 W Nominal at 230 VAC
129 W Nominal at 230 VAC with ATC-1400A

Nominal Input Current
0.44 A at 115 VAC
1.72 A at 115 VAC with ATC 1400A
0.23 A at 230 VAC
1.0 A at 230 VAC with ATC 1400A

Fuse Requirements

F2 and F4
100 to 120 VAC: 1.0 A, 250 V, Type F
220 to 240 VAC: 0.5 A, 250 V, Type F

F1 and F3
100 to 120 VAC: 3.0 A, 250 V, Type F
220 to 240 VAC: 3.0 A, 250 V, Type F

Safety Conditions

Use
Indoors

Altitude
≤4000 meters (13,124 feet)

Temperature
5 to 40° C

Relative Humidity
≤80% for temperatures up to 31°C decreasing linearly to 50% at 40°C

Mains Supply Voltage Fluctuations
≤±10% of the nominal voltage

Transient Overvoltages
According to installation Category II

Pollution Degree
2

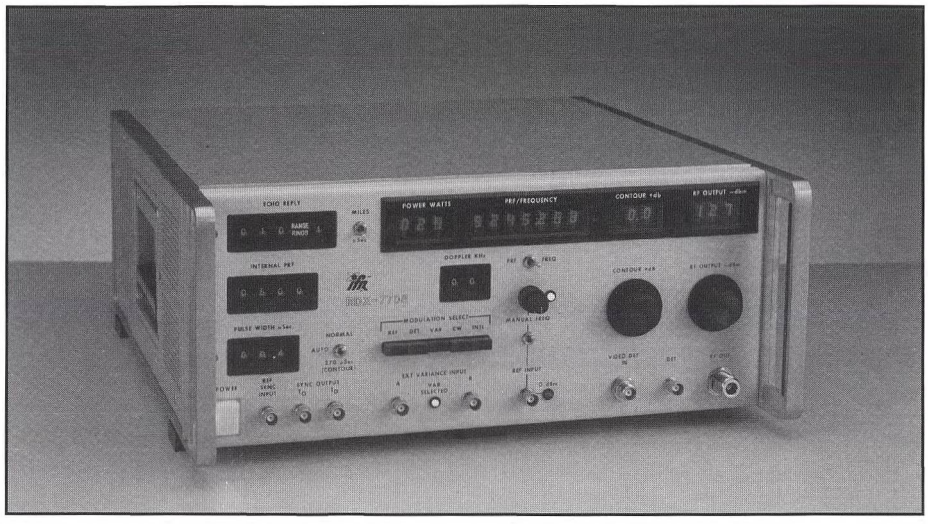
Versions and Accessories

When ordering please quote the full ordering number information

Ordering Number	*Version*
1404-110	SI-1404 Modes S & 4 Transponder with MLD, 110 VAC Certificate of Calibration
1404-110-C	SI-1404 Modes S & 4 Transponders with MLD, 110 VAC with Certificate of Calibration
1404-220	SI-1404, 220 VAC operation
1404-220-C	SI-1404, 220 VAC with Certificate of Calibration

WRX and WRC-7708 Weather Radar Test Set

An integrated test solution for ARINC 708 coherent weather radar systems



- Endorsed by OEM Weather Radar System manufacturers
- Built-in Doppler shift
- Digital readout of the output frequency or PRF
- Digital readout of transmitter power PRF controlled manually, or by transmitter, or external sync input
- Pulse width manually controlled, equal to transmitter input or 270 microseconds (fixed)

Designed to test weather radar systems, the WRX and WRC-7708 tests air transport weather radar systems. The system consists of three main elements: The RDX-7708R (or RDX-7708BRW) or the RDC-7708R, the STD-7000A and the DF-7708 plus a terminal display and keypad.

The RDX and RDC systems are the RF stimulus for the unit under test (UUT) R/T unit. The digital controller (STD-7000A) supplies the digital stimulus for the UUT on the applicable ARINC-429 and 453 digital bus interfaces through the DF-7708.

The STD-7000A controls the discrete function and interface unit (DF-7708), which supports the remaining UUT ARINC connector requirements necessary to make the WRX or WRC-7708 test system a complete test station for Rockwell Collins weather radar systems.

The RDX 7708BRW also interfaces with the Allied Signal air transport weather radar system for complete testing capability.

The RDX-7708 systems or RDC-7708 system provides an RF source and monitor for an ARINC-708 configured weather radar. This solid state unit offers complete testing of the RF capability of the receiver/transmitter, and when used with the STD-7000A and DF-7708, completes a manual test station for the Rockwell Collins weather radar system.

Additional Features

- Range reply selectable in 1 microsecond or 1 mile increments
- RF output adjustable in 1 dBm increments to -127 dBm
- Contour boost in 0.1 dB increments to +20 dB
- Built-in variance modulator

All the above can be remotely controlled through the IEEE 488-1978 GPIB versions

- Monitor outputs for detector, spectrum analyzer and sync

Specifications

RDX-7708R, BRW or RDC-7708R

Reference RF Input

Rockwell Collins X Band
152.777 MHz

Rockwell Collins C Band
146.666 MHz

Allied Signal X Band
78.6616 MHz

RF Output (Reference or Variable)

FREQUENCY

RDX-7708 Range
9295 thru 9425 MHz

RDC-7708 Range
5350 thru 5470 MHz

OUTPUT LEVELS

Range
-50 dBm thru -127 dBm in 1 dB steps (at 20 dB coupler output)

Accuracy
±2 dB over frequency and attenuation range

CONTOUR BOOST

Range
0 thru 19.9 dB for RF outputs less than or equal to -70 dBm

DOPPLER OFFSET

Range
0 kHz thru +29 kHz

Resolution
1 kHz

RF ON/OFF Ratio
70 dB or greater

Pulse Modulation

INTERNAL PRF GENERATOR

Range
0 thru 9999 pps

Resolution
1 Hz

OUTPUT PULSE WIDTH

Range
0 thru 99 ms and 270 µs (fixed)

Resolution
0.1 µs

RETURN DELAY

Range
1 thru 999 µs or NM

Resolution
1 unit

http://www.ifrinternational.com

Displays

FREQUENCY COUNTER

Accuracy
±3 kHz

Resolution
1 kHz

PEAK POWER INDICATOR

Range
RDX-7708 - 40 thru 250 watts
RDC-7708 - 80 thru 500 watts

Accuracy
-0.6 dB

Resolution
1 W

Versions and Accessories

When ordering please quote the full order number information

Ordering Numbers	*Selection Information*
RDC-7708R	Rockwell Collins C band
RDX-7708BRW	Allied Signal band X
RDX-7708CRW	Dual reference Rockwell Collins X band and Allied Signal X band
RDX-7708R	Rockwell Collins X band
	Versions
RDXR	RDX-7708R Weather Radar Bench Test (152.777 MHz/GPIB)
RDXR-C	RDX-7708R Weather Radar Bench Test (152.777 MHz/GPIB) with Certificate of Calibration
RDXBRW	RDX-7708BRW Weather Radar Bench Test (78.6616 MHz)
RDXBRW-C	RDX-7708BRW Weather Radar Bench Test (78.6616 MHz) with Certificate of Calibration
RDXCRW	RDX-7708CRW Weather Radar Bench Test (152.777 MHz & 78.6616 MHz/GPIB)
RDXCRW-C	RDX-7708CRW Weather Radar Bench Test (152.777 MHz & 78.6616 MHz/GPIB) with Certificate of Calibration
RDCR	RDC-7708R Weather Radar Bench Test (146.666 MHz/GPIB)
RDCR-C	RDC-7708R Weather Radar Bench Test (146.666 MHz/GPIB) with Certificate of Calibration
	Accessories (Supplied)
	Line Cord
	Microwave Coax Cable
	BNC to BNC Coax Cable (Video Detector)
	RF Power Module
	20 dB Attenuator RDX-7708 only

STD-7000A

The STD-7000A (WRX-7708 Program) generates and/or monitors the ARINC-429 and ARINC-453 buses as defined in the ARINC-708 Specification. Additionally, it interfaces to the DF-7708 discrete functions interface to control and monitor power and discrete signals to the unit under test (UUT) as defined by ARINC-708. All operator interface is via a 24 line by 80 character CRT monitor and a hex (16 key) keypad.

Standard Features

- Four ARINC-708 control bus outputs with independent control of data and transmission rate of each
- Selected display of one of four input control buses
- Two attitude bus outputs (onside and offside) with independent control of data and transmission rate of each
- Three ARINC-708 data bus outputs with a choice of four patterns (X/Y crosshatch, bar, arc and sector)
- Selected display of one of three input data buses
- All displays and controls are in ARINC-708 terminology to facilitate operator interface

Specifications

ARINC-429 (High and Low Speed I/O buses)

Number of Buses
Six (6) programmable high speed and low speed I/O buses

Low Speed Bit Rate
12.6 kHz

High Speed Bit Rate
100 kHz

Message Transmission Rate
Programmable from 0 to 255 messages per second, in minimum of 1 message per second increments.

ARINC-453 (Very High Speed I/O Buses)

Number of Buses
Three (3)

Bit Rate
1 MHz

BUS I/O CAPABILITIES

Output
Selected or simultaneous operation of all 3 output buses; data content and transmission rate of each bus are identical.

Message Transmission Rate
Programmable from 0 to 255 messages per second, in minimum of 1 message per second increments.

Versions and Accessories

When ordering please quote the full order number information

Ordering Number	*Versions*
7000	STD-7000A Controller/Monitor
7000-C	STD-7000A Controller/Monitor with Certificate of Calibration
	Accessories (Supplied)
	3 x Line Cord
	Operators Manual
	CRT Terminal & Keyboard
	CRT Interface
	RS-232 Cable

DF-7708

The DF-7708 provides all interfaces, except RF, between the test system and the unit under test (UUT). A separate and unique cable is provided for each type of UUT. All power and discrete signals to the UUT are controlled and monitored by circuitry in the DF-7708. Additionally, it routes the ARINC control buses, digital attitude buses and data buses to the appropriate connector pins on the UUT.

Standard Features

- Controls and monitors the appropriate UUT power
- Controls and monitors all discrete signals to the UUT per the ARINC-708 specification
- Sources both analog three wire and analog two wire voltages to the UUT
- Sources Johnson Code drive for Collins Antenna Pedestal
- Provides front panel test points to monitor all signals on the UUT connector

Specifications

Analog Pitch (3 W)
Outputs of 0, ±5°, ±10°, ±15°, ±20°, ±25°, and ±30°, with an accuracy of ±.1°

Analog Roll (3 W)
Same as Analog Pitch (3 W)

Analog Pitch (2 W)
Same as Analog Pitch (3 W)

Analog Roll (2 W)
Same as Analog Pitch (3 W)

ARINC Buses
Routes ARINC-429 and ARINC-453 buses from STD-7000A to correct connector pins on UUT

General

Dimensions (all units)
427 mm (16.8 in) wide, 178 mm (7 in) high, 467 mm (18.4 in) deep

Weight
RDX-7708 or RDC-7708 - 33 lb (15 kg)
STD-7000 - 9.1 kg (20 lb)
DF-7708 - 9.1 kg (20 lb)

Power Requirements
RDX-7708 or RDC-7708
110/220 VAC, 50-400 Hz
STD-7000
110 VAC, 50 or 60 Hz
DF-7708
110 VAC, 50-400 Hz
220 V, 50-400 Hz available on request

Power Consumption
100 W

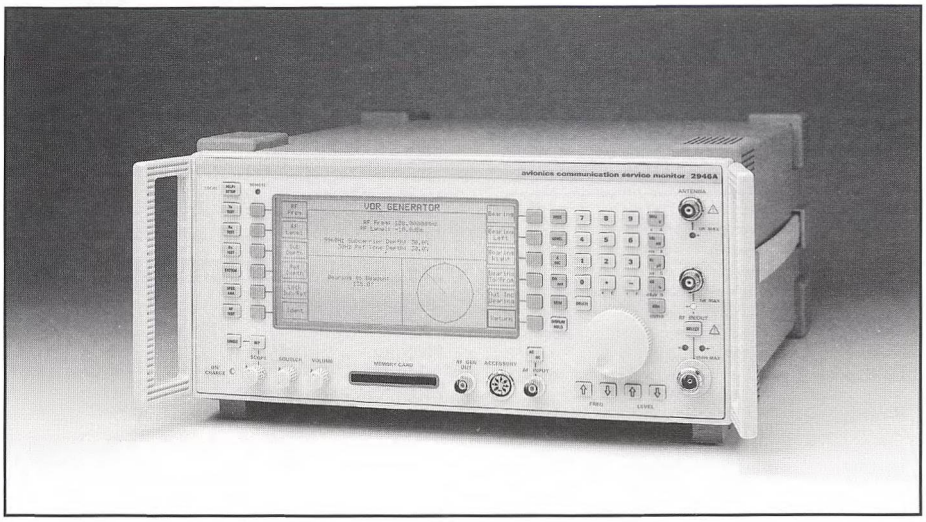
Versions and Accessories

When ordering please quote the full order number information

Ordering Numbers	*Versions*
7708	DF-7708 UUT Interface
7708-C	DF-7708 UUT Interface with Certificate of Calibration
	Accessories (Supplied)
	Line Cord
	STD-7000A to DF-7708 Interconnect Cable
	R/T Unit Cable
	Control Unit Cable

2946A
Avionics Communications Service Monitor

Communication and flightline testing of military and commercial aircraft in one instrument



- Comprehensive Radio Communication Test Set
- Full span Spectrum Analyzer with offset tracking generator
- Avionics modes for ILS, VOR, marker beacons and SELCAL
- Displays in avionics terms: SDM, DDM, Bearing and TO and FROM
- Extensive pre-sets for avionics functions DDM and Bearing
- Auto increment of VOR Bearing for aircraft display testing
- DC operation from aircraft power supplies or internal batteries
- Avionics testing in both Direct and 'Off Air' configurations

Avionics Systems Test Facility

The 2946A provides an impressive range of features for the aircraft and avionics maintenance industry.

In addition to the features provided by the general purpose 2945A, the dedicated 2946A Avionics Communications Service Monitor provides signals for testing the following: ILS receivers for localizer, including identification, glideslope and markers; VOR beacon receivers, with identification; SELCAL selective calling receivers.

The 2946A screen gives a representation of the aircraft's display in each mode, with the effective test signal parameters clearly indicated both diagramatically and numerically. Parameters can be altered in steps or continuously.

Specification

Avionics Systems

The Avionics feature provides amplitude modulated signals suitable for testing of Instrument Landing Systems (ILS) and VHF Omnidirectional Radio range (VOR) receivers.

ILS MODE

Sum of Depth of Modulation (SDM)
0-90% glideslope, 0-50% localizer in 0.1% steps representing the arithmetic sum of each tone depth.

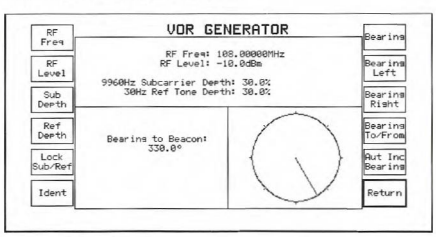
Selection
Keyboard entry

Accuracy of SDM
±5% of setting for carrier frequencies up to 400 MHz

Difference of Depth of Modulation (DDM)
0-45% glideslope, 0-25% localizer in 0.1% steps limited by SDM.

Selection
Keyboard entry and variation of rotary control

Localiser Presets
0, 4.6, 9.3 and 15.5% DDM



Glideslope Presets
0, 4.5, 9.1 and 17.5% DDM

Accuracy of DDM
At 0 DDM typically 0.003 DDM (0.1% depth)

Tone Frequencies
90 Hz and 150 Hz (either tone can be suppressed)

Additional Modulation
1020 Hz ident signal available on 0 DDM on ILS from an internal modulation source.

VOR MODE
9.96 kHz Sub-Carrier Range
0-99.0% in 0.1% steps

Modulation
FM by a 30 Hz tone with 480 Hz deviation

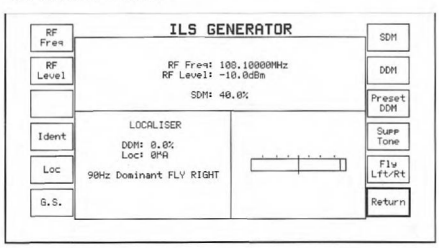
30 Hz Tone Range
0-99% in 0.1% steps

Bearing Control
Relative phase of the 30 Hz tone and sub-carrier modulation adjustable from 0 to 360° in 0.1° steps by entering VOR bearing. Bearing can be entered as TO or FROM the beacon.

Automatic VOR Test
Bearing automatically increments in 0.1° steps

Bearing Accuracy
0.5°

Additional Modulation
Ident signal (1020 Hz). Available on 0° bearing from an internal source.



SELCAL MODE
Provides amplitude modulation with SELCAL tones

Data Entry
By table selection of 2 pairs of characters labelled 'A' to 'S'.

Timing
1 s tone duration, 250 ms gap

MARKER BEACON MODE
Provides default modulation of 95% AM depth on a 75 MHz carrier at the rate of 400 Hz (outer beacon), 1.3 kHz (middle beacon) or 3 kHz (inner beacon). AM depth, carrier frequency and modulation frequencies can be changed from default values.

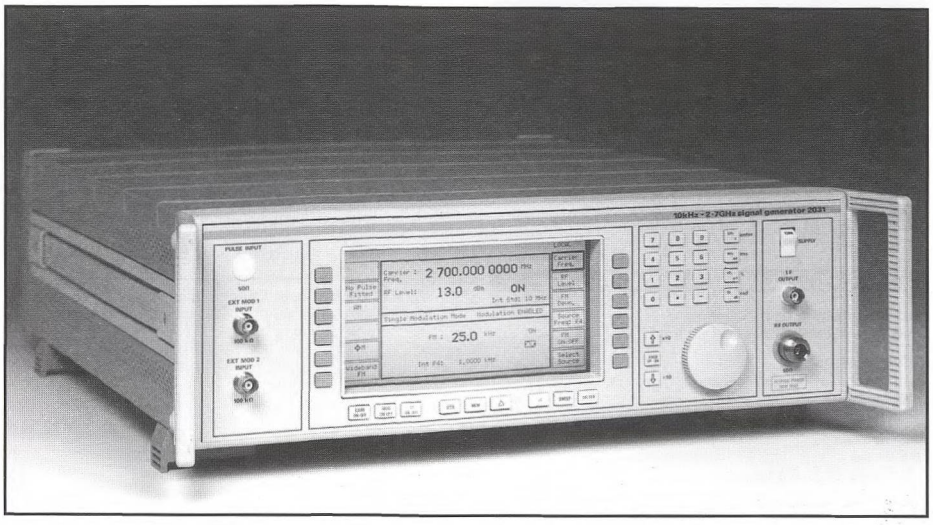
Versions and Accessories

See 2945A for general specification, ordering numbers, options and accessories

http://www.ifrinternational.com

2030 series
DME Avionics Option 10

To test the receiver stage of a DME transponder to the correct Gaussian shaped RF spectrum

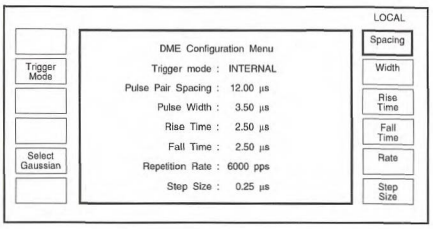


- Generates DME Gaussian shaped double pulses
- Variable pulse parameters
- Gaussian pulse spectrum
- Sync and Video outputs
- External trigger input
- Simple user interface with large screen
- GPIB programmable
- VOR/ILS/Marker Beacons with option 6

DME (Distance Measuring Equipment) provides aircraft with accurate and continuous information of their slant range distance from a ground reference point. Option 10 on the 2030 series signal generators produce the necessary signals required to test DME transponders. The option consists of two parts - an internal pulse generator to produce double pulses, and a linear RF modulator which produces the required Gaussian shaping with 90% of the transmitted energy within a bandwidth of 0.5 MHz in accordance with EUROCAE ED57. Front and rear panel connectors provide External Trigger input and Synchronization and Video outputs.

Simple Interface

Major parameters can be adjusted by keyboard entry of data, using the UP/DOWN keys or the rotary control. The use of a large screen dot matrix display ensures clear and unambiguous readout of the avionics and DME parameters.



DME Pulse Generator

This provides Gaussian shaped double pulses with variable control of pulse width, rise and fall times, pulse pair spacing and pulse repetition rate thus giving complete flexibility when defining the pulse profile. Continuous internally or externally triggered modes of operation are available with all parameters adjustable in both cases.

DME Pulse Modulator

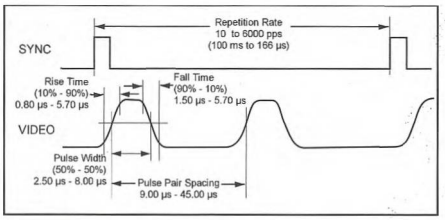
The Gaussian shaped double pulses from the generator can be used to modulate an RF carrier over the DME transmitter range of 960 MHz to 1215 MHz. Unlike a standard pulse modulator where the carrier is enabled or disabled by the modulating signal, the DME modulator is able to control the level of the RF signal at any particular time and thus produces a constrained spectrum corresponding to various standards including EUROCAE ED57 for DME. The Gaussian shaped pulses are identical in amplitude and shape with level accuracy of ±0.5 dB over the range -110 dBm to +10 dBm.

Memory

All the instrument configuration settings can be stored within non-volatile memory locations. These memories can be triggered via an external input or manually from the front panel in order that a test sequence may be quickly recalled.

Output Control

There are two additional outputs provided, SYNC and VIDEO. The SYNC output is available either with internally generated pulses or external trigger. The VIDEO output is the same Gaussian shaped signal that is applied to the RF modulator.



GPIB Programmable

All functions can be controlled over the interface bus and are GPIB IEEE 488.2 compatible.

Option 6 - Avionics

DME Option 10 is a natural complement to existing Avionics option 06 which includes VOR, ILS, Marker Beacons, ADF and SELCAL.

The Avionics option offers a complete test solution for the maintenance of avionics radio receivers by providing modes of operations suitable for testing ILS and VOR systems. In addition, it provides efficient testing of marker beacons, SELCAL receivers and ADF (Automatic Direction Finders).

In conjunction with the Avionics option, the 2030 series offers a simple solution which is particularly well suited for testing

Option 10

the complete avionics system - surveillance, alarm monitors and receivers. Direct digital synthesis techniques ensure excellent precision and stability.

Specification

Specifications remain as standard 2030 series with the following additions.

RF Output

Frequency Range
960 MHz to 1215 MHz

Level Range
-110 dBm to +10 dBm

Absolute Level Accuracy
Standard level error ±0.5 dB

Pulse Pair level Accuracy
±0.5 dB

ON-OFF Ratio
>80 dB

Video Output (Rear Panel BNC)

Pulse Characteristics
Double pulses, Gaussian shaped

Pulse Width
2.50 µs to 8.00 µs, resolution 50 ns

Rise Time
0.80 µs to 5.75 µs, resolution 50 ns

Fall Time
1.50 µs to 5.75 µs, resolution 50 ns

Pulse Pair Spacing
9.00 µs to 45.00 µs, resolution 50 ns

Repetition Rate
10 pp/s to 6000 pp/s

Level
Pseudo TTL (Typically 0 to 4.5 V, 0 to 2.5 V into 50 Ω

Sync Output (Rear Panel BNC)

Pulse Width
Typically 400 ns

Level
TTL (Typically 0 to 4.5 V, 0 to 2.5 V into 50 Ω)

Rise/Fall Time
Typically 5 ns

External Trigger ('Pulse Input')

Characteristics
Rising-edge, TTL level into 50 Ω
Min. pulse width 2 ns

Trigger to SYNC Delay
Typically 60 ns

Jitter
Typically 25 ns

Versions and Accessories

When ordering please quote the full ordering number information.

Ordering numbers	*Versions*
2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
Option 001	Second internal modulation oscillator
Option 006	Avionics, requires option 001, cannot use with 003
Option 010	DME requires option 001 & 006, cannot be used with option 005
	Supplied with
	AC Power Lead
	Operating Manual
	Options
Option 002	Pulse Modulation
Option 003	19 dBm output (2030 only)
Option 008	RF Profiles and Complex Sweep
Option 009	Internal Pulse Generator cannot be used with option 005
Option 112	Ext. mod 2 input 600 Ω

Please note that Option 5 is not available with DME. DME is not available on 2040 or 2050 series signal generators.

2030 series
ILS Monitor Software

Sets up 2030 repeatably whilst displaying on-line ILS maintenance schedule and providing results history



- Written in Microsoft Visual Basic
- Uses DDEs to communicate between Microsoft applications
- Displays the relevant part of the Microsoft Word Document as tests are being executed
- Sets up the 2030 repeatably
- Tabulates the results in Microsoft Word™, Excel™ or ASCII format
- Editor allows customization of:-
  - The number and sizes of rows and columns of test boxes
  - Row and column headings
  - The test run order
  - The results table column order
  - The GPIB commands sent to the IFR 2030
  - Runway database
- Results history available on-line

IFR Systems Group have written software which controls GPIB instruments and at the same time displays relevant paragraphs from a Microsoft Word maintenance schedule.

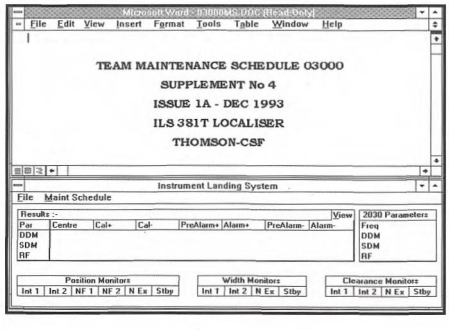
One implementation of this software is used to control the IFR 2030 Avionics Signal Generator to help test ILS monitors at CAA-controlled airports. Simultaneously, the software displays sections from the CAA's maintenance schedule document. The ILS software runs under Windows on a PC and controls the 2030 via a GPIB interface which can be a National Instruments PCIIA card for standard PCs or a PCMCIA plug-in card for portables.

The software presents the user with two windows: the top one displays the maintenance schedule for the ILS monitor equipment (a Microsoft Word document) and the bottom one provides the monitor test control panel. Each button on the test control panel is linked to a paragraph in the maintenance schedule. The software displays the relevant paragraph from the maintenance schedule while it performs each test. The user can refer to the paragraph for any supplementary information.

When a test is executed, the ILS software programs the 2030 to give the correct Frequency, DDM, SDM and RF levels. It also prompts the user to input readings obtained from the monitor under test. The results of each test are appended to a results file. This file can be in ASCII, Microsoft Word table format or an Excel spreadsheet and can be viewed from within the ILS software. The user can search the file for the history of results for a particular runway. The ILS software also provides an editor which allows the user to customize the control panel and configuration data.

APPLICATIONS

- ILS Monitor Testing
- Control of 2030 in conjunction with a maintenance schedule
- Control of GPIB instruments



Specification

Minimum Recommended PC Requirements
486 machine with 8 Mbyte of memory, 40 MHz clock, VGA screen resolution and running under Windows 3.1

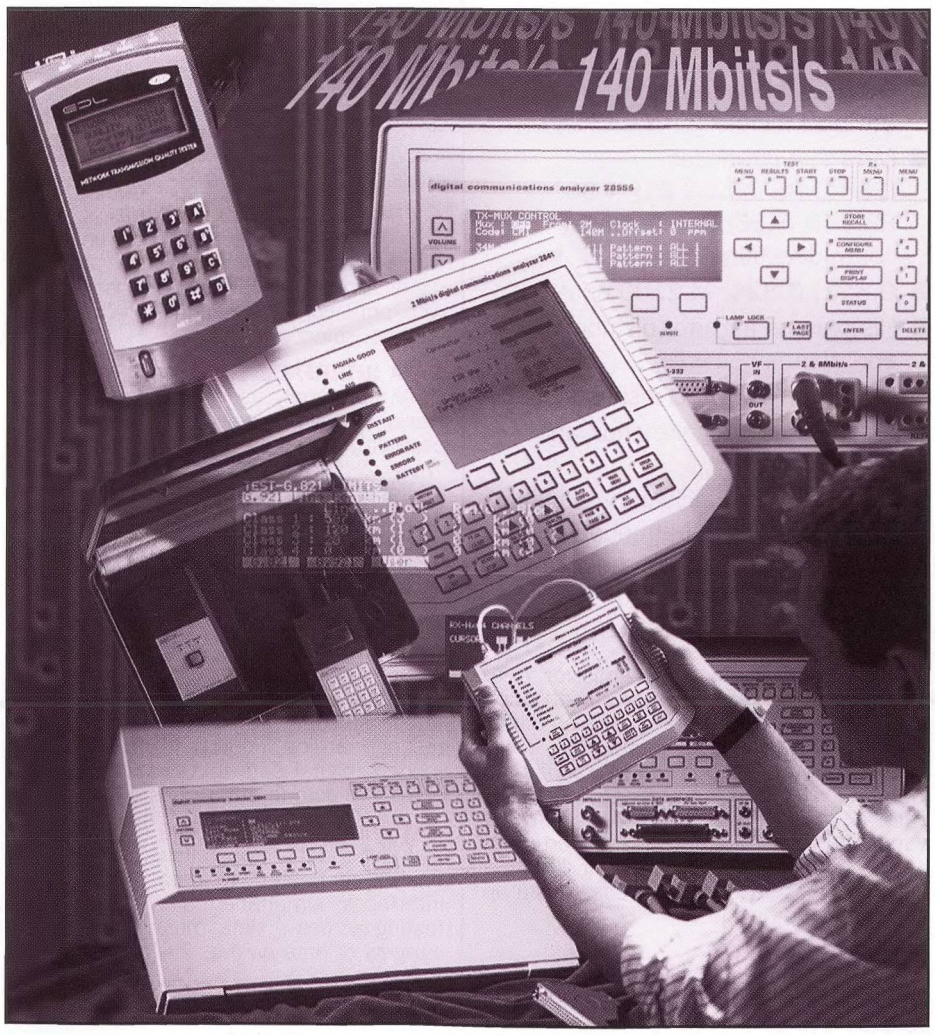
Microsoft Word Version
Word for Windows version 2.0 or 6.0

Microsoft Excel Version
Excel version 5.0

GPIB Interface
National Instruments PCIIA or PCMCIA interface

Telecommunications

The IFR range of telecommunications testers covers error performance and network equipment measurements from data rates to 140 Mbit/s in both hand-held and desktop instruments. Measurements are extended for remote unattended monitoring with PC based software, and for centralized remote network monitoring using hierarchical and multi-circuit scanning. Circuit and cable parameter measurements for service qualification, including PSTN, ISDN and xDSL, are provided in a range of hand-held units. Automated measurements ensure fast, easy and consistent results, enabling efficient new service introduction.



TELECOMMUNICATIONS

2841/40A 4.2
Digital Communications Analyzer
2 Mbit/s Transmission Analyzer

2850B/BS & 2851/S 4.8
Digital Analyzers

2852/S & 2853/S 4.18
Digital Analyzers

2854S/2855S 4.22
Digital Analyzers

285X 4.25
Remote Software

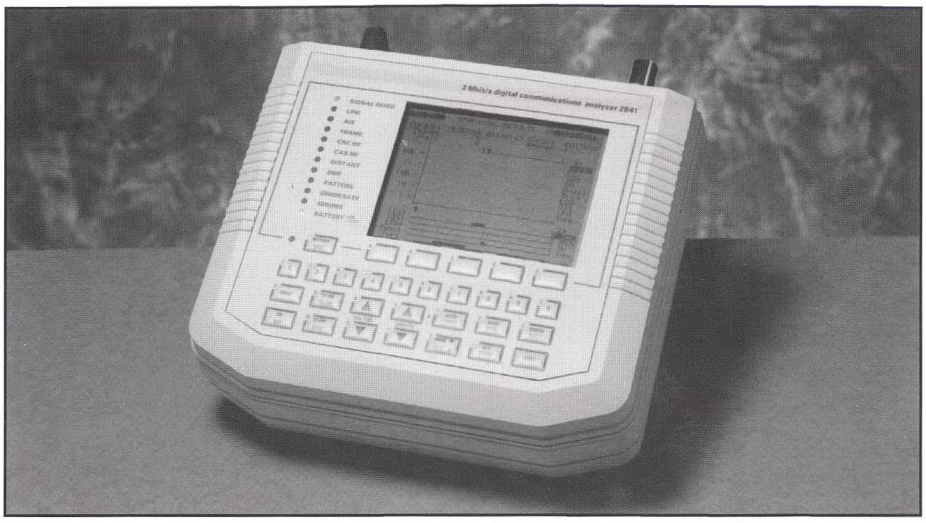
MIAMI 4.27
Remote Network Monitoring

Netlink 423/424 4.29
Network Transmission Quality Testers

Netlink 430 4.31
Digital Line Test Set

Digital Communications Analyzer 2841
2 Mbit/s Transmission Analyzer 2840A

Hand-held, high capability testing for 2 Mbit/s and data line systems and equipment



- Handheld, battery operated, data and PCM rate tester
- Framed and unframed operation at 2 Mbit/s including n x 64 kbit/s
- Data test interfaces: (2841) RS-232, X.21, V.35, RS-449 (V.36), codirectional, contradirectional
- G.821, G.826, M.2100 analysis
- Histograms for error distribution and alarms
- Print from up to 10 results stores
- Analog channel generation and measurement
- Measurements include propagation delay, output level attenuation, frequency deviation, frequency and level measurement, and CAS

GENERAL

The 2840A 2 Mbit/s Transmission Analyzer is a hand-held analyzer for installation and maintenance measurements on digital 2 Mbit/s lines and equipment. The 2841 Digital Communications Analyzer adds data interface testing to this 2 Mbit/s capability. The comprehensive measurement capability is contained in a compact, battery operated package, combined with a large graphics based LCD for ease of set up and results retrieval.

FRAMING SYSTEMS

2 Mbit/s framing systems with 30 and 31 channels, with and without CRC4, are generated and received to enable a range of tests on framing, alarms and signaling.

56 kbit/s and 64 kbit/s Channel Testing

Individual channels can be tested at 64 or 56 kbit/s, assisting in testing and fault location within digital data networks and cross connect switches.

n x 64 kbit/s Channel Testing

n × 64 kbit/s channels can be tested where they are carried within 2 Mbit/s digital signals. Full flexibility is provided with both contiguous and non-contiguous channel selection.

DATA INTERFACE TESTING (2841)

All commonly used data interfaces are available to give a comprehensive data test capability together with 2 Mbit/s testing. Thus 2 Mbit/s and data circuits and equipment can be tested in a hand-held, fully integrated test instrument. Data test interfaces provided are RS-232, X.21, V.35, RS-449 (V.36), codirectional and contradirectional.

Modes

Both synchronous and asynchronous modes as possible with a wide range of standard and user programmable data rates, so that traditional data interface testing can be addressed together with modern digital data services at 64 kbit/s, n x 64 kbit/s and other rates.

DATA MULTIPLEX TESTING (2841)

Independent transmitter and receiver enable connection to data and 2 Mbit/s interfaces simultaneously. This allows testing across a data multiplex to ensure integrity of data card to 2 Mbit/s path.

ERROR AND ALARM MEASUREMENTS

The 2840A and 2841 can detect simultaneously, Code, Framing, Pattern and CRC Errors. Further measurements are then made on a selected error type, including G.821, G.826, M.2100 and error distribution.

Error Distribution and Alarm Histograms

The error results and alarms are displayed in the form of a histogram with accumulation up to 7 days, and resolution up to 1 second. This provides a comprehensive record of long term measurements to assist in fault localization. A permanent record of these results can be obtained by printing a text equivalent or a facsimile of the histograms subsequent to the test.

Full Results Printing - Print from RAM

The instrument can be programmed to Autoprint selected parameters from the full set, on event or on timed intervals. These include errors, performance parameters, and alarms.

Alternatively up to 4000 print events per results store can be stored in memory (Print from RAM) for subsequent printing. This also removes the necessity of real time printing where subsequent analysis via a PC may prove this to be unnecessary.

G.821, G.826 and M.2100 Measurements

The usual ITU-T recommendation of G.821 for 64 kbit/s error performance measurement is applied. In addition the newer Recommendation G.826 extends measurements to 2 Mbit/s, while M.2100 adds other events such as alarms which contribute towards the G.821 and G.826 measurements.

MULTIPLE TEST STORAGE

Up to 8 full sets of results can be stored for later on screen analysis or printing. Again this can avoid real time printing.

RESIDUAL BIT ERROR RATE

Assessment of background error performance is useful in systems subject to degraded error performance, such as radio or satellite systems. RBER is long term mean error rate ignoring Severely Errored Seconds.

HIGH TOLERANCE TO BURST ERRORS

2840A and 2841 are particularly suited to measurements on systems subject to high error rates and burst errors, with the ability to ride through rapid fades as experienced on digital radio systems.

PROGRAMMABLE ERROR GATING

In addition to long term mean error ratio, a current error ratio is available with fixed gating periods of 1, 2, 5 or 10 seconds. Flexibility of application is thus assured, for example fade margin adjustment on digital radios.

IN-SERVICE AND OUT-OF-SERVICE MEASUREMENTS

The instrument is equally suited to installation and maintenance measurements. Interfaces are provided to enable the receiver to be connected to a number of network points at varying impedances and sensitivities. Automatic line equalization (automatic line build out, ALBO) is also provided to enable connection to signals attenuated by long sections of line.

IN-SERVICE CHANNEL ACCESS

Access is provided to receive timeslots for both analog and digital signals.

Voice Channels

Voice channels within a 2048 kbit/s signal can be monitored in-service and routed to an internal loudspeaker or a headphone socket for a first level check of analog level and quality.

Data Channels

64 kbit/s data channels can be routed to a V.11 interface for external measurement, for example connection of common channel signaling to a protocol analyzer.

Drop and Insert

Selected 64 or n x 64 kbit/s channels within an in-service 2048 kbit/s signal can be tested with minimum disruption of service to other in-traffic channels.

NETWORK EQUIPMENT TESTING

Comprehensive facilities enable the range of applications to be extended beyond digital link error performance testing to checking the functionality of various types of network equipment such as multiplexes and cross connect switches.

Multiplex Equipment

2840A and 2841 are able to simulate and detect alarm conditions associated with the various 2048 kbit/s frame structures, including full frame alignment strategy testing to G.706.

In addition the input level margin of the multiplex can be checked using the output level attenuation capability whilst frequency margin can be checked using the output frequency offset capability.

Cross Connect Switches

Cross Connect switches can be checked for switch path integrity using the 64 kbit/s channel test capability (or n × 64 kbit/s for new generation switches).

ANALOG CHANNEL MEASUREMENTS

Analog measurements are made on selected 2 Mbit/s channels including frequency response and linearity. The transmitter can generate sine waves across the full audio band with frequency and level resolution of 1 Hz and 0.1 dB respectively. Measurements are made of peak code, RMS level and frequency.

PROPAGATION DELAY MEASUREMENT

Delay measurements can be made on 2048 kbit/s digital circuits to a high level of accuracy. This is particularly important on satellite links where high values of delay are experienced and need to be measured, or for characterizing networks to assist in finding unwanted loopbacks.

Where data circuits are extended from 2048 kbit/s bearers out to subscribers, the overall network to subscriber loop delay can be measured at 64 or n x 64 kbit/s from within the 2048 kbit/s signal.

CHANNEL ASSOCIATED SIGNALING

The 4 bit word associated with a selected channel can be controlled on the transmitter. On the receiver all 30 channels can be monitored simultaneously. In addition for a selected channel the last 16 signaling word changes can be stored for later analysis.

DIGITAL SIGNAL LEVEL AND FREQUENCY MEASUREMENT

The frequency and amplitude of the incoming digital signal are displayed to enable early warning of degradation of the signal, or to check the loss of in-station cabling to ensure it conforms to limits.

BIT SLIP DETECTION

Single, uncontrolled bit slips can be detected within framed or unframed test patterns. This allows inter and intra network clocking problems to be isolated.

OCTET SLIP DETECTION

Octet slips can be detected at the 64 kbit/s channel level of a 2048 kbit/s signal, which allows the effects of frame slips introduced by network buffers to be assessed.

EASE OF USE

The instrument is set up quickly and easily using graphics based menu selection on a large LCD, with key pad and soft keys. Commonly used instrument configurations can be stored in memory further ensuring ease of use.

RS-232 REMOTE OPERATION

Remote unattended operation can be accomplished via an RS-232 port, which can also be used for local printing. Keyboard functions can be duplicated via RS-232 commands enabling complete remote configuration and reporting of results.

POWER OPTIONS

Internal batteries give five hours operation when both transmitter and receiver are being used. Battery life is extended in monitoring applications where the transmitter can be switched off. Fast charge circuits coupled with an AC power adapter enable recharge in only three hours.

For extended operation the AC power adapter can be used with the batteries as standby in the event of power failure.

Specification

2 Mbit/s Transmit Interface

FRAMING AND BIT RATES
Signals can be transmitted unframed or with the frame structure indicated.
2048 kbit/s - G.704
2048 kbit/s - G.704 no multiframe
2048 kbit/s - G.704 with CRC
2048 kbit/s - G.704 with CRC, no multiframe
2048 kbit/s - 32 frame multiframe (Option 02, French)

CLOCK SOURCE
Internal, external or derived from the received signal

Internal
Accuracy
±1 ppm from 0 to 55° C
±1 ppm / year
Frequency Offset
Small - Steps of ±5 and ±50 ppm to ±150 ppm
Large - Steps of ±2 and ±10 kbit/s to ±30 kbit/s

External
TTL
Sine wave
G.703 Figure 21

LINE CODES
AMI (50% duty cycle)
HDB3

TEST PATTERNS

Insertion
Single Channel
Selected 56 kbit/s or 64 kbit/s channel of framed signal
Channel Broadcast
All 56 kbit/s or 64 kbit/s channels of framed signal
n × 64 kbit/s Channel
Selected n × 56 kbit/s or n × 64 kbit/s channels of framed signal
Channel distribution can be contiguous or non-contiguous

Unframed
Unframed signal

PRBS
2^6-1, 2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23} -1

Sense
True or Inverted

Mode (framed only)

8 bit	PRBS data fills all 8 bits in an octet, ie 64 kbit/s per channel
7 + 1 bit	First 7 bits are PRBS and last bit is a 1, ie 56 kbit/s per channel

32 bit word
User programmable sequence of 32 bits
(16 bit word for Option 02, French)

Variable Sine Wave
(option 04 on 2840A)

Frequency Range	1 to 3999 Hz
Resolution	1 Hz
Level	+3 to -55 dBm0
Resolution	0.1 dB maximum.
Coding	A-Law

FILL PATTERNS
For 64 or n × 64 kbit/s operation the following patterns are used to fill all other channels

PRBS
2^{15}-1

8 bit word
User programmable sequence of 8 bits

DROP & INSERT
For framed operation the received signal is looped to the transmitter

Note that for CRC frame structures the CRC is recalculated before transmission

56 kbit/s or 64 kbit/s
A selected 56 kbit/s or 64 kbit/s channel is replaced by a test pattern.
n × 56 kbit/s or n × 64 kbit/s
A selected n × 56 kbit/s or n × 64 kbit/s channel is replaced by a test pattern. The channel selection can be contiguous or non-contiguous.

REGENERATOR LINE CURRENT LOOPTHROUGH
Line current on balanced lines can be looped through from receiver to transmitter of the instrument.

ERROR INJECTION

Target
Test Pattern Only, Framing Only, CRC Only, All

Error Type
Binary
Bits are inverted before coding.
Code
Code errors are injected by changing ±1 to 0 and 0 to ±1 where the polarity of the inserted mark is the same as the polarity of the last mark transmitted.

Injection Mode
Singly
By keypress
Fixed rate
Rate M x 10^{-N}, where M is 1 to 9 and N is 2 to 7

MAIN OUTPUTS

Balanced

Impedance	120 Ω
Peak Voltage	3 V ±0.3 V
Space Voltage	0 V ±0.3 V

Unbalanced

Impedance	75 Ω
Peak Voltage	2.37 V ± 0.237 V
Space Voltage	0V ± 0.237 V

Output Level Attenuation

Attenuation	6 and 10 dB
Accuracy	±0.5 dB

SIGNALING BIT CONTROL
For framing systems with Channel Associated Signaling capability the signaling bits can be changed.

Selected Channel	Set 4 bit word.
All Other Channels	Set 4 bit word.

C-BIT FRAMING
(Option 02, French)
Generation of C-Bit Frame for French TRANSMIC-2G System.
Control of C-Bit Frame message bits.

FRAMING TESTS
The following tests are available, depending on the framing system selected:

Frame alignment strategy
Set x in 4 consecutive frame words in error, single shot or continuously
Set x in 3 consecutive frame bits in error, single shot or continuously
Set x in 4 consecutive CRC multiframe words in error, single shot or continuously
Set x in 1000 CRC blocks in error continuously (default value is 915).

Signaling multiframe alignment strategy
Set x in 2 consecutive multiframe words in error, single shot or continuously

Time Slot 16 (Signaling)
Set to AIS (All 1s).
Set to All 0s.

ACCESS TO STRUCTURE BITS
Change unassigned, distant, distant multiframe and alarm bits.

2 Mbit/s Receive Interface

FRAMING AND BIT RATES
Signals can be received unframed or with the frame structure indicated.
As Transmitter.

Frequency Tolerance
2048 kbit/s ±50 ppm

LINE CODES
As Transmitter.
Indication of HDB3 signal present

AUTOCONFIGURE
The receiver can be set to autoconfigure to:
2 Mbit/s framed test pattern or unframed test pattern.
64 kbit/s channel test pattern (channel search or known channel).
n × 64 kbit/s channel test pattern (known channel).

INPUT MODES AND SENSITIVITY

Modes

Terminated	Terminates the line.
Bridging	Taps onto a terminated line or unprotected monitor point.
Monitoring	Connects to a protected monitor point.

BALANCED

	Terminated	*Bridging*	*Monitor*
Impedance	120 Ω	>1000 Ω	120 Ω (3000 Ω)
Normal	3 V +2 to -6 dB	3 V +2 to -6 dB	3 V -15 to -36 dB
ALBO	3 V +2 to -30 dB		

UNBALANCED

	Terminated	*Bridging*	*Monitor*
Impedance	75 Ω	>1000 Ω	75 Ω (2400 Ω)
Normal	2.37 V +2 to -6 dB	2.37 V +2 to -6 dB	2.37 V -15 to -36 dB
ALBO	2.37 V +2 to -30 dB		

TEST PATTERNS

Source
Selected single, contiguous, non-contiguous channels of framed signal.
Unframed signal.

PRBS
2^6-1, 2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23}-1

Sense
True or Inverted

Mode (framed only)
8 bit PRBS data fills all 8 bits in an octet, ie 64 kbit/s per channel
7 + 1 bit First 7 bits are PRBS and last bit is a 1, ie 56 kbit/s per channel

Repetitive Word
Any word which repeats over a 32 bit sequence. (16 bit sequence for Option 02, French)

PATTERN SYNCHRONIZATION

Loss Criterion
PRBS error rate greater than 1 in 5 for each of 10 consecutive desciseconds.

CHANNEL EXTRACT
For framed single channel operation a selected 64 kbit/s channel is extracted from the received signal:
Channel selection by increment and decrement keys
Voice frequency signals are routed to the internal loudspeaker, audio output socket, or headphone socket.
64 kbit/s data signals are output via a V.11 socket.

AUDIO CHANNEL MEASUREMENT
(option 04 on 2840A)
Frequency, Level, Peak code

Frequency	
Range	1 to 3999 Hz
Resolution	1 Hz
RMS Level	
Range	+6 to -60 dBm0
Resolution	0.1 dB maximum
Peak code	Positive and negative values are displayed.
Decoding	A-Law

VOICE FREQUENCY OUTPUT
(opt 04 on 2840A)

Range	0.3 to 3400 Hz
Decoding	A-Law
Impedance	600 Ω balanced

STATUS INDICATORS
LEDs indicate frame structure alarm conditions

Display modes
CURRENT ALARMS
Red LEDs illuminate to indicate alarm presence and extinguish when the condition clears. LEDs respond to alarm conditions with a resolution of one second.
HISTORY
When ALARM HISTORY is pressed the CURRENT ALARM LEDs indicate alarms which have illuminated since the last time the history reset button was pressed. RESET resets the ALARM HISTORY.
SIGNAL GOOD
Green LED illuminates to show absence of combination of LINE, AIS, FRAME, MF, CRC and PATTERN alarms.
LINE
Red LED ON indicates signal loss.
AIS
Red LED ON indicates signal is all 1's. All 1's is defined as signal with less than three zeros in two frame periods.
FRAME
Red LED ON indicates a loss of frame alignment.
CRC MF
Red LED ON indicates loss of CRC multiframe alignment.
CAS MF
Red LED ON indicates loss of signaling multiframe alignment.
DISTANT
Red LED ON indicates DISTANT alarm.
DMR
Red LED ON indicates Distant Multiframe Alarm.
PATTERN
Red LED ON indicates loss of pattern synchronization.
ERROR RATE
Red LED ON indicates that the error rate of the major error type is greater than a threshold set by the user. Threshold is 1 x 10^{-N} where N is 2 to 9.
ERRORS
Red LED ON indicates major errors detected.

Additional Display Indicators
(Auxiliary Alarms Page)

HDB3 SIGNAL	Present or Not Present
TS16 AIS	Present or Not Present

UNASSIGNED FRAMING BITS
The state of the unassigned bits is displayed.

Data Test Interfaces (2841)

X.21, RS-449 (V.36), V.35, RS-232, Co/Contradirectional and TTL

X.21, RS-449 (V.36), V.35, RS-232 and Co/Contradirectional
X.21 (V.11), RS-449 (V.11), V.35, RS-232 and Co/Contradirectional are presented to a common connector. DTE/DCE interfaces are provided by adapter cables which provide the appropriate connector and electrical interface. The DTE/DCE switching is internal.

Universal Connector
68 way type PCR female.

Adapter Cable Connectors
X.21 - 15 way D-Type, ISO 4903 female.
RS-449 (V.36) - 37 way D-Type, ISO 4902 female.
V.35 - 34 way MRAC, ISO 2593 female.
RS-232 - 25 way D-Type, ISO 2110 female.
Co/Contradirectional - 15 way D-Type, ISO 4903 female.
Codirectional - CF x 2 female.

Cable recognition
Automatic recognition of the cable type plugged in.

TTL

Code	NRZ
Connector	Miscellaneous 25 way D-Type

CONTROL LINES

X.21		
DTE	***DCE***	
I (Indication)	C (Control)	Displayed as 1, 0.
C (Control)	I (Indication)	Settable to 1, 0
RS-449 (V.36)		
DTE	***DCE***	
CS (Clear to send)	RS (Request to send)	Displayed as 1, 0
RS (Request to send)	CS (Clear to send)	Settable to 1, 0
DTR (Data terminal ready)	DSR (Data set ready)	Settable to 1, 0
DSR (Data set ready)	DTR (Data terminal ready)	Displayed as 1, 0.
	DCD (Data Carrier Detect)	Settable to 1, 0.
DCD (Data Carrier Detect)		Displayed as 1, 0.
V.35		
DTE	***DCE***	
CS (Clear to send)	RS (Request to send)	Displayed as 1, 0.

RS (Request to send)	CS (Clear to send)	Settable to 1, 0
DTR (Data terminal ready)	DSR (Data set ready)	Settable to 1, 0.
DSR (Data set ready)	DTR (Data terminal ready)	Displayed as 1, 0.
	DCD (Data Carrier Detect)	Settable to 1, 0.
DCD (Data Carrier Detect)		Displayed as 1, 0.

RS-232

DTE	***DCE***	
CTS (Clear to send)	RTS (Request to send)	Displayed as 1, 0.
DSR (Data set ready)	DTR (Data terminal ready)	Displayed as 1, 0.
RLSD (Receive line signal detect)	LL (Local loop)	Displayed as 1, 0.
TM (Test mode)	RL (Remote loop)	Displayed as 1, 0.
RTS (Request to send)	CTS (Clear to send)	Settable to 1, 0
DTR (Data terminal ready)	DSR (Data set ready)	Settable to 1, 0
	RLSD (Receive line signal detect)	Settable to 1, 0.
	TM (Test mode)	Settable to 1, 0.
LL (Local loop)		Set to 1 for V.54 loop 3 selected Set to 0 for V.54 loop 3 deselected
RL (Remote loop)		Set to 1 for V.54 loop 2 selected Set to 0 for V.54 loop 2 deselected

MODE
Synchronous
X.21, RS-449 (V.36), V.35, RS-232, TTL
Asynchronous
RS-449 (V.36), RS-232

IMPLEMENTATION

X.21, RS-449 (V.36), V.35, RS-232
DTE, DCE.

Electrical
X.21 - V.11 (balanced)
RS-449 (V.36) - V.11 (balanced)
V.35 - V.35 (data and timing)
V.28 (control lines)
RS-232 - V.28

Input Impedance
X.21, RS-449 (V.36)
V.11 Terminated, 120 Ω
V.11 Unterminated, >3000 Ω
V.35, 100 Ω

Data Rate
X.21, RS-449 (V.11) (Sync)
50 bit/s to 2.5 Mbit/s
V.35 (Sync)
50 bit/s to 2.5 Mbit/s.
RS-232 (Sync)
50 bits/ to 80 kbit/s
RS-232, RS-449 (Async)
50 bit/s to 38.4 kbit/s
TTL
50 bit/s to 2.5 Mbit/s

Timing
Synchronous
Transmit - DTE
From DCE
DCE input timing.
Internal - 1 bit/s steps.
Receiver - Receiver clock (assumes receiver is data interface, not 2048 kbit/s, and same rate as transmitter)
External - TTL input.

Transmit - DCE
Internal - 1 bit/s steps.
Receiver - Receiver clock
External - TTL input.

Receive - DTE
From DCE
DCE input timing
External - TTL input.
Signal - Extracted from receive signal

Receive - DCE
From Transmitter
Transmit clock (assumes transmitter is data interface, not 2048 kbit/s, and same rate as receiver)
External - TTL input.
Signal - Extracted from receive signal.
DTE - From DTE

Transmit - TTL
Internal - 1 bit/s steps.
Receiver - Receiver clock (assumes receiver is TTL interface, not 2048 kbit/s, and same rate as transmitter).
External - TTL input.

Receive - TTL
External - TTL input.
Signal - Extracted from receive signal.
From Transmitter
Transmit clock.

Sense - All input and output timing signals can be inverted in polarity.

Asynchronous
Transmit
Internal
50, 75, 100, 110, 134.5, 200, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 14400, 19200, 38400 bit/s.
Receive
Receive signal.
Async coding
Data bits - 7, 8.
Stop bits - 1, 2.
Parity - Odd, even, mark, space, none.
Async character rate
Transmitter
Selectable: low medium, high, (10, 50 and 100% maximum character rate).
Receiver - Up to 1000 character/sec.

TEST PATTERNS
Sync and async

PRBS
2^6-1, 2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23}-1
Sense - True or inverted

Sync
32 bit word
User programmable sequence of 32 bits

Async

Fox message	3 messages to ITU-T Recommendation R.52.
Fox 1	International alphabet 2.
Fox 2	International alphabet 5, 96 character set
Fox 3	International alphabet 5, 64 character set.
User message	1 to 64 characters.

ERROR INJECTION
Singly, By keypress, Fixed rate, Rate 9×10^{-2} to 1×10^{-7} (sync only)

ALARMS
Line, Errors, Pattern, No transmit clock

PROPAGATION DELAY (sync only)
Measured using a PRBS test pattern

Range	Up to 2 seconds
Resolution	1 bit period
Update rate	Typically 2 seconds. Can be longer at low data rates.

TIMING MEASUREMENT (DTE only)
Time intervals between changes of control lines

X.21	C and I
RS-449 (V.36)	RS and CS
V.35	RTS and CTS
Range	0 to 10s
Resolution	1 ms

BIT RATE MEASUREMENT
(Transmitter and Receiver)
Measurement of transmitter bit rate confirms DCE clock rate when DTE, or external clock rate.

Sync
The bit rate is measured every second displayed to nearest 1 Hz.

Async
The character rate is measured every second displayed to nearest 1 Hz.

Accuracy
±1 ppm.

Measurements

ERROR TYPES
Line Code (Bipolar Violations), Frame Bit, Frame Word, Pattern, CRC
(Pattern errors only for data test interfaces)

Main parameters
Made if the framing system and Test Mode allow.
Number of Errors.
Long Term Mean Error Ratio (LTMER).
Total Test Time.
Number of Loss of Signal (LOS) seconds.
Number of AIS seconds.
Number of No Frame Alignment seconds.
Number of No Pattern Sync seconds.
Number of No CRC Sync seconds.

OCTET SLIPS
Octet Slips are detected for single channel pattern measurements:
Number of positive and negative slips.
Time of last slip.
Time between last two slips.

BIT SLIPS
Single bit slips are detected within a 64 or n × 64 kbit/s test pattern within a 2 Mbit/s signal, an unframed 2 Mbit/s test pattern, or an unframed test pattern via one of the data test interfaces. Positive and negative bit slips are counted.
(Bit Slips and Octet Slips are mutually exclusive).

ADDITIONAL PARAMETERS

Current Error Ratio
Gating - 1, 2, 5 or 10 seconds.

Residual Bit Error ratio
(Background Error Rate)
Long Term Mean Error Ratio excluding Severely Errored Seconds.

G.821 ERROR PERFORMANCE MEASUREMENTS
64 kbit/s channel availability measurements are made to ITU-T Recommendation G.821, while for higher rates a channel performance to G.821 Annex D is applied.

Parameters
% Available Time.
Number of Errored Seconds.
% Error Free Seconds.
Number of Severely Errored Seconds (SES).
% Non SES.
Number of Degraded Minutes (DM).
% Non DM.
Number of Breaks.
The inverse % parameters are also available.
User programmable thresholds for %ES (%Errored Seconds), %SES (%Severely Errored Seconds), %DM (%Degraded Minutes) and %US (%Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	***Limit***	***Message***
%ES	XX.XXXX	%ES > limit
%SES	XX.XXXX	%SES > limit
%DM	XX.XXXX	%DM > limit
%US	XX.XXXX	%US > limit

X=1 to 9

M.2100
Implementation of Interpretation for the Receive and Send Direction columns in Table B2/M.2100 for 2 Mbit/s signal (non CRC4) and 2 Mbit/s (CRC4).
User programmable thresholds S1 and S2 for ES (Errored Seconds), SES (Severely Errored Seconds) and US (Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	***S1 Limit***	***S2 Limit***	***Message***
ES	XXXX	XXXX	ES >S1 limit or ES > S2 limit
SES	XXXX	XXXX	SES > S1 limit or SES > S2 limit
US	XXXX	XXXX	US > S1 limit or US > S2 limit

X=1 to 9

G.826

Parameters
Number of Errored Blocks (EB).
Number of Errored Seconds (ES).
Number of Severely Errored Seconds (SES).
Number of Background Block Errors (BBE).
Errored Second Ratio (ESR).
Severely Errored Seconds Ratio (SESR).
Background Block Error Ratio (BBER).

	Codirectional	Contradirectional
Line signal coding and level	To ITU-T Rec. G.703	To ITU-T Rec. G.703
Bit Rate	64 kbit/s	64 kbit/s
Format	Unstructured	Unstructured
Transmit Timing		
DTE	Receiver (from DCE) Internal External 2048 kbit/s	From DCE Internal Receiver External 2048 kbit/s
DCE	Internal (to DTE) External 2048 kbit/s	Internal (to DTE) External 2048 kbit/s
Receive Timing		
DTE	Extracted from receiver signal (from DCE)	Extracted from receiver signal
DCE	Extracted from receiver signal (from DTE)	Internal (to DTE) External 2048 kbit/s
Pinouts		
1, 9	Transmit Data	Transmit Data
3, 11	Receive Data	Receive Data
5, 13		Transmit Clock In (from DCE)
7, 15		Receive Clock In (from DCE)
4, 12		Transmit Clock Out (to DTE)
6, 14		Receive Clock Out (to DTE)
8	Earth	Earth

X.21 -DTE/DCE

Pins	From DTE (To DCE)	Circuit	Pins	To DTE (From DCE)	Circuit
2, 9	Transmit	T	4,11	Receive	R
3, 10	Control	C	6, 13	Timing	S
8	Ground		5, 12	Indication	I
			7, 14	Byte Timing	B

RS-449 (V.36) - DTE/DCE

Pins	From DTE (To DCE)	Circuit	Pins	To DTE (From DCE)	Circuit
4,22	SD Send Data	103	6,24	RD Receive Data	104
17,35	TT Tx Timing	113	8,26	RT Rx Timing	115
19	Signal Ground		5,23	ST Send Timing	114
7,25	RS (Request To Send)	105	9,27	CS (CTS)	106
12,30	DTR (Data Terminal Ready)	108/2	11,29	DSR (Data Set Ready)	107
			13, 31	DCD (Data Carrier Detect)	109

V.35 - DTE/DCE

Pins	From DTE (To DCE)	Circuit	Pins	To DTE (From DCE)	Circuit
P,S	Transmit Data	103	R,T	Receive data	104
U,W	Transmit Timing	113	V,X	Receive timing	115
B	Signal Ground		Y,AA	Transmit timing	114
C	Request to send	105	D	Clear to send	106
H	DTR (Data Terminal Ready)	108/2	E	DSR (Data Set Ready)	107
			F	DCD (Data Carrier Detect)	109

RS-232 - DTE/DCE

Pins	From DTE (To DCE)	Circuit	Pins	To DTE (From DCE)	Circuit
2	Transmit data	103	3	Receive data	104
24	Transmit timing	113	17	Receive timing	115
4	Request to send	105	15	Transmit timing	114
20	Data terminal ready	108	5	Clear to send	106
18	Local loop	141	6	Data set to ready	107
21	Remote loop	140	8	Receive line signal	109
7,1	Ground		25	Test mode	142

TTL (Miscellaneous connector)

Pins		Pins	
1	Power Feed Loopthrough A	10, 22	64 kHz clock out (V.11)
2	Power Feed Loopthrough B	11, 23	64 kHz data out (V.11)
3	Receive 2 Mbit/s or Data clock out	12, 13	Audio out (600 Ω)
4	Transmit 2 Mbit/s or Data clock out	14	Receive 2 Mbit/s or Data clock in
5	Transmit 2 Mbit/s or Data clock out	15	Transmit 2 Mbit/s or Data data in
6	Transmit external clock in	16, 17, 18	Earth
7, 19	8 kHz frame clock out (V.11)	21, 24, 25	Earth
8, 20	Octet market out (V.11)		
9	N/C		

Unavailable Seconds (US).
% Unavailable Seconds (%US).
% Available Seconds (%AS).
Number of Breaks.

User programmable thresholds for ESR (Errored Seconds Ratio), SESR (Severely Errored Second Ratio), BBER (Background Block Error Ratio) and %US (% Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	Limit	Message
ESR	X.XE-Y	ESR > limit
SESR	X.XE-Y	SESR > limit
BBER	X.XE-Y	BBER > limit
%US	X.XXXX	%US > limit

X=1 to 9, Y=2 to 8

PROPAGATION DELAY
Measured using a PRBS test pattern.

Mode
2048 kbit/s unframed.
64 kbit/s channel within 2048 kbit/s signal.
n × 64 kbit/s channel within 2048 kbit/s signal.

Range - Up to 2 seconds

Resolution - 1 µs or 1 bit whichever is the greater

Update rate - Typically 2 seconds.

STORED RESULTS

Storage Capacity
Up to 4,000 events per results store including errors and alarms stored with a time and date stamp to a resolution of 1 second.

Multiple Tests
8 full sets of results stored.

Results Retrieval
Print to external printer.
Selected results histograms.
Mark portion of histogram and print selection of errors, alarms and periodic results between marks.

Error and Alarm Distribution Histograms
Any one of the following parameters can be selected as the histogram display:

Parameters
Major Errors, Errored Seconds, Severely Errored Seconds, Degraded Minutes, Unavailability, Breaks, Loss of Signal, AIS, Loss of Frame Alignment, Loss of Pattern Synchronization

Resolution - 1 second, 1 Minute, 1 Hour, 1 Day

Accumulation time - Typically 7 days or better

Histogram page width
7 or more days with a resolution of 1 day.
30 hours with a resolution of 1 hour.
30 minutes with a resolution of 1 minute.
30 seconds with a resolution of 1 second.

The display is selectable from anywhere within the N days.

Display
The stored results are displayed as a histogram. A cursor is moved to point at any day, hour, minute or second. The number of events for the parameter selected for that interval are displayed together with the date and time.

Histogram Baseline Alarms
Alarms history is shown by histogram baselines. Totals for each alarm can be determined by displaying as the main histogram with cursor scrolling and reading of alarm totals for each interval.

Alarms
Loss of signal
AIS
Loss of Frame Alignment
Loss of Pattern Synchronization
Loss of Power (not available on the main histogram)

TEST TIMING

Start time
YYYY, MM, DD, HH, MM (year, month, day, hour, minute).
By keypress

Stop time
YYYY, MM, DD, HH, MM (year, month, day, hour, minute).
By keypress.

Duration
DD, HH, MM (days, hours, minutes)
Indefinite.

SIGNALING ANALYSIS
Channel associated signaling analysis for selected channel.

Display
Decimal and binary equivalent of current and previous 16 signaling codes.
Signaling code for all 30 channels simultaneously, with programmable IDLE and BUSY display.

C-BIT FRAMING

(Option 02, French)
Monitoring of C-Bit Frame for French TRANSMIC-2G System.
Display of C-Bit Frame message bits.

BIT RATE MEASUREMENT
The received bit rate is measured every second displayed to nearest 1 Hz.

Accuracy - ±1 ppm.

DIGITAL SIGNAL VOLTAGE MEASUREMENT
The amplitude of the incoming digital signal is measured and displayed in Volts base-to-peak and dB relative to nominal.

Range
+3 to -10 dB ±1 dB
-10 to -20 dB ±2 dB
-20 to -36 dB ±3 dB

General Characteristics

OPERATOR INTERFACE
The instrument is controlled via a keyboard containing a data entry keypad. The 24 line 42 character (plus graphics capability) LCD and keyboard are fully interactive providing menu and soft-key operation.

SET UP
Copy facility from Transmitter to Receiver and Receiver to Transmitter.

DISPLAYS
Transmit parameters
Receive parameters
Measurement results
RS-232C port parameters
Printer type selection
Measurement definition
Autoprint definition
Setup conditions (Stored Parameters)
Current status

Zoom
Selected results can be displayed in zoom mode with large character size.

AUDIBLE ALARM

Mode
When on alarm sounds on detection of:
A signal alarm, An errored second.

LOUDSPEAKER
Selected 64 kbit/s channels can be routed to the loudspeaker. There is a volume control.

SETUP CONDITIONS (STORAGE FACILITY)
A variety of information can be stored in non-volatile memory (battery backed-up).

Setup Conditions
6 sets of transmitter/receiver/test definition parameters can be selected for storage. Each set can be recalled whenever required, and can be identified with a 12 character label. In addition 13 non-alterable standard setups are available:
Unframed Transmitter and Receiver
30 Channel n × 64 kbit/s
31 Channel n × 64 kbit/s
30 Channel n × 64 kbit/s, CRC4.
31 Channel n × 64 kbit/s, CRC4.
30 Channel n × 64 kbit/s, Drop and Insert
31 Channel n × 64 kbit/s, Drop and Insert
30 Channel n × 64 kbit/s, CRC4, Drop and Insert
31 Channel n × 64 kbit/s, CRC4, Drop and Insert
30 Channel Monitor Live Traffic.
31 Channel Monitor Live Traffic.
30 Channel, CRC4 Monitor Live Traffic.
31 Channel, CRC4 Monitor Live Traffic.

REAL TIME CLOCK
Displays date and time.

Resolution - One second

Accuracy - ±1 minute per week.

KEYBOARD LOCKOUT
The keyboard can be disabled whilst a test is running.

PRINTER OPERATION
The RS-232 port is used for printer operations and remote control

Printers
40 column minimum, RS-232 interface

Page Printing
Page printouts are initiated by the PRINT key and cause the whole of the current page to be printed. Graphics display pages can be printed in a text equivalent or a facsimile to a suitable printer.

Autoprinting
The printer can be set to print automatically on the occurrence of any of the following (where applicable), each event printed with its date and time and two digit identity number. A twelve character label is also printed where appropriate:
Test start and stop.
Loss and restoration of signal.
Loss and restoration of alignment.
Loss and restoration of pattern sync.
Detection of errors (ES).
Detection of alarms.
Detection of octet slips.
Detection of short term (current) error ratio, for the selected major error type, crossing a user set threshold.
Detection of change of signaling code.
Cumulative printout at user selectable intervals, with a resolution of 15 minutes.
All stored results may be included in the interval print.
User selectable.
Loss and restoration of power.

REMOTE CONTROL
The RS-232 port is used for Remote configuration and collection of results.

RS-232 PORT - The RS-232 port is used for printer operations and remote control.

Type - Asynchronous, DTE, Full Duplex

Bit Rates - 300, 600, 1200, 2400, 4800 and 9600 bit/s.

Code - ASCII

Code bits. Parity/Stop bits
7/Odd/1, 7 /Even/1, 7/Odd/2, 7/Even/2, 8/None/1, 8/None/2

Terminator - None, CR, LF, CR \ LF.

Handshake
Hardware - DTR, RTS, CTS and DSR.
Software - XON and XOFF.

Lines used

Tx DATA	Pin 3
RTS	Pin 7
DTR	Pin 4
Rx DATA	Pin 2
CTS	Pin 8
DSR	Pin 6
Signal Ground	Pin 5

Connector - 9 way female D-type

Electrical - To RS-232C / V.28

DISPLAY LANGUAGES - English, French

LIMIT RANGE OF OPERATION

Temperature
0 to 55°C (Display specified to 50°C)

Safety
Complies with IEC 1010-1, BS EN61010-1 for class 3 hand-held equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 supply.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
-10 to +60°C

Humidity
Up to 90% relative humidity (non condensing)

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential)

ELECTROMAGNETIC COMPATIBILITY
Conforms to the protection requirements of Council Directive 89/336/EEC.
Complies with the limits specified in the following standards.
BS EN55011 Class B CISPR 11.
BS EN55082-1.
IEC 801-2, 3, 4.

POWER REQUIREMENTS
The instrument is powered by internal batteries which give a nominal 5 hours operation. This is extended in receive only mode.

UNIVERSAL AC POWER ADAPTER
The AC power adapter is capable of powering the instrument and at the same time recharging the batteries in 3 hours.

AC Voltage - 90 to 264 V.

Frequency - 45 to 440 Hz

Consumption - 20 VA maximum.

DIMENSIONS AND WEIGHT

	Height	*Width*	*Depth*	*Weight*
2841	77 mm	206 mm	170 mm	1.5 kg
2840A	57 mm	206 mm	170 mm	1.3 kg

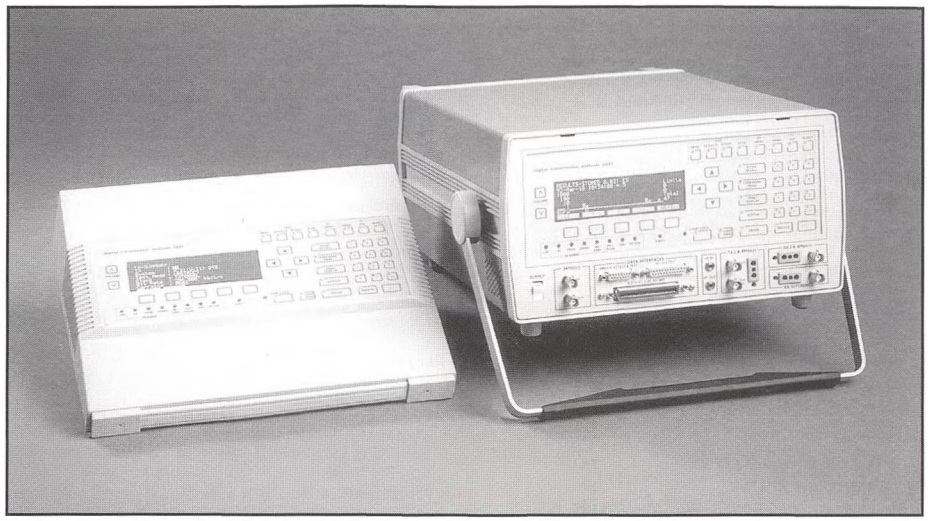
Versions and Accessories

When ordering please quote full ordering number information.

Ordering Numbers	*Versions*
2841	Digital Communications Analyzer.
2840A	2Mbit/s Transmission Analyzer.
	Options
Option 01	1.6/5.6 connectors.
Option 02	French key panel, C-Bit frame.
Option 04	Analog generation and measurement (2840A only - standard on 2841).
	Supplied Accessories
46882/290	Operating Manual 2841.
46882/227	Operating Manual 2840A.
46662/560	Universal AC Power Adapter (90 - 264V).
46662/561	Carrying Pouch. One adapter lead from the list below selected at time of order (2841).
	Adapter Leads (2841)
	One specified lead supplied at no charge. Additional leads can be ordered from the list below.
54311/190	X.21 (V.11) Adapter Lead, 0.2 m, female.
54311/191	RS-449 (V.11) Adapter Lead, 0.2 m, female.
54311/192	V.35 Adapter Lead, 0.2 m, female
54311/193	RS-232 Adapter Lead, 0.2 m, female.
54311/194	Co/Contradirectional Adapter Lead - 15 way D-Type, 0.2 m, female
54311/209	Codirectional Adapter Lead - CF connectors, 0.2 m, male.
54311/211	X.21 (V.11) Adapter Lead, 2 m, male.
54311/212	RS-449 (V.11) Adapter Lead, 2 m, male.
54311/213	V.35 Adapter Lead, 2 m, male.
54311/214	RS-232 Adapter Lead, 2 m, male.
54311/215	Co/Contradirectional Adapter Lead - 15 way D-Type, 2 m, male.
	Optional Accessories
46880/075	Service Manual.
54311/190	X.21 (V.11) Adapter Lead, 0.2 m, female (2841).
54311/191	RS-449 (V.36) Adapter Lead, 0.2 m, female (2841).
54311/192	V.35 Adapter Lead, 0.2 m, female (2841).
54311/193	RS-232 Adapter Lead, 0.2 m, female (2841).
54311/194	Co/Contradirectional Adapter Lead - 15 way D-Type, 0.2 m, female (2841).
54311/209	Codirectional Adapter Lead - CF connectors, 0.2 m, female (2841).
54311/211	X.21 (V.11) Adapter Lead, 2 m, male (2841).
54311/212	RS-449 (V.11) Adapter Lead, 2 m, male (2841).
54311/213	V.35 Adapter Lead, 2 m, male (2841).
54311/214	RS-232 Adapter Lead, 2 m, male (2841).
54311/215	Co/Contradirectional Adapter Lead - 15 way D-Type, 2 m, male (2841).
54311/121	RS-232 Lead - male to male - 25 Way D-Type - 1.5 m (2841).
54311/122	X.21 Lead - male to male - 15 way D-Type - 1.5 m (2841).
54311/147	RS-449 Lead - male to male - 37 way D-Type - 1.5 m (2841).
54311/148	V.35 Lead - male to male - 34 Way MRAC - 1.5 m (2841).
54311/130	Co/Contradirectional Test Lead - 15 way D-Type to free end (2841).
46662/562	Hard Carrying Case.
54717/039	Scriptos printer.
54311/217	RS-232 special lead Scriptos to 2841.
46662/620	Scriptos paper 10 packs.
46883/805	Signal lead balanced (CF-CF).
54311/210	Signal lead unbalanced (BNC-BNC).
46662/387	Null Modem (female to male).
46662/388	BNC to 1.6/5.6 adapter.
46662/564	RS-232 adapter - 9 way male to 25 way female D-Type.

2850B & 2850BS/2851 & 2851S Digital Analyzers

Desktop and rack-mountable digital testers for a wide range of PCM and data measurement applications up to 8 Mbit/s



- Combined data and PCM rate tester
- Framed and Unframed operation at 2048 and 8448 kbit/s with option of 1544 kbit/s (T1) or 704 kbit/s
- All data test interfaces as standard: RS-232, X.21, V.35, RS-449 (V.36) (2851), codirectional, contra-directional with EUROCOM optional (2850B & 2851)
- 50 bit/s to 2.5 Mbit/s in 1 bit/s steps
- Data interface and analog channel access
- G.821, G.921, G.826, M.2100 and G.962 analysis
- Measurements include propagation delay, frequency deviation, frequency and level measurement, DTMF and CAS
- DC power and internal battery options
- Remote control via RS-232 or IEEE-488 with optional PC applications software

The 2850B Digital Transmission Analyzer provides 64 kbit/s, 2 and 8 Mbit/s error performance analysis, and in addition other functionality such as DTMF and channel associated signaling capability, and propagation delay measurement. The 2851 Digital Communications Analyzer provides all of this plus data interface testing as standard for all commonly used interfaces. A structured data option enables detailed testing of X.50, 6+2 and reiterated data systems. With the addition of DC and battery power options, a full range of field and exchange digital and data measurement requirements can be met with a choice of desktop and rack-mountable packages. A choice of RS-232 or IEEE-488 remote control completes the picture, extending remote applications from unattended monitoring to laboratory and factory test requirements.

PCM FRAMING SYSTEMS

2850B and 2851 are able to generate and receive all commonly used framing systems up to 8448 kbit/s, for both the European and North American digital hierarchies.

The instruments can be optioned as European, North American or hybrid versions, and this includes an all bit rate version (European plus North American).

Thus 2850B and 2851 have the flexibility to address global applications, including operation in International Gateways where there is a requirement to test mixtures of European and North American traffic carried on satellite systems.

56 kbit/s and 64 kbit/s Channel Testing

Individual channels within T1, 704, 2048 and 8448 kbit/s (G.704/G.744) can be tested at 64 or 56 kbit/s, assisting in testing and fault location within digital data networks and cross-connect switches.

64 kbit/s Channel Testing

The expanding services at n x 64 kbit/s can be tested where they are carried within primary rate digital signals. All systems and n x 64 kbit/s cross-connect switches are catered for with the flexibility of contiguous and non-contiguous channel selection.

Tributary Testing

Individual 2048 kbit/s tributaries within 8488 kbit/s signals can be tested to ensure correct functioning of multiplexes.

Unstructured

Where the structures on digital links do not conform to the usual ITU-T Recommendations, for example inter-computer links, they can be tested using an unframed format.

DATA INTERFACE TESTING

All commonly used data interfaces are provided as standard to give a comprehensive data test capability together with primary and second order PCM rate testing. Thus PCM and data circuits and equipment can be tested with one compact, fully integrated test instrument. Data test interfaces provided are RS-232, X.21, RS-449 (V.36), V.35 (2851), codirectional and contradirectional (2850B and 2851). DTE is standard, DCE optional, EUROCOM D/1 is optionally available for European military network applications.

Modes

Both synchronous and asynchronous modes are possible with a wide range of standard and user programmable data rates, so that traditional data interface testing can be addressed together with modern digital data services at 64 kbit/s, n x 64 kbit/s and other rates.

REMOTE LOOPBACK

Remote loop activation and deactivation is provided for the RS-232 test interface according to ITU-T Recommendation V.54 by means of control lines. This facilitates testing of data circuits automatically without the need for manual intervention.

STRUCTURED DATA OPTION

The Structured Data option for 2850B/S and 2851/S provides comprehensive X.50, 6+2 and reiterated structured data test capability through Co/Contradirectional, V.11 and TTL data interfaces, and within a 2048 kbit/s digital signal.

Channel rates

As well as the standard sub-channel rates up to 19.2 kbit/s additional rates of 14.4, and 48 kbit/s are provided. It is also possible for the user to programme other rates for special applications.

Out-of-service testing

Out-of-service testing can be used for error performance testing of structured data sub-channels out to subscribers' equipment as well as checking functionality of multiplex equipment. The equipment can be stressed by injecting errors into framing bits. Alarms and housekeeping bits can also be exercised to complete this flexible test capability.

Test access can be directly at 64 kbit/s or via a 64 kbit/s channel within a 2 Mbit/s signal.

Remote loop activation is provided according to national requirements to facilitate testing out to subscribers' equipment.

In-service testing

Two types of in-service testing can be performed, in-service monitoring and drop and insert testing.

In-service monitoring

An X.50 or reiterated data signal can be monitored directly at 64 kbit/s or via a 64 kbit/s channel of a 2 Mbit/s signal.

For 64 kbit/s signals via V.11 or Co/Contradirectional interfaces connection can be made across the line in high impedance mode (bridging). For 2 Mbit/s signals monitor and bridging modes are available.

Various parameters can be monitored during in-service testing including framing errors and housekeeping and alarm bits. Where test patterns are being carried within selected sub-channels these can also be monitored for errors.

X.50 Drop and Insert Testing

Drop and insert testing can be performed directly at 64 kbit/s or on 64 kbit/s channels within 2 Mbit/s signals.

For 64 kbit/s signals via V.11 or Co/Contradirectional interfaces the X.50 signal is looped through and an X.50 sub-channel replaced by a test pattern. A second 64 kbit/s receiver is provided to enable monitoring of the return signal for test pattern errors.

For 2 Mbit/s signals an X.50 signal can be looped through on a selected channel and at the same time performing drop and insert on an X.50 sub-channel.

These are the normal drop and insert modes that will be used in-traffic for 64 kbit/s and 2 Mbit/s signals. Other configurations can be adopted for special applications for mixed 2 Mbit/s and 64 kbit/s connections.

FLEXIBLE ERROR MEASUREMENTS

Where appropriate, 2850B and 2851 have the ability to detect, simultaneously, Code Errors, Framing Errors, Pattern Errors and CRC Errors. Further measurements are then made on a selected error type, including error distribution.

Error Distribution/Histogram

The results are displayed in the form of a histogram with accumulation over 72 hours, and a maximum resolution of 1 minute. Other events such as sync loss are also stored on the histogram. All stored results are tagged with time and date, so that a comprehensive record of long term measurements is available to assist in fault localization. A permanent record of results can also be obtained by printing a text equivalent or a facsimile of the histogram subsequent to the test. In addition the instrument can be programmed to Autoprint selected parameters on event or at timed intervals.

G.821 and G.921 Measurements with Histograms

Where availability measurements are being made on 64 kbit/s channels, results in G.821 format will be provided, while for higher rates Annex D of G.821 is applied. In addition up to 100 day histograms are provided for each of the G.821 parameters with automatic recognition of exceeding daily limits, defined by circuit grade and length for G.821, or circuit classification for G.921. Alternatively user defined limits can be entered directly. Where short tests are required histograms can be selected up to 25, 50 or 100 hours with a resolution of 15, 30 or 60 minutes.

G.826 and M.2100 Measurements

G.826 extends measurements to 2 Mbit/s and above, while M.2100 adds other events such as alarms which contribute towards G.821 and G.826 measurements.

RESIDUAL BIT ERROR RATE

Assessment of background error performance is useful in systems subject to periodic degraded performance, such as radio or satellite systems. This measurement is a long term error rate ignoring severely errored seconds.

BURST ERROR CAPABILITY

Qualification of Burst Errors within Networks, and Network Performance under Burst Error conditions is difficult to achieve. 2850B and 2851 provide comprehensive facilities to stress network equipment with test patterns injected with programmable error bursts and burst rates, while on the receive side, different burst sizes can be detected and recorded. Thus, since the errors can be injected at both logic and code level, network performance under burst conditions can be determined.

HIGH TOLERANCE TO BURST ERRORS

2850B and 2851 are particularly suited to measurements on systems subject to high error rates and burst errors, with the ability to ride through rapid fades as experienced on digital radio systems.

CRC BLOCK ERROR INJECTION TO G.962

2048 kbit/s systems with CRC for ISDN applications can register G.821 parameter events when certain CRC block error rate thresholds are exceeded. The instrument is able to check the thresholds for Severely Errored Seconds, Degraded Minutes and Errored Seconds. The thresholds can be preset for each parameter, and multiplex and other equipment can be quickly and easily checked for conformance to the G.962 Recommendation.

ISDN ERROR REPORT BIT MONITORING TO G.962

A further facility for the 2048 kbit/s systems with CRC is to carry information within the Not Frame Word bits 6, 7 and 8, on the occurrence of G.821 events (Severely Errored Seconds, Degraded Minutes and Errored Seconds), and where the events originated. The origin is determined by the position of these bits with respect to the CRC multiframe. The instrument decodes and displays this information in real time or latched mode, and can Autoprint it if required.

PROGRAMMABLE ERROR GATING

In addition to long term mean error ratio, a current error ratio measurement is available with fixed gating periods of 1, 2, 5 or 10 seconds, as well as automatic gating adjustment. Flexibility of application is thus assured, for example fade margin adjustment on digital radios.

IN-SERVICE AND OUT-OF-SERVICE MEASUREMENTS

2850B and 2851 are equally suited to both installation and in-service maintenance measurements. Interfaces are provided to enable the receiver to be connected to a number of network points at varying impedances and signal sensitivities, including the provision of automatic equalization (automatic line build out, ALBO) at 2048 kbit/s (1544 kbit/s for North American versions).

CHANNEL ACCESS

Flexible access is provided to transmit and receive timeslots in appropriate frame structures at 704, 2048, 1544 and 8448 kbit/s. Note that analog access is possible only at 1544 and 2048 kbit/s.

Drop and Insert

In addition to checking error performance of selected 64 kbit/s and n x 64 kbit/s channels with transmitter and receiver operating independently, a Drop and Insert configuration can be adopted so that 64 kbit/s and n x 64 kbit/s channels can be tested with minimum disruption of service to other in-traffic channels.

2850B/BS, 2851/S

External Access

Access is provided to selected transmit and receive channels, at both analog and digital levels. Thus, if required, external analog or digital test equipment can be connected to make specific channel measurements beyond the capability of 2850B and 2851.

TERMINAL EQUIPMENT TESTING

2850B and 2851 are able to simulate and detect alarm conditions associated with the various framing systems, so that terminal equipment can be tested for correct operation. This includes the ability to generate programmable Frame or Code Errors to check equipment thresholds.

In addition, there are automatic test sequences for checking Frame and Multiframe Alignment Strategy, and access is allowed to control and display the condition of all unassigned frame bits.

PROPAGATION DELAY MEASUREMENT

Delay measurements on data and PCM rate circuits are accomplished to a high level of accuracy. This is particularly important on satellite links where high values of delay are experienced and need to be measured, and for characterizing networks to assist in finding unwanted loopbacks.

CHANNEL ASSOCIATED SIGNALING

The four-bit word associated with a selected transmit channel can be controlled. In addition dialled numbers can be generated to simulate call set up.

On the receive side, the selected channel can be monitored, and dialling information displayed. The parameters associated with the dial pulses are user programmable as a mask, so that deviations will be displayed as errors.

All 30 channels of a 2048 kbit/s signal or 24 channels of a 1544 kbit/s signal can also be monitored simultaneously, for example when searching for an idle channel.

DTMF SIGNALING

DTMF supplements channel associated signaling capability to provide a more comprehensive signaling test capability. Tone and dialling generation and monitoring facilities are provided.

DIGITAL SIGNAL LEVEL AND FREQUENCY MEASUREMENT

The frequency and amplitude of the incoming digital signal is displayed which enables early warning of degradation of the signal.

2 CHANNEL SYNCHRONIZATION MEASUREMENT

2 primary rate digital signals can be compared for frequency synchronization, thereby assisting in isolating network clocking problems.

OCTET SLIP DETECTION

Octet slips can be detected at the channel level of a primary rate signal, which allows the effects of frame slips introduced by network buffers to be assessed.

EASE OF USE

2850B and 2851 are set up using a combination of menus, key pad and soft keys. Eighteen complete set up conditions can be stored in non-volatile memory, thus ensuring ease of use.

RS-232 REMOTE OPERATION

Remote unattended operation can be accomplished via an RS-232 port, which can also be used for local printing. Keyboard functions can be duplicated via RS-232 enabling complete remote reconfiguration and reporting of results.

IEEE-488

For 2850BS and 2851S IEEE-488 can be specified as an option in addition to the standard RS-232 for factory test and laboratory applications or where IEEE-488 is preferred.

ALTERNATIVE PACKAGES

Alternative packages are offered for field portable (2850B and 2851), and rackmount (2850BS and 2851S) applications.

REMOTE APPLICATIONS SOFTWARE

This optional PC based software runs on Windows 95 and NT platforms. It provides full remote control, storage of results, and a comprehensive results display capability.

END-TO-END VOICE COMMUNICATION

The instrument has a loudspeaker to which can be connected a selected voice channel, via an internal Codec, from frame structures at 1544 and 2048 kbit/s. It is also possible to connect an external microphone to a selected transmit channel, thereby enabling end-to-end voice communication to be established between two 2851 instruments to assist in setting up tests.

POWER OPTIONS

In addition to mains power, options are provided for battery and DC power to cater for all operational requirements including factory, exchange and field.

Specification

PCM Transmit Interface

Framing and Bit Rates
Signals can be transmitted unframed or with the frame structure indicated.

Enabling option
See table at end of specification.

03, 04, 07
704 kbit/s - 10 Channel System.

02, 04, 05
1544 kbit/s - T1
1544 kbit/s - T1 no signaling
1544 kbit/s - T1ESF
1544 kbit/s - T1ESF no signaling
1544 kbit/s - T1DM, DDS Data Mux.

01, 06, 07
2048 kbit/s - G.704
2048 kbit/s - G.704 no multiframe
2048 kbit/s - G.704 with CRC
2048 kbit/s - G.704 with CRC, no multiframe
2048 kbit/s - 32 frame multiframe.

04, 05
3152 kbit/s - DS1C mode 1 synchronous
3152 kbit/s - DS1C mode 2 asynchronous.

04, 05
6312 kbit/s - DS2 96 channels synchronous
6312 kbit/s - DS2 asynchronous
6312 kbit/s - 2048 kbit/s interworking to G.747.

01, 07
8448 kbit/s - G.742 asynchronous
8448 kbit/s - G.745 asynchronous
8448 kbit/s - G.704/741 synchronous
8448 kbit/s - G.704/744, 120 channels, synchronous.

01, 25
256 kbit/s - EUROCOM D/1 IB5
512 Kbit/s - EUROCOM D/1 IB5
1024 kbit/s - EUROCOM D/1 IB5.

Permitted combinations of bit rates
2048 & 8448 kbit/s or
704 & 2048 & 8448 kbit/s or
1544 & 2048 & 8448 kbit/s or
1544 & 3153 & 6312 kbit/s or
704 & 2048 & 8448 & 1544 & 3152 & 6312 kbit/s
256 & 512 & 704 & 1024 & 2048 & 8448 kbit/s.

AIS
All ones signal with zeros programmable at a rate of $Mx10^{-N}$, where M is 1-9 and N is 2-7.

CLOCK SOURCE
Internal, external or derived from the received signal.

INTERNAL

Accuracy
±5 ppm from 0°C to 55°C, ±3 ppm/year.

Small Offset
Steps of 5 and 25 ppm to maximum of ±150 ppm.

Large Offset
Up to 2.5 MHz
Steps of 2 kHz to maximum of ±96 kHz.
Over 2.5 MHz
Steps of 8 kHz to maximum of ±96 kHz.

External

Range - 1 kHz to 11 MHz.

Level
TTL square wave, In accordance with G.703, Figure 21.

Impedance - 1000 Ω.

Connector - BNC.

CLOCK OUTPUT - TTL via 50 Ω.

LINE CODES
AMI, HDB3, B8ZS, B6ZS, NRZ (TTL level).

NON STANDARD
Unframed only.

Clock - Internal, External

Range - 1 kbit/s to 9 Mbit/s

Steps - 1 bit/s

Line Code - NRZ

Level (data and clock) - TTL

Connector
Auxiliary connector, 25 way D-Type
(for pinout see end of specification)

TEST PATTERNS

Insertion
Single Channel
Selected 64 kbit/s channel of framed signal.

n x 64 kbit/s Channel
Selected n x 64 kbit/s channel of framed signal.
Channel distribution can be contiguous or non-contiguous.

Framed - All channels of framed signal.

Unframed - Unframed signal.

PRBS
2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1.
Optional maximum 14 or 7 successive 0 limitation for 1544 and 3152 kbit/s systems.

Sense - True or inverted.

Mode (framed only)

8 bit - PRBS data fills all 8 bits in an octet.

7 + 1 bit - First 7 bits are PRBS and last bit is a 1.

All zeros - Continuous sequence of 0000.

All ones - Continuous sequence of 1111.

Alternating - Alternating sequence of 1010.

16 bit word - User programmable sequence of 16 bits.

8 + 8 word - Two user programmable 8 bit sequences are alternated by an external TTL input.

The changeover occurs at the end of 8 bits.

1 kHz 0 dBm0 sine wave
Digital representation of a sinusoidal signal of 1 kHz at a nominal level of 0 dBm0, coded according to A-Law, inserted into single channel. This facility is not available for 1544 kbit/s systems.

FILL PATTERNS
In single channel framed operation the following patterns are used to fill all other channels.

PRBS - 2^{15}-1.

8 bit word - User programmable sequence of 8 bits.

EXTERNAL VOICE/DATA
For framed operation, an externally input 64 kbit/s data stream or a voice frequency signal can be inserted into one of the channels in the transmitted signal instead of a test pattern.

DATA INPUT
Applies only to frame structures at 704, 1544, 2048 and 8448 kbit/s (G.704/G.744).

Data Input Interface
Codirectional to G.703.
Contradirectional to G.703 (AMI 100% or Bipolar NRZ).
X.21, RS-449 (V.36), V.35 (using DCE cable adapter accessory).
NRZ (TTL level).

VOICE FREQUENCY INPUT
Applies only to 1544 and 2048 kbit/s systems.

Range - 0.3 to 3.4 kHz.

Encoding - A-Law for 2048 kbit/s, μ-Law for 1544 kbit/s.

Impedance - 600 Ω balanced.

Max Input Level - +3 dbm0.

DROP & INSERT
For framed operation the received signal is looped to the transmitter.
Note that for CRC frame structures the CRC is re-calculated before re-transmission.

64 kbit/s
A selected 64 kbit/s channel is replaced by a test pattern or by an externally input digital signal.

Audio
A selected 64 kbit/s channel is replaced by an externally input voice frequency signal (as above).

n x 64 kbit/s
A selected n x 64 kbit/s channel is replaced by a test pattern. The channel selection can be contiguous or non-contiguous.

ERROR INJECTION

Target
Test Pattern Only, Framing Only, CRC Only, Traffic (Drop and Insert Mode).

Error Type

Binary - Bits are inverted before coding.

Code - Code errors are injected by changing ±1 to 0 and 0 to ±1 where the polarity of the inserted mark is the same as the polarity of the last mark transmitted.

Injection Mode

Singly - By keypress.

Fixed rate - Rate $3x10^{-1}$ to $1x10^{-7}$.

In bursts
Pseudo Random Burst with user selectable burst length of 8, 16, 32, 64, 128, 256 errors. The actual transmitted error ratio with bursts at a fixed rate is fixed rate x the number of errors in the burst eg. a burst length of 16 at a rate of 2×10^{-6} will measure 3.2×10^{-5}.
Bursts may not stay confined to the designated target type.

CRC Block Errors
To ITU-T Recommendation G.962.

Range
1-999 errored blocks in 1,000 or 60,000 blocks.

Threshold Presets
Programmable presets for Severely Errored Seconds, Degraded Minutes and Errored Seconds thresholds.

MAIN OUTPUTS
Balanced

Impedance
European versions - 120 Ω.
North American versions - 105 Ω.

Peak Voltage - 3 V ±0.3 V.

Space Voltage - 0 V ±0.3 V.

Unbalanced

Impedance - 75 Ω.

Peak Voltage - 2.37 V ±0.237 V.

Space Voltage - 0 V ±0.237 V.

NRZ - TTL.

CABLE SIMULATOR

North American versions only
1000 ±100 feet of 22 gauge ABAM cable to Bell TA-TSY-000009.

SIGNALING BIT CONTROL
For framing systems with Channel Associated Signaling capability:
The signaling bits can be changed.
Dialled numbers up to 20 digits can be generated.

DTMF SIGNALING
See Measurements Section.

C-BIT FRAMING
Generation of C-Bit Frame for French TRANSMIC-2G System.
Control of C-Bit Frame message bits.

ACCESS TO STRUCTURE BITS
The following tests are available, depending on the framing system selected:
Frame alignment strategy.
Multiframe alignment strategy.
Change unassigned, distant, distant multiframe and alarm bits.
Change Auxiliary Data Bits (T1 systems).
Send BELL Yellow Alarm:
Bit 2 Suppression (T1SF).
Facility Data Link message (T1ESF)

LOOPBACK (T1 SYSTEMS ONLY)
Activates and deactivates automatic remote loop equipment.
4 loopback codes, each of 3-16 bits (2 loopup and 2 loopdown) can be user programmed and stored in non-volatile memory for subsequent use.

SYNC OUTPUTS
PRBS.
Polarity - Negative pulse.
Interface - TTL.

PCM Receive Interface

FRAMING AND BIT RATES

Signals can be received unframed or with the frame structure indicated.
As Transmitter plus 1544 kbit/s - T1SLC96 (synchronization and channel access).

Permitted combinations of bit rates
As Transmitter.

Frequency Tolerance
704 kbit/s ±50 ppm.
1544 kbit/s ±130 ppm.
2048 kbit/s ±50 ppm.
3152 kbit/s ±30 ppm.
6312 kbit/s ±33 ppm.
8448 kbit/s ±30 ppm.

LINE CODES - As Transmitter.

NON STANDARD - Unframed only.

Clock - External.

Range - 1 kbit/s to 11 Mbit/s.

Line Code - NRZ.

Level (data and clock) - TTL.

Connector
Auxiliary connector, 25 way D-Type (see end of specification for pinout).

INPUT MODES AND SENSITIVITY

Modes

Terminated - Terminates the line.

Bridging - Taps onto a terminated line or unprotected monitor point.

Monitoring - Connects to a protected monitor point.

Automatic Line Equalization
Automatic Line Equalization (Automatic Line Buildout, ALBO) is provided at 2048 kbit/s for Option 01 (except when option 04 fitted) or at 1544 kbit/s for option 05 (except when option 07 fitted).

BALANCED	***Terminated***	***Bridging***
Impedance		
European Versions	120 Ω	>1000 Ω
North American Versions	105 Ω	>1000 Ω
Level		
Normal European Versions	3 V + 2 -6 dB	3 V + 2 -6 dB
North American Versions	3 V +2 -6 dB	3 V +2 -6 dB
ALBO		
European Versions	3 V - 3 -30 dB	3 V - 3 -30 dB
North American Versions	3 V - 3 -30 dB	3 V - 3 -30 dB
UNBALANCED	***Terminated***	***Bridging***
Impedance	75 Ω	>1000 Ω
Level:		
Normal	2.37 V + 2 -6 dB	2.37 V + 2 -6 dB
ALBO	2.37 V - 3 - 30 dB	2.37 V -30 dB
BALANCED	***Monitor (-30 dB)***	***Monitor (-20 dB)***
Impedance		
European Versions	120 Ω (3000 Ω)	120 Ω (1000 Ω)
North American Versions		105 Ω (860 Ω)
Level:		
Normal		
European Versions	115 mV +2 -6 dB	300 mV + 2 -6 dB
North American Versions		325 mV +2 -6 dB
ALBO		
European Versions	115 mV - 3 -30 dB	300 mV - 3 -30 dB
North American Versions		325 mV - 3 -30 dB
UNBALANCED	***Monitor (-30 dB)***	***Monitor (-20 dB)***
Impedance	75 Ω (2400 Ω)	75 Ω (680 Ω)
Level		
Normal	75 mV + 2 -6 dB	237 mV + 2 -6 dB

TEST PATTERNS

Source
Selected channel of framed signal.
All channels of framed signal.
Unframed signal.

PRBS
2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1.
Optional max 14 or 7 successive 0 limitation for 1544 and 3152 kbit/s systems.

Sense - True or Inverted.

Mode (framed only).

8 bit - PRBS data fills all 8 bits in an octet.

7 + 1 bit - First 7 bits are PRBS and last bit is a 1.

Repetitive Word
Any word which repeats over a 16 bit sequence.

PATTERN SYNCHRONIZATION

Loss Criterion

PRBS
Error rate greater than 1 in 5 for each of 10 consecutive deciseconds (1 in 10 above 5 Mbit/s).

16-bit word
Error rate greater than 1 in 20 for each of 10 consecutive deciseconds.

Async Message
Error rate greater than 1 in 20 for each of 10 consecutive deciseconds.

CHANNEL EXTRACT
For framed single channel operation a selected 64 kbit/s channel is extracted from the received signal and output as a data signal or voice frequency signal. The audio output is also available on the internal loudspeaker.

2850B/BS, 2851

Data Output
Applies only to frame structures at 704, 1544, 2048 and 8448 kbit/s (G.704/G.744).

Data Output Interface
Codirectional to G.703.
Contradirectional to G.703 (100% AMI or Bipolar NRZ).
X.21, RS-449 (V.36), V.35 (using DCE cable adapter accessory)
NRZ (TTL level).

Frame or AIS alarm detected
All 1's transmitted.

Signal loss detected - Outputs are off.

Clock output - 64 kHz NRZ (TTL).

Voice Frequency Output - 1544 and 2048 kbit/s systems only.

Range - 0.3 to 3.4 kHz.

Decoding - A-Law for 2048 kbit/s, μ-Law for 1544 kbit/s.

Impedance - 600 Ω balanced.

STATUS INDICATORS
LEDs indicate frame structure alarm conditions.

Display modes

AUTORESET
LEDs show current condition and extinguish when the alarm condition clears. LEDs are ON for the length of time an alarm condition exists with a minimum of 1 sec.

LAMP LOCK - LEDs remain on after alarm clears.

LINE - ON indicates signal loss.

AIS - ON indicates signal is all 1's. All 1's is defined as signal with less than three zeros in two fame periods.

FRAME - ON indicates a loss of frame alignment.

ERRORS
ON indicates that the error rate of the major error type is greater than a threshold set by the user. Threshold is 1×10^{-9} to 9×10^{-3}.

MF/ZEROS
ON indicates:
Loss of multiframe alignment (2048 kbit/s)
More than 31 consecutive zeros have been received (1544 kbit/s).

DIST/YELLOW - ON indicates:
Distant alarm (2048 kbit/s),
Yellow alarm (1544 kbit/s)

DMF/ - ON indicates:
Distant multiframe alarm (2048 kbit/s)
ISDN error report alarm (2048 kbit/s systems for ISDN applications).

PATTERN - ON indicates loss of pattern synchronization.

REMOTE - ON indicates the instrument is under remote control and the keyboard is inoperative.

RX: CRC UNSYNC - The loss of CRC synchronization is indicated by a message on the display.

C-BIT: UNSYNC - Loss of C-Bit framing sequence synchronization.

ALARM EXTENSION - An output is provided corresponding to an alarm condition.

Polarity - Positive for alarm.

Interface - TTL.

ERRORS OUTPUT
An output pulse is provided for each code error, pattern error, frame error, or CRC error (as selected to be the major measurement - see measurements section). (Pin 16 of auxiliary connector).

Interface - TTL.

Pulse Width - 50% of bit interval.

UNASSIGNED FRAMING BITS
The state of the unassigned bits is displayed. Applies to 704, 2048 and 8448 kbit/s systems.

ISDN ERROR REPORT BITS - (to ITU-T Rec. G.962)
Applies to 2048 kbit/s CRC system with no signaling multiframe, to G.704.

Bits monitored
Bits 4, 5, 6, 7 and 8 in Not Frame Word.

Function
Detects, displays and Autoprints occurrence of valid error alarm pulses within bits 6, 7 and 8 corresponding to Severely Errored Seconds, Degraded Minutes and Errored Seconds, and their relation to the CRC multiframe, in frame pairs. Alarm pulses can be latched.
Bits 4 and 5 are displayed.
Changes in the state of bit 5 are Autoprinted.

ISDN ERROR REPORT BITS
Applies to 2048 kbit/s system with no signaling multiframe, to G.704.

Bits monitored
Bits 4, 5, 6, 7 and 8 in Not Frame Word.

Function
Detects, displays and Autoprints occurrence of valid error alarm pulses within bits 6, 7 and 8 corresponding to Severely Errored Seconds, Degraded Minutes and Errored Seconds. Four sets of bits 6, 7 and 8 are displayed corresponding to the four combinations of bits 4 and 5 (00, 01, 10 and 11, each of which exists for 250 ms each second).

SYNC OUTPUTS - PRBS.

Polarity - Negative pulse.

Interface - TTL

Data Test Interfaces

X.21, RS-449 (V.36), V.35 and RS-232
2851 and 2851S only.

X.21, RS-449 (V.36), V.35
X.21 (V.11), RS-449 (V.11) and V.35 circuits are presented to a common connector. DTE interfaces are provided by supplied cables which provide the appropriate connector and electrical interface. A series of optional cables provide alternative combinations of V.10, DTE and DCE.

Connector (instrument) - 50 way type 57 female.

Cable Connectors

X.21 - 15 way D-Type, ISO 4903 female.

RS-449 (V.36) - 37 way D-Type, ISO 4902 female.

V.35 - 34 way MRAC, ISO 2593 female.

Cable recognition
Automatic recognition of the cable type plugged in. Dedicated interface, DTE, DCE provided by means of optional cable.

RS-232 - 25 way D-Type female, ISO 2110.

Mode	
X.21	Synchronous.
RS-449 (V.36)	Synchronous.
	Asynchronous.
V.35	Synchronous.
RS-232	Synchronous.
	Asynchronous.
Implementation	DTE.
	DCE (Option).
Electrical	
X.21	V.11 (Balanced).
	V.10 (Unbalanced) (Option).
RS-449 (V.36)	V.11 (Balanced).
	V.10 (Unbalanced) (Option).
V.35	V.35 (data and timing).
	V.28 (control lines).
RS-232	V.28.
Line Code	
RS-232, V.35	NRZ.
X.21, RS-449	NRZ.
(V.10, V11)	Biphase Mark.
	Biphase Space.
Input Impedance	
X.21, RS-449 (V.36)	
V.11 Terminated	120 Ω
V.11 Unterminated	>3000 Ω
V.10	>3000 Ω
V.35	100 Ω
Data Rate	
V.11	50 bit/s to 2.5 Mbit/s
V.11	50 bit/s to 9 Mbit/s (option 26)
V.10	50 bit/s to 100 kbit/s.
V.35	50 bit/s to 2.5 Mbit/s.
RS-232	
Async.	50 bit/s to 38.4 kbit/s
Sync.	50 bit/s to 80 kbit/s
Timing	
Synchronous	
Transmitter	External, from DCE, Internal
Receiver	External, from TX, from DTE, from DCE.
Asynchronous	
Transmit	50, 75, 100, 110, 134.5, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, 19200, 38400 bit/s.
Receive	Receive signal.

Polarity
The polarity of the transmitter incoming and outgoing clocks and the receiver incoming clock can be selected.

Async coding

Data bits	5, 6, 7, 8
Stop bits	1, 1.5, 2
Parity	Odd, even, none

Async character rate

Transmitter	Selectable: low, medium, high
Receiver	Up to 1000 characters/sec.

Receiver Clock Recovery
The receiver clock can be recovered from the data.

TEST PATTERNS - Sync and async.

PRBS
2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1

Sense - True or inverted.

All Ones - Continuous sequence of 1111.

All Zeros - Continuous sequence of 0000.

Alternating - Alternating sequence of 1010.

Sync.

16 bit word
User programmable sequence of 16 bits.

8 + 8 word
Two user programmable 8 bit sequences are alternated by an external TTL input. The changeover occurs at the end of 8 bits.

Async.

Fox Message
3 messages to ITU-T Recommendation R.52.

Fox 1 - International alphabet 2.

Fox 2 - International alphabet 5, 96 character set.

Fox 3 - International Alphabet 5, 64 character set.

User message - 1-19 characters.

ERROR INJECTION

Singly - By key press.

Fixed rate - Rate 3×10^{-1} to 1×10^{-7}(sync only)

ALARMS
Line, errors, pattern.

SYNC OUTPUTS - PRBS transmit and receive.

Polarity - Negative pulse.

Interface - TTL

Pulse width - 50% of bit interval.

Structured Data (Option 24)

X.50

Framing
Division 2, 80 channel
Division 3, 20 channel

Status Bit Mode

Unframed
The S bit can be set to 1 or 0, and monitored

Framed (France)
The S bit is F +7D where F is the status bit framing and is alternating 1 and 0, and D are data bits. The D bits can be set to 1 or 0, and monitored.

Distant End Alarm Bit (A)
The A bit can be controlled and monitored.

Housekeeping Bits (B to H)
The B to H bits can be controlled and monitored.

X.50 channel rate

Division 2, 80 channel - 600, 1200, 2400, 4800, 9600 bit/s.

Division 3, 20 channel - 2400, 4800, 9600 bit/s.

Additional rates - 14.4, 19.2, 48 kbit/s and programmable X.50 bit rate

X.50 bit rate - 64 kbit/s.

6+2 and REITERATED DATA

Framing - 8 bit envelope with first bit framing, last bit status and 6 data bits.

Framing Bit - The framing bit alternates 1,0.

Status Bit - Set to 1 or 0 on transmitter and displayed on receiver.

Channel Rate - 600, 1200, 2400, 4800, 9600, 19200 and 48000 bit/s.

Bit Rate

Reiterated - 64 kbit/s.

6+2 (non-reiterated) - 800, 1600, 3200, 6400, 12800, 25600, 64000, User.

Reiteration - 7 bit and 8 bit.

REMOTE LOOP ACTIVATION

UK - Fixed word

Italy - Unstructured - Programmable 8 bit word.
Structured - Programmable 6 bit word.
DER Multipoint - Programmable tributary sequence number.

INTERFACE

Codirectional, Contradirectional, V.11, TTL, 2048 kbit/s channel.

Codirectional - Line Signal Coding and Level to ITU-T Recommendation G.703.

Transmit Timing - Internal, recovered 64 kbit/s clock, external 2048 kbit/s clock.

Receive Timing - Recovered 64 kbit/s clock.

Contradirectional - Line Signal Coding and Level to ITU-T Recommendation G.703

Transmit Timing - Contradirectional, internal, recovered 64 kbit/s clock, external 2048 kbit/s clock.

Receive Timing - Contradirectional

Connector (Co/Contra)
15 way D-Type, ISO4903.

Pinouts	
1,9	Transmit Data Out.
2,10	Transmit D&I Data In.
3,11	Receive Data In.
4,12	Transmit Clock Out.
5,13	Transmit Clock In.
6,14	Receive Clock Out.
7,15	Receive Clock In.
8	Earth.

Receiver Termination - Terminated, Bridging

V.11

Transmit Timing
V.11 input, Internal, Recovered 64 kbit/s clock, External 2048 kbit/s clock.
Receive Timing
V.11 input, Recovered 64 kbit/s clock.
Connector - 15 way D-Type, ISO4903.

Pinouts	
1,9	Transmit Data Out.
2,10	Transmit D&I Data In.
3,11	Receive Data In.
4,12	Transmit Clock Out.
5,13	Transmit Clock In.
6,14	Receive Clock Out.
7,15	Receive Clock In.
8	Earth.

Receiver Termination - Terminated, Bridging

Via 2048 kbit/s channel
64 kbit/s X.50 encoded signals can be inserted into a transmit 2048 kbit/s signal, and extracted from a receive 2048 kbit/s signal.

Transmit and Receive Timing
2048 kbit/s channel.

TTL - Transmit Timing, internal TTL input, recovered 64 kbit/s clock, external 1024 kbit/s clock.

Receive Timing - TTL input, recovered 64 kbit/s clock.

Level - NRZ, Biphase (M), Biphase (S).

Connector - 15 way D-Type, ISO4903.

Pinouts	
1	Transmit Data Out.
2	Transmit D&I Data In.
3	Receive Data In.
4	Transmit Clock Out.
5	Transmit Clock In.
6	Receive Clock Out.
7	Receive Clock In.
8, 9, 11, 13	Earth.

X.21 -DTE/DCE

Pins	*From DTE (To DCE)*	*Circuit*	*Pins*	*To DTE (From DCE)*	*Circuit*
2, 9	Transmit	T	4, 11	Receive	R
3, 10	Control	C	6, 13	Timing	S
8	Ground		5, 12	Indication	I

- For unbalanced operation the second pin of each pair is earth.

RS-449 (V.36) - DTE/DCE

Pins	*From DTE (To DCE)*	*Circuit*	*Pins*	*To DTE (From DCE)*	*Circuit*
4, 22	SD Send Data	103	6,24	RD Receive Data	104
17, 35	TT Tx Timing	113	8,26	RT Rx Timing	115
19	Signal Ground		5, 23	ST Send Timing	114
7, 25	RS (RTS)	105	9, 27	CS (CTS)	106
12, 30	DTR	108/2	11, 29	DSR	107

- For unbalanced operation the second pin of each pair is earth.
- DTR present on DTE cable option but not monitored on DCE cable option.
- DSR present on DCE cable option but not monitored on DTE cable option.

V.35 - DTE/DCE

Pins	*From DTE (To DCE)*	*Circuit*	*Pins*	*To DTE (From DCE)*	*Circuit*
P, S	Transmit Data	103	R, T	Receive data	104
U, W	Transmit Timing	113	V, X	Receive timing	115
B	Signal Ground		Y, AA	Transmit timing	114
C	Request to send	105	D	Clear to send	106
H	DTR	R, T108/2	E	DSR	107

- DTR present on DTE cable option but not monitored on DCE cable option.
- DSR present on DCE cable option but not monitored on DTE cable option.

RS-232 - DTE/DCE

Pins	*From DTE (To DCE)*	*Circuit*	*Pins*	*To DTE (From DCE)*	*Circuit*
2	Transmit data	103	3	Receive data	104
24	Transmit timing	113	17	Receive timing	115
4	Request to send	105	15	Transmit timing	114
20	Data terminal ready	108	5	Clear to send	106
18	Local loop	141	6	Data set to ready	107
21	Remote loop	140	8	Receive line signal detect	109
7, 1	Ground		25	Test mode	142

Control Lines		
X.21		
DTE	DCE	
I (Indication)	C (Control)	Displayed as ON or OFF
C (Control)	I (Indication)	Settable to ON or OFF (Normally ON when transmitter ON and OFF when transmitter OFF
RS-449 (V.36)		
DTE	DCE	
CS (Clear to send)	RS (Request to send)	Displayed as ON or OFF
RS (Request to send)	CS (Clear to send)	Settable to ON or OFF (Normally ON when transmitter ON and OFF when transmitter OFF
DTR (Data terminal ready)	DSR (Data set ready)	Set to on
V.35		
DTE	DCE	
CS (Clear to send)	RS (Request to send)	Displayed as ON or OFF
RS (Request to send)	CS (Clear to send)	Settable as ON or OFF (normally ON when transmitter ON and OFF when transmitter OFF
DTR	DSR	Set to ON
RS-232		
DTE	DCE	
CTS (Clear to send)	RTS (request to send)	Displayed as ON or OFF.
DSR (data set ready)	DTR (data terminal ready)	Displayed as ON or OFF.
RLSD (receive line signal detect)	LL (local loop)	Displayed as ON or OFF.
	RL (remote loop)	Displayed as ON or OFF.
TM (Test Mode)		Displayed as ON or OFF.
RTS (request to send)	CTS (clear to send)	Settable to ON or OFF.
DTR (data terminal ready)	DSR (data set ready)	(normally ON when Transmitter On and OFF when Transmitter OFF).
	RLSD (receive line signal detect)	Settable to ON or OFF.
	TM (Test Mode)	Settable to ON or OFF.
LL (local loop)		Set to ON for V.54 loop 3 selected Set to OFF for V.54 loop 3 deselected
RL (remote loop)		Set to ON for V.54 loop 2 selected Set to OFF for V.54 loop 2 deselected

MODE - Transmit and receive are independent.

Transmit - Test pattern inserted within selected sub-channel.

Receive - Test pattern extracted from selected sub-channel and monitored for errors.

Drop and Insert - 64 kbit/s or 2048 kbit/s signal looped through and a test pattern inserted in a selected sub-channel of an X.50 signal.
For Receive and Drop and Insert the same or different sub-channel can be monitored for pattern errors on the receiver.

TEST PATTERNS

PRBS
2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23}-1.

Programmable Word - 12 bit word.

FILL PATTERN - 2^7-1 PRBS, programmable 6 bit word

ERROR INJECTION

Singly - by keypress.

Fixed rate - $1x10^{-2}$ to $1x10^{-8}$ in decade steps.

Target - Framing bits, Data bits.

AIS INJECTION - AIS can be injected into transmit data in programmable bursts.

Burst Range - 0.01 to 99.9s

Burst resolution - 0.01s

ALARMS

Transmitter - Tx no clock, D&I no clock, D&I no sync

Receiver - Line, Frame, Framed Status Unsync, Errors, Distant, Pattern.

Measurements

ERROR TYPES

PCM Interfaces
Line Code Errors (Bipolar violations), pattern errors, framing errors, CRC errors.

Data Interfaces - Pattern Errors.

Structured Data - Pattern Errors, Framing Errors.

MAIN PARAMETERS
Number of Errors.

Depends on PCM or Data Interface, Framing System and Test Mode
Long Term Mean Error Radio (LTMER).
Total Test Time.
Number of Loss of Signal (LOS) seconds.
Number of AIS seconds.
Number of No Frame Alignment seconds.
Number of No Pattern Sync seconds.
Number of No CRC Sync seconds.

Octet Slips (Primary Rate PCM and 8448 kbit/s G.744 Systems only)
Octet slips are detected for single channel pattern measurements.
Number of positive and negative slips.
Time since last slip.
Time between last two slips.

Further measurements
One of the four error types is selected to be the basis for further measurements. The selection also controls the type of measurement presented as an error distribution with time and the source of errors routed to the rear panel ERRORS socket.

ADDITIONAL PARAMETERS

Current Error Ratio

Automatic - Error ratio measured using short term algorithm.

Fixed Gating - 1, 2, 5 or 10 seconds.

Burst Measurements
Number of bursts, time between last two bursts, Time since last burst.

Residual Bit Error Rate (Background Error Rate)
Long Term Mean Error Ratio excluding Severely Errored Seconds.

G.821 ERROR PERFORMANCE

Measurements
64 kbit/s channel availability measurements are made to ITU-T Recommendation G.821, while for higher rates a channel performance to G.821 Annex D is applied.

Parameters
% Available Time
Number of Errored Seconds
% Error Free Seconds
Number of Severely Errored Seconds (SES).
% Non SES.
Number of Degraded Minutes (DM).
% Non DM.
Number of Breaks.

G.821/G.921 HISTOGRAMS

Parameters
Errored Seconds (ES).
Severely Errored Seconds (SES).
Degraded Minutes (DM).
Breaks.

Test Length
Up to: 100 days, 100 hours, 50 hours, 25 hours.

Codirectional, Contradirectional and EUROCOM D/1 (2850B, 2850BS, 2851 and 2851S)

	Codirectional	*Contradirectional*	*EUROCOM D/1*
Line Signal Coding Level	To ITU-T Rec. G.703	To Rec.ITU-T G.703	TO EUROCOM D/1, IB6
Bit Rate	64 kbit/s	64 kbit/s	32, 64, 128, 256, 512, 1024, 2048 kbit/s
Format	Unstructured	Unstructured	Unstructured
Transmit Timing	Internal Receiver External 2048 kbit/s	Contradirectional Input Receiver Internal External 2048 kbit/s	Internal Receiver External (EUROCOM)
Transmit Timing Output	TTL at 64 kHz	TTL at 64 kHz	TTL at bit rate
Receive Timing			
Connector	15 way D-Type, ISO 4903	15 way D-Type, ISO 4903	15 way D-Type, ISO 4903

Pinouts	*Codirectional*	*Contradirectional*	*EUROCOM D/1*
1,9	Transmit Data Out (test interface) Transmit Data Out (receiver time slot access)	Transmit Data Out (test interface) Transmit Data Out (receiver time slot access)	Transmit Data Out
3,11	Receive Data In (test interface) Receive Data In (transmitter time slot access)	Receive Data In (test interface) Receive Data In (transmitter time slot access)	Receive Data In
5,13		Transmit Clock In (test interface)	Transmit Clock In (External)
7,15		Receive Clock In (test interface)	Receive Clock In
4,12		Transmit Clock Out (receiver time slot access and test interface)	Transmit Clock Out
2,6,8,14	Earth	Earth	Earth

Resolution
100 days - 1 day.
100 hours - 60 minutes.
50 hours - 30 minutes.
25 hours - 15 minutes.

Parameter Limits
Limits calculated from user entered data and applied to selected resolution of 1 day, 60, 30 or 15 minutes. Histogram bar highlighted when limit exceeded.

G.821 limits
User enters:
length in km for High Grade section of line.
length in km for Medium Grade section of line.
length in km for Local Grade section of line.
The line can be a combination of grades.
The limits for each are calculated and added.
For a Local or Medium grade block allocation user enter 1250 km.

G.821 Limits (Radio)
As for G.821 except limits are degraded for adverse propagation conditions.

G.921 limits
User enters:
length in km for Classification 1 section of line.
length in km for Classification 2 section of line.
length in km for Classification 3 section of line.
length in km for Classification 4 section of line.
The line can be a combination of all Classifications.
The block allocations are calculated for each and the overall limits totalized.

G.921 Limits (Radio)
As for G.921 except limits are degraded for adverse propagation conditions.

User defined limits
User enters the day, 15, 30 or 60 minute limit directly for each parameter. The period limits are then calculated.

Display
Histogram page for each of four parameters.

Printing Results
PRINT DISPLAY prints histogram plus text equivalent of results and setup.
SHIFT PRINT DISPLAY prints results for all four parameters for complete test.

M.2100
Implementation of Interpretation for the Receive and Send Direction columns in Table B2/M.2100 for 2 Mbit/s signal (non CRC4) and 2 Mbit/s (CRC4).
User programmable thresholds S1 and S2 for ES (Errored Seconds), SES (Severely Errored Seconds) and US (Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	*S1 Limit*	*S2 Limit*	*Message*
ES	XXXX	XXXX	ES > S1 limit or ES > S2 limit
SES	XXXX	XXXX	SES > S1 limit or SES > S2 limit
US	XXXX	XXXX	US > S1 limit or US > S2 limit

X=1 to 9

G.826
Parameters
Number of Errored Blocks (EB).
Number of Errored Seconds (ES).
Number of Severely Errored Seconds (SES).
Number of Background Block Errors (BBE).
Errored Second Ratio (ESR).
Severely Errored Second Ratio (SESR).
Background Block Error Ratio (BBER).
Unavailable Seconds (US).
% Unavailable Seconds (%US)
% Available Seconds (%AS)
Number of Breaks.
User programmable thresholds for ESR (Errored Second Ratio), SESR (Severely Errored Second Ratio), BBER (Background Block Error Ratio) and %US (%Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	*Limit*	*Message*
ESR	X.XE-Y	ESR > limit
SESR	X.XE-Y	SESR > limit
BBER	X.XE-Y	BBER > limit
%US	X.XXXX	%US > limit

X=1 to 9, Y=2 to 8.

STORED RESULTS

Error Distribution and Histograms
The errors associated with the selected error type are stored, minute by minute, for later analysis.

Accumulation Time - 72 hours.

Histogram
Page width
20 hours with a resolution of 1 hour.
20 minutes with a resolution of 1 minute.
The display is selectable from anywhere within the 72 hours.

Display
The stored results are displayed as a histogram of errors. A cursor is moved to point at any hour or any minute. The number of errors, the number of errored seconds (ES) and the number of severely errored seconds (SES) for that interval are then displayed, together with the date and time.

Intervals of loss of synchronization and power loss are displayed on the baseline.

TEST DURATION - When a test is started all previous results are cleared.

Duration
Indefinite, Timed, Range
Programmable in the range 1 minute to 100 hours.
Tests may be stopped at any time.

PROPAGATION DELAY
Measured using a PRBS unframed test pattern to allow operation under high error rate conditions.

Range - Up to 2 seconds.

Resolution - 1 bit period ±2 microseconds.

Update rate - Typically 2 seconds. Can be longer at low data rates.

CHANNEL ASSOCIATED SIGNALING
Selected channel signaling analysis for systems incorporating channel associated signaling.
Display: Signaling Code

2048 kbit/s
Decimal and binary equivalent of current and previous signaling code
Signaling code for all 30 channels simultaneously

T1
Current and previous state of A and B bits
Signaling code for all 24 channels simultaneously

T1 ESF
Current and previous state A, B, C and D bits
Signaling code for all 24 channels simultaneously

Analysis
From a set of user entered values (signaling codes and mask limits), the last 20 dialled digits are displayed. An error indication is given if the mask limits are exceeded.

Errors
Wrong signaling code.
Dial break pulse too wide.
Dial break pulse too narrow.
Inter Dial break pulse too wide or inter digit pulse too narrow.
Inter Dial break pulse too narrow.
11 or more dial break pulses.

C-BIT FRAMING
Monitoring of C-Bit Frame for French TRANSMIC-2G system.
Display of C-Bit Frame message bits.

DTMF SIGNALING

(Dual tone multifrequency)
DTMF tones are generated and detected within 64 kbit/s channels on 2048 kbit/s and 1544 kbit/s (T1) systems.

Tone pairs (one from each group)
Low group - 697, 770, 852, 941 Hz.
High group - 1209, 1336, 1477, 1633 Hz.

Generator
Generation of tone digits by keyboard entry.

Modes
Tone burst to preset length.
Sequence preset up to 19 digits.
Tone generated sent to loudspeaker if switched on.

Receiver
Receipt and display of valid tone digits.
No detection of short tones or other errors is provided.

BIT RATE MEASUREMENT
The bit rate is measured every second displayed to nearest 1 Hz.

Accuracy - ±5 ppm.

DIGITAL SIGNAL LEVEL MEASUREMENT
The amplitude of the incoming digital signal is measured and displayed in Volts peak and dB relative to nominal.

Range - +3 to -35 dB.

Accuracy - +3 to -10 dB ±1.5 dB
-10 to -20 dB ±2 dB
-20 to -30 dB ±3 dB.

2 CHANNEL SYNCHRONIZATION MEASUREMENT
The clocks are extracted from two primary rate digital signals and compared for synchronization.
One of the inputs is used as a reference.
A sync slip is registered for each bit of relative phase shift.

Measurement
Number of slips in current second.
Total slips since start of test.

Timing measurement (DTE only)
Time intervals between changes of control lines.

X.21 - C and I.

RS-449 (V.36) - RS and CS.

V.35 - RTS and CTS.

RS-232 - RTS and CTS.

Range - 0-10 s.

Resolution - 1 ms.

PARAMETER RULES

Loss of signal (LOS)
Errors in a loss of signal (LOS) second are discarded.

Framing errors
Errors in a loss of frame (LOF) second are discarded.

Pattern errors
Pattern errors are counted up to the point when pattern synchronization is lost. The count is suspended until synchronization is regained.

CRC errors
Errors in any second with loss of CRC multiframe sync are discarded.

Allowed Seconds
Seconds in which errors are not discarded.

Error counts
Count displays reach 999,999,999 and then stop.

Errors ratios
Displayed in the form $Xx10^{Y}$ where X is 1 to 9 and Y is 2 to 11.

Percentages
Calculated to 6 decimal places and displayed rounded to 5.

Update rate
Results and displays are updated every second.

Unavailable Time
A period of unavailable time begins when the error ratio in each second is worse than $1x10^{-3}$ (or otherwise severely errored) for ten consecutive seconds. These ten seconds are considered part of the unavailable time. The period of unavailable time terminates when the error ratio in each second is better than 1×10^{-3} for ten consecutive seconds. These ten seconds are considered part of the available time.

Break
A period of unavailable time.

Errored Seconds
A second of available time in which one or more errors are detected.

Error Free Second
A second of available time in which no errors are detected.

Severely Errored Seconds
A second of available time in which the error ratio is worse than 1×10^{-3}.
A second of available time in which the CRC block error rate is greater than:
830 errored CRC blocks in 1 second for 2048 kbit/s systems (M.2100).
320 errored CRC blocks in 1 second for 1544 kbit/s system (M.2100).
Note that a one second interval containing loss of signal or loss of synchronization is considered to be a severely errored second.

Non Severely Errored Second
A second of available time in which the error ratio is equal to or better than 1×10^{-3}.

Degraded Minute
A one minute interval during which the error ratio is worse than $1x10^{-6}$. The one minute intervals are obtained by ignoring unavailable time and severely errored seconds and consecutively grouping the remaining seconds.

Non Degraded Minute
A one minute interval (as defined above) during which the error ratio is equal to or better than $1x10^{-6}$.

MEASUREMENTS

Total Test Time
A count incremented once every second that the test is in progress. Displayed as days, hours, mins, seconds.

Number of Errors
The total number of errors (to date or to end of test) in the allowed seconds.

Long Term Mean Error Ratio (LTMER)
The ratio of Number of Errors to the Total Number of relevant bits.

Number of Loss of Signal (LOS) seconds
The total number of seconds in which there was no input signal.

Loss of Signal events
The number of blocks of consecutive Loss of Signal seconds.

Number of AIS seconds
The total number of seconds in which an AIS is detected.

AIS events
The number of blocks of consecutive AIS seconds. LOS seconds are not included.

Number of Loss of Frame Alignment (LOF) seconds
The total number of seconds in which a Frame Alarm is detected.

Loss of Frame events
The number of blocks of consecutive Loss of Frame seconds. LOS and AIS seconds are not included.

Number of Loss of Pattern Sync (LOP) seconds
The total number of seconds during which there was no Pattern Sync.

Loss of Pattern Sync events
The number of blocks of consecutive Loss of Pattern Sync seconds. LOS, AIS and LOF seconds are not included.

Number of Loss of CRC Sync (LOC) seconds
The total number of seconds during which Loss of CRC Alignment (LOC) was detected.

Loss of CRC Sync events
The number of blocks of consecutive Loss of CRC Sync seconds. LOS, AIS and LOF seconds are not included.

Short Term (Current) Error Ratio
The Auto algorithm used results in a fast attack/slow decay response which responds quickly to a rise in error ratio but falls slowly when the error ratio decreases. Also 1, 2, 5, 10 seconds gating.

Number of Bursts
The total number of bursts in the allowed seconds. A burst is defined as the detection of more than X errors in a multiframe where X may be set between 8 and 256.

Time Between Last Two Bursts
The time between the last two bursts is displayed in hours, mins, sec, millisecs.

Time Since Last Burst
The time since the last burst is displayed in hours, mins, sec, millisecs.

% Available Time
The ratio of available time to total test time.

% Unavailable Time
The ratio of unavailable time to total test time.

Number of Errored Seconds
The total number of available seconds in which one or more errors were detected.

% Errored Seconds
The ratio of errored seconds to available time.

% Error Free Seconds
The ratio of errored seconds to available time.

Number of Severely Errored Seconds (SES)
Total number of SES.

% Severely Errored Seconds
The ratio of SES to available time.

% Non Severely Errored Seconds
The ratio of non SES to available time.

Number of Degraded Minutes (DM)
Total number of DM.

% Degraded Minutes
The ratio of DM to available time.

% Non Degraded Minutes
The ratio of non DM to available time.

Number of Breaks
Total number of Breaks.

General Characteristics

OPERATOR INTERFACE
The instrument is controlled via a keyboard

containing a data entry keypad, dedicated keys and five soft-keys used in conjunction with a Cold Cathode Backlit Liquid Crystal Display. The 8 line by 40 character (plus graphics capability) LCD and keyboard are fully interactive providing menu and soft-key operation.

DISPLAYS
Transmit parameters.
Receive parameters.
Measurement Results including Stored Results.
RS-232C Port parameters.
Printer Type selection.
Measurement definition.
Autoprint definition.
Setup Conditions (Stored Parameters).
Current Status.

DISPLAY LANGUAGE
English, French, Italian, Spanish.
User Selectable.

AUDIBLE ALARM

Mode - ON, OFF.

ON - Alarm sounds on detection of:
Loss of any sync/signal.
Any errored second.

LOUDSPEAKER
Selected 64 kbit/s channels can be routed to the loudspeaker. There is a volume control.

SETUP CONDITIONS (STORAGE FACILITY)
A variety of information can be stored in non-volatile memory (battery backed-up).

Last Operation
The instrument retains all setup parameters when powered down. These are reinstated when the instrument is powered up.

Configuration Stores
18 sets of transmitter/receiver/test definition parameters can be selected for storage. Each set can be recalled whenever required, and can be identified with a 12 character label.

REAL TIME CLOCK - Displays date and time.

Resolution - One second.

Accuracy - ±1 minute per week.

POWER FAIL/TEST CONTINUE
If mains power is lost during a test, the test is resumed when power returns.

Indications - Power Fail page, Autoprint output.

MULTIPLE TESTS STORAGE
6 full sets of test results can be stored for later analysis and/or printing.

PRINT TO RAM
Up to 8,000 print lines can be stored in memory for subsequent scrolling on screen with full or partial print capability. Where required Print to RAM results can be stored with associated test results.

KEYBOARD LOCKOUT
The keyboard can be disabled whilst a test is running.

PRINTER FACILITIES

Page print or Autoprint printers
40 column minimum.

Page printing
Page printouts are initiated by the PRINT key and cause the whole of the current page to be printed. Graphics display pages can be printed in a text equivalent or a facsimile to a suitable printer.

Autoprinting
The printer can be set automatically to print on the occurrence of any of the following (where applicable), each event printed with its date and time and two digit identity number. A twelve character label is also printed where appropriate:
Test start and stop.
Loss and restoration of signal.
Loss and restoration of alignment.
Loss and restoration of pattern sync.
Detection of errors (ES).
Detection of burst errors.
Detection of ISDN error report alarm pulse (2048 kbit/s ISDN system).
Detection of change of state of bit 5 in Not Frame Word (2048 kbit/s ISDN system).
Detection of alarms.
Detection of octet slips.
Detection of a short term (current) error ratio, for the selected major error type, crossing a user set threshold.
Detection of change of signaling code.
Cumulative printout at preselectable intervals of 15 mins, 30 mins, 1 hour, 6 hours, 12 hours or 24 hours.
Stored results, G.821 results, and two channel synchronization slips may be included in interval print.
Loss and restoration of power.

Printer Operation
Page printing, long term collection of information via the Autoprint facility.

Remote Control
Remote commands are made up from a mixture of text and data. Commands are grouped into logical sets and allow for ease of use and self-documenting control programs.
Most controls are remotely programmable.

RS-232 PORT
The RS-232 port is used for printer operations, remote control, or for duplication of the display onto a terminal.

Type - Asynchronous, DTE, Full Duplex.

Bit Rates - 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400 bit/s.

Code - ASCII

Code bits/Parity/Stop bits
7/Odd/1, 7/Even/1, 7/Odd/2, 7/Even/2, 8/None/1, 8/None/2.

Handshake Hardware - DTR, RTS, CTS and DSR

Software - XON and XOFF

Lines Used

Tx DATA - Pin 2

RTS - Pin 4

DTR - Pin 20

Rx DATA - Pin 3

CTS - Pin 5

DSR - Pin 6

Connector - 25 way female D-type.

Electrical - To RS-232C/V.28.

IEEE-488 (Option) (2850BS and 2851S only)

Remote Control
Used for remote control or printer operations.

LIMIT RANGE OF OPERATION

Temperature - 0 to 55°C.

Safety
Complies with IEC 348, HD401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature - -40 to +70°C

Humidity - Up to 90% relative humidity (non condensing).

Altitude - Up to 2500 m (pressurized freight at 27 kPa differential).

ELECTROMAGNETIC COMPATIBILITY
Conforms to the protection requirement of Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:
BS EN 55011 Class B CISPR 11.
BS EN 50082-1 IEC 801-2, 3, 4.
BS EN 60555-2 IEC 555-2

POWER REQUIREMENTS

AC Operation

AC Voltage - 230 V nominal. 190 to 264 V.
115 V nominal. 90 to 120 V.

Frequency - 45 to 66 Hz.

Consumption - 20 VA maximum.

DC operation (Option)
One of three options can be specified.

48V Range - ±36 to ±60 V.

24 V Range - ±20 to ±60 V.

12 V Range - ±10 to ±18 V.

Battery operation (Option)

Operating time
7 hours with backlight timeout of 5 minutes for temperature range of 17 to 27°C.

Charge time - 15 hours.

Temperature range for full nominal charge
10 to 30°C.

Temperature range for full nominal discharge
0 to 50°C.

Limit range of operation

Charge - 0 to 35°C.

Discharge - 0 to 50°C.

2850B and 2851 - Mounts under 2851.

2850BS and 2851S - Mounts inside 2851S.

Weight - 2.7 kg

DIMENSIONS AND WEIGHT

	Height	*Width*	*Depth*	*Weight*
2850B/ 2851	110 mm max	353 mm	297 mm	4 kg
2850BS/ 2851S	197 mm	345 mm	477 mm	7.5 kg

Auxiliary Connector 25 Way D-Type

Pin	*Function*
1-2	Earth
3	Transmit external TTL clock input
4	Alarm extension output
5	Transmit PRBS sync output
6	Receive PRBS sync output
7	+5 V
8	Pattern alternate input
9-13	Earth
14	Receive NRZ line data input
15	Receive NRZ clock data input
16	Errors input
17	Spare
18	Transmit TTL data output
19	Transmit NRZ 64 kbit/s data input/receive TTL data input
20	Receive NRZ 64 kbit/s clock output
21	Receive NRZ 64 kbit/s data output
22	Transmit NRZ line data output
23	Transmit NRZ line clock output/transmit TTL clock output
24	Receive demultiplex clock output
25	Receive demultiplex data output

Versions and Accessories

When ordering please quote the full order number information

Ordering Numbers	Versions	
2850B	Desktop version	
2850BS	Metal case version	
2851	Desktop version	
2851S	Metal case version	
	Supplied Accessories	
43123-076	Supply Lead	
41690-485	Stowage Cover (2851S only)	
46884-604	Audio jacks plus (Qty 2)	
46884-403	15 Way D-Type Connector	
54311-125	X.21 Adapter Lead - V.11, DTE	
54311-127	RS-449 Adapter Lead - V.11, DTE	
54311-131	V.35 Adapter lead - DTE	
46882-128	Operating Manual	
46882-127	Introductory guide	
	Optional Accessories	
46880-004	Service manual	Common
54311-126	X.21 Adapter lead-V.10, DTE, female	Common
54311-140	X.21 Adapter lead-V.11, DCE, female	Common
54311-141	X.21 Adapter lead-V.10, DCE, female	Common
54311-128	RS-449 Adapter lead-V.10, DTE female	Common
54311-142	RS-449 Adapter lead-V.10, DCE female	Common
54311-143	RS-449 Adapter lead-V.10, DCE female	Common
54311-144	V.35 Adapter lead-DCE, female	Common
54311-152	RS-232 Adapter lead-DCE, female	Common
54311-121	RS-232 lead-male to male-25 way D type - 1.5 m	Common
54311-122	X.21 lead-male to male-15 way D type 1.5 m	Common
54311-147	RS-449 lead-male to male-37 way D type 1.5 m	Common
54311-148	V.35 lead-male to male- 34 way MRAC 1.5 m	Common
54311-130	Co/contradirectional test lead-15 way D type to free end	Common
43129-189	IEEE-448 lead (2851S)	Common
46662-387	RS-232 null modem female to male	Common
54717-039	Scriptos printer	Common
54311-216	RS-232 special lead Scriptos to 2850B/2851	Common
46662-260	Scriptos paper 10 pack	Common
46662-383	Bantam/310 adapter	N American
46662-491	Signal lead Bantam/Bantam	N American
46662-384	Signal lead 310/Bantam	N American
46662-382	Bantam plug	N American
46883-805	Signal lead balanced (CF-CF)	European
54311-210	Signal lead unbalanced - (BNC-BNC)	European
46662-388	BNC to 1.6/5.6 adapter	European
46884-402	D-type connector 25 way	Common
46662-490	Hard carrying case (2850B/2851)	Common
46662-493	Soft carrying case (2850B and 2851)	Common
46662-192	Transit case (2850BS/2851S)	Common
46662-499	Soft carrying case (2850BS/2851S)	Common
44991-035	Remote applications software: single license version	Common
44991-039	Remote applications software: site license version	Common
46883-852	Null modem (female to female)	Common
46883-824	Gender changer (female to female)	Common
54127-309	Rack mount kit (2850BS to 2851S only)	Common
46662-607	Codirectional test lead 15 way D-type to RTG16 - 2 m	European
49000-002	Remote Applications Software single user license	Common
49000-003	Remote Applications Software 20 user license	Common

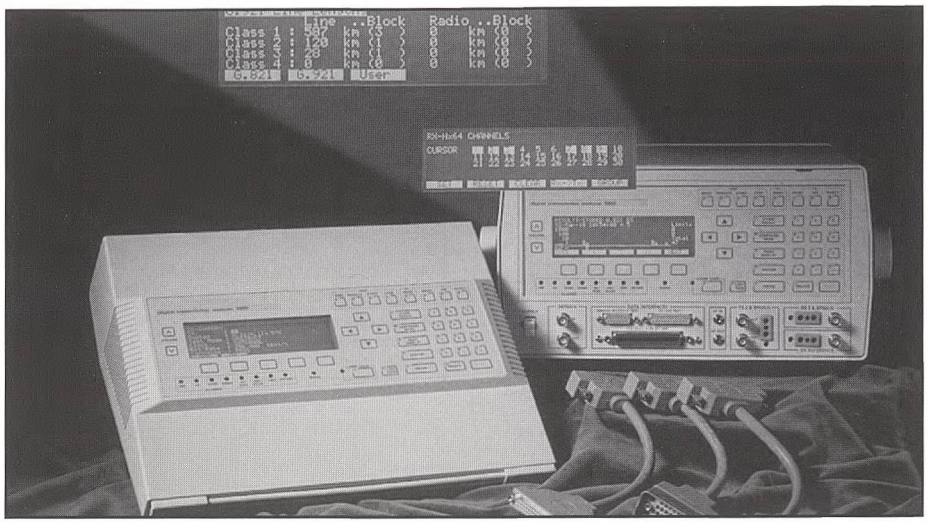
Option	Allowed Combinations							Description
01	★	★	★	★				European - 2048 & 8448 kbit/s
02		★						European - Add 1544 kbits
03			★					European - Add 704 kbit/s.
04				★				European - Add 704 kbit/s, T1, T1C, T2 (No ALBO)
05					★	★	★	North American - T1, T1C, T2
06						★		North American - 2048 kbit/s instead of T2
07							★	North American - Add 704, 2048, 8448 kbit/s (No ALBO)
08	†	†	†	†				French key panel.
09	†	†	†	†				1.6/5.6 Connectors
12	†	†	†	†	†	†	†	Battery
13	†	†	†	†	†	†	†	IEEE-488 (2852S and 2853S).
15	†	†	†	†	†	†	†	DC Input - ±36 V to ±60 V (includes cable)
16	†	†	†	†	†	†	†	DC Input - ±20 V to ±36 V (includes cable)
17	†	†	†	†	†	†	†	DC Input - ±10 V to ±18 V (includes cable)
22	†	†	†	†	†	†	†	EUROCOM D/1 IB6
23	†	†	†	†	†	†	†	Interface switching unit (2850S)
24	†	†	†	†	†	†	†	Structured data (X.50, 6+2, reiterated data)
25	†							EUROCOM D/1 IB5 and IB6
26	†	†	†	†	†	†	†	V.11 data rate to 9 Mbit/s

★ Basic options
† Additional options
Options 15, 16 and 17 are mutually exclusive

Option 12 is available only on 2850BS and 2851S
Option 15, 16, 17 and 24 are mutually exclusive on 2850B and 2851
For Option 24, the TTL interface is not available on 2850B and 2851

2852 & 2852S/2853 & 2853S Digital Analyzers

Desktop and rackmountable digital testers for PCM and data applications up to 34 Mbit/s including mux/demux



- PCM and data pattern generator and error detector from 50 bit/s to 34 Mbit/s
- Demultiplex and hierarchical errors and alarms monitoring
- Generate and monitor test patterns, framed or unframed, at all hierarchical levels within 8 and 34 Mbit/s signals
- All data test interfaces as standard: RS-232, X.21, V.35, RS-449 (V.36) (2853), codirectional, contradirectional with EUROCOM optional (2852 & 2853)
- Data interface and analog channel access
- G.821, G.921, M.2100 and G.962 analysis
- Measurements include propagation delay, frequency deviation, frequency and level measurement, DTMF and CAS
- DC power and internal battery options
- Remote control via RS-232 or IEEE-488 with optional PC applications software
- 2850B and 2851 full functionality

The 2853 Digital Communications Analyzer extends the capabilities of the 2850B and 2851 series of analyzers to include support of the newer service offerings from PTTs world-wide. Testability from data communications interfaces to high speed digital links and multiplexes at 2, 8 and 34 Mbit/s in a single portable and battery operated unit provides unrivalled flexibility for support of modern digital and data networks and equipment. The 2852 Digital Transmission Analyzer provides most of this functionality but limits the data test capability to Codirectional and Contradirectional interfaces.

2853 and 2852 include all the capabilities of 2851 and 2850B respectively. **This data sheet, therefore contains only those capabilities and specifications which are incremental relative to 2851 and 2850B.**

PCM FRAMING SYSTEMS

2852 and 2853 are able to generate and receive all commonly used framing systems up to 34 Mbit/s, for both the European and North American digital hierarchies.

The instrument can be optioned as European or hybrid versions, and this includes an all bit rate version (European plus North American).

Thus 2852 and 2853 have the flexibility to address global applications, including operation in International Gateways where there is a requirement to test mixtures of European and North American traffic carried on satellite systems.

56 kbit/s and 64 kbit/s Channel Testing

Individual channels within T1, 704, 2048, 8448 (G.704/G.744 and G.742), and 34368 kbit/s can be tested at 64 or 56 kbit/s, assisting in testing and fault location within digital data networks and cross-connect switches.

n x 64 kbit/s Channel Testing

The expanding services at n x 64 kbit/s can be tested where they are carried within T1, 704, 2048, 8448 and 34368 kbit/s digital signals. All systems and n x 64 kbit/s cross-connect switches are catered for with the flexibility of contiguous and non-contiguous channel selection.

Tributary and Channel Testing

2048 kbit/s tributaries within 8448 kbit/s digital signals and 2048 and 8448 kbit/s tributaries within 34 Mbit/s digital signals can be tested to ensure correct functioning of multiplexes.

Unstructured

Where the structures on digital links do not conform to the usual ITU-T Recommendations, for example inter-computer links, they can be tested using an unframed format.

DATA INTERFACE TESTING

All commonly used data interfaces are provided as standard to give a comprehensive data test capability together with primary, second and third order PCM rate testing. Thus PCM and data circuits and equipment can be tested with one compact, fully integrated test instrument, from 50 bit/s to 34 Mbit/s. Data test interfaces provided are RS-232, X.21, RS-449 (V.36), V.35 (2853), codirectional and contra-directional (2852 and 2853). DTE is standard, DCE optional. EUROCOM D/1 is optionally available for European military network applications.

Modes

Both synchronous and asynchronous modes are possible with a wide range of standard and user programmable data rates, so that traditional data interface testing can be addressed together with modern digital data services at 64 kbit/s, n x 64 kbit/s and other rates.

IN-SERVICE AND OUT-OF-SERVICE MEASUREMENTS

2852 and 2853 are equally suited to both installation and in-service maintenance measurements at rates up to 34 Mbit/s. Interfaces are provided to enable the receiver to be connected to a number of network points at varying impedances and signal sensitivities.

DEMULTIPLEX MONITORING

Comprehensive and flexible in-service monitoring is provided to enable simultaneous measurement of framing and CRC errors for a complete demultiplex path for 8448 and 34368 kbit/s signals. At the same time selected 64 kbit/s or n x 64 kbit/s channels, or 2048 or 8448 kbit/s tributaries, can be monitored for pattern errors, whilst analog channels can be monitored using the loudspeaker. Both Channel Associated and DTMF Signaling can be monitored within selected 2048 kbit/s tributaries, and alarms are monitored for the full demultiplex path.

CHANNEL ACCESS

Digital access is provided to transmit and receive timeslots in 704, 2048, 1544 and 8448 kbit/s (G.744) digital signals, or to 2048 kbit/s tributaries within 8448 and 34368 kbit/s digital signals. Analog access is possible only at 1544 and 2048 kbit/s, or within 2048 kbit/s tributaries of 8448 and 34368 kbit/s signals.

External Access

Access is provided to selected transmit and receive channels, at both analog and digital levels, for primary, secondary and third order digital signals. Thus, if required, external analog or digital test equipment can be connected to make specific channel measurements beyond the capability of 2852 and 2853. One example would be X.50 measurements using the 2851 Data Communication Analyzer.

TERMINAL EQUIPMENT TESTING

2852 and 2853 are able to simulate and detect alarm conditions associated with the various framing systems, so that terminal equipment can be tested for correct operation. This includes the ability to generate programmable Frame or Code Errors to check equipment thresholds.

It is also possible to test across multiplexes by inserting and monitoring test patterns within 2048 and 8448 kbit/s tributaries.

In addition, there are automatic test sequences for checking Frame and Multiframe Alignment strategy, and access is allowed to control and display the condition of all unassigned frame bits.

DIGITAL SIGNAL LEVEL AND FREQUENCY MEASUREMENT

The frequency and amplitude of the incoming digital signal is displayed which enables early warning of degradation of the signal.

RS-232 REMOTE OPERATION

Remote unattended operation can be accomplished via an RS-232 port, which can also be used for local printing. Keyboard functions can be duplicated via RS-232 enabling complete remote reconfiguration and reporting of results.

IEEE-488 (GPIB)

For 2852S and 2853S IEEE-488 can be specified as an option in addition to the standard RS-232 for factory test and laboratory applications or where IEEE-488 is preferred.

ALTERNATIVE PACKAGES

Alternative packages are offered for field portable (2852 and 2853), and rack-mount (2852S and 2853S) applications.

POWER OPTIONS

In addition to mains power, options are provided for battery and DC power to cater for all operational requirements including factory, exchange and field.

Specification

PCM Transmit Interface

FRAMING AND BIT RATES
As 2850, 2851 PLUS.

34368 kbit/s
Unframed, G.751 asynchronous (option)

Permitted combinations of bit rates
2048 & 8448 & 34368 kbit/s or
704 & 2048 & 8448 & 34368 kbit/s or
1544 & 2048 & 8448 & 34368 kbit/s or
704 & 2048 & 8448 & 1544 & 3152 & 6312 & 34368 kbit/s.

AIS
Unframed
All ones signal with zeros programmable at a rate of M x 10^{-N}, where M is 1 to 9 and N is 2 to 7.
Framed
34368 kbit/s: All ones signal transmitted in a selected 8448 kbit/s tributary.
8448 kbit/s: All ones signal transmitted in a selected 2048 kbit/s tributary.

CLOCK SOURCE
34 Mbit/s - Internal or external.

Internal
Accuracy
±2 ppm from 0 to 55°C, ±3 ppm/year.

Small Offset
34 Mbit/s
Steps of 5 and 25 ppm to maximum of ±60 ppm.

External
34 Mbit/s - Pin 12 of 15 way D-Type connector (34 Mbit/s NRZ).
Framed - 34.368 MHz ±60 ppm.
Unframed - 8 to 35 MHz.
Level - 0 dBm sine or square wave.
Impedance - 50 Ω.

CLOCK OUTPUT - TTL via 50 Ω.

LINE CODES - AMI (50% duty cycle), HDB3, NRZ (TTL level).

MAIN OUTPUTS (34 Mbit/s)
Unbalanced
Impedance - 75 Ω.
Peak Voltage - 1.0 V ±0.1 V.
Space Voltage - 0 V ±0.237 V

NRZ DIGITAL OUTPUT (34 Mbit/s)
(Unframed only)
Frequency Range - 0.5 to 35 Mbit/s.
Level - TTL.
Connector - 15 way D-Type (see end of specification for pinout).

TEST PATTERNS
Insertion
Single Channel
Selected 64 kbit/s channel of framed signal.
Selected 64 kbit/s channel of 2048 kbit/s tributary.
(8 and 34 Mbit/s output - option 14 fitted).
n x 64 kbit/s Channel
Selected n x 64 kbit/s channel of framed signal.
Selected n x 64 kbit/s channel of 2048 kbit/s tributary.
(8 and 34 Mbit/s output - option 14 fitted).
Channel distribution can be contiguous or non-contiguous.
2048 kbit/s Tributary
Selected 2048 kbit/s tributary. (8 and 34 Mbit/s output - option 14 fitted).
8448 kbit/s Tributary
Selected 8448 kbit/s tributary. (34 Mbit/s output only - option 14 fitted).
Unframed
Unframed signal.

PRBS
34 Mbit/s
2^{15}-1, 2^{18}-1, 2^{20}-1, 2^{23}-1, 2^{25}-1, 2^{28}-1.
All zeros - Continuous sequence of 0000.
All ones - Continuous sequence of 1111.
Alternating - Alternating sequence of 1010.
Word - User programmable sequence of 24 (34 Mbit/s only), 16 or 8 bits.
8+8 word
Two user programmable 8 bit sequences are alternated by an external TTL input. The changeover occurs at the end of 8 bits.
1 kHz 0 dBm0 sine wave
Digital representation of a sinusoidal signal of 1 kHz at a nominal level of 0 dBm0, coded according to A-Law. This facility is not available for 1544 kbit/s systems.

FILL PATTERNS
All other channels in single channel and n x 64 kbit/s framed operation.
PRBS, User programmable 8 bit word

8 and/or 2 Mbit/s tributaries (option 14 fitted)
AIS (ALL 1s), PRBS, ALL 0s, Alternating 10 and 2 or 8 Mbit/s test pattern

EXTERNAL VOICE AND DATA
For framed and multiplex operation, an externally input 64 kbit/s data stream or a voice frequency signal can be inserted into one of the channels in the transmitted signal instead of a test pattern.
Data Input
Applies to frame structures at 704, 1544, 2048 and 8448 kbit/s (G.704/G.744).
Applies to 2048 kbit/s tributaries within frame structures at 8448 kbit/s (G.742) and 34 Mbit/s (G.751) (option 14 fitted).

Data Input Interface
Codirectional to G.703.
Contradirectional to G.703 (AMI 100% or Bipolar NRZ).
X.21, RS-449 (V.36), V.35 (using DCE cable adapter accessory)
NRZ (TTL level).

VOICE FREQUENCY INPUT
Applies to frame structures at 1544 and 2048 kbit/s.
Applies to 2048 kbit/s tributaries within frame structures at 8448 kbit/s (G.742) and 34 Mbit/s (G.751) (option 14 fitted).
Range - 0.3 to 3.4 kHz.
Encoding - A-Law for 2048 kbit/s
μ-Law for 1544 k/bits.
Impedance - 600 Ω balanced.
Max Input Level - +3 dBm0.

ERROR INJECTION
Target - At 34 Mbit/s, unframed test pattern only.
Error Type
Binary - Bits are inverted before coding.
Code
Code errors are injected by changing ±1 to 0 and 0 to ±1 where the polarity of the inserted mark is the same as the polarity of the last mark transmitted.

Injection Mode
Singly - By keypress.
Fixed rate - Rate $3x10^{-1}$ to $1x10^{-7}$.
34 Mbit/s - $3x10^{-2}$ to $1x10^{-8}$.

2852/S, 2853/S

ACCESS TO STRUCTURE BITS
Frame alignment strategy.
Change unassigned, distant, and alarm bits.

SYNC OUTPUTS - PRBS.

Polarity - Negative Pulse.

Interface - TTL.

PCM Receive Interface

FRAMING AND BIT RATES - As Transmitter

Permitted Combinations of Bit Rates
As Transmitter

Frequency Tolerance - As 2850B, 2851 PLUS 34368 kbit/s ±60 ppm

LINE CODES - As Transmitter.

DIGITAL INPUT
Connector - BNC.
Impedance - 75 Ω unbalanced.

NRZ DIGITAL INPUT (34 Mbit/s)
Unframed only
Frequency Range - 0.5 to 35 Mbit/s
Level - TTL.
Connector - 15 way D-Type (see end of specification for pinout).

INPUT MODES AND SENSITIVITY

34 Mbit/s

Terminated - Terminates the line.

Sensitivity - ±1 V +3 -12 dB cable attenuation or -18 dB linear attenuation

Bridging - Taps onto a terminated line or unprotected monitor point.

Sensitivity - ±1 V +3 -9 dB cable attenuation or -12 dB linear attenuation

Monitor - Connects to a protected monitor point.

Sensitivity
-14, -26, -38 dB relative to nominal with range of +3 to -9 dB cable attenuation or -12 dB linear attenuation.

TEST PATTERNS

Source

Single Channel
Selected 64 kbit/s channel of framed signal.
Selected 64 kbit/s channel of 2048 kbit/s tributary. (8 and 34 Mbit/s input - option 14 fitted).

n x 64 kbit/s Channel
Selected n x 64 kbit/s channel of framed signal.
Selected n x 64 kbit/s channel of 2048 kbit/s tributary.
(8 and 34 Mbit/s input - option 14 fitted).
Channel distribution can be contiguous or non-contiguous.

2048 kbit/s Tributary
Selected 2048 kbit/s tributary. (8 and 34 Mbit/s input - option 14 fitted).
8448 kbit/s Tributary
Selected 8448 kbit/s tributary. (34 Mbit/s input only - option 14 fitted).

Unframed - Unframed signal.

PRBS

34 Mbit/s
2^{15}-1, 2^{18}-1, 2^{20}-1, 2^{23}-1, 2^{25}-1, 2^{28}-1.

Repetitive Word
Any word which repeats over a 24 bit (34 Mbit/s only) or 16 bit sequence.

CHANNEL EXTRACT
For framed single channel and demultiplex operation a selected 64 kbit/s channel is extracted from the received signal and output as a data signal or voice frequency signal. The audio output is also available on the internal loudspeaker.

Data Output
Applies to frame structures at 704, 1544, 2048 and 8448 kbit/s (G.704/G.744).
Applies to 2048 kbit/s tributaries within frame structures at 8448 kbit/s (G.742) and 34 Mbit/s (G.751) (option 14 fitted).

Data Output Interface
Codirectional to G.703.
Contradirectional to G.703 (100% AMI or Bipolar NRZ).
X.21, RS-449 (V.36), V.35 (using DCE cable adapter accessory)
NRZ (TTL level).

Frame or AIS alarm detected
All 1's transmitted.

Signal loss detected - Outputs are off.

Clock output - 64 kHz NRZ (TTL).

Voice Frequency Output
Applies to frame structures at 1544 and 2048 kbit/s.
Applies to 2048 kbit/s tributaries within frame structures at 8448 kbit/s (G.742) and 34 Mbit/s (G.751) (option 14 fitted).

Range - 0.3 to 3.4 kHz.

Decoding - A-Law for 2048 kbit/s.
μ-Law for 1544 kbit/s.

Impedance - 600 Ω balanced.

STATUS INDICATORS
A combination of LEDs and an alarm page indicate frame structure alarm conditions for the input signal and, for demultiplex operation, the tributaries selected. For Demux mode hierarchical AIS, FRAME and DISTANT alarms are ORed to the LED indicator.

UNASSIGNED FRAMING BITS
The state of the unassigned bits is displayed.

SYNC OUTPUTS - PRBS.

Polarity - Negative pulse.

Interface - TTL.

Data Test Interfaces

X.21, RS-449 (V.36), V.35 and RS-232
As 2851 (2853 only).

Codirectional and Contradirectional
As 2850B, 2851

TEST PATTERNS - As 2851

ERROR INJECTION - As 2851

ALARMS - As 2851

SYNC OUTPUTS - As 2851

ERRORS OUTPUT - As 2851

Measurements

ERROR TYPES

PCM Interfaces
Line Code Errors, Pattern Errors, Framing Errors, CRC Errors.

Data Interfaces
Pattern Errors.
Line Code Errors
Measured on input signal rate.
Framing Errors
Measured at each hierarchical level for the demultiplex path selected.
Pattern Errors
Measured for the selected test pattern which can be a tributary, 64 kbit/s, n x 64 kbit/s channel, or unframed.
CRC Errors
Measured as appropriate for selected input signal, or 2048 kbit/s tributaries.

MAIN PARAMETERS - As 2851.

ADDITIONAL PARAMETERS - As 2851

G.821 ERROR PERFORMANCE - As 2851

G.821/G.921 HISTOGRAMS - As 2851

STORED RESULTS - As 2851

TEST DURATION - As 2851

PROPAGATION DELAY
Measured using a PRBS unframed test pattern to allow operation under high error rate conditions.

34 Mbit/s

Range - Up to 8 seconds.

Resolution - 1 bit.

Update rate - Typically up to 8 seconds.

SIGNALING - As 2851

BIT RATE MEASUREMENT
The bit rate is measured every second or every 2 seconds (34 Mbit/s) and displayed to the nearest 1 Hz.

Accuracy - ±2 ppm ±1 count.

DIGITAL SIGNAL LEVEL MEASUREMENT
The amplitude of the incoming digital signal is measured and displayed in Volts peak and dB relative to nominal.

34 Mbit/s
Terminated and Bridging Range +3 to -20 dB.

Accuracy - ±1 dB.

Monitoring Range
14 dB: -10 to -34 dB
26 dB: -22 to -44 dB
38 dB: -34 to -44 dB

Accuracy - ±2 dB.

2 CHANNEL SYNCHRONIZATION MEASUREMENT
As 2851

TIMING MEASUREMENT (DTE ONLY)
As 2851

General Characteristics

As 2851 except:

IEEE-488 (Option) - 2853S only.

POWER REQUIREMENTS

AC Operation
AC Voltage
230 V nominal. 190 to 264 V.
115 V nominal. 90 to 120 V.
Frequency - 45 to 66 Hz.
Consumption - 45 VA maximum.

DC operation (Option) - As 2850B/S, 2851/S

Battery operation (Option)
Operating time
7 hours or 3 hours (34 Mbit/s) with backlight timeout of 5 minutes for temperature range of 17 to 27° C.
2852 and 2853
Battery mounts under 2852 and 2853.
2852S and 2853S
Battery mounts inside 2852S and 2853S.
Weight of battery
2.7 kg.

DIMENSIONS AND WEIGHT

	Height	*Width*	*Depth*	*Weight*
2850B/ 2851	110 mm max	353 mm	297 mm	4 kg
2850BS/ 2851S	197 mm	345 mm	477 mm	7.5 kg

34 Mbit/s NRZ CONNECTOR 15 way D-Type

Pin Number	*Description*	*Function*
1,3,5,7,9, 11,13	0 V	
6	Transmit Clock In	NRZ
10	Transmit Clock Out	NRZ
8	Transmit Data Out	NRZ
2	Receive Clock In	NRZ
4	Receive Data In	NRZ
12	Transmit Clock In	HDB3/AMI clock - 50 Ω

Versions and Accessories

When ordering please quote full ordering number information

Ordering Numbers	*Versions*
2852S	Metal Case Version.
2852	Desktop Version.
2853S	Metal Case Version.
2853	Desktop Version.

Note that 2852 and 2852S do not provide RS-232, X.21, RS-449 and V.35 test interfaces.

	Supplied with
43123-076	Supply Lead
41690-485	Stowage Cover (2851S only)
46884-604	Audio jacks plus (Qty 2)
46884-403	15 Way D-Type Connector
54311-125	X.21 Adapter Lead - V.11, DTE
54311-127	RS-449 Adapter Lead - V.11, DTE
54311-131	V.35 Adapter lead - DTE
46882-128	Operating Manual
46882-127	Introductory guide
	Optional Accessories
	As 2850B/S, 2851/S

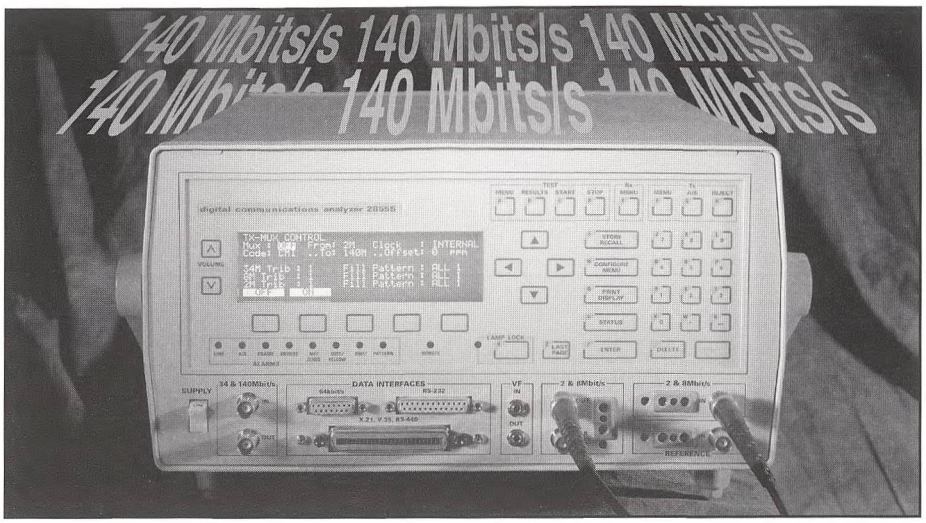
http://www.ifrinternational.com

Option	Allowed Combinations								Description
01	★	★	★	★	★	★	★	★	2, 8 Mbit/s framed & 34 Mbit/s unframed
02		★				★			Add 1544 kbit/s (T1).
03			★				★		Add 704 kbit/s.
04				★				★	Add 704 kbit/s, T1, T1C, T2 (No ALBO).
14					★	★	★	★	Add 34 Mbit/s framed & mux/demux.
08	†	†	†	†	†	†	†	†	French key panel.
09	†	†	†	†	†	†	†	†	1.6/5.6 Connectors.
15	†	†	†	†	†	†	†	†	DC Input - ±36 V to ±60 V (includes cable).
16	†	†	†	†	†	†	†	†	DC Input - ±20 V to ±36 V (includes cable).
17	†	†	†	†	†	†	†	†	DC Input - ±10 V to ±18 V (includes cable).
12	†	†	†	†	†	†	†	†	Battery.
13	†	†	†	†	†	†	†	†	IEEE-488 (2852S and 2853S).
22	†	†	†	†	†	†	†	†	EUROCOM D/1 IB6.
25	†				†				EUROCOM D/1 IB5 and IB6.
26	†	†	†	†	†	†	†	†	V.11 data rate to 9 Mbit/s

★ Basic options.
† Additional options.
Options 15, 16 and 17 are mutually exclusive.
Option 13 is available only on 2852S and 2853S.

2854S/2855S
Digital Analyzers

Digital testers for PCM and data applications up to 140 Mbit/s including mux/demux



- PCM and data pattern generator and error detector from 50 bit/s to 140 Mbit/s
- Demultiplex and hierarchical errors and alarms monitoring
- Generate and monitor test patterns, framed or unframed, at all hierarchical levels within 8, 34 and 140 Mbit/s signals
- All data test interfaces as standard: RS-232, X.21, V.35, RS-449 (V.36) (2855S), codirectional, contradirectional with EUROCOM optional (2854S and 2855S)
- Data interface and analog channel access
- G.821, G.921, G.826, M.2100 and G.962 analysis
- Measurements include propagation delay, frequency deviation, frequency and level measurement, DTMF and CAS
- DC power and internal battery options
- Remote control via RS-232 or IEEE-488 with optional PC applications software
- 2850B and 2851 full functionality

The 2855S Digital Communications Analyzer extends the capabilities of the 285X series of analyzers to include support of the latest service offerings from PTTs world-wide. Testability from data communications interfaces to high speed digital links and multiplexes at 2, 8, 34, and 140 Mbit/s in a single portable and battery operated unit provides unrivalled flexibility for support of modern digital and data networks and equipment. The 2854S Digital Transmission Analyzer provides most of this functionality but limits the data test capability to Codirectional and Contradirectional interfaces.

This Data Sheet, therefore, contains only those capabilities and specifications which are incremental to 2850B and 2851.

PCM Framing Systems

2854S and 2855S are able to generate and receive all commonly used framing systems up to 140 Mbit/s for the European digital hierarchy. North American rates are also available to 6 Mbit/s.

The instrument can be optioned as European or hybrid versions, and this includes a mixed rate version (European plus North American).

Thus 2854S and 2855S have the flexibility to address global applications, including operation in International Gateways where there is a requirement to test mixtures of European and North American traffic carried on satellite systems.

56 kbit/s and 64 kbit/s Channel Testing

Individual channels within T1, 704, 2048, 8448 (G.704/G.744 and G.742), 34368 and 139264 kbit/s can be tested at 64 or 56 kbit/s, assisting in testing and fault location within digital data networks and cross-connect switches.

n × 64 kbit/s Channel Testing

The expanding services at n × 64 kbit/s can be tested where they are carried within T1, 704, 2048, 8448, 34368 and 139264 kbit/s digital signals. All systems and n × 64 kbit/s cross connect switches are catered for with the flexibility of contiguous and non-contiguous channel selection.

Tributary Testing

2048 kbit/s tributaries within 8448 kbit/s digital signals, 2048 and 8448 kbit/s tributaries within 34368 kbit/s digital signals, and 2048, 8448 and 34368 kbit/s tributaries within 139264 kbit/s digital signals, can be tested to ensure correct functioning of multiplexes.

Unstructured

Where the structures on digital links do not conform to the usual CCITT Recommendations, for example inter-computer links, tests can be performed using an unframed format.

DATA INTERFACE TESTING

All commonly used data interfaces are provided as standard to give a comprehensive data test capability together with primary, second, third and fourth order PCM rate testing. Thus PCM and data circuits and equipment can be tested with one compact, fully integrated test instrument, from 50 bit/s to 140 Mbit/s. Data test interfaces provided are RS-232, X.21, RS-449 (V.36), V.35 (2855S), codirectional and contradirectional (2854S and 2855S). DTE is standard, DCE optional.

Modes

Both synchronous and asynchronous modes are possible with a wide range of standard and user programmable data rates, so that traditional data interface

testing can be addressed together with modern digital data services at 64 kbit/s, n × 64 kbit/s and other rates.

IN-SERVICE AND OUT-OF-SERVICE MEASUREMENTS

2854S and 2855S are equally suited to both installation and in-service maintenance measurements at rates up to 140 Mbit/s. Interfaces are provided to enable the receiver to be connected to a number of network points at varying impedances and signal sensitivities, including the provision of automatic equalization (automatic line build out, ALBO) at 2048 kbit/s.

DEMULTIPLEX MONITORING

Comprehensive and flexible in-service monitoring is provided to enable simultaneous measurement of framing and CRC errors for a complete demultiplex path for 8448, 34368 and 139264 kbit/s signals. At the same time selected 64 kbit/s or n × 64 kbit/s channels, or 2048, 8448 or 34368 kbit/s tributaries, can be monitored for pattern errors, whilst analog channels can be monitored using the loudspeaker. Both Channel Associated and DTMF Signaling can be monitored within selected 2048 kbit/s tributaries, and alarms are monitored for the full demultiplex path.

CHANNEL ACCESS

Digital access is provided to transmit and receive timeslots in 704, 2048, 1544 and 8448 kbit/s (G.744) digital signals, or to 2048 kbit/s tributaries within 8448, 34368 and 139264 kbit/s digital signals. Analog access is possible only at 1544 and 2048 kbit/s, or within 2048 tributaries of 8448, 34368 and 139264 kbit/s signals.

Drop and Insert

In addition to checking error performance of selected 64 kbit/s and n × 64 kbit/s channels with transmitter and receiver operating independently, a Drop and Insert configuration can be adopted for 704, 2048 and 1544 kbit/s systems so that 64 kbit/s and n × 64 kbit/s channels can be tested with minimum disruption of service to other in-traffic channels.

External Access

Access is provided on front panel connectors to selected transmit and receive channels, at both analog and digital levels, for first, second, third and fourth order digital signals. Thus, if required, external analog or digital test equipment can be connected to make specific channel measurements beyond the capability of 2854S and 2855S.

TERMINAL EQUIPMENT TESTING

2854S and 2855S are able to simulate and detect alarm conditions associated with the various framing systems, so that terminal equipment can be tested for correct operation. This includes the ability to generate programmable Frame or Code Errors to check equipment thresholds.

It is also possible to test across multiplexes by inserting and monitoring test patterns within 2048, 8448 and 34368 kbit/s tributaries.

In addition, there are automatic test sequences for checking Frame and Multiframe Alignment Strategy, and access is allowed to control and display the condition of all unassigned frame bits.

RS-232 REMOTE OPERATION

Remote unattended operation can be accomplished via an RS-232 port, which can also be used for local printing. Keyboard functions can be duplicated via RS-232 enabling complete remote reconfiguration and reporting of results.

IEEE-488 (GPIB)

IEEE-488 can be specified as an option in addition to the standard RS-232 for factory test and laboratory applications or where IEEE-488 is preferred.

POWER OPTIONS

In addition to mains power, options are provided for battery and DC power to cater for all operational requirements including factory, exchange and field.

Specification

PCM Transmit Interface

FRAMING AND BIT RATES
As 2850B, 2851 PLUS
34368 kbit/s - G.751 asynchronous
139264 kbit/s - G.751 asynchronous

Permitted combinations of bit rates
2048 & 8448 & 34368 & 139264 kbit/s or
704 & 2048 & 8448 & 34368 & 139264 kbit/s or
1544 & 2048 & 8448 & 34368 & 139264 kbit/s or
704 & 2048 & 8448 & 1544 & 3152 & 6312 & 34368 & 139264 kbit/s.

AIS - Unframed all ones signal.

CLOCK SOURCE - Internal, external or derived from the received signal.

Internal - 34 and 140 Mbit/s

Accuracy - ±2 ppm from 0° C to 55° C

Offset - ±100 ppm.

External

Unframed and Multiplex Clock - BNC connector.

Range - 6 MHz to 160 MHz

Interface - Sine or square wave (ECL/TTL)

Impedance - 50 Ω

CLOCK OUTPUT - TTL or ECL into 75 Ω.

LINE CODES
CMI, AMI (50% duty cycle), HDB3, NRZ

MAIN OUTPUTS - 34 and 140 Mbit/s

Unbalanced

Impedance - 75 Ω.

Peak Voltage
34 Mbit/s - 1.0 V ±0.1 V.
140 Mbit/s - 0.5 ±0.05 V

Space Voltage - 0 V ±10% peak.

NRZ DIGITAL OUTPUT - 34 and 140 Mbit/s

Unframed only with external clock

Frequency Range - 6 to 160 Mbit/s.

Level - TTL or ECL to 50 Mbit/s, ECL above 50 Mbit/s.

Connector
Data - main digital output BNC.
Clock - BNC on rear panel.

TEST PATTERNS

Insertion

Single Channel
Selected 64 kbit/s channel of framed signal at 2048 kbit/s or 8448 kbit/s (G.744).
Selected 64 kbit/s channel of 2048 kbit/s tributary.(8, 34 and 140 Mbit/s output), or 8448 kbit/s (G.744) tributary (34 and 140 Mbit/s output).

n × 64 kbit/s Channel
Selected n × 64 kbit/s channel of framed signal at 2048 kbit/s or 8448 kbit/s (G.744).
Selected n × 64 kbit/s channel of 2048 kbit/s tributary (8, 34 and 140 Mbit/s output).
Channel distribution can be contiguous or non-contiguous.

2048 kbit/s Tributary
Selected 2048 kbit/s tributary (8, 34 and 140 Mbit/s output).

8448 kbit/s Tributary
Selected 8448 kbit/s tributary (34 and 140 Mbit/s output).

34368 kbit/s Tributary
Selected 34368 kbit/s tributary (140 Mbit/s output).

Unframed
Unframed signal.

PRBS - 34 and 140 Mbit/s
2^{15}-1, 2^{18}-1, 2^{20}-1, 2^{23}-1, 2^{25}-1, 2^{28}-1, 2^{31}-1

All zeros - Continuous sequence of 0000.

All ones - Continuous sequence of 1111.

Alternating - Alternating sequence of 1010.

Word - User programmable sequence of 24 (34 and 140 Mbit/s only), 16 or 8 bits.

8 + 8 word
Two user programmable 8 bit sequences are alternated by an external TTL input. The changeover occurs at the end of 8 bits (not at 34 or 140 Mbit/s).

1 kHz 0 dBm0 sine wave
Digital representation of a sinusoidal signal of 1 kHz at a nominal level of 0 dBm0, coded according to A-Law, inserted into single channel. This facility is available for 704 and 2048 kbit/s systems only.

FILL PATTERNS
All other channels in single channel and n×64 kbit/s framed operation
PRBS, 2^{15} -1.
User programmable 8 bit word.

34 and/or 8 and/or 2 Mbit/s tributaries
All 1s, All 0s, PRBS, Alternating 10.
Copy of 2 or 8 or 34 Mbit/s test signal.

EXTERNAL VOICE and DATA
For framed and multiplex operation, an externally input 64 kbit/s data stream or a voice frequency signal can be inserted into one of the channels in the transmitted signal instead of a test pattern.

Data Input
Applies to frame structures at 704, 1544, 2048 and 8448 kbit/s (G.704/G.744).
Applies to 2048 kbit/s tributaries within frame structures at 8448 kbit/s (G.742), 34 and 140 Mbit/s (G.751) and 8448 kbit/s (G.744) tributaries within 34 and 140 Mbit/s.

Data Input Interface
Codirectional to G.703
Contradirectional to G.703 (AMI 100% or Bipolar NRZ).
X.21, RS-449 (V.36), V.35 (using DCE adapter cable accessory).
NRZ (TTL level).

VOICE FREQUENCY INPUT
Applies to frame structures at 1544 and 2048 kbit/s.
Applies to 2048 kbit/s tributaries within frame structures at 8448 kbit/s (G.742), 34 and 140 Mbit/s (G.751).

Range - 0.3 to 3.4 kHz

Encoding - A-law for 2048 kbit/s.
μ-Law for 1544 kbit/s.

Impedance - 600 Ω balanced.

Max Input Level - +3 dBm0

ERROR INJECTION - 34 and 140 Mbit/s

Target - Test Pattern.

Framing. - Error Type

Binary - Bits are inverted before coding.

Code
Code errors are injected by changing ±1 to 0 and 0 to ±1 where the polarity of the inserted mark is the same as the polarity of the last mark transmitted. There is no injection into CMI line code at 140 Mbit/s.

Injection Mode

Singly - By keypress.

Fixed rate
34 Mbit/s
3×10^{-2} to 1×10^{-8} (pattern and code)
3×10^{-2} to 1×10^{-7} (frame)
140 Mbit/s
3×10^{-3} to 1×10^{-9} (pattern)
3×10^{-3} to 1×10^{-7} (frame)

2854S, 2855S

ACCESS TO STRUCTURE BITS
34 and 140 Mbit/s
Frame alignment strategy
Change unassigned, distant, and alarm bits

PCM Receiver Interface

FRAMING AND BIT RATES - As Transmitter

Permitted combinations of bit rates - As Transmitter.

Frequency Tolerance - As 2850B, 2851 PLUS

34368 kbit/s - ±60 ppm.

139264 kbit/s - ±60 ppm.

LINE CODES - As Transmitter.

DIGITAL INPUT

Connector - BNC.

Impedance - 75 Ω unbalanced.

NRZ DIGITAL INPUT - 34 and 140 Mbit/s

Unframed only

Frequency Range - 6 to 160 Mbit/s.

Level - TTL or ECL to 50 Mbit/s, ECL above 50 Mbit/s.

Connector
Data - main digital output BNC.
Clock - BNC on rear panel.

INPUT MODES AND SENSITIVITY
34 and 140 Mbit/s

Terminated - Terminates the line.

Sensitivity
±1 V (34 Mbit/s), ±0.5V (140 Mbit/s), nominal.
+3 dB -12 dB cable attenuation.
+3 dB -18 dB linear attenuation.

Monitor - Connects to a protected monitor point.

Sensitivity
Nominal attenuation of 15, 20, 26 and 30 dB.
+3 dB -6 dB cable attenuation.
+3 dB -12 dB linear attenuation.
Maximum total attenuation 38 dB.

TEST PATTERNS

Source

Single Channel
Selected 64 kbit/s channel of framed signal at 2048 kbit/s or 8448 kbit/s (G.744).
Selected 64 kbit/s channel of 2048 kbit/s tributary.(8, 34 and 140 Mbit/s input), or 8448 kbit/s (G.744) tributary (34 and 140 Mbit/s input).

n × 64 kbit/s Channel
Selected n × 64 kbit/s channel of framed signal at 2048 kbit/s or 8448 kbit/s (G.744).
Selected n × 64 kbit/s channel of 2048 kbit/s tributary (8, 34 and 140 Mbit/s input).
Channel distribution can be contiguous or non-contiguous.

2048 kbit/s Tributary
8448 kbit/s Tributary
Selected 2048 kbit/s tributary (8, 34 and 140 Mbit/s input).
Selected 8448 kbit/s tributary (34 and 140 Mbit/s input).

34368 kbit/s Tributary
Selected 34368 kbit/s tributary (140 Mbit/s input).

Unframed - Unframed signal.

PRBS - 34 and 140 Mbit/s
2^{15}-1, 2^{18}-1, 2^{20}-1, 2^{23}-1, 2^{25}-1, 2^{28}-1, 2^{31}-1.

Repetitive Word
Any word which repeats over a 24 bit (34 and 140 Mbit/s only), 16 bit or 8 bit sequence.

CHANNEL EXTRACT
For framed single channel and demultiplex operation a selected 64 kbit/s channel is extracted from the received signal and output as a data signal or voice frequency signal. The audio output is also available on the internal loudspeaker.

Data Output
Applies to frame structures at 704, 1544, 2048 and 8448 kbit/s (G.704/G.744).
Applies to 2048 kbit/s tributaries within frame structures at 8448 kbit/s (G.742), 34 and 140 Mbit/s (G.751) and 8448 kbit/s (G.744) tributaries within 34 and 140 Mbit/s.

Data Output Interface
Codirectional to G.703.
Contradirectional to G.703 (100% AMI or Bipolar NRZ).
X.21, RS-449 (V.36), V.35 (using DCE adapter cable accessory).
NRZ (TTL level).

Frame or AIS alarm detected - All 1's transmitted.

Signal loss detected - Outputs are off.

Clock output - 64 kHz (TTL).

Voice Frequency Output
Applies to frame structures at 1544 and 2048 kbit/s.
Applies to 2048 kbit/s tributaries within frame structures at 8448 kbit/s (G.742), 34 and 140 Mbit/s (G.751).

Range - 0.3 to 3.4 kHz

Decoding - A-Law for 2048 kbit/s
μ-Law for 1544 kbit/s.

Impedance - 600 Ω balanced.

STATUS INDICATORS
A combination of LEDs and an alarm page indicate frame structure alarm conditions for the input signal and, for demultiplex operation, the tributaries selected.
For Demux mode hierarchical AIS, FRAME and DISTANT alarms are ORed to the LED indicator.

UNASSIGNED FRAMING BITS
The state of the unassigned bits is displayed.

DATA TEST INTERFACES

X.21, RS-449 (V.36), V.35 and RS-232
As 2851 (2855S only).

TEST PATTERNS - As 2851.

ERROR INJECTION - As 2851.

ALARMS - As 2851.

SYNC OUTPUTS - As 2851.

ERRORS OUTPUT - As 2851.

Measurements

ERROR TYPES

PCM Interfaces
Line Code Errors (Bipolar Violations), Pattern Errors, Framing Errors, CRC Errors.

Data Interfaces
Pattern Errors, Line Code Errors, Measured on input signal.

Framing Errors
Measured at each hierarchical level for the demultiplex path selected.

Pattern Errors
Measured for the selected test pattern which can be a tributary, 64 kbit/s, n × 64 kbit/s channel, or unframed.

CRC Errors
Measured as appropriate for selected input signal, or 2048 kbit/s tributaries.

MAIN PARAMETERS - As 2851.

ADDITIONAL PARAMETERS - As 2851.

G.821 ERROR PERFORMANCE - As 2851.

STORED RESULTS - As 2851.

PROPAGATION DELAY - 34 and 140 Mbit/s

Range - Up to 8 seconds.

Resolution - 1 bit, 4 bits at 140 Mbit/s.

Update rate - Typically up to 8 seconds.

SIGNALING

BIT RATE MEASUREMENT
The bit rate is measured every other second and displayed to the nearest 1 Hz, or 4 Hz at 140 Mbit/s.

Accuracy - ± 2 ppm, ±1 count.

DIGITAL SIGNAL LEVEL MEASUREMENT
The amplitude of the incoming digital signal is measured and displayed in Volts peak and dB relative to nominal.

34 and 140 Mbit/s

Range - +3 to -40 dB.

Accuracy
+3 to -30 dB ±2 dB
-30 to -40 dB ±3 dB

2 CHANNEL SYNCHRONISATION MEASUREMENT
As 2851.

BIT RATE MEASUREMENT
The bit rate is measured every other second and displayed to the nearest 1 Hz, or 4 Hz at 140 Mbit/s.

Accuracy - ± 2 ppm, ±1 count.

DIGITAL SIGNAL LEVEL MEASUREMENT
The amplitude of the incoming digital signal is measured and displayed in Volts peak and dB relative to nominal.

34 and 140 Mbit/s
Range - +3 to -40 dB

Accuracy
+3 to -30 dB ±2 dB.
-30 to -40 dB ±3 dB.

2 CHANNEL SYNCHRONIZATION MEASUREMENT
As 2851.

General Characteristics

As 2851 except

IEEE-488 (Option)
Used for remote control or printer operations.

POWER REQUIREMENTS

AC Operation
AC Voltage
230 V nominal. 190 to 264 V
115 V nominal. 90 to 120 V

Frequency - 45 to 66 Hz

Consumption - 80 VA maximum

DC Operation (Option)

48V - Range ±36 to ±60 V

Battery Operation (Option)

Operating time
1½ hours with backlight timeout of 5 minutes for temperature range of 17 to 27° C.

Charge time - 15 hours

Temperature range for full nominal charge
10 to 30° C

Temperature range for full nominal discharge
0 to 50° C

Limit range of operation
Charge - 0 to 35° C
Discharge - 0 to 50° C

Weight of battery - 2.7 kg

INSTRUMENT DIMENSIONS AND WEIGHT

Height	Width	Depth	Weight
197 mm	345 mm	477 mm	8 kg

Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2854S	Digital Transmission Analyzer
2855S	Digital Communications Analyzer
	Supplied Accessories
	As 2850B/S, 2851/S
	Optional Accessories
	As 2850B/S, 2851/S

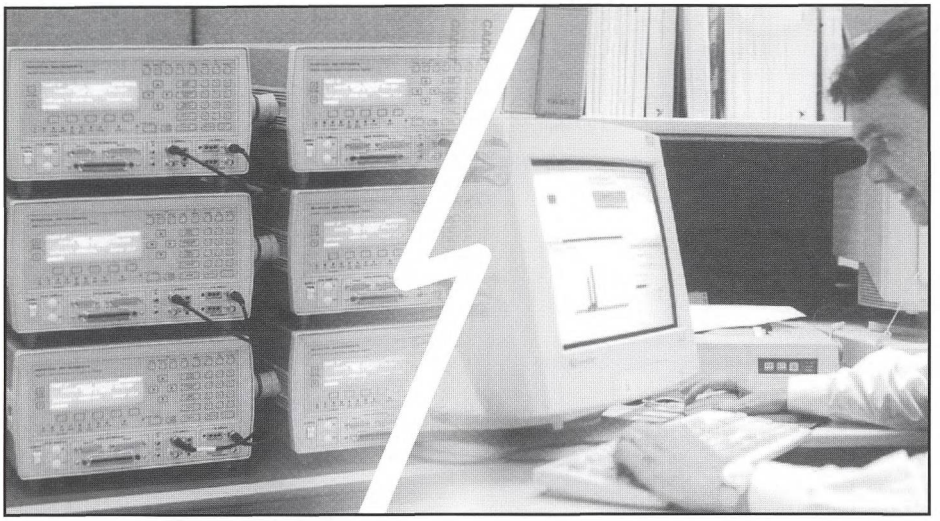
Note that 2854S does not provide RS-232, X.21, RS-449 and V.35 test interfaces

Option	*Allowed Combinations*				*Description*
01	★	★	★	★	2, 8, 34 and 140 Mbit/s Framed and Mux/Demux
02		★			Add 1544 kbit/s (T1)
03			★		Add 704 kbit/s
04				★	Add 704 kbit/s, T1, T1C, T2 (No ALBO)
08	†	†	†	†	French key panel
09	†	†	†	†	1.6/5.6 Connectors
12	†	†	†	†	Battery
13	†	†	†	†	IEEE-488
19	†	†	†	†	DC Input - ±36 to ±60 V (includes cable)
22	†	†	†	†	EUROCOM D/1 IB6
25	†				EUROCOM D/1 IB5 & IB6
26	†	†	†	†	V.11 data rate to 9 Mbits/s

★ Basic options.
† Additional options.

285X Remote Software Special Systems

A software system specifically designed for the remote control of a number of 2850 series transmission analyzers through a Windows 95 and NT Interface



- Windows 95 / NT compatible
- Telnet (TCP/IP), MODEM or Direct link options
- Simple to use Graphical User Interface with full on-line help
- Real time logging of test results with 10 second resolution
- Graphical, Tabular and Comma Separated Variable outputs
- Logging of stored results from instruments with 1 minute resolution
- The last 72 hours results can be recalled and stored during or after a test

This modular, user friendly software is a powerful addition to the 285X series of Digital Transmission Analyzers. It runs on both Windows 95 and NT platforms, and through its easily understood user interface, with its use of a mouse and pull-down menus, it provides a comprehensive, easy to use remote operation and results collection facility, enabling fast and efficient measurement analysis.

The software can be used to expand the instrument's capability by providing virtually unlimited storage of measurement results. It will be of particular interest to those working within design and development environments, and to those with long term test or monitoring applications, either local or remote.

This package enhances the operation of the 285X by providing three key facilities: full remote control, storage of results during or after a test, and a comprehensive results display capability.

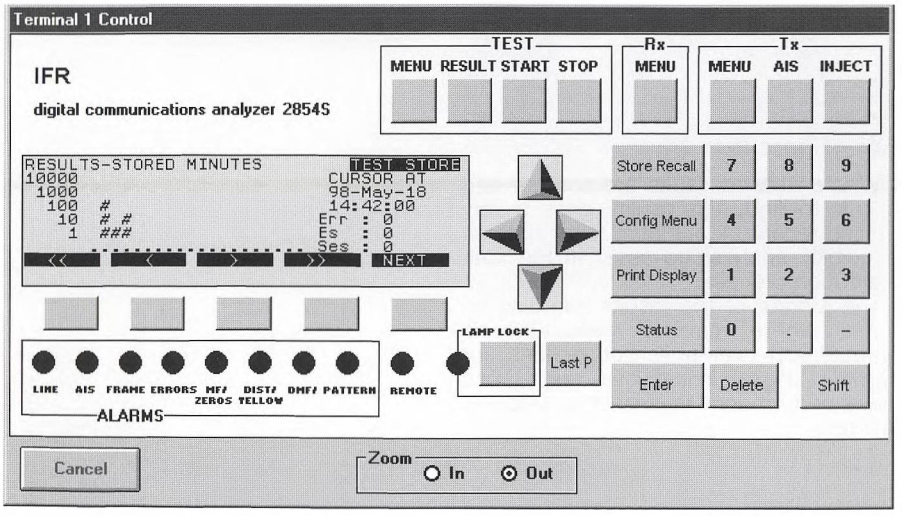
Communication

The software offers a choice of communication methods between the controlling PC and the 285X instruments, and the software parameters for each method can be quickly and easily set up. For a direct connection the user can configure the data structure to match that of the instrument. Similarly, modem communication can be used but is limited to one instrument at any one time. Alternatively the software supports TCP/IP communication over a LAN or WAN, in which case the connection with the remote instrumentation is achieved using terminal servers. When using this method multiple instruments can be connected at one or many sites.

Virtual Instruments

Through a unique terminal mode, multiple instruments can be simultaneously controlled and a virtual instrument representation of each can be displayed on a terminal. The physical location of each virtual instrument could be in different parts of the same building, or anywhere in the world, wherever the network requires.

Instrument control is provided through simple keyboard or mouse operation. The virtual instrument buttons operate exactly as those on the actual instrument. This negates the need for extra software and instrument training. Instrument responses are displayed on the virtual instrument's real-time viewing panel. The panel has a

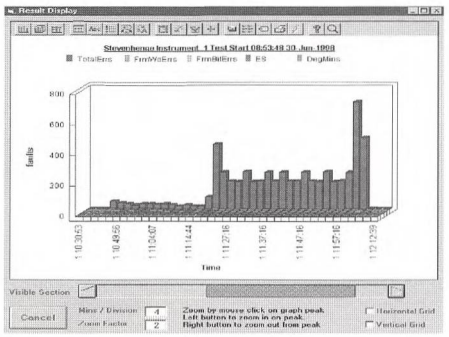


285X Remote Software

zoom function that allows for enhanced view of the instrument.

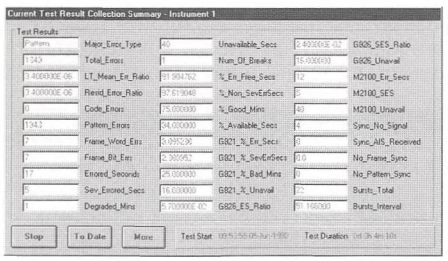
Stored Results

On connecting to an instrument a check is made as to the status of any testing that is being performed. If a test is found to be running the operator is given the opportunity to stop the test and collect the results or to enter the virtual instrument mode to check on the status of the test. Should the operator choose to collect the results, either now or later, the results are transferred to the controller's local storage where they can be viewed in either a textual or enhanced graphical form.



Store Live Results

If required the operator is given the opportunity to remain connected to the remote instrument whilst a test is running. This mode of operation gives access to in excess of 70 pieces of constantly updating information from up to two instruments per operator. The storage of results is limited only by disk space available. The results are saved to disk to a resolution of 10 seconds minimum. All the information stored is also displayed as it is collected on the controlling PC. A 'snapshot' button is provided that closes a log file for subsequent display or analysis on a separate PC. This facilitates the generation of status reports prior to the end of long term tests.



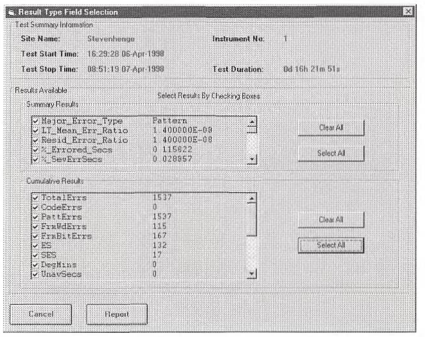
Where network faults are obscure and difficult to find, this facility gives a very detailed record of long term tests that can be quickly analyzed to assist in the fault localization process.

The storing of live results can also be useful where circuits need to be characterized over prolonged periods, for example digital microwave radio links whose performance is subject to seasonal variations.

Display Results

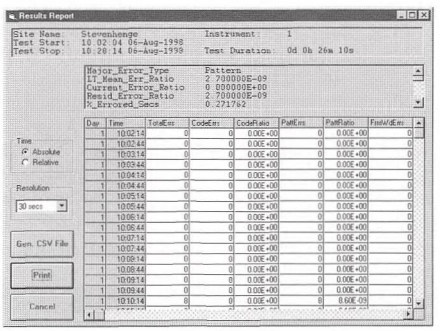
Results which are stored to disk or on an associated networked PC can be recalled and displayed in textual or graphical format.

Based upon the selection criteria the results can also be reported in a textual or graphical form, or saved in a comma separated variable form for inclusion in other applications. The results can be viewed in either a relative time to the start of test or absolute to the time of day the test took place. The greatest resolution is always shown by default but the user has the option to view the results by grouping in time intervals up to 1 month steps.



All displays and reports can be printed to a suitable printer attached to the operating PC.

All results are stored in a file that is configured by the user to define which results are needed and whether or not the results contain snap shot summary information of data that is valid as cumulative over time and hence is able to be graphed.



Specification

Communication Parameters

Link
Direct via RS-232 connection
Modem (Software will communicate with supported modems)
Local Area Network. TCP/IP link to an instrument connected to a terminal server. IFR are pleased to quote for the supply of suitable equipment.

REMOTE FUNCTIONS
Recall instrument configuration on connection to an instrument.
Full or reduced virtual instrument control of up to two instruments at a time.
Instrument operation via mouse and keyboard of the controlling PC.

Stored Results

Resolution
1 minute.

Capacity
72 hours.

Information Stored
Major error type.

Errored seconds.	(Cumulative)
Severely errored Seconds.	(Cumulative)
Synchronization status.	(Cumulative)
Power status	(Cumulative)

Various summary data available from the instrument.

Live Results

Resolution
10 seconds.

Capacity
Only limited by disk storage available.

Information stored
Any results available from the instrument.
Information categorized as Summary or Cumulative.
To date summary available
Continuous visibility of stored information.

Display

Types
Textual
Tabular
Graphical

Resolution
Absolute or relative
Months, days, hours, 15 minutes, minutes and seconds.

Graphical data
All graphical data user selected.
6 items per graph.
Auto scaling.
Printable and available to bitmaps and clipboard.

Software Platform

Windows 95 or Windows NT 4.0

Ordering Information

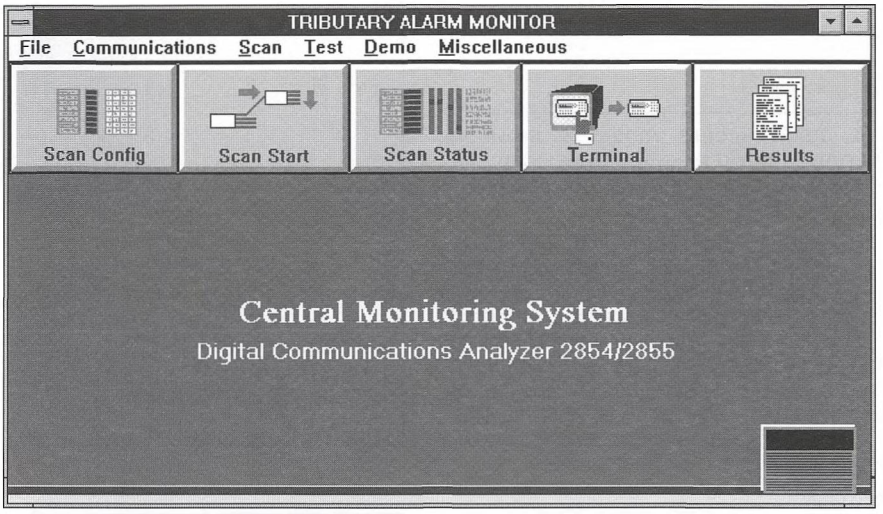
When ordering please quote the full order number information

Ordering Numbers	*Versions*
49000/002	Single user license
49000/003	20 user license

http://www.ifrinternational.com

MIAMI
Remote Network Monitoring

Allows pro-active fault finding of telecomms networks from a central site. Uses configurable scans and graphical displays



- Reduces maintenance costs
- Automatic scanning of trunks and tributaries
- Allows pro-active fault finding
- Control test equipment from a central site
- Terminal emulation mode
- Graphical display of G.821 errors

One application area of increasing importance is that of network monitoring. This is especially true where the network is providing a service to the public, for example a telecommunications network or a cable network. IFR has provided remote network monitoring solutions which allow network operators to monitor PDH traffic at key network nodes from a central location.

The monitoring system is split into two parts - the central node and multiple remote nodes. The central node provides facilities for configuring the whole system and is connected to the remote nodes using ISDN, kilostream or modem and bridges. It additionally provides access to any of the remote nodes for in depth monitoring of lines and analysis of errors and alarms.

The remote nodes are equipped with IFR 2854/5 Digital Transmission / Communications Analyzers which are connected to the 140 Mbit/s transmission lines through a switch module. This allows the computers at the remote nodes to select which of the 140 Mbit/s lines are being scanned at any particular time.

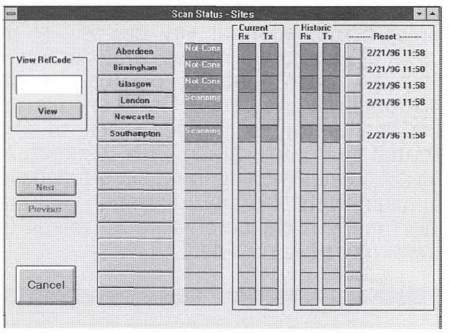
Proactive Fault Finding

The system provides records of network error levels. These can be used to reduce the time taken to locate and diagnose the causes of faults. In addition, the continuous monitoring of the networks means that you can be pro-active in fault finding. Instead of reacting to fault reports from customers, you can detect and correct potential problems before they are noticed.

The software facilities are split into four main modes, Scan Configure, Scan, Test and Terminal Emulation of the instrument front panel.

Scan Configure

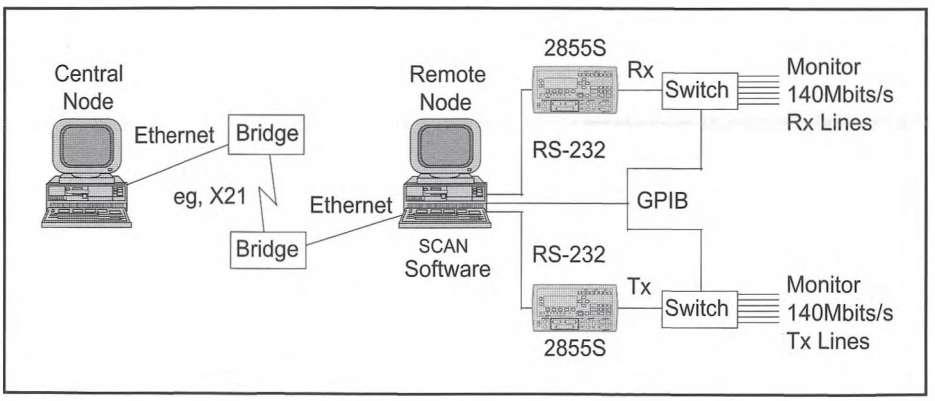
This mode allows the system to be configured from the central node. Remote nodes can be added to a site list and which trunk and tributaries will form part of the scan can be selected. Configuration tables show the status of each node and list the numbers of lines and tributaries selected at each node.



Status Mode

Scan

Scans are performed automatically by the remote computers but can be monitored centrally. Each configured switch port in turn is selected and the computer stores the results of all alarms down to 2 Mbit/s. The results of these scans can be



Example Configuration

monitored from the central node and date stamped records of failure alarms can be logged to a file. Three levels of display allow the choice of displays for site, trunk or tributaries.

Features on the displays are colour coded to indicate the status of the different lines.

Feature	*Colour*
Untested tributaries	Blue
Unconfigured tributaries	Grey
Passes	Green
Failures	Red
Historical failures	Orange

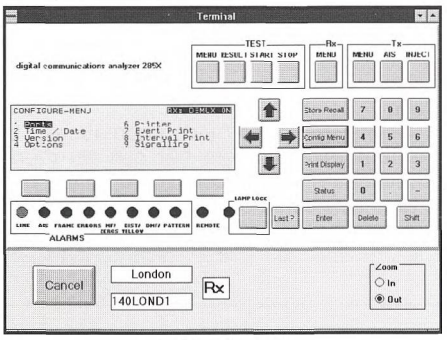
A quick access mode is provided whereby individual tributaries can be selected by means of a reference code.

Test

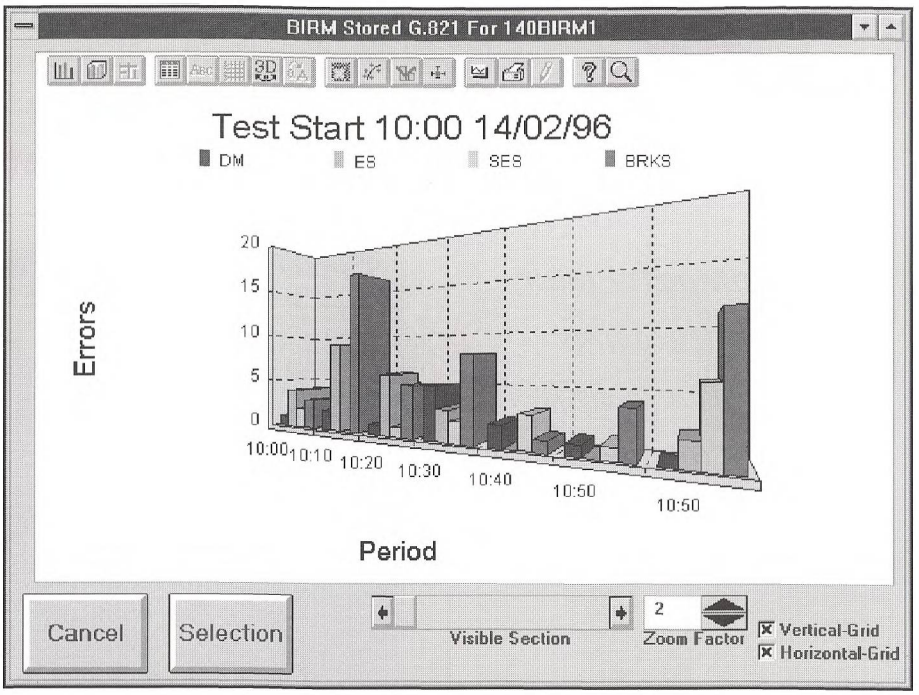
The test mode allows the user to perform tests for various errors and present the results in a format which can be customised to suit his needs. Standard facilities include graphical representation of G.821 errors and major errors against time. Other facilities include the logging of DTMF numbers against time, and displays of CAS and Frequency values. Results can also be obtained in tabular format.

Terminal

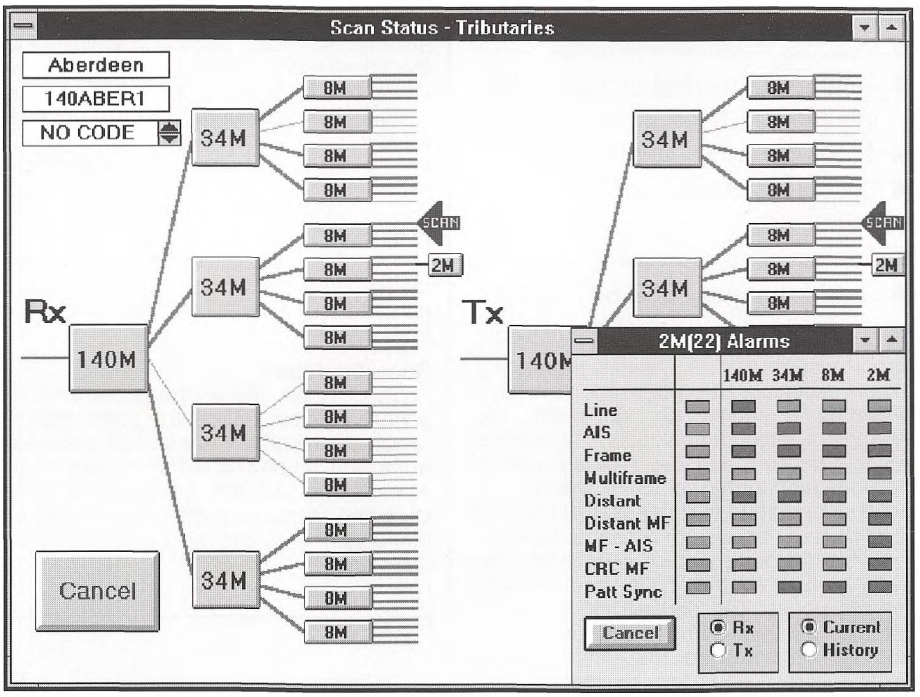
The terminal mode gives the user full control of the analyzer at any remote node. By a combination of key presses or by using the computer mouse, the operator is able to 'push' buttons on the remote instrument front panel. The response on the instrument is echoed back to the central computer screen. This means that no additional training is required for those familiar with manual operation of the instrument. A choice of standard screen or zoom modes is provided.



Terminal Mode



Test Mode



Scan Mode

Typical Specification

Minimum Recommended PC Requirements
486 machine with 8 Mbytes of memory, SVGA resolution and Windows for Workgroups 3.11.

Digital Communications Analysis
G.703 input
2 Mbit/s - 140 Mbit/s
Frame Analysis
2 Mbit/s, 8 Mbit/s, 34 Mbit/s and Analysis of CAS signal codes
Detection of alarm and errors at all tributary levels
2 Mbit/s G.703 output
DTMF Decoding
Analog output for voice analysis

Multi-way Input Selection
Modular, up to 126 receive and 126 transmit digital signals at 140Mbit/s
75 Ω BNC connectors or Type 43
19 in rack or bench mounted

GPIB Interface
National Instruments PCIIa or PCMCIA

Netlink 423/424
Network Transmission Quality Testers

Find your network problems before your customers do!



- Service qualification testing
- End to end network testing
- Inter exchange network testing
- Network fault finding
- Customer access network testing
- Acoustic and telephone testing
- PABX and special services testing
- Network quality assurance

The NETLINK 423 Network Test Transponder and NETLINK 424 Network Test Responder can be operated individually or as a system across the network to give a comprehensive analysis of the network, find faults and to maintain required performance standards.

Ease of Operation

NETLINK 423 can be used at customer premises, main exchanges, PABXs, cable pits and pillars. It plugs into the telephone service via a 2 wire connection.

To perform a test or sequence of tests, the user simply selects the test functions and parameters from the NETLINK 423 options menu, enters the test origin and destination details and presses the test button. Tests are automatically performed and results stored in non-volatile memory for subsequent display or retrieval via a modem or data link. The results can be printed out in hard copy.

The NETLINK 424 Responder provides an answer base for test calls originated from other NETLINK instruments, and from other network users and testers.

The NETLINK instruments can be used in stand alone mode or controlled from a PC using one of the standard ComLink application software packages.

Applications

The NETLINK 423 and 424 test the characteristics of the customer access network and the inter-exchange network, as well as the performance of the end to end network from the customer's perception. The instruments enable field staff to quickly and easily carry out a wide range of fully automatic network measurements, with minimum of training and experience.

Measurements

The network tests, automatically performed by NETLINK 423 and 424 include:

- DC loop current
- Dial tone delay and post dialling delay
- Ring voltage
- Transmission loss
- High and low frequency slope
- Multiple impedance swept frequency Return loss
- Noise (flat or psophometric at both ends)
- Echo (both ends) and round trip propagation delay
- Duration of call

NETLINK 423 includes a number of other special tests for network investigation and fault finding:

- Impulse noise test
- Tone dropout test (amplitude hits)
- Ring monitor test
- Tone monitor test
- Traffic route test
- Direct line test
- Auto sequence test

DC Loop Current

A significant Customer Access Network (CAN) characteristic which can affect the performance of the customer's telephone if too low or too high.

Dial Tone Delay & Post Dialling Delay

Key indicators of the switching performance of the network, and can cause a customer dissatisfaction if these become excessive.

Ring Voltage

Low ring voltage is a major factor in customer complaints relating to loss of incoming calls, answering machine and facsimile answering problems.

Transmission Loss

For CAN and Inter Network Exchange verification testing, identifying excess CAN loss problems, digital network loss faults and marginal signal to noise ratios causing problems with modems and facsimile equipment.

High and Low Frequency Slope

At up to twenty optional programmable test frequencies; also key network verification parameters useful for identifying problems with loaded cables and also affecting high speed modems.

Multiple Impedance Swept Frequency Return Loss

Is a measure of impedance mismatches between the customer's premises equipment and the CAN through to the exchange equipment. Mismatches are a major cause of lack of speech clarity and data transmission errors.

Noise (flat or psophometric)

A key pointer to cable joint, moisture and imbalance faults in the CAN and signal to noise margin problems with high speed modems.

Echo and Propagation/Echo Delay

Far end impedance mismatch on long distance calls is perceived as echo.

Netlink 423/424

Propagation delay is a useful indication of call routing.

Duration of Call

For metering checks and is user programmable to assist in the location of call cut-off problems.

Impulse Noise Test

Against four thresholds for a user selectable test time of 1-99 minutes.

Tone Drop Out Test (amplitude hits)

Against four thresholds relative to signal level, for a user selectable test time of 1 to 99 minutes.

Ring Monitor Test

Measures the voltage, frequency and cadence of incoming ring current to ensure it meets the requirements for answering and facsimile machines.

Tone Monitor Test

Measures the level, frequency and cadence of tone signals on the line (ring, busy etc).

Traffic Route Test

Checks call set-up and network switching performance without performing transmission measurements.

Direct Line Test

Measures the transmission characteristics of a direct line disconnected from the exchange (private line, customer cable, tie line, VF bearer, dedicated point to point modem circuit).

Auto Sequence Test

Carries out up to 250 standard test calls and displays the statistical summary of the results (call set up fails categories, loss ranges etc).

NETWORKING AND COMMUNICATIONS

The Netlink instruments incorporate in-built data modem and communications port that support remote controlled testing and remote data acquisition.

Test data from field test units can be directly accessed by network providers computers and network quality management systems via modem or data link using the ComLink family of software packages. The ComLink software automates testing and result acquisition, thus providing significant cost and time savings from productivity improvement, and also ensuring that the results are free from human error or misinterpretation, and have a complete audit trail.

ComLink Access

This is a single user Windows™ application program that provides field staff with a user-friendly interface to a Netlink tester.

The software automatically executes the required tests and displays tests results in a user-friendly graphical format that is easy to understand. All results are stored on the PC hard disc for subsequent retrieval and analysis.

ComLink Manager

ComLink Manager is a distributed network user application program which allows authorised management staff to access a central ODBC database of Netlink test results from anywhere in the Provider's data network.

Managers can browse, view and print test results in real time, and statistically analyse results against network performance criteria.

ComLink Executive

ComLink Executive enables system administrators to set up and maintain a network of Netlink Test Responders via its Responder database.

The Executive software allows administrators to set the test and system parameters of the Netlink Responders and to perform maintenance services such as auto calibration.

ComLink Executive also automatically maintains an ODBC database of network test results.

The ComLink Executive maintains communications with one or more groups of centralised Netlink Test Responders based on their test activity.

As each test in the network is completed it is automatically stored in a local or remote ODBC database.

Specification

NETLINK 423 - Measurement Ranges

Level
-40 dBu to +10 dBu @ 0.1 dB resolution
Noise
-70 dBu to -20 dBu @ 0.1 dB resolution
Slope
30 dB to -10 dB @ 0.1 dB resolution
Return Loss
0 to 40 dBu @ 0.1 dB resolution
Echo
-50 dBu to 0 dBu @ 0.1 dB resolution
1 to 65 ms @ 1 ms resolution
Propagation Delay
1 to 65 ms @ 1 ms resolution
Line Current
0 to 70 mA @ 0.1mA resolution
Dial Tone Delay
0 to 99.9 secs @ 0.1s resolution
Answer Delay
0 to 99.9 secs @ 0.1s resolution
Call Duration
0 to 99 mins 59 secs @ 0.1s resolution
Ring Signal Level
0 to 125 Vrms @ 1 Vrms resolution
Ring Signal Frequency
10 to 50 Hz
Ring Signal Cadence
0 to 990 ms
Tone Signal Level
-40 dBu to +10 dBu
Tone Signal Frequency
0 to 4000 Hz
Tone Signal Cadence
0 to 990 ms
Impulse Noise Count
0 to 64,000
Signal Drop-Out Count
0 to 64,000

Test Tone Oscillator
Frequency Standards
1020Hz and 820Hz
Transmission Tests
300 Hz to 3800 Hz @ -10 dBu
Tone Tests
300 Hz to 3800 Hz @ -10 dBu
Sweep Tests
200 Hz - 4000 Hz - 200 Hz @ -10 dBu
Signal Drop-Out Test
1020 Hz @ -10 dBu
Echo Tests
1900 Hz - 1980 Hz @ -10 dBu (4ms)
Propagation Test
1900 Hz - 1980 Hz @ -10 dBu (4ms)

NETLINK 424

Acoustic Tests

Transmission	-10 to -40 dBr
Reception	-42 to -6 dBr
Sidetone	-82 to -46 dBr
Noise	-40 to -80 dBr

Tone Transmit Tests
300 to 4000 Hz programmable
-10 dBu test tone level
Programmable cadence and duration
Programmable sweep tone

Tone Responder Tests
300 to 4000 Hz response tone
-20 dBu trigger level

Special Responder Modes
Impulse noise test
Signal drop out test
1 - 99 minutes programmable

Transmission Measurements
-10 to +40 dB loss
-10 to +30 dB slope
-70 to -20 dBu noise
-50 to 0 dBu echo

General

Automatic Tests
2 - 250 tests
1 dB or 3 dB statistical bins

Switching Measurements
0.1 to 250 seconds call timing
Call fail categorisation
Programmable hold and trace facility

Test Impedances
TN6 (600 Ω), or TN12 (programmable) for transmission tests.
TN6 (600 Ω), BN1, BN12 for return loss tests.

Signaling
DTMF or decadic dialling
1200/75 bps V.23/V.21 autodial/auto answer modem for remote control and data, or unit to unit communication

Serial Data Comms Port
Opto-isolated multipoint RS232
Programmable data rate 1200-9600 bps
Programmable data format and parity
Terminal/printer mode
PC/Computer controller protocol
2500V AC isolation

Power Supply
Internal rechargeable NiCad batteries or External 10-15V AC, 12-16 V DC plug-pack
Power consumption:
100 mA (typ) during test
10 mA (typ) during idle (waiting)

Mechanical
NetLink 423 - 220 mm x 115 mm x 60 mm
Portable hand-held enclosure
NetLink 424 - 245 mm x 160 mm x 65 mm

Environment

Storage	-10°C to 70°C
Operating	5°C to +45°C
Humidity	5-95% RH (non-condensing)
Shock	1g 1/2 sinewave 10 ms
Vibration	0.5g, 0-63 Hz

External Connections

Test Line	RJ12 connectors Standard telephone cord Optional adapter test cords
External Supply	2.5 mm dc jack

Serial Comms Port 9 pin female D-connector
Pin 2 = Transmit Data
Pin 3 = Receive Data
Pins 4,6 = Data Terminal Ready
Pin 5 = Signal Ground
Pins 7,8 = Clear to Send

Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Version*
61000	NETLINK 423 Network Test Transponder MA-423-000
61001	NETLINK 424 Network Test Responder MA-424-000
61003	ComLink Access Software ES-422-100
61004	ComLink Manager Software ES-422-200
61005	ComLink Executive Software ES-422-300

Netlink 430
Digital Line Test Set

Is your copper network ready for the digital super highway? Get the answer with the Netlink 430 Digital Line Test Set



- Test cable pairs in high frequency digital transmission system
- DPGS, PRA/BRA ISDN, HDSL, ADSL
- Identify fault conditions easily
- Easy to use
- Single user operation
- Battery operated

NETLINK 430 Digital Line Test Set is an integrated multi-function instrument to test the suitability of cable pairs for high frequency digital transmission systems such as digital pair gain systems, primary and basic rate ISDN, HDSL and ADSL.

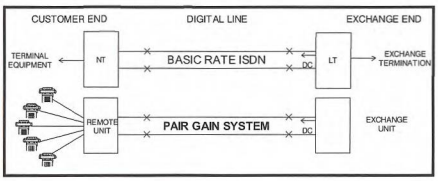
The Test Set consists of a digital Meter and a remote controlled Transponder. A single user can use the Meter to control the remote Transponder and to quickly and easily perform a comprehensive range of tests to identify cable conditions which can adversely affect high frequency digital signaling systems.

As demand for telephone and data services continues to exceed the capacity of most telephone networks, network operators are looking for ways to increase the utilisation of cable pairs by the provision of remote multiplexers, pair gain systems and ISDN services.

These services require the cable pair to transmit high frequency digital signals, and in most cases, to also carry DC power to the remote multiplexer and terminal equipment. This places stringent demands on the cable's high frequency transmission performance, noise levels and DC insulation characteristics.

NETLINK 430 Digital Line Test Set enables field staff to readily identify cable conditions which can prevent digital systems from operating correctly and reliably:

- High frequency insertion loss
- Loading coils
- Split pairs
- Dry joints
- Low insulation resistance
- Bridged taps
- Noise and cross talk



Ease of Operation

The Meter and Transponder combine the tests and functions of a number of instruments to give such a simple operation that only one technician is needed.

All measurements are performed automatically by the user simply by pressing the required test button on the Meter keypad. The Meter sends a message to the Transponder requesting it to provide the appropriate test signal and/or test termination as required. When it receives acknowledgement from the Transponder, the Meter automatically performs the selected test and displays the result.

Applications

NETLINK 430 Digital Line Test Set can be used for cable pre-qualification testing to ensure that the cable pair is capable of reliably carrying the digital transmission of pair gain systems, ISDN services, etc. before the service is commissioned.

The Meter/Transponder remote control operation enables a single user to perform these tests and then automatically thru-connect the customer's new service to line when the pre-qualification tests are completed.

The Test Set also enables a user to identify cable problems in existing digital transmission installations, typically causing intermittent faults and errors. These faults have previously been difficult to identify with conventional non-integrated test equipment, leading to repeat service calls and customer dissatisfaction.

NETLINK 430 Digital Line Test Set enables network operators to be confident that a high standard of quality and reliability is maintained to its customers on the introduction of new services, and also that these services are provided in a timely and efficient manner.

Test Integration

By integrating the range of essential test functions the NETLINK 430 Digital Line Test Set replaces a number of normal test instruments. At the same time achieving better results more quickly and easily.

Measurements

The following measurements can be performed:

- Earth leakage, foreign battery
- VF insertion loss
- VF frequency response (slope)
- Digital (HF) transmission loss
- Noise (wideband, narrowband and impulse)
- Unbalance (longitudinal conversion transfer loss)
- AC/DC voltage
- Loop resistance

Netlink 430

- Insulation resistance
- Cable capacitance
- Loading coil detection
- High impedance monitor

VF Tests

These tests characterize and/or verify the cable's voice frequency (VF) transmission characteristics. The Meter and Transponder measure the VF insertion loss of the cable, which is displayed on the meter with a range of 0 to 20 dB and a resolution of 0.1 dB, and is carried out at a test impedance of 600 Ω. The VF test range of the instrument corresponds typically to 0 to 15 km of 0.40 mm cable. The standard insertion loss test frequency is the ITU-T VF standard 1020 Hz. The Test Set also provides frequency response measurements: high frequency slope HFS (2800 Hz) and low frequency slope LFS (400 Hz).

HF Tests

The instrument will measure the high frequency loss of the test cable. Typically for ISDN and pair gain systems this should not exceed 45 dB. Standard test frequencies are provided for digital pair gain, ISDN, HDSL and ADSL systems. The instrument readily identifies bridged taps by measuring HF loss 3 dB or more in excess of the expected value.

Noise Tests

The Test Set measures wide-band and narrow-band noise. The test displays the continuous and peak noise measured and retains the peak value at the end of the test. Together with the test duration, this enables the instrument to indicate impulse noise, including 1 second noise pulses due to electric fences in rural areas. The instrument's noise tests can also be a pointer to cross talk, unbalance (split pair) problems and leakage to ground or foreign battery.

Unbalance Test

This test is designed to assist in identifying "split pair" problems in randomly jointed cables. Split pairs can adversely affect digital transmission systems due to noise and cross talk, etc. However, this may not show up at installation or prequalification (e.g. if pair B is not in use at that time). The test is a measurement of "Longitudinal Conversion Transverse Loss" (refer ITU-T Rec 0.121). This involves the Transponder transmitting a test signal longitudinally on both legs of the test pair with respect to ground, and the Meter measuring the transverse signal at the other end due to any impedance unbalance of the two legs of the pair with respect to ground. The method is also relatively independent of the total length of cable. A reading greater than -50 dB strongly indicates a split pair or unbalance fault (e.g. asymmetric inductance) which could adversely affect digital transmission systems. The Capacitance Test (refer below) can also be used as an indicator of pair unbalance problems.

DC Volts Test

This test measures DC volts (0 - 500 V) on the test cable, either leg to leg, or leg to ground (e.g. foreign battery). The test is "unobtrusive" as it is performed at a test resistance of approx. 5 MΩ and it therefore can be used to check if the pair is in use without disturbing an existing telephone call.

Loop Resistance Test

In this test, the Transponder places a short circuit across the far end of the cable pair, and the Meter measures and displays the cable loop resistance. The normal range of measurement is 0 to 5000 Ω (e.g. 0 - 20 km (typ) of 0.40 mm cable) with an over-range to 9,990 Ω for high resistance cable faults.

Insulation Resistance Tests

For this test, the Transponder open-circuits the far end of the line, and the Meter applies a high volts "Megger" test voltage to the line and then measures and displays the insulation resistance over a period of 15 to 20 seconds. At the end of the test, the Meter automatically connects a discharge resistance across the line to discharge the line capacitance for safety.

Line Capacitance Tests

The Test Set measures the line-to-line or line-to-ground capacitance of the cable under test (with the far end open-circuited by the Transponder). The measurement range is 0-10,000 nF, with a bottom end resolution of 100 pF. The line to line capacitance measurement can be used to provide further information or confirmation of the type and length of cable or to estimate the length of a cable pair which is open-circuit at the far end. Line-to-line capacitance readings higher than expected are an additional indicator of bridged taps. Line-to-line capacitance, and line-to-ground capacitance measurements can also be used by comparison with measurements on another (reference) pair to indicate pair unbalance problems, e.g. split pairs, split bridged taps, etc. The line-to-line capacitance of a split pair will typically be at least 20% lower than a matched pair, whilst the leg-to-ground capacitance of a split pair will typically (but not always) show significant unbalance.

Calibration and Battery Test

Pressing the [CAL] button causes the Meter to perform a series of internal calibration checks and to display a message of CALIBRATION OK or calibration fault. Pressing the [BAT] button causes the Meter to display the battery terminal voltages of its own battery and the remote Transponder battery, as an indication of the remaining battery capacity. The user then has the option to continue and/or to charge the battery.

Multi-Mode Test

In this mode the Meter provides the function of a DC voltmeter, auto-ranging VF level meter and a VF frequency counter. The unit automatically displays the DC voltage across the test line (0 to 500 V), the VF signal level (0 dBm to - 70 dBm), and the frequency of the signal (300 Hz to 4000 Hz) if the signal level is greater than - 35 dBm.

Specification

HF Insertion Loss

Test Frequency
DPGS 40 kHz
BRA ISDN 100 kHz
HDSL 150 kHz
ADSL 300 kHz
PRA ISDN 1024 kHz

HF Stepping Tests
100 kHz to 1000 kHz in 100 kHz steps
Manual or automatic stepping
Measuring range: 0 to 60 dB
Resolution: ± 0.1 dB
Test level: 0 dBu
Test Impedance: 120 Ω complex impedance

VF Insertion Loss
Frequencies: 400, 1020, 2800 Hz
Measuring range: 0 to 20 dB
Resolution: ± 0.1 dB
Test level: - 10 dBm
Test impedance: 600 Ω

HF Noise
Measuring range: 0 to -80 dBu
Peak detection and hold plus impulse noise counter (threshold 12 dB above noise floor)
1 MHz bandwidth.
Test impedance 120 Ω (complex)

VF Noise
Measuring range: 0 to - 80 dBm
Psophometric weighting and averaging
Resolution: ± 0.1 dB

Loop Resistance
Measuring range: 0 to 10,000 Ω
Resolution: ±2% ± 10 Ω

Insulation Resistance
Measuring range: <0.1Ω to 200 MΩ
High range: 0 to 1500 MΩ
Test voltage: 500 V

Cable Capacitance
Measuring range: 0 to 10,000 nF
Resolution: 100 pF
Includes nF/km distance converter

Longitudinal Conversion Transfer Loss
Measuring range: 0 to 70 dB
Resolution: 1 dB

AC/DC Volts
Measuring range: 0 to 350 V ac
0 to 500 V dc
Resolution: 1 V
Impedance: 5 MΩ

Physical Size
(Meter and Transponder)
190 x 100 x 35 mm
Environment: 5 to 40°C (operating)
- 10 to 70°C (storage)

Power Supply
Internal battery: 7.2 V NiCad.
Power save modes
Low battery indicator
Rechargeable from mains or vehicle

Supplied Accessories
User Manual
Carry case MA-430-010
Mains Plug Pack MA-430-300
DC Double Adapter Lead MB-430-301
DC Vehicle Adapter Cord MB-430-302
Transponder Line Lead MB-430-401
Meter Line Lead MB-430-402

Versions

When ordering please quote the full ordering number information

Order number	*Version*
61002	NETLINK 430 Digital Line Test Set MA-430-000

Microwave

IFR's experience in supplying test instruments for RF and microwave components goes back over 60 years. Building on this experience, the company has established an enviable reputation for supplying innovative solutions that meet the needs of test engineers working across a range of applications.

MICROWAVE

6800 series 5.2
RF and Microwave System Analyzers

6200B series 5.7
RF and Microwave Test Sets

6210 5.12
Reflection Analyzer

6250 series 5.16
Millimeter Wave Reflectometer

6200 series 5.18
Memory Card - PC Utilities

6200 series 5.20
Guided Measurements Application

6200 series 5.22
Gain Compression Application

6230A/L series 5.24
Detectors, Return Loss Bridges and Autotesters

6240 series 5.26
Fault Locators

6146 5.27
Pulse Modulator

6148 5.29
Pulse Generator and Modulator

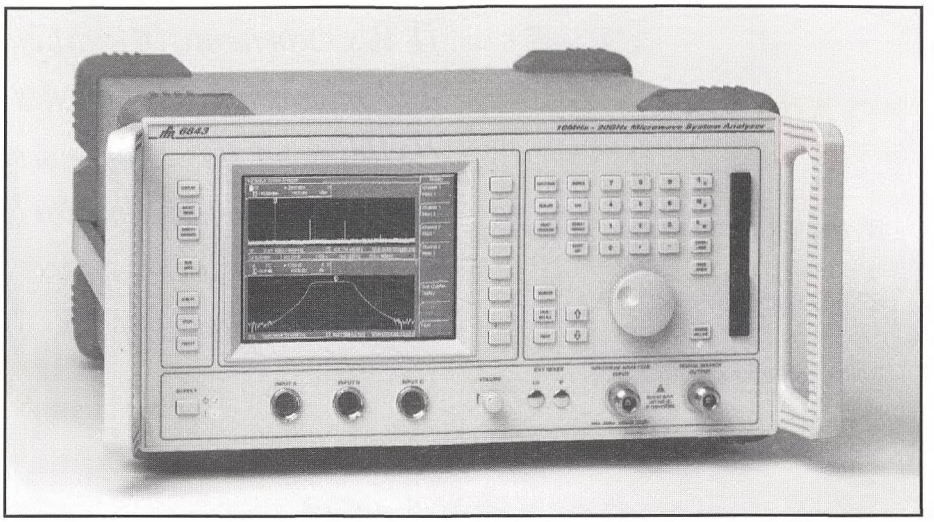
6800 series 5.31
Ordering Numbers

6200B series 5.32
Ordering Numbers



6800 series
RF & Microwave System Analyzers

6800 series Microwave System Analyzers provide an integrated solution to component and subsystem testing

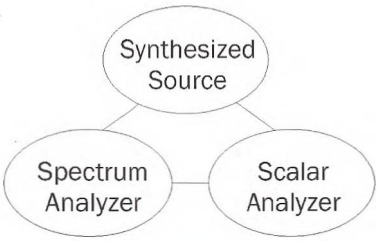


- Integrated synthesized source, scalar and spectrum analyzer
- 3 GHz, 8.4 GHz, 20 GHz and 24 GHz frequency versions
- Precision scalar network measurements
- Spectrum analyzer with full range tracking generator
- Offset tracking on network measurements
- Complete solution to comprehensive component and subsystem characterization
- Real time transmission line Fault Location with 0.1% accuracy
- EEPROM corrected scalar detectors for accurate measurements
- Applications interface allows guided and automatic testing
- Modular design for rapid service
- 3.5 in disk drive for results storage

A New Concept in RF Measurements

The 6800 series RF and microwave system analyzers are a powerful new tool for the microwave industry. Integrated into a single instrument are a synthesized source, a three input scalar analyzer and a synthesized spectrum analyzer. The internal source can be used as a simple CW output, as a swept source for scalar measurements, as a tracking generator with the spectrum analyzer and as an offset tracking source for network measurements on frequency translation devices.

This flexibility simplifies a range of previously complex but commonly made measurements.



1 Series - 8 Instruments

The 6800 series offers two ranges of instruments, the 6820 series of scalar analyzers and the 6840 series of microwave system analyzers. Each range is offered in four frequency versions covering the most commonly required frequency bands. All incorporate a synthesized source.

Model	Description
6821	1 MHz to 3 GHz scalar analyzer
6822	10 MHz to 8.4 GHz scalar analyzer
6823	10 MHz to 20 GHz scalar analyzer
6824	10 MHz to 24 GHz scalar analyzer
6841	1 MHz to 3 GHz scalar analyzer with 4.2 GHz spectrum analyzer
6842	10 MHz to 8.4 GHz scalar analyzer with 20 GHz spectrum analyzer
6843	10 MHz to 20 GHz scalar analyzer with 20 GHz spectrum analyzer
6844	10 MHz to 24 GHz scalar analyzer with 24 GHz spectrum analyzer

Synthesized Source

The synthesized source has low phase noise and 1 Hz frequency resolution. VCOs are used for frequencies above 3 GHz and an integrated RF synthesizer for the 1 MHz to 3 GHz range. Internal filtering results in excellent harmonic performance of <-55 dBc for improved scalar measurement accuracy. Optional step attenuators are available to set low output powers for amplifier or receiver testing.

In CW mode the source can be used for local oscillator substitution. A power sweep is provided for amplifier gain compression testing.

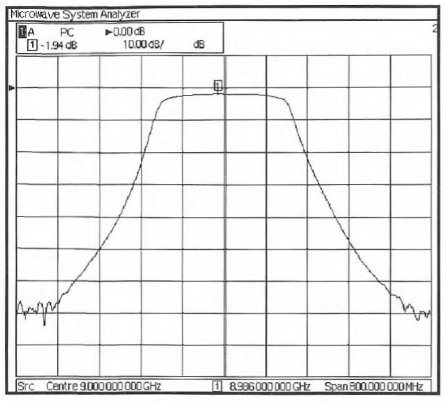
When used with the scalar analyzer the source provides a swept synthesized output for frequency characterization of components and systems. It can also be used as a spectrum analyzer tracking generator to 24 GHz. The source can be set to any frequency offset or frequency multiple of the receiver tuned input. This powerful feature simplifies measurements of mixers, upconverters and down-converters that have frequency translation.

Scalar Analyzer

The three input scalar analyzer provides network characterization on components and systems. Simultaneous measurement of insertion and return loss are displayed on the 6800 color screen. Excellent measurement accuracy is assured by the use of EEPROM corrected detectors. Each detector is individually characterized for linearity and frequency response to provide a measurement accuracy close to that achieved with a power sensor. A range of autotesters with high directivity is available for return loss measurements.

It is also possible to make scalar measurements with a tuned input. A tuned input gives improved dynamic range. Insertion loss measurements of >80 dB are possible.

http://www.ifrinternational.com



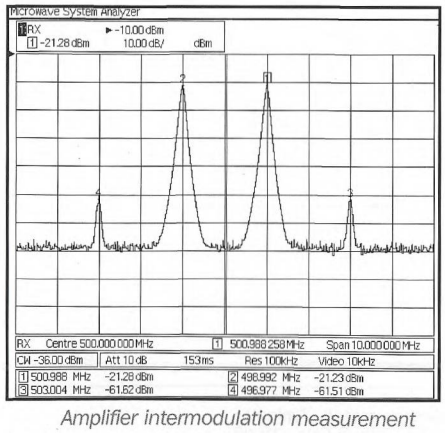
Bandpass filter insertion loss measurement

Spectrum Analysis

The 6840 variants contain an integral synthesized spectrum analyzer with 3 MHz to 1 kHz resolution bandwidth filters, >80 dB instantaneous dynamic range and an excellent 3rd order intermodulation intercept point. 6840 series are designed to make routine spectrum measurements on RF and microwave components, subsystems and systems.

Continuous full band sweeps simplify harmonic and spurious measurements. The low distortion front end combined with wide dynamic range ensures that even on full span sweeps, spurious measurements to better than -60 dBc can be performed. High sensitivity at microwave frequencies is ensured by the use of wideband oscillators, this reduces the harmonic number used in the front end mixer.

The spectrum analyzer is fully featured with FM demodulator and built in loudspeaker. This is ideal for locating and identifying the source of interfering transmissions. Individual signals can be precisely identified by use of the internal frequency counter.



Amplifier intermodulation measurement

Optimized operation is provided by the coupling of the fundamental analyzer parameters of resolution bandwidth, sweep speed, video filter and input attenuation. These parameters are automatically set for optimum sweep speed and dynamic range. For specific applications the user can manually overide the coupled functions.

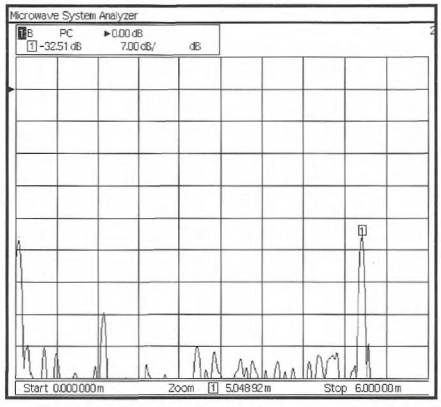
Autotune automatically sweeps the full span of the spectrum analyzer and then displays the largest signal at the center and top of the screen. Markers can also be used to select any signal and display it at the center of the screen.

The integral source enables network measurements in normal tracking mode or by applying a frequency offset and/or multiplication factor. Any frequency offset can be supported. This facility makes measurements faster and easier than assembling together separate instruments and a PC controller.

Fault Location

Fault location software is standard on all 6800 series instruments. Many modern communication systems rely on a coaxial or waveguide feed between the transmitter and antenna. The fast fault location facility of the 6800 can quickly locate the position of faults causing poor return loss in the feed, which can seriously impact system performance.

Measurement resolution and accuracy is assured by the use of a synthesized source with up to 1601 measurement points.



Fault location measurement of a coaxial feed and antenna

Simplified User Interface

Integration of a source, spectrum analyzer and scalar analyzer into a single instrument has many benefits. The operator uses a single interface to set up any measurement. This saves time and is easier than writing software to perform complex measurement tasks, such as frequency offset network measurements.

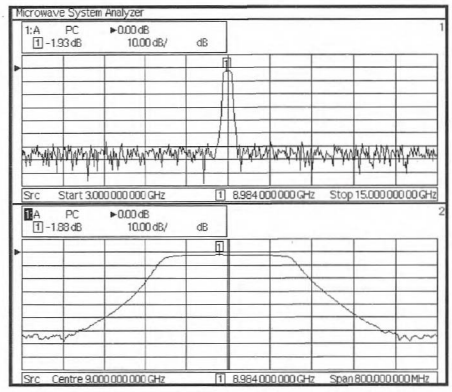
Eight softkeys give rapid access to all commonly used parameters. Softkeys are shaped to inform the user of the action that the key will perform, e.g. enter data, select from list, move to another menu or immediate action. All commonly accessed functions are no more than one level deep, so that the instrument operation is easily learnt.

Applications Interface

An applications interface is built into the 6800 series which allows the user to create their own measurement routines and guide the operator through the test procedure. For example it can display on the 6800 screen how to set up the measurement, lead the operator through a calibration, show where to connect the device under test and then test the devices performance against predefined limits. The applications facility can reduce the incidence of operator error, improve measurement repeatability, provide guidance to infrequent users or simplify complex test procedures.

Color Display

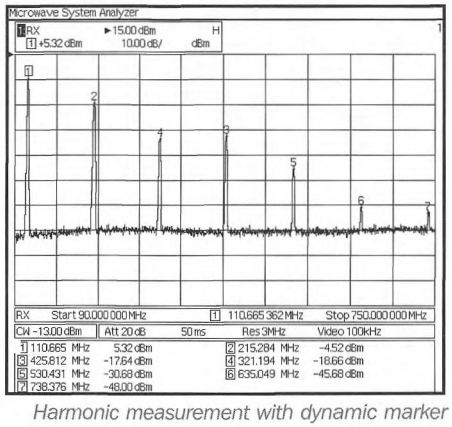
A large TFT color display is fitted to the 6800 as standard displaying up to four measurements on two channels. Scalar and spectrum measurements can be displayed simultaneously on independent channels. Alternatively two spectrum channels can be shown with a wide and narrow frequency sweep. This could be used to scan a frequency spectrum for interfering signals whilst simultaneously displaying the wanted carrier.



Dual channel display, showing wide band and narrow band frequency sweeps

Comprehensive Markers

Up to eight markers are available. The marker menus provide the tools that are most commonly used in each of the measurement modes.



Harmonic measurement with dynamic marker table

In spectrum mode the markers identify the frequency and level of a signal, position signals on the display and measure relative signal values. A peak search feature places markers on the eight highest signals displayed for spurious signal identification. A table displayed below the traces shows the values of all eight markers dynamically.

In scalar mode markers automatically calculate peak to peak ripple, N - dB bandwidth and find maximum and minimum signal levels. This simplifies device characterization and reduces test time.

For fault location measurements the next peak left/right feature identifies the position and magnitude of each of the discontinuities along the transmission line.

The peak find softkey quickly locates the biggest discontinuity on the line.

Fast Field Repair

6800 has a modular architecture with modules slotted onto a common mother board. In the event of a module failure the instrument can be repaired by module replacement to reduce instrument downtime. Following a repair, software routines realign the replaced module.

Future Proof

The 6800 series microwave system analyzers have been designed to expand and adapt to changing test requirements. A standard instrument has capacity for additional modules. As future options are added, the flexibility and capability of the 6800 platform will expand. This ensures that investment made in the 6800 series today will provide a basis for future test needs.

For Design Engineers

For designers of components and subsystems the 6800 provides a powerful and flexible analysis tool. Devices such as filters, amplifiers, mixers, attenuators and oscillators can be characterized with a single test instrument. This flexibility reduces design cycles as the need to make instrument interconnections is reduced. 6800 has a low noise source for LO substitution and swept frequency measurements. The use of EEPROM detectors ensures accurate scalar measurements. Amplifiers can be precisely characterized for gain compression, output power and frequency response. The use of a tuned input can give >80 dB dynamic range for filter testing and the accessory autotesters, with 40 dB directivity, ensure accurate return loss results. The spurious and harmonic output of oscillators can be measured with the wide span high dynamic range spectrum analyzer.

Manufacturing Test

To the production manager the 6800 offers reduced programming time, reduced test time and simplified archiving of results. 6800 is fully compliant with the IEEE 488.2 GPIB commands. A full 401 data points can be transferred over the GPIB in typically <50 ms. Individual data points can be repetitively read in typically 10 ms. This enables full results archiving with minimal time penalty.

A single instrument replaces 'rack and stack' alternatives which makes program generation simpler. Rack space is also reduced.

Continuity of test is essential in a production environment. A failed test system can result in expensive loss of output. 6800 with its field replaceable modules minimizes any output loss due to test system failure.

Installing and Maintaining Systems

During the installation period of a microwave system it is always necessary to revalidate key parameters. 6800 provides a comprehensive solution for installation teams. It is housed in a ruggedized case, has secure handles and can be supplied with a protective carrying case.

For systems with long waveguide or coaxial feeds, the 6800 is used by the installation team to measure return loss and if necessary fault location. The synthesized source with 1601 measurement points ensures precise fault location measurements. The 6840 series provides a tuned input that can be used for return loss and fault location measurements. This measurement technique rejects interfering signals from other transmitters, a common cause of poor measurement performance in the field.

By archiving results onto disk, or the internal instrument memory, the 6800 forms the basis of a preventative maintenance system. Experience shows that degradation in the antenna feed is the major source of system field failures. 6800 has the accuracy to monitor and identify gradual system degradation with time.

Results Logging and Outputting

Measurement results can either be saved to internal non-volatile memory or to 3.5 in disk. Traces saved onto disk can then be archived or imported into a spreadsheet for viewing.

An alternative method for displaying results in a standard word processor document or in a graphics package is to use the optional MIPlot software. MIPlot captures the measurement data either via the GPIB or from a saved trace on disk. This data can then be embedded into a document and reformatted, colors changed, markers and text added.

Specification

Versions	
6821	1 MHz to 3 GHz scalar analyzer
6822	10 MHz to 8.4 GHz scalar analyzer
6823	10 MHz to 20 GHz scalar analyzer
6824	10 MHz to 24 GHz scalar analyzer
6841	1 MHz to 3 GHz scalar analyzer with 4.2 GHz spectrum analyzer
6842	10 MHz to 8.4 GHz scalar analyzer with 20 GHz spectrum analyzer
6843	10 MHz to 20 GHz scalar analyzer with 20 GHz spectrum analyzer
6844	10 MHz to 24 GHz scalar analyzer with 24 GHz spectrum analyzer

Source

Functionality
Synthesized CW
Synthesized sweeper for use with scalar analyzer,
Tracking generator for use with spectrum analyzer.
Offset tracking generator for use with spectrum analyzer (offset by scale or multiplication factor)
CW Power sweep.

Frequency range
6821/6841, 1 MHz to 3 GHz
6822/6842, 10 MHz to 8.4 GHz
6823/6843, 10 MHz to 20 GHz
6824/6844, 10 MHz to 24 GHz

Resolution (settable)
1 Hz

CW accuracy
(Frequency Standard error x Frequency) ± 10 Hz

Swept accuracy (typical)
300 µs Step Time
1 MHz to 3 GHz, <20 kHz
3 GHz to 24 GHz, <200 kHz
1 ms Step Time
1 MHz to 3 GHz, <1 kHz
3 GHz to 24 GHz, <10 kHz
10 ms Step Time
1 MHz to 3 GHz, <100 Hz
3 GHz to 24 GHz, <1 kHz

Levelled power range
68X1/2/3/4 standard
1 MHz to 3 GHz, -10 dBm to +10 dBm
3 GHz to 24 GHz, -10 dBm to +5 dBm
6821/41 + option 010 (110 dB Step Attenuator)
1 MHz to 3 GHz, -120 dBm to +8 dBm
68X2/3 + option 011 (70 dB Step Attenuator)
10 MHz to 3 GHz, -80 dBm to +8 dBm
3 GHz to 20 GHz, -80 dBm to +2 dBm
68X2/3/4 + option 012 (90 dB Step Attenuator)
10 MHz to 3 GHz, -100 dBm to +8dBm
3 GHz to 24 GHz, -100 dBm to +2 dBm

Note: For option 002 (Field Replaceable connectors) guaranteed levelled output is reduced by 0.5 dB

Settable power resolution
0.01 dB

Power sweep range (from maximum levelled power) without attenuator
>20 dB

Internal levelling accuracy at 0 dBm
(no options fitted)
1 MHz to 3 GHz, ± 0.7 dB
3 GHz to 24 GHz, ± 1.0 dB

Levelled Power accuracy with options 010, 011, 012
1 MHz to 3 GHz
< ± 1 dB (± 0.3 dB ± 2% of attenuator setting in dB whichever is greater)
3 GHz to 24 GHz
< ± 1 dB (± 1 dB ± 4% of attenuator setting in dB whichever is the greater)

Linearity (no options fitted) over levelled range relative to 0 dBm
1 MHz to 3 GHz, -10 to +10 dB, ± 0.5 dB
3 GHz to 24 GHz, -10 to +5 dBm, ± 0.5 dB

Power Stability with temperature typical
1 MHz to 24 GHz <0.1 dB/°C

Harmonics and Sub-Harmonics Over Levelled Power Range

Harmonics
<70 MHz, <-25 dBc
70 MHz to 24 GHz, <-55 dBc

Sub-Harmonics
1 MHz to 3 GHz, <-60 dBc
3 GHz to 24 GHz, none

Spurious signals (Typical)
For carrier frequencies <375 MHz
Offset:
30 kHz to 150 kHz, <-50 dBc
150 kHz to 1 MHz, <-55 dBc
> 1 MHz, <-55 dBc

For carrier frequencies >375 MHz
Offset:
30 kHz to 150 kHz, <-50 dBc
150 kHz to 1 MHz, <-60 dBc
> 1 MHz, <-60 dBc

Phase Noise in <dBc/Hz in CW mode

CW Freq	*Frequency offset*		
	1 kHz	*10 kHz*	*100 kHz*
0.25 GHz	-86	-95	-108
0.5 GHz	-98	-112	-134
1 GHz	-92	-106	-128
2 GHz	-86	-100	-122
4 GHz	-84	-92	-105
10 GHz	-75	-84	-95
20 GHz	-70	-78	-86
24 GHz	-68	-76	-84

Source match (Typical)
1 MHz to 3 GHz, 15 dB
3 GHz to 20 GHz, 10 dB
20 GHz to 24 GHz, 8 dB

Output connector
68X1/2/3; Precision N type, female
68X4: Precision 3.5 mm, female
or optional field replaceable connectors

Spectrum Analyzer

6840 series only

FREQUENCY

Frequency range
6841, 1 MHz to 3 GHz (usable to 4.2 GHz)
6842, 6843, 10 MHz to 20 GHz
6844, 10 MHz to 24 GHz (usable to 30 GHz)

Frequency span range
Full span to Zero span, plus any intermediate value.

Start frequency accuracy
(start frequency x frequency standard error) ± frequency readout resolution ± 3% of span ± 20% resolution bandwidth setting

Span accuracy
Fully synthesized for spans of 20 MHz or less.
± 3% for spans >20 MHz

Number of measurement points
Fixed 512

Frequency readout resolution
Span/512

Marker readout accuracy
As per start frequency accuracy

Sweep speed
Auto coupled or user set,
10 ms/div to 50 s/div

Phase noise in <dBc/Hz

Analyzer freq	*Frequency offset*	
	20 kHz	100 kHz
10 MHz	-90	-100
4.2 GHz	-90	-100
(N=1 on the Harmonic Mixer)		
8.6 GHz	-84	-94
(N=2 on the Harmonic Mixer)		
18.5 GHz	-77	-87
(N=3 on the Harmonic Mixer)		

System related sidebands
<-65 dBc at offsets greater than 30 kHz from the carrier

AMPLITUDE
Maximum input amplitude
+20 dBm

Damage level
+ 30 dBm @ >10 dB attenuation
+ 20 dBm @ 0 dB attenuation

Input Return Loss (typical) with ≥ 10 dB of input attenuation

10 MHz to 3 GHz	20 dB
3 GHz to 12 GHz	12 dB
12 GHz to 24 GHz	10 dB

Input attenuator
Range: 0 to 60 dB in 10 dB steps

Reference level
Range: +30 dBm to -99 dBm

Amplitude scaling
Range: 10 dB /div to 0.1 dB /div

Amplitude accuracy at 0 dBm reference level and 0 dBm input
(at selected bandwidth)

10 MHz to 3 GHz	± 1 dB
to 4.2 GHz	± 1.5 dB*
to 20 GHz	± 4.0 dB
to 24 GHz	± 4.5 dB

* 6842, 6843 and 6844 only

Incremental reference level accuracy from +20 dBm to -40 dBm (typical)
± 0.5 dB

Response flatness (typical)
± 3.0 dB

Log Incremental accuracy (typical)
0.2 dB / 10 dB

Display linearity
± 1.5 dB over 8 divisions (10 dB / div)

Gain compression (0 dB attenuation)
< 0.5 dB with -10 dBm on the input mixer

Resolution bandwidth range
1 kHz to 3 MHz in 1, 3, 10 sequences

Resolution bandwidth accuracy
± 20 %

Resolution bandwidth selectivity
60 dB / 3 dB ratio
1 kHz to 3 MHz 15:1

Resolution bandwidth switching error
<0.25 dB

Video bandwidth
1, 3, 10, 30, 100, 300, Hz
1, 3, 10, 30, and 100 kHz

Third order intermodulation response
<-70 dBc with 2 tones each -30 dBm, with >50 kHz separation incident upon the mixer

Third order intercept point
>+ 5 dBm

Second order single tone intercept point
>+45 dBm

Second harmonic distortion > 40 MHz and @ -40 dBm
< -70 dBc for -40 dBm at the mixer

Residual responses (input terminated with 50 Ω)
< -90 dBm

Other input related spurii
< -60 dBc with -10 dBm on the input mixer

Typical displayed average noise level in 1 kHz RBW, 30 Hz VBW, 0 dBm attenuation (input terminated with 50 Ω)

@ 1 GHz	<-105 dBm
@ 6 GHz	<-105 dBm
@ 12 GHz	<-100 dBm
@ 18 GHz	<-95 dBm

EXTERNAL MIXER INTERFACE (option)
LO output, 4.5 - 9.2 GHz @ +17 dBm typical
IF input, 479.3 MHz, maximum level -15 dBm typical

DEMODULATION
Narrow band FM, <20 kHz
Display, kHz vs time
Audio output via speaker

MEASUREMENT FEATURES
Frequency counter
Ability to display channel occupancy masks, user defined
Accurate marker frequency readout
Multiple markers
Two independent channels
Scrollable center frequency, span and resolution bandwidth
Measurement of noise in a 1 Hz bandwidth
Auto-tune display set-up for CW signals
NBFM demodulator with audio output
Demodulated output displayed on screen
Speed 1 ms / div to 1 s / div

Scalar Analyzer

SYSTEM FEATURES

Frequency range
As per source frequency range

Number of inputs
3 detector inputs plus tuned input

Number of Measurement Points
User 2 to 1601 selectable from

Applications
Return loss vs frequency
Insertion loss vs frequency
Fault Location
Voltage vs frequency

Detection modes
AC and DC

Noise reduction
Averaging, 1 to 1000
Smoothing, 0.01 to 20%

Power measurements
Using scalar detectors

Detector correction
Frequency response and linearity read from EEPROM for 6230A/L and fault locators.
Support for 6230 and autotesters.

INSERTION LOSS MEASUREMENTS

Measurement dynamic range, AC scalar detection, with 6230A detector
Max source output to -60 dBm
Max source output to -65 dBm (with averaging)
Typical values:
>65 dB (10 MHz to 24 GHz)
>75 dB (1 MHz to 3 GHz) only with 6232A

Measurement dynamic range, tuned input
Maximum source output to -75 dBm
>80 dB
Typically (10 MHz - 17 GHz)

Measurement update rate
401 points in 270 ms with DC detection.

Calibration
Through path calibration or short and short/open calibrations for single ended insertion loss.

Inputs
Single input or ratio.

Accuracy
Linearity + mismatch.

Linearity (for power levels >-50 dBm)
±0.2 dB / 10 dB but not > 0.5 dB in total.

RETURN LOSS MEASUREMENTS

Measurement update rate
401 points in 270 ms with DC detection.

Calibration
Short, Open, Short/Open.

Inputs
Single input or ratio.

Accuracy
Linearity + directivity + test port mismatch.

Linearity (for power levels >-50 dBm)
±0.2 dB / 10 dB but not > 0.5 dB in total.

FAULT LOCATION MEASUREMENTS

Measurement range
Up to 25 km depending on cable or waveguide loss.

Units
Feet or meters.

Number of Measurement Points
User selectable from 50 to 1601

Minimum resolution
For 2 equal amplitude discontinuities using maximum sweep width
68X1: 12.18 x Vr cm
68X2: 4.32 x Vr cm
68X3: 1.82 x Vr cm
68X4: 1.51 x Vr cm

Where Vr is the relative velocity factor for the transmission line.

Measurement update rate
512 points in 250 ms, DC detection.

Dynamic range
DC detection 70 dB.
AC detection 80 dB.

Distance accuracy
3 mm or 0.1% of range for a single fault.

Transmission line database
Data supplied as standard

Required accessory
624X series fault locator
or 658X series transmission line test head
or divider

Frequency Standard

Internal 10 MHz OCXO
Drift
± 5 in 10^8 over 0 to 55°C

Ageing
± 2 in 10^7 per year (OCXO)

External frequency standard
1 MHz or 10 MHz
Connector: BNC

Rear Panel Connectors

RS-232
9 way D-type connector, male.
Baud rate 300 to 9600 bits per second.

GPIB interface
GPIB is IEEE 488.1 and 488.2 compatible. The interface has 2 functions.
-Instrument control with full Talk/Listen capability
-Control of plotter using HPGL. Plotter is buffered to permit measurements to proceed whilst plotting.

10.7 MHz IF Output (from spectrum analyzer)
Connector: BNC

Printer output
25 way D-type connector
Parallel interface.
Drivers supplied for standard DeskJet and LaserJet printers

External monitor
Standard VGA, 640 by 480 colour output.
15 way high density D-type female connector.

Voltage output
Settable for 0 - 10 V ramp, fixed voltage or chart recorder drive.

Video output
Output from spectrum analyzer detector.
Bandwidth: as per RBW setting.

External levelling input
Input voltage range: 0 to +1 V
Connector: BNC

General Features

Number of display channels
2.

Number of measurements
4 (2 per display channel).

Number of measurement points
2 to 1601 for one trace, scalar
512 fixed, spectrum

Display
Color active matrix TFT liquid crystal display with 16.5 cm (6.5 in) visible diagonal

Data storage
3.5 in floppy disc drive, 1.44 Mb. Trace storage in DOS format.

Limits
4 stores of 12 segments each. Each segment defines an upper limit, upper and lower limits, or a point. Any store can be applied to any trace.

MARKERS
8 per trace plus separate delta marker.

Marker functions
Marker, delta marker, minimum, maximum, search left, search right, N-dB bandwidth (with center frequency), marker tracking.

Spectrum analyzer
Find Peak / Next Peak (next lowest amplitude or next Left / Right) / Identity Peaks
MKR to CF
MKR to Ref Level
Counter / Set Resolution
Measure Relative to Carrier (dBc)
Search Left / Right
Delta MKR / Set Span / Fixed Delta

Scalar analyzer
Active marker Max / Min
Max / Min Tracking
Find PK-PK
PK-PK Tracking
Search Right / Left
Bandwidth / Optional CF / DF (Q)
dB / Octave, dB / Decade Readout
Delta Marker On / Off

Fault location
Find Max / Track Max
Next PK Right / Left
Set PK Level
Delta marker On / Off

General
Marker Table
Assign Active MKR / Position Active MKR
Set-up Markers (i.e. On / Off, Position)
Large Readout
All Off

Marker resolution
Frequency: 6 digits or 1 Hz, user selectable
Power: 0.01 dB.
Voltage: 1 nV.

Measurement manipulation
Display live measurement.
Display trace memory.
Display live measurement relative to trace memory.
Measurement hold may be applied for each trace.
Any input or ratio of inputs may be assigned to any one or more than one trace(s). A trace may display absolute power, power relative to a path calibration or power minus a trace memory.

Input offsets
An offset in the range -99.99 dB to +99.99 dB in 0.01 dB steps may be applied per detector input.

Weight - variant and option dependent
682X 16 kg.
684X 24 kg.

Size
682X 230 mm H x 430 mm W x 500 mm D.
684X 230 mm H x 430 mm W x 570 mm D.

Power supply
Autosensing 90 V to 265 V, 45 Hz to 65 Hz AC.
Plus 90 V to 110 V, 400 Hz AC.
6840 series: Consumption 220 W
6820 series: Consumption 150 W

Rated range of use

Temperature	0 to 55°C.
Humidity	Up to 93% RH at 40°C.

Conditions of storage and transportation

Temperature	-40°C to +71°C
Humidity	Up to 93% RH at 40°C
Altitude	Up to 4570 m (15000 ft)

Electromagnetic Compatibility
Conforms with the protection requirements of EEC Council directive 89/336/EEC.
Conforms with the limits specified in the following standards:

EN55011:1991	(Emissions)
CISPR11	
CLASS B	
EN50082-1:1992	(Immunity)
IEC801-2:1991	
IEC801-3:1984	
IEC801-4:1988	
EN61000-3-2:1995	(Mains Harmonics)
EC1000-3-2:1995	

Safety
Complies with IEC1010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.

Versions and Options

When ordering please quote full ordering number information.

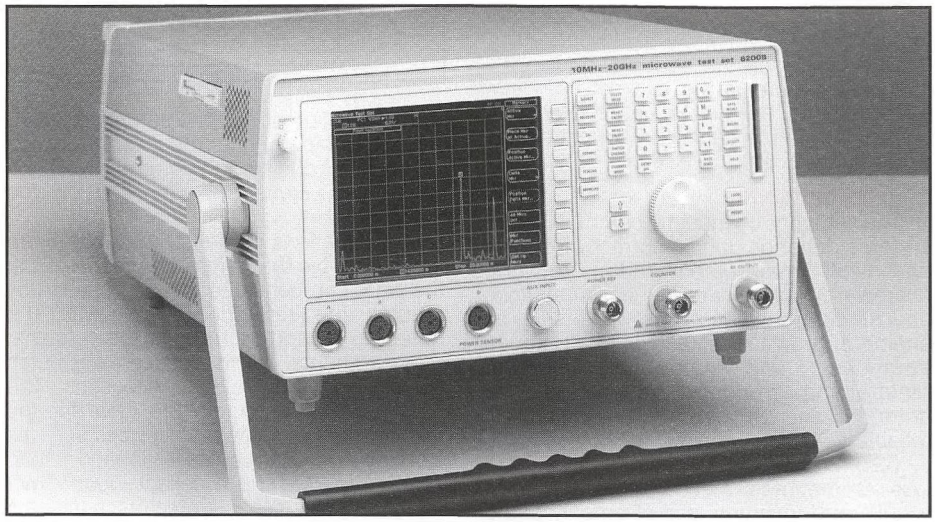
Ordering Number	*Versions*
6821	1 MHz to 3 GHz scalar analyzer
6822	10 MHz to 8.4 GHz scalar analyzer
6823	10 MHz to 20 GHz scalar analyzer
6824	10 MHz to 24 GHz scalar analyzer
6841	1 MHz to 3 GHz scalar analyzer with 4.2 GHz spectrum analyzer
6842	10 MHz to 8.4 GHz scalar analyzer with 20 GHz spectrum analyzer
6843	10 MHz to 20 GHz scalar analyzer with 20 GHz spectrum analyzer
6844	10 MHz to 24 GHz scalar analyzer with 24 GHz spectrum analyzer
	Options
002	Field replaceable precision N (f) or 3.5 mm (f) RF connectors for source output. (not available on 6821 / 6841)
010	3 GHz 110 dB Step attenuator (only available for 6821 and 6841)
011	20 GHz 70 dB step attenuator. (not available for 6821 / 6824 / 6841 / 6844)
012	26.5 GHz 90 dB step attenuator. (not available for 6821 / 6841)
020	External mixer interface. (not available for 6820 series)

Note : All specifications quoted are for operation at calibration temperature ±3C.
Specifications involving Type N connectors above 18 GHz are not traceable to national standards as these do not exist at present.
Typical specifications are non-warranted.

http://www.ifrinternational.com

6200B series
RF and Microwave Test Sets

The 6200B combines the key microwave instruments for scalar network measurements, power and frequency measurements in a compact and portable product



- Precision Scalar Network measurements
- Integral Frequency Counter and Power Meter
- Real time Fault Location with 0.1% accuracy
- Economical, compact and portable
- 2 GHz, 8 GHz, 20 GHz, 26.5 GHz and 46 GHz versions
- Synthesized signal source with optional step attenuator
- 3.5 in disk drive for results storage
- Dynamic calibrator and EEPROM corrected detectors for accurate measurements
- 6210 Reflection Analyzer for precision reflection coefficient and time domain measurements

The 6200B series RF and Microwave Test Sets (MTS) are an innovative range of instruments. An MTS combines the key microwave instruments for scalar network measurements, power and frequency measurements into a compact and portable product. Powerful fault location software adds the ability to measure return loss (VSWR) against distance to speed up fault identification on coaxial or waveguide transmission lines.

Integration offers many benefits over an assembly of discrete instruments. A single user interface makes operation faster and simpler. Measurements can be configured and changed quickly as fewer instrument connections are necessary. A single display can show a multitude of parameters making results viewing easier, and more reliable. Capital costs are reduced as the MTS provides an economical way of providing a comprehensive test solution.

Targeted Frequency Versions

Five versions of the MTS are available so that users can select the unit that exactly matches their requirements. The 6202B RF Test Set covers 10 MHz to 2 GHz and is ideal for manufacturers of components for the mobile communications industry. Its light weight and small size also make 6202B the ideal instrument for field engineers installing and maintaining mobile radio antenna and antenna feeders.

8 GHz, 20 GHz and 26.5 GHz versions are available for users in the major microwave bands. A 46 GHz instrument is provided for those users working on the increasingly important millimetric bands. A comprehensive range of accessories is available to support each of these units.

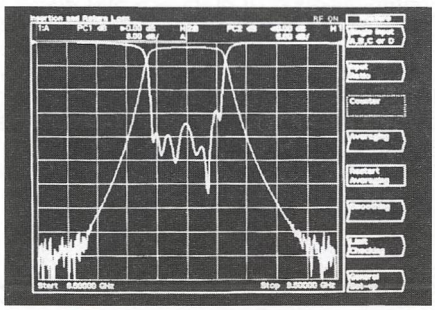
Development

The flexibility and accuracy of the 6200B series MTS make it an excellent instrument for the development engineer. A synthesized signal source with 1 Hz resolution can be used as both a CW source or synthesized sweep generator. A new OCXO frequency standard provides high stability frequency settings and measurements. New 6230A/L series scalar detectors with EEPROM correction and a new dynamic calibrator give power meter accuracy even during swept frequency measurements. The dynamic calibrator in the 6200B characterizes the detector linearity enabling precision insertion loss measurements.

An integral voltage/current source can be used to bias devices such as PIN diodes or to provide a swept voltage stimulus for characterizing VCO's. The integral frequency counter of the MTS allows the unique graphical display of frequency as a function of swept voltage.

The integrated nature of the 6200B series means that a wide range of devices can be characterized with a single test instrument, reducing bench clutter.

For engineers who demand the best possible accuracy when measuring reflection coefficient, the addition of a 6210 Reflection Analyzer to a standard 6200B series MTS provides error corrected measurement of reflection coefficient (S^{11}). 6210 also gives Smith Chart displays and Time Domain measurements as standard.



Production

6200B series MTS reduces production test time, simplifies the generation of test methods and test programs, at a reduced capital cost.

All aspects of the 6200B can be controlled through the GPIB, IEEE 488.2, interface. Space requirement in a test rack is reduced due to the small volume of the MTS.

The improved scalar network analyzer performance of the 6200B series means that production stand-offs can be reduced resulting in greater production yield.

A macro facility automates and customizes many measurement procedures. Repetitive test methods can be stored into memory along with production limits and operator prompts. Branching and looping within macros means that test methods can allow for device tuning and adjustment. An external keyboard can be connected via a standard keyboard interface to simplify macro editing and generation of operator instructions.

Operator errors are reduced due to the simplified nature of the test set up. New test methods are quickly learned as only one instrument is necessary to test a wide variety of devices.

Installation and Maintenance

The integrity of modern communication systems depends upon a correctly installed and well maintained radio network. Microwave links, satellite earth stations and RF communications networks such as analog and digital cellular radio all require antennas and antenna feeders. Maintaining the performance of the antenna and its feed is essential for reliable communications.

6200B series MTS measures the return loss (sometimes measured in terms of VSWR) and insertion loss of antennas and feeders. In the event of an out of specification return loss measurement the MTS can perform a fault location measurement. This gives a display of return loss (or VSWR) against distance, pinpointing the position of all causes of reflection in the antenna and feeder. From this display the field engineer can quickly identify the component or position along the transmission line at fault and expedite a repair.

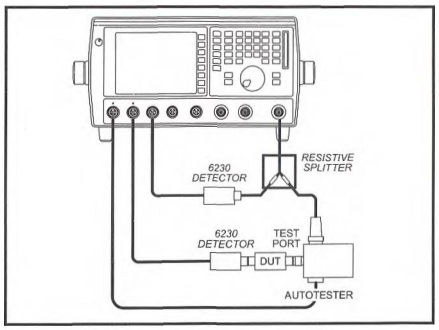
The new 6240 series Fault Locators offer a small ruggedized solution for the measurement of return loss and fault location. Both measurements can be made simultaneously from a single test port speeding up and simplifying the characterisation of antennas and antenna feeders. A guided measurements application leads the test engineer through the most common field measurements. The application assists in setting up and calibrating the measurement through a series of operator prompts and on screen diagrams. This results in fast, accurate and repeatable measurements.

APPLICATIONS

Insertion loss and return loss measurement using a reference channel

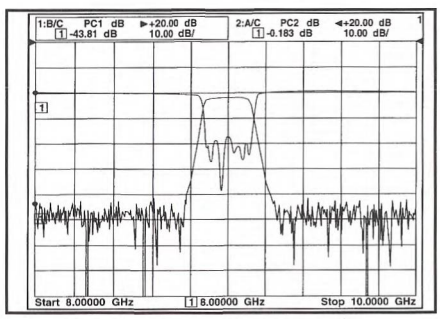
The diagram shows the basic set-up to measure insertion loss and return loss for common components such as filters and attenuators using an autotester and detectors. A 6230A series detector will give over 70 dB dynamic range for insertion loss measurements. Use of an autotester provides wide frequency bandwidth coupled with excellent directivity for precise return loss measurements.

In this set-up a power splitter is used to monitor the power close to the measurement port. This is especially important when a cable is used between



the source output and the autotester input. The reference channel reduces the effects of the error due to source match which is seen as a ripple superimposed on the measurement.

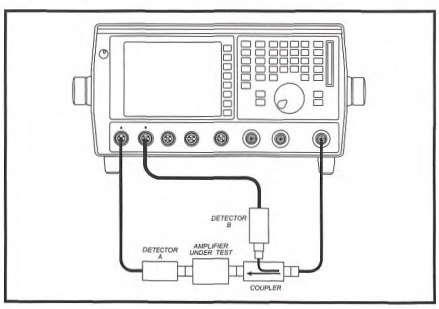
Any variations in the DUT input level are measured by the reference channel and the MTS compensates for the variation by ratioing the reference signal with the reflected and transmitted signal measurements. This reduces mismatch ripples caused by multiple reflections. The 6230L series detectors are ideal for the measurement of low loss devices such as semi-rigid coaxial cables or inband filters. This is because the excellent input VSWR of the 6230L series detectors minimizes mismatch between the DUT and the detector.



Filter measurement with live reference

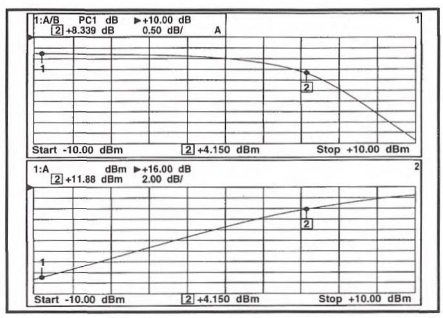
Amplifier gain compression measurement

This measurement set-up can be used to determine the power handling capacity of an amplifier. This is achieved by measuring the 1 dB compression point of an amplifier. Detector B is configured to monitor the incident power to the amplifier while detector A measures the output power. The 6230L series detectors are recommended due to their power handling capability and accuracy. A coupler is used to sense the incident power, so that most of the available power from the source can



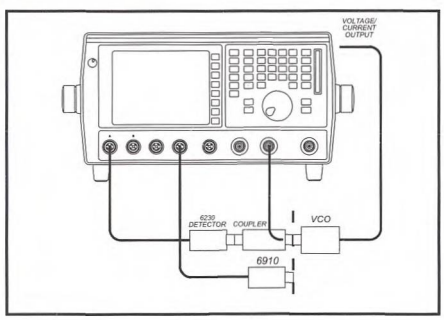
be used to drive the amplifier into compression.

A special gain compression application enables the 6200B series MTS to measure the gain compression of an amplifier against frequency. The gain compression application generates this display quickly and easily with minimal user interaction, completing a 401 frequency point measurement typically in under 30 seconds. This application is especially useful in the design and production of broadband amplifiers.

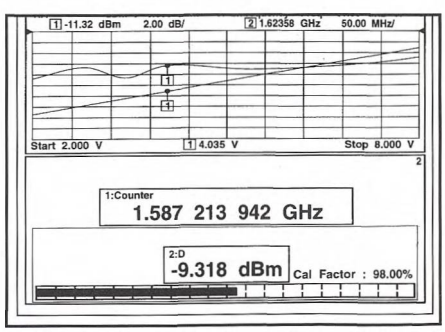


Amplifier gain compression test, showing normalized gain (top) and output power (bottom) of amplifier

VCO characterization

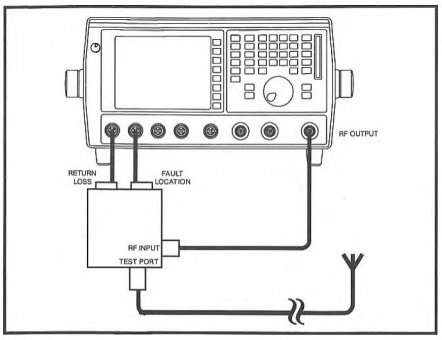


The diagram shows the set-up required to characterize a voltage controlled oscillator (VCO). This is achieved by determining the maximum and minimum frequencies of operation, the frequency linearity and measuring the output power against tuning voltage of the device. The unique capability of the 6200B series MTS to measure frequency against tuning voltage of a VCO speeds up production test and reduces bench clutter.

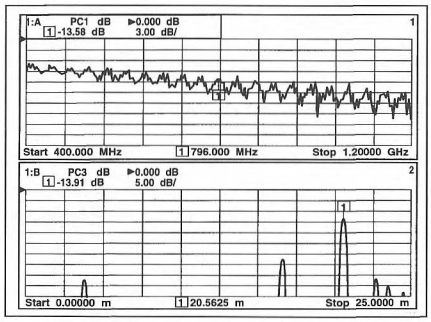


VCO swept voltage characteristics, showing output power and frequency against tuning voltage

Simultaneous return loss and fault location measurement



The diagram shows the set-up used to make a simultaneous return loss and fault location measurement. A typical application would be to measure the performance of an antenna and antenna feeder, coaxial or waveguide. New RF communications systems, such as analog and digital cellular radio networks, and standard microwave links can have antenna feeds up to 100 metres long. Good system performance is dependent on a correctly installed and maintained antenna and antenna feeder. The fault locator measures both fault location and return loss from a single test port. It is small and lightweight and therefore ideal for field use. Both measurements can be displayed simultaneously using the dual channel mode on the MTS as shown below.



Specification

Scalar Analyzer

NUMBER OF INPUTS
Four (A, B, C and D)

DETECTION MODES
AC and DC.

DYNAMIC RANGE

AC detection:	80 dB (-60 to +20 dBm, 623XA), (-54 to +26 dBm, 623XL) 85 dB typical (-65 to +20 dBm, 623XA), (-59 to +26 dBm, 623XL)
DC detection:	70 dB (-50 to +20 dBm, 623XA), (-44 to +26 dBm, 623XL)

MEASUREMENT POINTS
User selectable from 2 to 1601

NUMBER OF CHANNELS
Two channels, two measurements may be made per channel allowing a total of four simultaneous measurements.

SWEEP TIME

Settable range
40 ms to 500 s.

Measurement times

401 points:	<200 ms
1601 points:	<800 ms

DIRECT VOLTAGE INPUT RANGE

Input A, B and C	0 V to -4.5 V or 0 V to +4.5 V.
Input D	0 V to -9 V or 0 V to +9 V

(Depending on accessory cable used)
(Always displayed as negative value)

NOISE REDUCTION

Averaging
1 to 1000 (applied per measurement).

Smoothing
Aperture settable from 0.01 to 20% of span, resolution 0.01%

CALIBRATION

Path calibration (Normalization) types
Through, short/open, short, open

INSTRUMENTATION ACCURACY
<±0.05%

SYSTEM ACCURACY
Refer to individual specifications for Detectors and Return Loss Bridges.

DYNAMIC CALIBRATION
When calibrating 6230A series steps between -30 dBm to +20 dBm
When calibrating 6230L series steps between -24 dBm to +26 dBm
Note:- For frequency specification refer to Power Reference section.

Output Connector
N(f), 50 Ω (Adapter supplied with 6203B and 6204B for use with 3.5 mm and 2.92 mm detectors).

Synthesized Sweep Generator

FREQUENCY

Range

6200B:	10 MHz to 20 GHz
6201B:	10 MHz to 8 GHz
6202B:	10 MHz to 2 GHz
6203B:	10 MHz to 26.5 GHz
6204B:	10 MHz to 46 GHz

Resolution

0.01 to 26.5 GHz:	1 Hz
26.5 GHz to 46 GHz:	2 Hz

CW Accuracy
<±50 Hz ± Frequency standard accuracy to 26.5 GHz
<±100 Hz ± Frequency standard accuracy to 46 GHz

Typical Swept Accuracy

	Frequency	
Step Time	**Up to 2 GHz**	**>2 GHz**
250µs	<5 kHz	<100 kHz
1 ms	<500 Hz	<1.5 kHz
10 ms	<50 Hz	<50 Hz

POWER

6200B/6201B/6202B/6203B standard

	Power-levelled (dBm)	
Frequency range (GHz)	*Guaranteed*	*Maximum typical*
0.01 to 2	-10 to +7	+11
2 to 8	-10 to +6	+8
8 to 18	-10 to +5	+10
18 to 20	-10 to +5	+8
20 to 26.5	-10 to +4	+8

6204B standard

	Power-levelled (dBm)	
Frequency range (GHz)	*Guaranteed*	*Maximum typical*
0.01 to 2	-10 to +6	+10
2 to 8	-10 to +5	+8
8 to 18	-10 to +5	+8
18 to 20	-10 to +5	+6
20 to 26.5	-10 to +3	+6
26.5 to 40	-10 to 0	+2
40 to 46	-10 to -3	-1

620XB + Opt.001, 009 (step attenuator)

	Power-levelled (dBm)	
Frequency range (GHz)	*Guaranteed*	*Maximum typical*
0.01 to 2	+5	+9
2 to 8	+4	+6
8 to 18	+3	+7
18 to 20	+2	+5
20 to 26.5	+1	+4
26.5 to 40	-2	+1

For option 001 minimum levelled power -80 dBm
For option 009 minimum levelled power -100 dBm
For option 002 (Field replaceable RF connector) guaranteed output is reduced by 0.5 dB.

Settable power range

620XB Standard	-20 dBm to +20 dBm
620XB + option 001	-90 dBm to +20 dBm
620XB + option 009	-110 dBm to +20 dBm

Resolution
0.01 dB

Power Sweep range
(From maximum levelled power)

620XB standard

0.01 to 26.5 GHz	>25 dB
26.5 GHz to 40 GHz	>10 dB
40 to 46 GHz	>7 dB typical
620XB + option 001	>80 dB
620XB + option 009	>100 dB

INTERNAL LEVELLING

Accuracy
(including flatness at 0 dBm)

All standard versions and option 002 if fitted

0.01 to 26.5 GHz:	<±1 dB, ±0.5 dB typical
26.5 to 40 GHz:	<±1.5 dB, ±0.7 dB typical
40 to 46 GHz:	<±3.0 dB typical.

Linearity
<±0.5 dB over guaranteed levelled power range.

620XB with option 001, 009 (including option 002 if fitted)

10 MHz to 8 GHz:	<±1 dB (±0.3 dB ±2% of attenuator setting in dB)
8 GHz to 26.5 GHz:	<±1 dB (±1 dB or ±4% of attenuator setting in dB, whichever is greater)
26.5 GHz to 40 GHz	<±1.5 dB (±1 dB or ±4% of attenuator setting in dB, whichever is greater)

EXTERNAL LEVELLING
Via rear panel BNC input socket.
Accepts signals from a detector (positive or negative) or from the analog output of a power meter (0 to ±1 V)
Accuracy depends on levelling technique.

SIGNAL PURITY

Harmonics

0.01 to 2 GHz	<-27 dBc, -35 dBc typical
2 to 8 GHz	<-35 dBc, -40 dBc typical
8 to 26.5 GHz	<-40 dBc, -50 dBc typical
26.5 to 40 GHz	<-20 dBc typical.

Sub-Harmonics

2 to 26.5 GHz	None
26.5 to 40 GHz	<-40 dBc typical

Spurious signals, typical

	30 kHz to 150 kHz	*150 kHz to 1 MHz*	*>1 MHz*
0.01 to 2 GHz	<-50 dBc	<-60 dBc	<-60 dBc
2 to 8 GHz	<-50 dBc	<-50 dBc	<-60 dBc
8 to 26.5 GHz	<-50 dBc	<-60 dBc	<-60 dBc
26.5 to 40 GHz	<-40 dBc	<-50 dBc	<-50 dBc

Phase noise
Typical values measured in 1 Hz bandwidth at 20 kHz offset from the carrier in CW mode.

0.01 to 2 GHz	<-90 dBc/Hz
2 to 8 GHz	<-78 dBc/Hz
8 to 12 GHz	<-74 dBc/Hz
12 to 20 GHz	<-70 dBc/Hz
20 to 26.5 GHz	<-67 dBc/Hz
26.5 to 40 GHz	<-57 dBc/Hz

Residual FM
In 100 kHz bandwidth in CW mode:

0.01 to 2 GHz	<1 kHz peak

2 to 26.5 GHz	<(500 x f) Hz peak
26.5 to 46 GHz	<(1000 x f)

where f is the frequency in GHz

OUTPUT CONNECTOR

Type

6200B/ 6201B/6202B:	Precision N (female), 50 Ω
6203B:	MPC (IFR Precision Connector) 3.5 mm (female), 50 Ω
6204B:	Precision 2.92 mm (female), 50 Ω
Option 002:	Field replaceable, 50 Ω precision 3.5 mm (female) and N-type (female) - not for 6204B.

Reverse input power
100 mW maximum

Source Match (internally levelled)
With option 001, 009 minimum return loss specification degrades by up to 5 dB
With option 002 minimum return loss specification degrades by up to 3 dB.

6200B/6201B/6202B/6203B

Frequency Range (GHz)	*VSWR*	*Return Loss (dB) Minimum*	*Typical*
0.01 to 0.05	<1.45:1	>15	>17
0.05 to 2	<1.11:1	>26	>33
2 to 8	<1.2:1	>21	>30
8 to 12	<1.35:1	>16.5	>25
12 to 26.5	<1.45:1	>15	>20

6204B

0.01 to 40	<1.93:1	>10	>12
40 to 46			>10

VOLTS/GHz
Voltage proportional to frequency available from rear panel BNC Voltage/Current output.
Range: 1 V/GHz or 0.5 V/GHz selectable (20 V maximum in 1 V/GHz mode).
Linearity: ±15 mV.

FIXED RAMP
0 to 10 volt ramp corresponding to frequency start and stop.

Fault Location

DISTANCE

Units
Metres or feet.

Accuracy
<0.1% of range or 3 mm, whichever is the larger (for a single fault up to 1 km range).

Full scale
Up to 25 km depending on cable or waveguide loss.

Minimum resolution
For two equal amplitude discontinuities using maximum sweep width:
6200B: 1.82 x Vr cm.
6201B: 4.54 x Vr cm.
6202B: 18.28 x Vr cm.
6203B: 1.37 x Vr cm.
6204B: 0.91 x Vr cm.
Where Vr is the relative velocity of the transmission line.

DYNAMIC RANGE

Detection	Frequency to 26.5 GHz	26.5 to 40 GHz
AC	80 dB	>40 dB typical
DC	70 dB	>40 dB typical

MEASUREMENT TIME (401 POINTS)

Normal mode:	<250 ms
Enhanced mode:	<500 ms

NUMBER OF MEASUREMENT POINTS
User selectable from 51 to 1024.

Power Meter

FREQUENCY RANGE
30 kHz to 46 GHz, dependent upon sensor used.

POWER RANGE
-65 dBm (300 pW) to +35 dBm (3 W), dependent upon sensor used.

INSTRUMENTATION ACCURACY
<±0.05%.

CORRECTION

Calibrator Factor

Range:	0.01% to 200%
Resolution:	0.01%

Linearity Factor

Range:	0.1 to 15
Resolution:	0.1

Noise (after Auto Zero)

6910 Series:	500 nW (-33 dBm).
6920:	300 pW (-65 dBm).
6923/6924:	100 nW (-50 dBm).
6930 series:	15 mW (-18 dBm).

RESPONSE TIME
<100 ms

AVERAGING
1 to 1000 selected automatically or manually entered.

RESOLUTION
2 to 4 digits, user selectable.

CHART RECORDER
Rear panel voltage/current BNC output gives a voltage proportional to measured power.

Sensitivity
0 V to 5 V:0 V level dependent upon detector or sensor.

Log mode
1 V per decade

Linear mode
Scaling dependent on detector or sensor.

POWER REFERENCE

Output Connector
N(f), 50 Ω. (Adapter supplied with 75 Ω and MPC (IFR Precision Connector), 3.5 mm and 2.92 mm power sensors).

Frequency
50.3 MHz ± 0.1 MHz

Level
1 mW

Uncertainty
±0.7% traceable to National Standards

Accuracy
±1.2% worst case for 1 year.

Frequency Counter

FREQUENCY RANGE

6202B:	10 MHz to 2 GHz
6200B/6201B	10 MHz to 20 GHz
6203B/6204B	10 MHz to 26.5 GHz

RESOLUTION

Readout mode
1 Hz to 100 MHz, user selectable

Swept mode
6 digits

ACCURACY

Readout mode
<±25 Hz ± frequency standard error.

Swept mode
<(6 significant figures or ±100 Hz, whichever is greater)
± frequency standard error.

TYPICAL SENSITIVITY

6200B/6201B/6202B/6203B	6204B
25 MHz to 10 GHz <-20 dBm	<-19 dBm
10 GHz to 20 GHz <-15 dBm	<-14 dBm
20 GHz to 26.5 GHz <-10 dBm	<-8 dBm.

MAXIMUM INPUT LEVEL
+5 dBm.

DAMAGE LEVEL
+27 dBm peak

INPUT CONNECTOR

Type

6200B/ 6201B/6202B:	Precision N Type (female)
6203B/6204B:	PC (Precision Connector) 3.5 mm (female).
Option 002:	Field replaceable, 50 Ω precision 3.5 mm (female) and N-type (female)

Input impedance
50 Ω nominal.

FM TOLERANCE

Readout mode
20 MHz peak to peak at 45 Hz to 10 MHz rate.

Swept mode
1.5 MHz peak to peak at 75 Hz to 10 MHz rate.

AM TOLERANCE
Up to 40% modulation depth for signals within the range of sensitivity and maximum input level.

ACQUISITION TIME

Readout mode
Typically 2 s for frequencies greater than 300 MHz, for 1 Hz resolution.

Swept mode
Typically 150 ms per point for frequencies greater than 300 MHz.

SELECTIVITY
Typically 25 dB.

Programmable Voltage/Current Source

VOLTAGE OUTPUT

Range:	-15 V to +15 V
Resolution:	1 mV
Accuracy:	<±15 mV.

Total power supplied not to exceed 2.5 W

CURRENT OUTPUT

Range:	-150 mA to +150 mA
Resolution:	10 mA
Accuracy :	<±300 mA

Total power supplied not to exceed 1.25 W.

Stability with temperature
10 µA/°C

OUTPUT CONNECTOR
Rear panel BNC.

Display

TYPE
Color active matrix TFT Liquid Crystal Display with 16.5 cm (6.5 in) visible diagonal.
External colour monitor (VGA) output on rear panel.

NUMBER OF CHANNELS
Two. A channel may be configured either as a swept channel for displaying traces or a readout channel for displaying read-outs of values such as power and frequency.

NUMBER OF TRACES/READOUTS
Four. Maximum of two per channel.

TITLES
Screen title plus individual measurement titles.
Individual title coded to each trace/readout.

Swept Channel Characteristics

The horizontal and vertical axes can be configured to display a variety of different measurements. The horizontal axis, referred to as 'Domain', may be defined to display the stimulus such as frequency, power, voltage and current. The vertical axis, referred to as 'Response', may display frequency, power and voltage.

DOMAIN (Horizontal Axis)

Frequency Modes
CW, start/stop, center/span, alternate sweep.

Frequency Resolution
Settable to 1 Hz, displayed as six digits.

Frequency Offset
Frequency offset between source and display can be entered to characterize frequency changing devices such as mixers.

Frequency Scaling
Multiplication factor between source and display can be entered to characterize frequency multipliers and dividers.

Power Sweep Range
Range depends on option - refer to Synthesized Sweep Generator section.

Power Offset
Power offset between source and display can be entered for use when measuring amplifiers and attenuators.

RESPONSE (Vertical Axis)

Units
dBm, dB, pW to kW, nV to V, VSWR, Hz to GHz.

Scaling
Manual auto-scale (single shot), continuous auto-scale (every sweep) or user selectable.

Reference level position
Reference level may be set to any graticule line.

Reference level value
-199.99 to +199.99 all units except VSWR.
1 to 100 VSWR.

MEASUREMENT MANIPULATION

Scalar detector and counter inputs
Display live measurement
Display trace memory
Display live measurement relative to trace memory.
Measurement hold may be applied for each trace.

Scalar detector inputs only
Any input or ratio of inputs may be assigned to any one or more than one of the traces. A trace may display absolute power, power relative to a path calibration or power minus a trace memory.

Complex limit lines
Four stores of 12 segments each. Each segment defines an upper and a lower limit line or point. Any store can be applied to any trace.

Input Offsets
An offset in the range -99.99 to +99.99 dB in 0.01 dB steps may be applied per detector input.

MARKERS
Eight per trace plus a separate delta marker.

Marker functions
Marker, delta marker, minimum, maximum, search left, search right, N-dB bandwidth (with center frequency) marker tracking. Peak to peak response value and optional test against limit.

Marker resolution

Domain (Horizontal)

Frequency
Selectable, either 6 digits or 1 Hz.

Power
0.01 dB

Voltage
1 mV

Current
10 µA.

Response (Vertical)

Power
0.01 dB

Frequency
Six digits

Voltage
1 nV.

Readout Channel Characteristics

RESOLUTION

Power
2 to 4 digits, user selectable.

Frequency
1 Hz to 100 MHz, user selectable

Voltage
Four digits

UNITS

Power
dBm, dB, pW to kW.

Frequency
Hz to GHz

Voltage
nV, µV, mV, V, kV

MEASUREMENT MANIPULATION

Marker readout
Spot readings may be made at the domain value specified by the active marker.

Limit checking
Upper and lower test limits may be entered.

Relative measurement
To display the measured offset from a previously entered or measured reading.

Max/Min hold
To display maximum and minimum values over a period of time for drift measurements.

Duty Cycle
To display peak power given by average power measured/duty cycle. Range: 0.001 to 100%.

Peaking Meter Display
Analog display to assist when adjusting power levels.

Input Offsets
An offset in the range -99.99 to +99.99 dB in 0.01 dB steps may be applied per detector or sensor input.

Auxiliary Inputs and Outputs

GPIB INTERFACE
GPIB is IEEE 488.1 and 488.2 compatible. The interface has three applications:-
-Instrument control with full talk and listen capability.
-Control of a plotter using HPGL. Plotter output is buffered to permit measurements to proceed whilst plotting.
-Control of a second MTS for mixer measurements. The instruments may be set to sweep with a fixed frequency offset between them.

MEMORY CARD INTERFACE
For external storage of data or installation of memory card applications.

PARALLEL PRINTER OUTPUT
Compatible with Epson FX, Hewlett Packard DeskJet/LaserJet 4, color DeskJet or Canon BJ series printers. Output is buffered to allow further measurements whilst printing.

FREQUENCY STANDARD IN/OUT BNC
1 or 10 MHz input or 10 MHz output (nominally 2 V pk-pk into 50 Ω) selectable from front panel.

EXTERNAL LEVELLING INPUT BNC
For connection of remote detector or power meter for source levelling.

VOLTAGE/CURRENT OUTPUT BNC
User definable to be:

Fixed Ramp
0 to 10 volt ramp corresponding to frequency start and stop.

Volts/GHz
Voltage proportional to frequency output from source.

Fixed
Fixed voltage or current output for bias measurements.

Swept V/I
Swept voltage or current for voltage/current domain measurements.

Chart recorder
Voltage proportional to power level of scalar detector or power meter sensor input.

EXTERNAL MONITOR
Output to a VGA 640x480 standard, color monitor Rear panel 15 way 'high density' D type female connector.

EXTERNAL KEYBOARD
To interface to compact keyboard (optional accessory)

General

FREQUENCY STANDARD
For synthesized sweep generator and frequency counter.

Internal
10 MHz Oven Controlled Crystal Oscillator

Temperature stability
Better than ±5 in 10^{-8}, 0 to 50°C

Ageing
Better than 2 in 10^{-7} per year

External Input
1 or 10 MHz standard rear panel BNC socket.

Output
10 MHz, rear panel BNC socket.

MEMORIES

Trace memories
Four.

Settings stores
Ten.

Power sensor cal stores
Stores for 10 sets of Power Sensor calibration and linearity factor data.

Memory card
Extra stores available on memory card.

3.5 in DISK DRIVE (OPTION 003)
Up to two hundred trace memories can be stored on a 3.5 in disk. Disks can also store the same parameters as the memory card or instrument memories.

REAL TIME CLOCK

Date and Time
Used to date-stamp hard copies.

ELECTRO-MAGNETIC COMPATIBILITY
Conforms with the protection requirements of EEC Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011-1991 (Emission)	CISPR11
EN50082-1:1992 (Immunity)	IEC801-2:1991
	IEC801-3:1984
	IEC801-4:1988
EN60555-2:1987 (Mains Harmonics)	
	IEC555-2

SAFETY
Complies with IEC 1010-1. BS EN61010-1 for class 1 portable equipment and is for use in a population degree 2 environment. The instrument is designed to operate from an installation category 2 supply.

RATED RANGE OF USE

(over which full specification is met)

Temperature
0 to 50°C

Humidity
Up to 93% RH at 40°C

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
-40 to +70°C

Humidity
Up to 93% RH at 40°C

POWER REQUIREMENTS

Switchable voltage ranges

115 V set:	90 to 132 V
230 V set:	188 to 265 V

AC Supply
45 to 440 Hz. 500 VA maximum.

DIMENSIONS AND WEIGHT

Height	Width	Depth
197 mm	389 mm	546 mm
7.75 in	15.3 in	21.5 in

Weight

6200B	16 kg 35 lb
6201B	15 kg 33 lb
6202B	14.5 kg 32 lb
6203B	16.25 kg 36 lb
6204B	17 kg 37.4 lb

Notes:
Guaranteed Power Range, Power Accuracy and VSWR are calibrated for the temperature range 0 to 50°C and are subject to the availability of National Standards.
Typical performance figures are non-warranted.

Options

Option 001
70 dB step attenuator

Option 002
Field replaceable RF connectors (3.5 mm and N type) (not available on the 6204B)

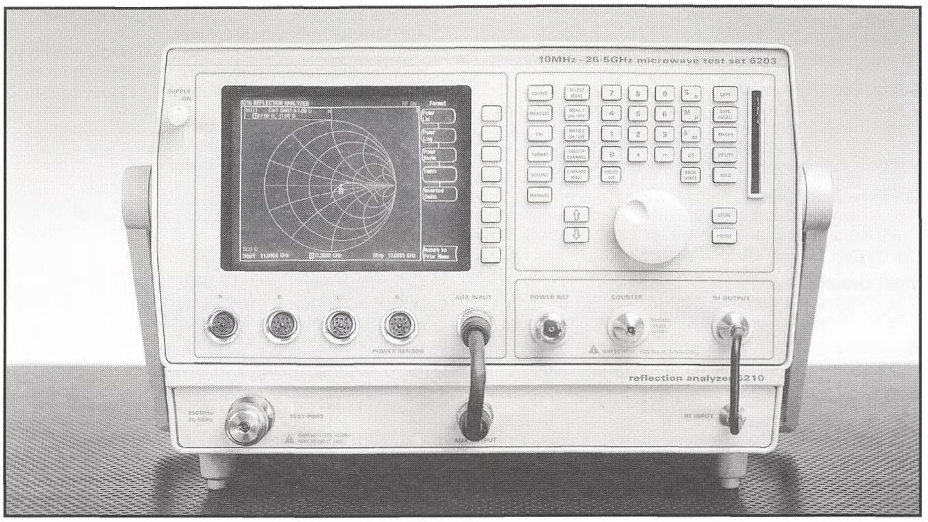
Option 003
3.5 in floppy disk drive (standard on 6202B)

Option 008
8.4 GHz frequency extension (6201B only)

Option 009
90 dB step attenuator
(not available on the 6204B)

6210
Reflection Analyzer

6210 enhances the capability of 6200 series by providing precision, reflection coefficient and time domain measurements

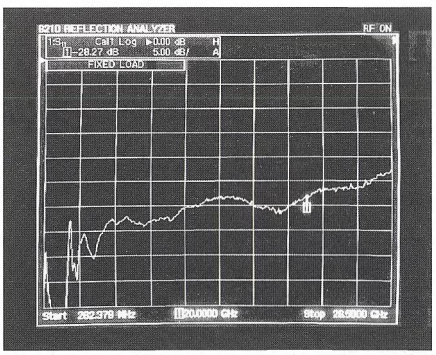


- Excellent directivity and test port match for precise measurements of reflection coefficient
- Time domain software for pinpointing impedance discontinuities in devices or systems
- Polar and Smith Chart displays to facilitate matching of devices in circuits
- Fast sweep rate to speed up alignment of components in production test
- Wide range of calibration kits for 3.5 mm, Type N and 7 mm connectors
- Works with standard 6200 series Microwave Test Set for easy upgrade route

The 6210 Reflection Analyzer is designed specifically for precision measurements of reflection coefficient from 250 MHz to 26.5 GHz. 6210 fits underneath a 6200 series Microwave Test Set (MTS) which provides the synthesized signal source and analyzer display to form a single integrated test system. 6210 consists of additional hardware and software to enable error corrected reflection coefficient measurements with both cartesian and polar displays.

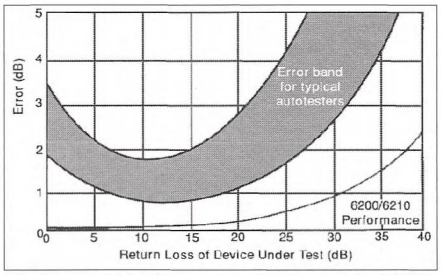
Accurate Return Loss Measurements

Reflection coefficient is the primary performance test for microwave systems and components. Return loss and VSWR are derivatives of reflection coefficient, they can be measured with a standard scalar analyzer and a directional RF bridge such as an autotester. An analysis of return loss measurements using an autotester shows that errors are dominated by test port match and directivity. The 6210 Reflection Analyzer makes error corrected return loss measurements to give improved accuracy and reduced uncertainty. The test port match and directivity achieved with 6210 is significantly better than that obtainable from autotesters.



6210 performs precision reflection coefficient measurements from 250 MHz to 26.5 GHz

Depending upon the test port connector and the quality of the calibration kit a test port match of >40 dB and directivity of >50 dB can be achieved.



Improvement of accuracy obtained with 6210 compared to an autotester.

In production areas this means less stand off due to measurement uncertainty resulting in higher yield and shorter test and rework time. To design engineers it means greater confidence in the quality of the initial design.

The measurement can be displayed in log magnitude, linear magnitude, VSWR, phase, polar, real, imaginary or Smith Chart formats.

Integration of the synthesized source, reflection analyzer and display unit into one system makes the 6210 ideal for both production testing and design work. The soft key menu structure leads the user through the measurement and prompts appear when data has to be entered. Measurement setups and calibrations can be stored in the instrument memory. The macro facility reduces test time in production areas by automating repetitive test methods.

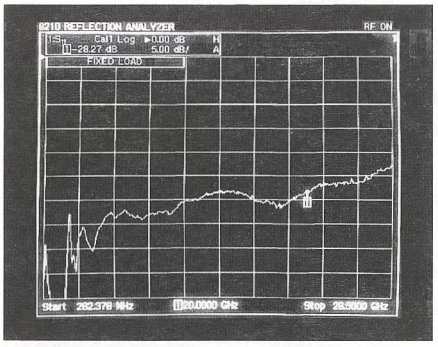
Time Domain Analysis

For design engineers early iterations of systems or components often need trouble shooting. A poor return loss can be the result of bad connector assembly, unoptimized track layout or incorrect

component design. Time domain software gives a display of reflection coefficient against time (or distance) which simplifies diagnosis and pinpoints the problem area. The nature of the problem, capacitive or inductive, can be identified from the reflection coefficient value. Engineers can easily see if the device under test is faulty or needs improved impedance matching between adjacent components.

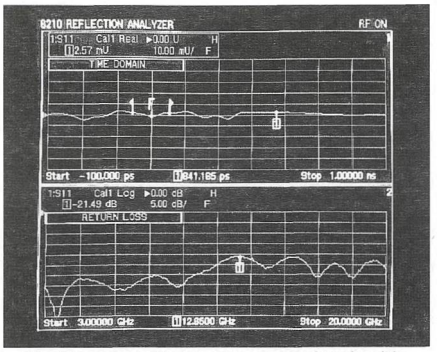
Time domain works by performing an inverse Fourier transform on the frequency domain data. Both low-pass and band-pass modes are available. Low-pass mode simulates a traditional Time Domain Reflectometer (TDR). It can be set up for both step and impulse responses. Low-pass mode can only be used on devices whose frequency characteristics extend down to DC. For frequency selective devices such as waveguide, filters and antennas band-pass mode must be used. The display zoom feature can be used to examine the frequency range of interest with greater clarity rather than the complete range of the calibration.

To overcome the effects of dispersion in waveguide a non linear (warped) frequency sweep can be selected. A normal linear sweep would blur the position of a discontinuity. Warped sweeps allow the discontinuity to be pinpointed accurately.



Time domain response and return loss measurement of a microwave component

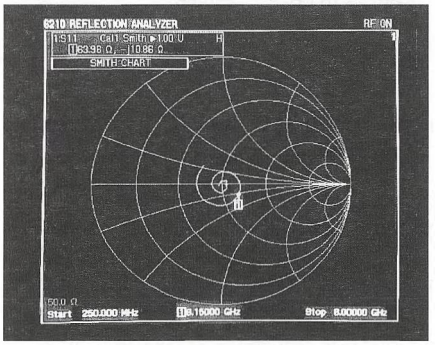
Once a discontinuity has been identified the gating and fencing functions can be used to isolate it mathematically. Fencing allows the user to see what the return loss would be without the effect of a particular fault. Conversely gating allows the user to see what the return loss of a specific fault or discontinuity is. These features are very powerful tools for diagnosing and improving the performance of a system. Knowing the position and severity of faults in a device means that they can be modified in the shortest possible time, speeding up design cycles.



For the same device shown previously, this display shows time domain response with fence around fault and return loss of device with effect of discontinuity removed

Complex Reflection Coefficient

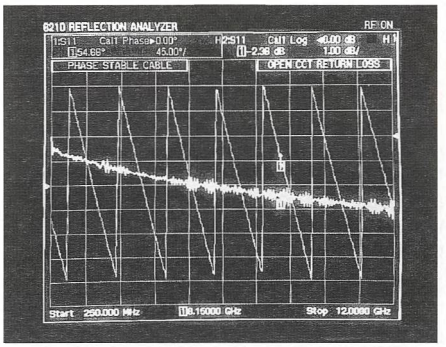
When building up systems which include devices such as transistors, PIN diodes, varactor diodes, capacitors and resistors, it is often necessary to fully characterize these devices. This allows prediction of the performance of a circuit at an early stage of the design reducing the number of design iterations. In order to match consecutive devices in a circuit it is essential to have knowledge of the complex reflection coefficient of each stage (input and output). This enables a matching circuit to be designed to ensure the overall circuit performance meets its specification. 6210 can display complex reflection coefficient in either polar or Smith Chart format. The accuracy of the device characterization can be enhanced by using the time domain gating function and electrical delay.



Smith Chart gives impedance information to aid design of matching circuits

The electrical delay facility of 6210 allows the user to shift the reference plane. When characterizing devices on a substrate or in a test fixture it is often necessary to shift the reference plane to the input of the device. This removes the response of the length of transmission line between the test port and the device input resulting in a display of input impedance of the device.

Phase Display



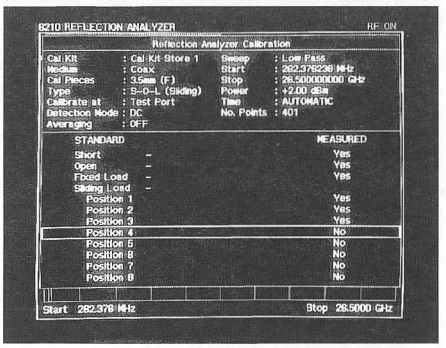
Phase characteristics and open circuit return loss measurement on a phase stable cable

The display can be formatted to show phase in degrees against frequency. This facility is invaluable for testing the phase stability of cables and for phase matching lengths of transmission line such as semi-rigid coax.

A cable with poor phase stability will introduce errors into measurements if moved after a calibration. Storing the phase characteristics of a cable into a trace memory and then comparing with a live trace enables the quality of the cable to be evaluated quickly.

Fast Calibration

An intuitive menu structure enables the user to quickly calibrate the 6210. Calibration kits are available for coaxial 3.5 mm, Type N and 7 mm connectors. Waveguide calibrations are also supported. A sliding load can give directivities of over 50 dB for coaxial measurements.



Screen displays lead the user through the calibration procedure

The overall performance of the 6210 is determined by the specification of the calibration kit used. The directivity, source match and response errors can be characterized by measuring known standards. Error correction routines in the 6210 then minimize errors during normal measurements. IFR offer full calibration kits including short and open circuits, fixed and sliding loads, connector gauges, test port adapters and torque spanners. To verify calibrations optional airlines are also available. The calibration kits are supplied in a protective wooden storage box.

Economy calibration kits which include open and short circuits and fixed loads are also available.

Active Device Measurement

For testing some active devices such as PIN and varactor diodes and transistors it is necessary to have a biasing voltage on the output of the test port. The optional bias tee (option 011) allows voltages to be applied to the test port. The internal voltage/current source of the MTS can be used as the supply.

Test Port Flexibility

The use of adapters at the test port to provide the most suitable test port connector does not degrade measurement accuracy. This is because calibration removes the effect of the adapter. Errors associated with scalar analyzers and autotesters using test port adapters are therefore not encountered when using the 6210 Reflection Analyzer.

A range of ruggedized test port cables are available. Test port cables allow error corrected measurements to be made remote from the front panel connector with the choice of test port connectors including 3.5 mm male and female and Type N male and female or 7 mm. All test port cables are phase stable so that repositioning the cable after a calibration will still give good measurement accuracy.

Comprehensive Measurement System

A 6210 can be added to any 6200 series Microwave Test Set. All the features of the 6200 are retained including absolute power measurement, frequency counter, voltage/current source, standard scalar analyzer and synthesized sweep generator. The synthesizer can also be used as a CW signal source.

6210 can be added to an MTS at any time giving an easy upgrade route for users whose measurement requirements become more demanding. The comprehensive marker functions, limit lines, scaling and plotting functions are all available when using the 6210 Reflection Analyzer.

Specification

NUMBER OF TEST PORTS
1 for the measurement of S_{11}

FREQUENCY RANGE
When used with

6202:	250 MHz to 2 GHz
6201:	250 MHz to 8 GHz
6200:	250 MHz to 20 GHz
6203 or 6204:	250 MHz to 26.5 GHz.

DYNAMIC RANGE (NOISE FLOOR)
(Source set to + 3 dBm)

250 MHz to 500 MHz	>50 dB, 60 dB typical
500 MHz to 18 GHz	>60 dB
18 GHz to 26.5 GHz	>50 dB, 60 dB typical.

INSERTION LOSS FROM RF INPUT TO TEST PORT
Typically 5+ (8 x f / 26.5) dB
where f is the set frequency in GHz.

NUMBER OF MEASUREMENT POINTS
User selectable 2 to 800.

SWEEP TIME

Auto
Sweep time is as fast as possible for the attributes selected.

Manual
Sweep time will never be less than the sweep time entered and may be greater depending on constraints imposed by the system hardware, number of points and measurement software processing overhead.

Fastest time (401 points)
300 ms.

Settable range
40 ms to 500 s.

NOISE REDUCTION

Averaging
1 to 1000 (applied instrument wide).

Smoothing
0.01% to 20% of span, resolution 0.01%.

CALIBRATION

Calibration Types
1 Port

COAX	WAVEGUIDE
short, open, fixed load	short, offset short, fixed load
short, open, sliding load	short, 2 x offset shorts
short, offset short	sliding load.

In addition the ability to specify sex and connector type of the test port.

Number of cal points
Same as number of measurement points.

Calibration kits (optional)
Economy – Type N and 3 5 mm.
Full – Type N, 3.5 mm and 7 mm.

Calibration stores
4, with number of calibration points user selectable 2 to 800.
Additional storage is available via memory card (optional accessory).

REFLECTION ANALYZER SYSTEM PERFORMANCE
Dependent on calibration kit used. Specifications assume a 2 hour warm up period from power on and an ambient temperature of 23°C ±3°C.

N type calibration kit (economy)

Reflection	
Directivity	
<2 GHz	>40 dB
2 GHz to 18 GHz	>30 dB.
Source Match	
<2 GHz	>30 dB
2 GHz to 18 GHz	>24 dB.
Frequency response	Within ±0.25 dB.

N type calibration kit (full)

Reflection	
Directivity	>40 dB.
Source Match	>30 dB.
Frequency response	Within ±0.2 dB.

7 mm type calibration kit (full)

Reflection	
Directivity	>50 dB.
Source Match	>40 dB.
Frequency response	Within ±0.1 dB.

3.5 mm type calibration kit (economy)

Reflection	
Directivity	
<2 GHz	>40 dB
2 GHz to 26.5 GHz	>25 dB.
Source Match	
<2 GHz	>30 dB
2 GHz to 26.5 GHz	>22 dB.
Frequency response	Within ±0.4 dB.

3.5 mm type calibration kit (full)

Reflection	
Directivity	>40 dB.
Source match	>30 dB.
Frequency response	Within ±0.2 dB.

REFLECTION ANALYZER CHANNEL FEATURES

DOMAINS

Frequency
Modes
CW, F1-F2, CF/span, frequency list sweep, harmonic frequency sweep, waveguide frequency sweep.
Ability to blank frequency information to be restored by PRESET.
Resolution
1 Hz settable.
Six digits displayed on graticule.

Power
Sweep range:
25 dB.
85 dB with MTS attenuator option.
Resolution:
0.01 dB settable.
Offset:
Ability to enter offset (per channel) between source and display.

Time
Time domain response for impedance discontinuity analysis.
Stimuli:
Low-pass step
Low-pass impulse
Band-pass impulse.
Resolution (26.5 GHz sweep):
Reflection (in air transmission lines).
Low-pass 0.7 cm
Band-pass 1.4 cm.
Point spacing:
<0.01 cm.
Windowing:
Kaiser Bessel - user definable.
Gating:
User definable start, stop and shape.
Fencing:
User definable start, stop and shape.

Voltage/Current
Ability to sweep rear panel V/I output in the range –15 V to +15 V(±15 mV, 2.5 W max) or in the range
–150 mA to +150 mA (±300 mA, 1.25 W max).
Voltage resolution:
1 mV.
Current resolution:
10 mA.

REFLECTION ANALYZER CHANNEL FEATURES

RESPONSE

Format
Cartesian:
Logarithmic magnitude, Linear magnitude, Phase, VSWR, Real, Imaginary.
Polar:
Smith and Inverse Smith chart, Logarithmic magnitude, Linear magnitude.

Scaling
Magnitude:
Log format 0.01 dB/div to 20 dB/div in 1, 2, 5 sequence.
Lin format 10-12 units/div to 10^3 units/div.
Phase
Cartesian: 0.1°/div to 180°/div.
Polar: 45°/div.

Reference level position
Any graticule line.

Reference level value
–99.99 to +99.99 all units except VSWR
1 to 100 VSWR

MEASUREMENT MANIPULATION

Display
Display live measurement.
Display trace memory.
Display user defined expressions involving subtraction and division on a live measurement and a trace memory.
Measurement Hold applied per trace.

Complex limit lines
Four stores of 12 segments each. Each segment defines an upper and a lower limit line. Any store can be applied to any cartesian trace

Markers
Eight per trace, any one of which can be enabled to become the active marker, plus a separate delta marker.
Marker domain resolution:
Frequency
Six digits by default. User has the ability to select 1 Hz resolution.
Power:
0.01 dB.

http://www.ifrinternational.com

Power:
0.01 dB.
Voltage
1 mV.
Current
10 mA.

Marker response resolution:
Magnitude
Log 0.01 dB.
Lin Six digits.
Phase 0.01°.
Marker functions
Active marker, delta marker, minimum, maximum, search left, search right, 'N-dB' bandwidth, peak-to-peak response.

Reference Plane extension
User definable.
Electrical delay
±1 s maximum or ±300,000 km.
Phase offset
±360° maximum.

Non-dispersive media

Ability to enter delay as either physical length (m)
or electrical delay (s).
Relative velocity (Vr) and relatively permittivity (εr) may be entered.

Characteristic impedance
User definable, default 50 Ω.

Waveguide cut off frequency
User definable.

TEST PORT CONNECTOR

Type
Ruggedized precision 3.5 mm male.

Maximum input power

0.5 W.

POWER SUPPLY

Consumption
50 W maximum (in addition to MTS consumption).

SIZE
46 mm high, 325 mm wide 450 mm deep.

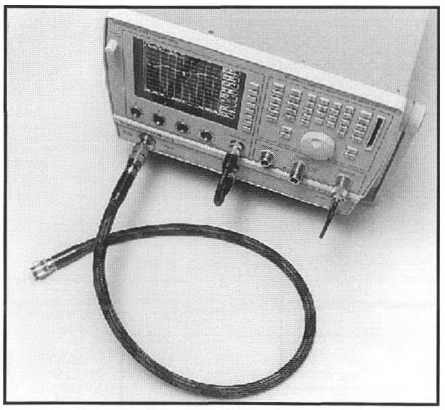
WEIGHT
6.5 kg (including interconnecting cables and fixing kit).

OPTIONAL BIAS TEE

Bias voltage range
±42 V.

Current range
0.5 A max.

Insertion loss
<1.5 dB.



Ruggedized test port cables are available with 3.5 mm, Type N and 7 mm connectors

Versions and Calibration kits

When ordering please quote the full ordering number information.

REFLECTION ANALYZER

Order numbers	Versions
6210	250 MHz to 26.5 GHz Reflection Analyzer
	Options
Option 011	Bias tee
Option 012	Retrofit version
	Supplied with
43138/328	Auxiliary signal channel cable
43138/283	Auxiliary data cable
43138/284	Auxiliary power cable
43138/366	RF interconnection cable – N type
43138/367	RF interconnection cable – 3.5 mm

Note: The 6210 Reflection Analyzer can be supplied as part of a system with one of the 6200 series Microwave Test Sets above or as a retrofit version for fitting to an existing 6200 series Microwave Test Set. Microwave Test Sets must be fitted with software issue 2.0 or higher. Contact your local IFR Service Center if a software upgrade is required.

TEST PORT CABLES

Phase stability 0 2 x f (GHz) degrees

54311/155	Rugged 3.5 mm female to 7 mm
54311/156	Rugged 3.5 mm female to N type male
54311/157	Rugged 3.5 mm female to N type female
54311/158	Rugged 3.5 mm female to rugged 3.5 mm male
54311/159	Rugged 3.5 mm female to std. 3.5 mm female

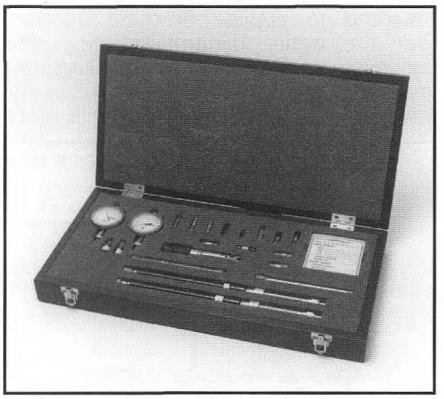
50 Ω FIXED LOADS

Specification as for calibration kits

54421/009	7 mm Fixed Load
54421/010	3.5 mm (f) Fixed Load
54421/011	3.5 mm (m) Fixed Load
54421/012	N Type (f) Fixed Load
54421/013	N Type (m) Fixed Load

ACCESSORIES

54112/157	Soft carrying case
54124/028	Front stowage cover for assembled MTS and 6210



Full and Economy calibration kits are available with 3.5 mm, Type N and 7 mm connectors

BOXED CAL KITS IN 3.5 MM

Order numbers	Versions
54424/009	***Economy***
	Consisting
	2 x short circuit (male and female)
	2 x open circuit (male and female)
	2 x fixed load (male and female)
	Female/female precision adapter
	Fixed load return loss
	<2 GHz 40 dB
	2 GHz to 26.5 GHz 25 dB
	Optional Accessories
54425/005	Gauge kit (3.5 mm), comprising:- 2 x Gauges (m) and (f), adapter and gauge blocks
54152/001	3.5 mm torque wrench
54311/164	3.5 mm male/male matched adapter
54311/165	3.5 mm male/female matched adapter
54424/007	***Full***
	Consisting
	As economy kit including optional accessories plus 2 x sliding load (male and female)
	Optional Accessory
54425/003	Precision 15 cm airline (3.5 mm)

BOXED CAL KITS IN 7 MM

Economy not available

54424/001	***Full***
	Consisting
	Short circuit
	Open circuit
	Fixed load
	Sliding load
	Gauge and gauge block
	Rugged 3.5 mm (female) to 7 mm adapter
	Collet extractor
	Torque wrench
	Fixed load return loss
	<2 GHz 50 dB
	2 GHz to 18 GHz 30 dB
	Optional Accessories
54425/001	Precision 30 cm airline (7 mm)
54311/163	Rugged 3.5 mm (female) to 7 mm adapter
54421/009	Fixed matched load (return loss as above)

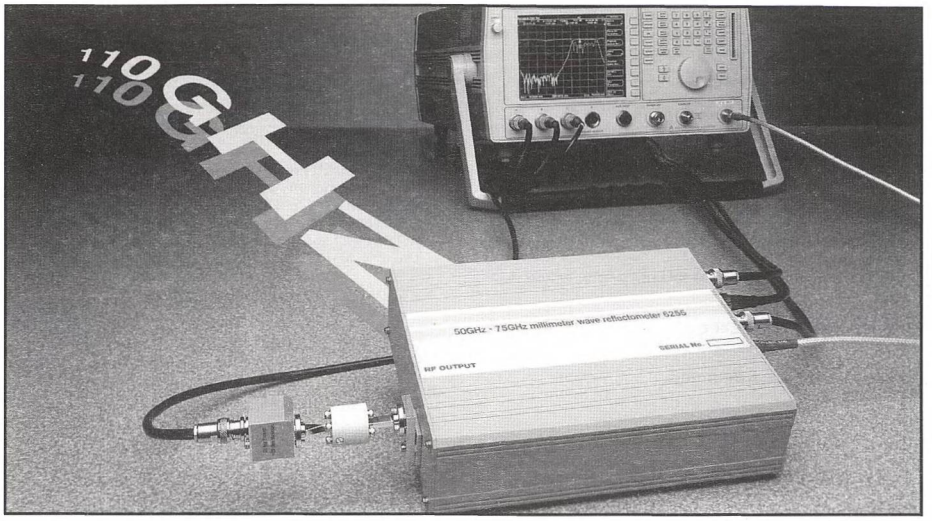
BOXED CAL KITS IN TYPE N

Order numbers	Versions
54424/005	***Economy***
	Consisting
	2 x short circuit (male and female)
	2 x open circuit (male and female)
	2 x fixed load (male and female)
	Rugged 3.5 mm to N(m) Adapter
	Rugged 3.5 mm to N(f) Adapter
	Fixed load return loss
	<2 GHz 40 dB
	2 GHz to 18 GHz 30 dB
	Optional Accessories
54425/004	Gauge kit (N type), comprising:- 2 x Gauges (m) and (f), adapters and gauge blocks
54311/166	N type male/male matched adapter
54311/167	N type male/female matched adapter
54311/168	N type female/female matched adapter
54424/003	***Full***
	Consisting
	As economy kit including optional accessories plus 2 x sliding load (male and female)
	Optional Accessory
54425/002	Precision 30 cm airline (N type)

Note: Calibration kits and accessories carry a one year warranty excluding wear and tear and misuse.

6250 series
Millimeter Wave Reflectometer

The 6250 series adds millimetric wave measurement capability to a standard 6200 series MTS



- Accurate Return Loss and Insertion Loss measurements to 110 GHz
- Compatible with standard 6200, 6203 or 6204 series Microwave Test Set
- Millimetric detectors for transmission measurement
- 50 to 75 GHz and 75 to 110 GHz frequency versions

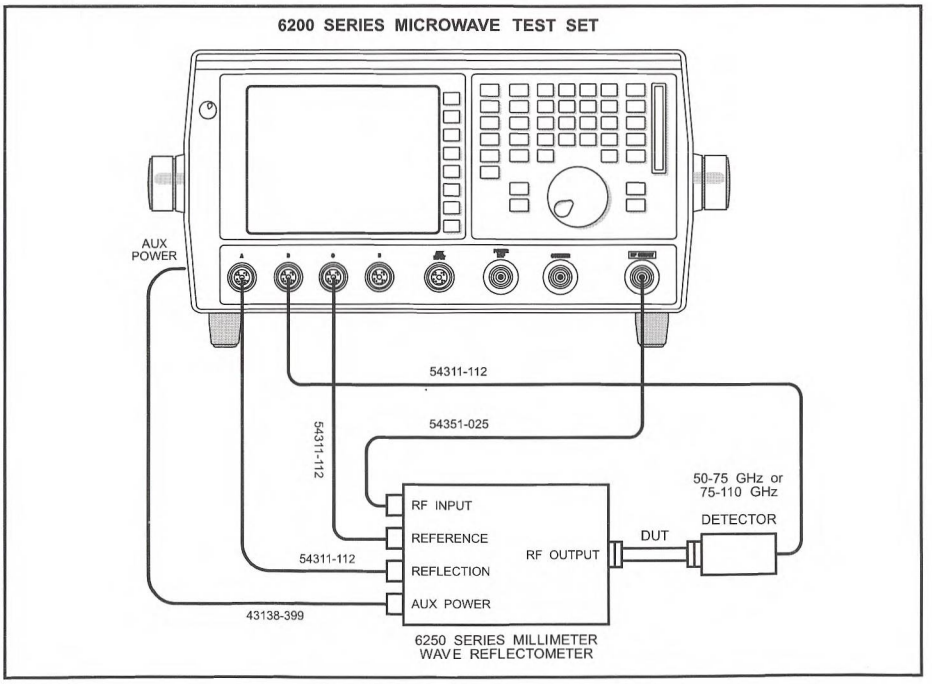
The Millimeter Wave Reflectometers are used to extend the measurement capabilities of the 6200 series Microwave Test Set (MTS) to millimeter wave frequencies. The Model 6255 (V-band) extends the frequency range to cover 50 to 75 GHz, and the Model 6256 (W-Band) extends the range to cover 75 to 110 GHz. Millimetric bands are most commonly used in the communications, radar and electronic warfare markets.

The 6250 series contain frequency multipliers that convert the RF output of the 6200 series Microwave Test Set to either of two bands. RF output power levels in the millimeter wave band typically exceed 0 dBm. Model 6255 (V-Band) multiplies the input frequency, 12.5 to 18.75 GHz, by 4 times, resulting in output frequencies from 50 to 75 GHz (V-Band); Model 6256 (W-Band) multiples the input frequency, 12.5 to 18.333 GHz, by 6 times, thus producing output between 75 and 110 GHz (W-Band). The display of the 6200 series MTS can be scaled to show all traces with their true millimetric frequencies.

The units contain the necessary amplifier/multiplier circuits, and appropriate filters. The source module in each unit includes a full band isolator to provide a good source match. Each unit also contains a high directivity dual waveguide directional coupler, an internal reference detector for ratioed measurements and a separate reflection detector for return loss measurements. Each detector output is linearized to provide excellent accuracy over the entire dynamic range. The transmission detectors are also linearized and are equipped with a full band waveguide isolator to provide a good match.

A set of two band pass filters and one all pass filter are supplied with the units. All frequency multipliers produce undesired harmonic and spurious products. In addition to undesired higher order multiples of the output frequency, mixing products are also created. The filters are used to suppress the undesired harmonics and mixing products resulting in higher quality measurements.

DC power for the units is supplied by the 6200 MTS.



Reflectometer Specification

REFLECTOMETER	*6255*	*6256*
Frequency Range (dependant on filter installed)		
with F AP (All Pass)	50 to 75 GHz	75 to 110 GHz
with F LP (Low Pass)	50 to 58 GHz	75 to 92 GHz
with F HP (High Pass)	57 to 75 GHz	89 to 110 GHz
Waveguide Interface Compatibility	MIL-F-3922/76B-008 Flange, WR-15	MIL-F-3922/76B-010 Flange, WR-10
Reflectometer Output Power, with F AP installed	0 dBm minimum +5 dBm typical	-5 dBm minimum, +2 dBm typical
Dynamic range when used with 6200 series MTS		
Transmission	50 dB (nominal)	50 dB (nominal)
Reflection	40 dB (nominal)	40 dB (nominal)
Source Spurs and Harmonics	-20 dBc typical with F AP -50 dBc maximum with F LP or F HP	-20 dBc typical with F AP -50 dBc maximum with F LP or F HP
Source Match	17 dB Typical	17 dB Typical
Reflectometer Directivity	35 dB minimum, 40 dB typical	35 dB minimum, 40 dB typical
Source Input Frequency	12.5 to 18.75 GHz (Internally multiplied by 4 for 50 to 75 GHz Output)	12.5 to 18.333 GHz (Internally multiplied by 6 for 75 to 110 GHz Output)
Required Input Power	+5 dBm min.	+5 dBm min.
Detector Output Connectors	BNC female	BNC female
Size	8.4 in x 4.25 in x 2.25 in 213 mm x 108 mm x 57 mm	7.4 in x 4.25 in x 2.25 in 187 mm x 108 mm x 57 mm
Supply Voltage	+25 VDC (supplied from MTS Auxiliary Power socket)	+25 VDC (supplied from MTS Auxiliary Power socket)

Detector Specification

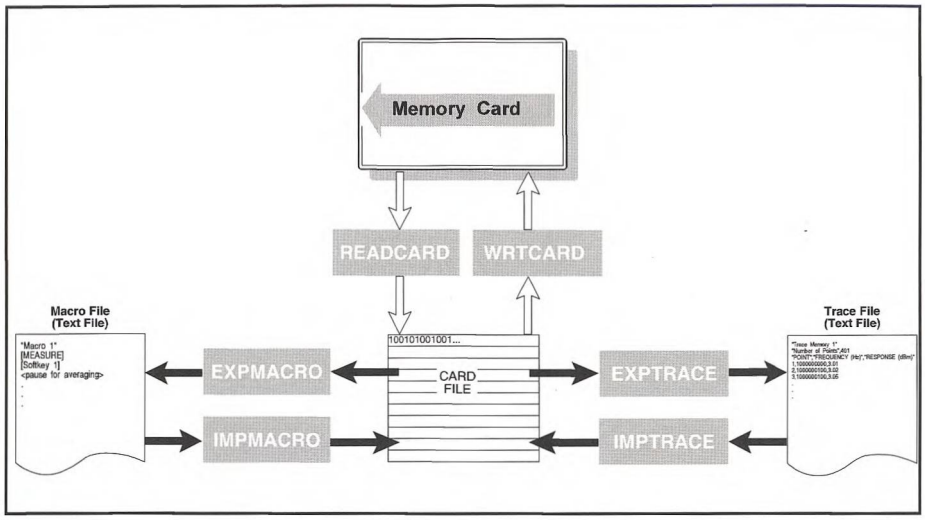
DETECTOR	*6255*	*6256*
Frequency Range	50 to 75 GHz	75 to 110 GHz
Waveguide Interface Compatibility	MIL-F-3922/76B-008 Flange, WR-15	MIL-F-3922/76B-010 Flange, WR-10
Detector Return Loss	18 dB typical	18 dB typical
Detector Flatness	±3 dB	±3 dB
Detector Output	350 mV/mW typical	150 mV/mW typical
CW Input Power	100 mW maximum	100 mW maximum
Detector Output Connector	BNC female	BNC female

Order Codes

6255 Order Number	*Millimeter Wave Reflectometer 50 to 75 GHz*	*6256 Order Number*	*Millimeter Wave Reflectometer 75 to 110 GHz*
	Supplied Accessories		***Supplied Accessories***
None	50 to 75 GHz Low VSWR detector.	None	75 to 110 GHz Low VSWR detector.
54311/112	Negative voltage measurement cable x 3	54311/112	Negative voltage measurement cable x 3
54351/025	RF Cable 3.5 mm (m) to 3.5 mm (m)	54351/025	RF Cable 3.5 mm (m) to 3.5 mm (m)
54311/177	Precision Adaptor N (m) to 3.5 mm (f)	54311/177	Precision Adaptor N (m) to 3.5 mm (f)
None	Waveguide calibration short	None	Waveguide calibration short
43138/399	DC power lead for connection to 6200 series MTS	43138/399	DC power lead for connection to 6200 series MTS
None	Flanged waveguide, 1 in (26 mm) long.	None	Flanged waveguide, 1 in (26 mm) long.
None	3 filters: all pass, low pass, high pass	None	3 filters: all pass, low pass, high pass
46882/292	Instruction Manual	46882/292	Instruction Manual
22951/031	Hexagonal key	22951/031	Hexagonal key
46662/608	Protective carrying case	46662/608	Protective carrying case

6200 series
Memory Card - PC Utilities

The Memory Card - PC Utilities software package enables the user to archive trace on a PC disk and to write and exit macros



- Facilitates archiving of MTS traces on a PC disk.
- Speeds up and simplifies generation and editing of macros.
- Includes a shell programme for ease of use.
- Runs on any IBM compatible PC with an 80286 or higher.
- Memory card reader/writer unit for transferring traces and macros between MTS and PC (available as accessory)

The Memory Card - PC Utilities software package supports all of the 6200 series Microwave Test Sets (MTS). It is ideal for users who want to archive a large number of traces or who need to write and edit macros. The software requires a personal computer with the Intel 80286 processor (or higher), 512k of RAM and running MS-DOS 3.1 or later.

The complete contents of an MTS memory card can be read into the PC. This process requires the memory card reader/writer which connects to the parallel port of the PC via a 25-pin D-type connector. Using this technique results traces stored at a remote location can be archived for use at a later date. Tests made in the future can then be compared with earlier results on the PC screen, or MTS. All records can be kept without the need for creating a hard copy.

For users who write long or sophisticated macros the PC Utilities software package makes this process easier. Existing macros can be read into the PC and then edited. This makes modifying text messages simple as the keyboard of the PC can be used. New sections or additional submacros can be added to existing macros.

The PC Utilities package consists of six DOS based routines together with a menu driven shell program to allow quick access between each of them. Example macros to generate traces using popular spreadsheets are also provided.



The PC Utilities shell menu

Memory card access

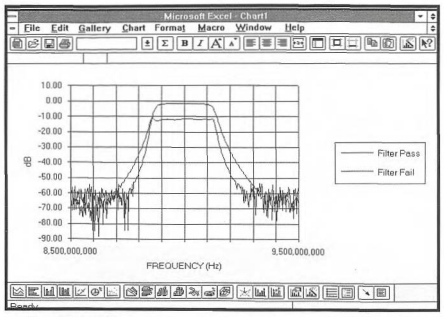
MTS memory cards are available with 128k to 512k of memory. These cards can be configured on the MTS for a number of store types and macros. A 128k memory card can store up to 18 display traces. The complete contents of a memory card can be read into a PC and stored in a card-file. Conversely, new or modified macros and other data can be transferred from the PC to a memory card. Two utilities READCARD and WRTCARD are used for this process.

A memory card reader/writer unit is used for transferring data between the memory card and the PC. The reader/writer connects to the parallel port, which means that desktop and portable PCs can be used. READCARD copies the complete contents of a memory card to a card-file in binary format. The user then gives the card-file a name. A display of current card-files in a directory shows each card title, the number of each type of stores configured on that card (e.g. 8 display memories) and the number of macros on the card. WRTCARD copies the contents of a card-file to a memory card.

Trace memories

Display trace memories can be exported from or imported to a card-file on the PC. Exporting a trace from a card-file allows it to be used in a standard spreadsheet, such as Lotus 123™, Microsoft Excel™ or CA-SuperCalc™. Once in a spreadsheet the trace data can be manipulated and displayed. Two traces can be displayed simultaneously allowing comparisons to be made. In this way the current performance of a device or system can be compared with its recorded performance from an earlier measurement.

EXPTRACE is the utility that exports a selected trace memory from a card-file as an ASCII file. This is then called a trace memory file. Notes can be added to help identify it in future. Trace memory files can be imported into popular spreadsheets and displayed on the PC display or printed out. Simple spreadsheet macro examples with explanatory notes are provided that import and display trace memories.



Screen shot of two traces generated from a spreadsheet

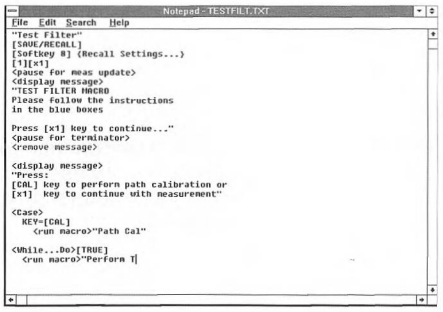
IMPTRACE utility provides a facility for importing a trace memory stored on the PC into a card-file. In this way historical results can be taken out into the field and the current performance of a device or system compared with its earlier performance.

MTS macros

The EXPMACRO utility allows an MTS macro to be exported from a card-file to an ASCII file. The macro can then be edited on the PC. An MTS macro is a recording of operations that the MTS will carry out automatically. They are ideal when repetitive test routines are used such as in a production environment, or when complex tasks need to be performed and their implementation needs to be simplified or deskilled. Macros can be generated by recording a sequence of MTS key presses and adding operator prompts. Macros created with Issue 2 MTS software also allow for decision making with branching and looping conditions.

Once a macro exists as an ASCII file on a PC it can be edited or expanded using the PC keyboard and display. This makes both the generation and editing of macros simpler.

The IMPMACRO utility is used to import a macro from an ASCII file into a card-file. Any syntax errors are detected and highlighted when the new macro is imported. Once in a card file the macro can be stored onto a memory card and then loaded into an MTS for use. (A macro written on an MTS with issue 2 software may not work on an MTS with issue 1 software).



Macro editing on a PC screen

Specification

Minimum systems requirements
PC with Intel 80286 processor (or higher), 512k of RAM and running Windows 3.1 or higher. A full installation of memory card PC Utilities requires 400k bytes of disk space.

Disks supplied
The PC Utilities software is supplied on both 5¼ in and 3½ in formats.

Functionality

READCARD
Transfers the contents of an MTS memory card into a card-file on a PC.

WRTCARD
Transfers the contents of a card-file from a PC onto an MTS memory card.

EXPTRACE
Transfers a display trace memory from a card-file to a trace memory file.

IMPTRACE
Transfers a trace memory file into a card-file.

EXPMACRO
Transfers a macro from a card-file to an ASCII file.

IMPMACRO
Transfers a macro from an ASCII file into a card-file.

Memory Card Reader/Writer

The accessory memory card reader/writer must be used to transfer data using the READCARD and WRTCARD utilities. Supplied with integral data lead for the PC parallel port, 25-pin D type connector.

DC input requirement
9 V to 18 V, 140 mA via a 2.1 mm power connector

Size
30 mm x 82 mm x 152 mm

Weight
220 g.

EMC
Electromagnetic Compatibility
Conforms with the protection requirements of the EEC Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:
EN55011 Class B CISPR 11
EN50082 1 IEC 801-2,3,4

Safety
Complies with IEC 950 (EN60950)

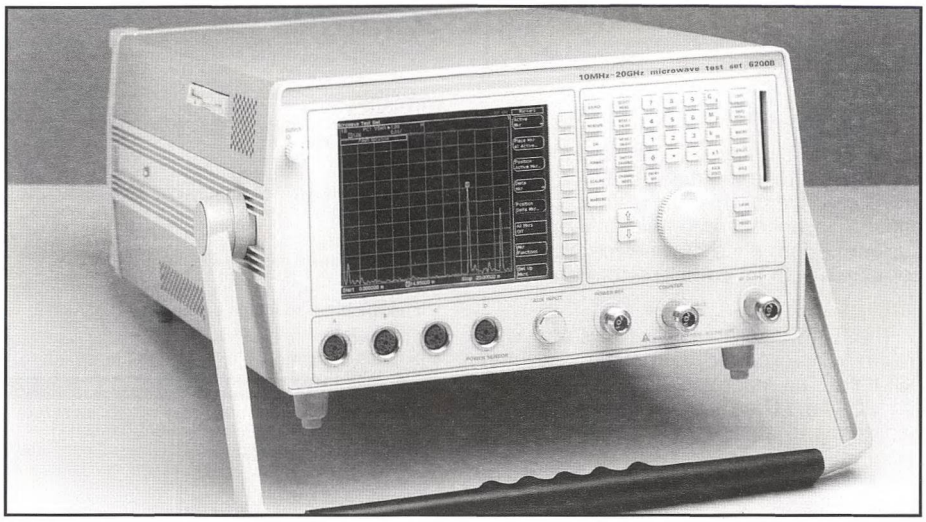
Versions Accessories

When ordering please quote full ordering number information

Ordering Numbers	*Versions*
59000/190	MTS PC-Utilities software
	Both 5¼ in and 3½ in disks supplied
	Supplied with
46882/300	Operating manual
	Optional accessories
54211/004	Memory card reader/writer unit.
	Must be used with one of the AC adaptors listed below. One adaptor must therefore be ordered with each reader/writer unit.
54441/016	AC Adaptor - UK style
54441/017	AC Adaptor - European style
54441/018	AC Adaptor - USA style

6200 series
Guided Measurements Application

The guided measurements application software leads the user through measurement set-up on both waveguide and coaxial systems

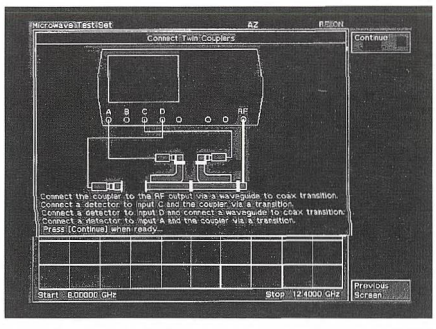


- Simplifies transmission line measurements with 6200 series Microwave Test Set
- Designed specifically for the installation, commissioning and maintenance of RF and Microwave antenna systems
- Supports VSWR, Return Loss, Insertion Loss and Fault Location measurements
- Guides the user through measurement set-up
- On screen diagrams show instrument and component connections
- Ideal for less experienced users
- All levels of user can achieve fast, accurate and repeatable measurements

The 6200 series Microwave Test Set (MTS) integrates a synthesized sweep generator and scalar analyzer into a compact instrument making it ideal for field measurements of return loss, VSWR, insertion loss and fault location. The guided measurements application runs on the 6200 series MTS to guide the user through common transmission line measurements.

When installing and commissioning a new RF or microwave radio link the quality of the antenna and antenna feed, waveguide or coaxial, is fundamental to the overall link performance. Return loss is the principal measurement made to quantify the quality of the antenna and feed installation. Some users prefer to measure VSWR which is an alternative presentation of the same measurement.

With the guided measurements application the user is lead through the measurements. It is not necessary to have a comprehensive understanding of the MTS as the application presets key instrument parameters. Prompts and message boxes appear for the user to enter values specific to their system such as start and stop frequencies. Large on-screen diagrams show the user how to connect up the necessary components such as detectors, couplers and test heads.



Connection diagram for measurement of return loss and insertion loss in a waveguide feed using couplers

The guided measurements application supports measurements on both waveguide and coaxial systems. Should the system under test fail to meet the specified return loss (VSWR) measurement limit, the same application can be used to guide the user through a fault location measurement. Fault location identifies the position of a fault or discontinuity such as might occur at a coax connector or waveguide flange.

The 6200 series MTS is designed for people to install and maintain RF and microwave antenna systems. The excellent performance along with the integrated and compact design mean that it can be operated in all locations with confidence. When used with the guided measurements application, fast accurate and repeatable measurements are guaranteed. This results in minimum installation time and quick repair of faulty sites.

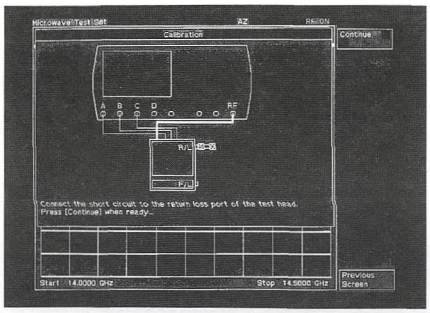
Performing the Measurement

The application commences by prompting for the following information

- type of measurement return loss, fault location, insertion loss
- transmission line medium waveguide, coax
- equipment to be used test head, waveguide couplers

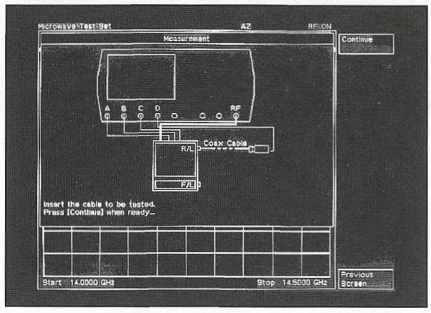
A diagram is then displayed to show the user how to connect the components to make the measurement. Messages prompt for data entry of parameters such as start and stop frequencies.

The user is then guided through the appropriate calibration for the chosen measurement. This routine minimizes errors to give the best possible measurement accuracy.



On-screen diagrams guide the user through the calibration process

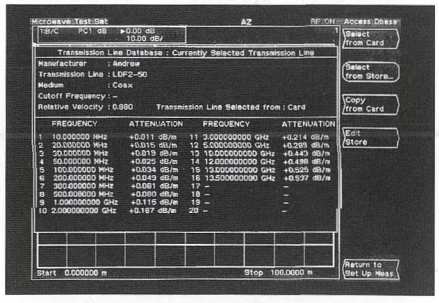
After calibration, on-screen diagrams show how to connect the equipment to measure the transmission line under test. The MTS will now display the trace of the measurement or measurements selected. Operation of the MTS returns to the standard user interface which allows markers to be positioned and traces plotted or stored to memory for further examination at a later date.



The application shows when and where to connect transmission line under test

Transmission Line Database

A separate memory card is available which contains the fundamental parameters of relative velocity, attenuation and cut off frequency for the most commonly used coaxial and waveguide transmission lines. This transmission line database complements the use of the guided measurement application and eliminates the need to carry transmission line manufacturers catalogs to the antenna site.



The Transmission Line Database contains the key parameters of the most common transmission lines

Specification

RF Performance
As for MTS (see separate specification)

6200 series MTS requirements
Runs on any 6200 series Microwave Test Set (MTS) with issue 3.0 software or higher.

Equipment Required

The application will require one or more of the following pieces of test equipment.
6581 Transmission Line Test Head,
10 MHz - 20 GHz
6583 Transmission Line Test Head,
10 MHz - 26.5 GHz
(Usable to 40 GHz for fault location measurements)
6581E Fault Location Test Head,
10 MHz - 20 GHz
6583E Fault Location Test Head,
10 MHz - 26.5 GHz
(Usable to 40 GHz for fault location measurements)
6240 series Fault locators
Single waveguide coupler
Two single waveguide couplers or one dual coupler
Coaxial-to-waveguide transformers (waveguide transitions) to allow the system detectors to be used.
Short circuit plate for calibration
6230 series scalar detector(s).

Other Features
The application is of the Auto Run type. When the MTS powers up with the application card inserted, and if Auto Run was previously enabled, the application will be started automatically.

Ordering Numbers

When ordering please quote full ordering number information

Ordering Numbers	*Versions*
59000/280	Guided measurements application for 6200 series Microwave Test Set (MTS). Supplied on MTS memory card.
	Supplied with
46882/241	Operating Manual
	Complementary Product
59000/264	Transmission Line Database

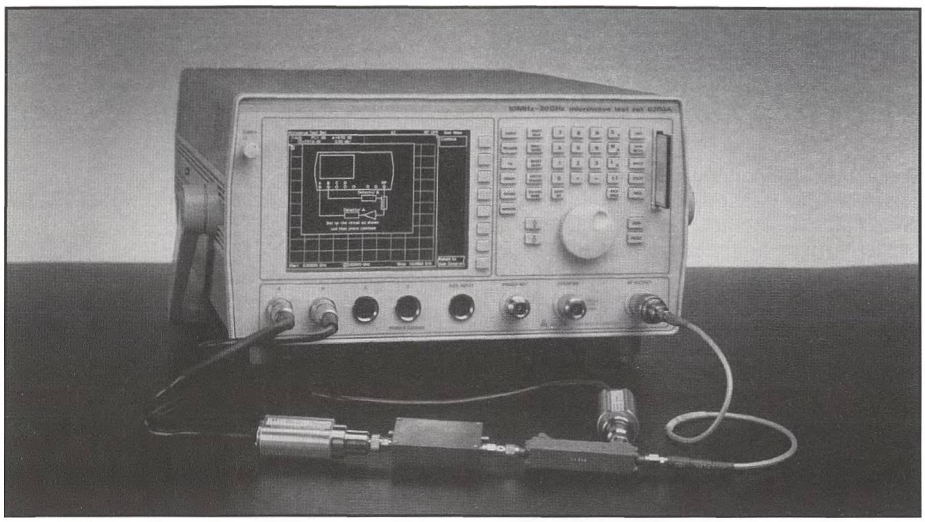
† Requires issue 4.00 firmware or higher.
†† Requires issue 5.00 firmware or higher running on a 6200B series MTS.

Measurements supported

Transmission Line Medium	Accessories Used	Measurements Available
Coax	Test Head	Insertion Loss Single Ended Insertion Loss†† Return Loss VSWR Fault Location Insertion & Return Loss Insertion Loss & VSWR Insertion Loss & Fault Location
	Fault Locator	Insertion Loss† Single Ended Insertion Loss†† Return Loss† VSWR† Fault Location† Insertion & Return Loss† Insertion Loss & VSWR† Insertion Loss & Fault Location† Return Loss & Fault Location† VSWR & Fault Location† Insertion Loss, Return Loss & Fault Location† Insertion Loss, VSWR & Fault Location†
	Bridge	Single Ended Insertion Loss†† Return Loss VSWR
	Divider	Fault Location†
	None	Insertion Loss
Waveguide	Test Head	Insertion Loss Fault Location Insertion Loss & Fault Location
	Fault Locator	Insertion Loss† Fault Location† Insertion Loss & Fault Location†
	Single Coupler	Insertion Loss Return Loss VSWR Insertion & Return Loss Insertion Loss & VSWR
	Twin Couplers	Return Loss VSWR Insertion & Return Loss Insertion Loss & VSWR
	None	Insertion Loss

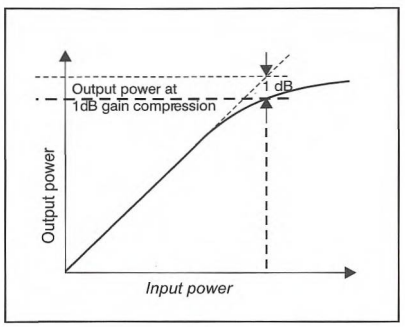
6200 series
Gain Compression Application

The gain compression application software provides a fast, effective way to measure gain compression against frequency through on screen connection diagrams



- Fast measurement of gain compression against frequency
- On screen connection diagrams for operator guidance
- GPIB controllable for production test requirements
- Remote levelling capability

The gain compression software utility runs on the 6200 series Microwave Test Set (MTS) to provide a powerful tool for characterising amplifiers. It is often necessary to characterize the power handling capability of an amplifier. A key aspect of this is the output power at which the gain of the amplifier drops to 1 dB below the small signal value; this is known as the 1 dB compression point. When an amplifier is in compression its characteristics become non-linear. Consequently, signals passing through it will be distorted.

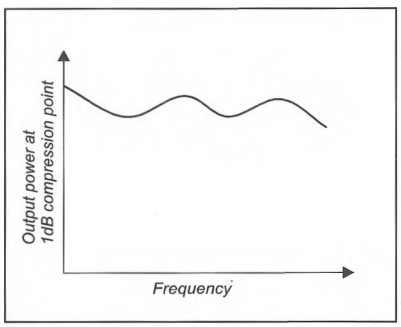


Output power variation against input power showing amplifier going into compression

Although the 1 dB compression point is the most commonly used, other values are also measured.

For example the 3 dB or 6 dB compression points of high powered devices, such as travelling wave tubes (TWT) or klystrons, are often measured as a definition of amplifier saturation.

For many classes of power amplifier the degree of gain compression varies with frequency. The frequency at which gain compression is greatest determines the power limit of the amplifier.



The output power of an amplifier at the 1 dB compression point varies with frequency

The gain compression software allows the user to perform a swept frequency compression measurement. Deficiencies in power handling become immediately apparent.

The 6200 screen displays the frequency dependant gain compression and the corresponding output power level. Conventional methods when applied to wideband amplifiers can involve considerable testing time, without the near instantaneous results necessary for adjusting performance interactively. This capability is especially useful during the design and production stages of broadband amplifiers.

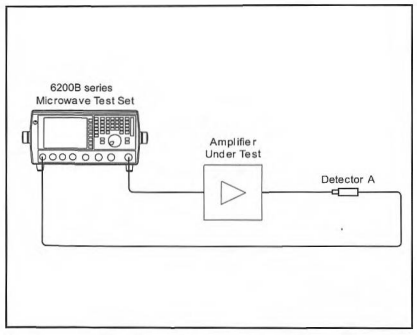
The gain compression software utility generates this display quickly and easily with minimal user interaction, completing the entire measurement typically in under 30 seconds.

The gain compression software is held on a memory card and run by inserting the card into the MTS front panel slot. The software can be configured to run automatically from power on or instrument preset so as to simplify its operation in a production environment.

Operation

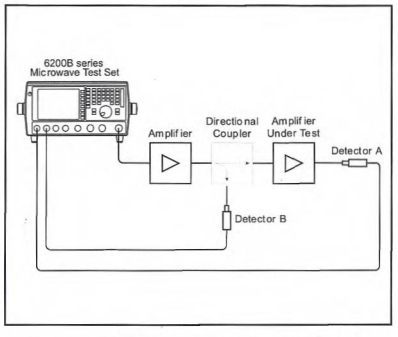
During the measurement set up, clear diagrams are displayed on the MTS screen showing how to connect the measurement components. The user is guided through calibration and measurement. Consequently, procedural measurement errors are eliminated and test time is minimized.

The basic measurement set up is shown below. The RF output of the MTS is applied directly to the input of the amplifier under test, and a scalar detector connected to input A measures the amplifier output.



Basic measurement set up

It is possible to modify the basic set up by the use of attenuators at either the input or output stages of the amplifier or by the use of a pre-amplifier. A pre-amplifier may be necessary when testing low gain, high compression point amplifiers which the standard MTS may not be able to drive into compression.



Test set up for ratioed measurements

The power level of the source is set to an initial value in the small signal gain region of the amplifier. A frequency sweep is then performed to give a display of the small signal gain against frequency. The output power of the MTS source is then increased at each measurement point in an iterative process until the amplifier is at the 1 dB compression point at all frequencies. (Compression values other than 1 dB can be selected before the measurement is made).

Two traces are then displayed; one is the gain at the 1 dB compression point as a function of frequency, the other is the amplifier power output (or input) at the compression point as a function of frequency.

When the measurement has completed the user can store the results to non volatile memory or generate a hard copy print or plot as necessary. This whole process typically takes less than 30 seconds and enables full and comprehensive testing of amplifiers that may not otherwise have been possible.

GPIB Control

For automated measurements the application can be controlled over the standard MTS GPIB. In this way amplifier production can also be simplified with automated pass/fail analysis of the measurement within the test program.

Remote levelling capability

The software can also be used for fast power levelling of the MTS at the end of a test cable. This facility allows the user to connect a long RF cable to the RF output of the MTS and achieve levelled power of a user defined value at the test port of the cable. In this way the frequency response of devices between the MTS output and the test port can be eliminated. Remote levelling takes typically less than one minute and removes the need for a separate power meter which is usually necessary with alternative systems.

Specification

Runs on any 6200 series Microwave test Set (MTS) with issue 2.0 software or higher. It is recommended that the MTS is fitted with the optional internal attenuator. (Option 001 or 009).

Measurements provided
Amplifier gain, input power or output power as a function of frequency at N dB compression (where N is in the range 100 to -100 dB).

Measurement definitions
Supports single detector and ratio measurements.

Additional capability
Correction for attenuators on amplifier output. Correction for attenuation or pre amplification on amplifier input using ratio measurement. (Pre amplification may be necessary in order to compress low gain high power amplifiers).

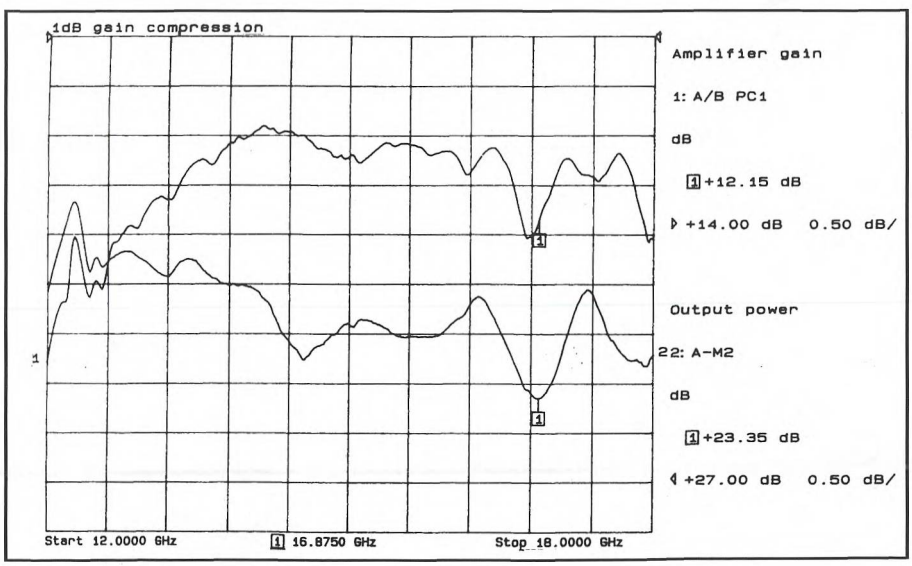
Source control
Number of measurement points 2 to 1601.
User specified maximum RF output power.

RF performance
As for MTS. See separate specification.

Versions and Accessories

When ordering please quote full ordering number information.

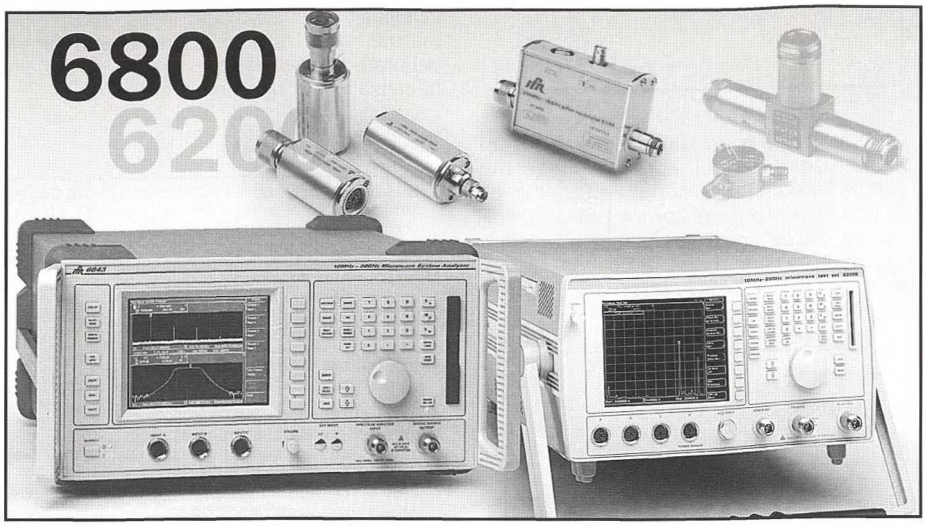
Ordering Numbers	*Versions*
59000/265	Gain compression application for 6200 series Microwave Test Set (MTS). Supplied on MTS memory card.
	Supplied with
46882/232	Operating manual



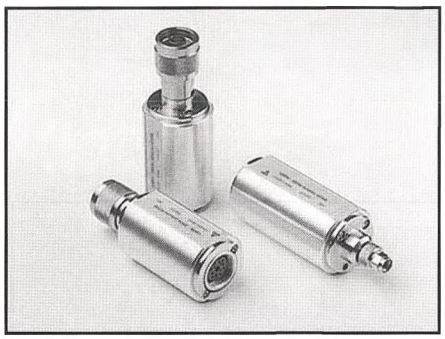
Plot of measurement results. Trace 1 (top trace) Shows amplifier gain against frequency. Trace 2 (lower trace) shows amplifier output power against frequency. All frequency measurement points are at 1 dB compression.

6230A/L Series Scalar Detectors, Return Loss Bridges and Autotesters

Standard and low VSWR scalar detectors for use with 6800 and 6200 series instruments



6230A/L Series Scalar Detectors



The 6230A and 6230L series of scalar detectors have EEPROM correction for improved frequency response. Users can achieve swept power measurements with accuracy close to that achieved with a power sensor.

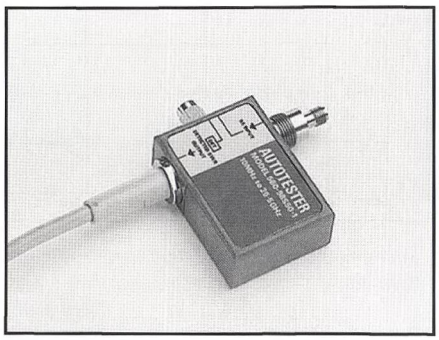
6230A series scalar detectors have typically 85 dB dynamic range (-65 dBm to +20 dBm) and are used when best sensitivity and maximum dynamic range are required. The 6230L series scalar detectors (-59 dBm to +26 dBm typically) have integral input attenuators. This provides improved input match and greater power handling capability. 6230L series detectors should be used when measuring low loss devices, such as semi-rigid cables or when measuring high power devices such as amplifiers.

Scalar Detectors (with EEPROM correction)

Ordering Number	*Version*
6230A series	***Standard detectors***
	(-65 dBm to +20 dBm) typical
6230A	10 MHz to 20 GHz, N type (m)
6232A	1 MHz to 3 GHz, N-type (m)
6233A	10 MHz to 26.5 GHz, 3.5 mm (m)
6234A	10 MHz to 46 GHz, 2.92 mm (m)
6230L series	***Low VSWR detectors (-59 dBm to +26 dBm) typical***
6230L	10 MHz to 20 GHz, N type (m)
6233L	10 MHz to 26.5 GHz, 3.5 mm (m)
6234L	10 MHz to 46 GHz, 2.92 mm (m)
	Supplied accessories
43138/663	1.5m DC cable
	Optional accessories
43138/664	3.0m DC cable
43138/665	10m DC cable
43138/666	25m DC cable
43138/667	50m DC cable

Typical specifications are non-warranted

Autotesters



For measurement of return loss (or VSWR) with a scalar analyzer an autotester is the best solution. An autotester is an RF bridge with a built in detector. An RF bridge needs to be used with a 6230 series detector for the measurement of return loss. An autotester with the correct type and sex of test port connector should be used because test port adapters seriously degrade directivity and hence measurement accuracy.

Autotesters

Ordering Number	*Version*
59999/151	10 MHz to 18 GHz 7 mm
59999/158	10 MHz to 18 GHz N (m)
59999/159	10 MHz to 18 GHz N (f)
59999/152	10 MHz to 26.5 GHz 3.5 mm WSMA (m)
59999/166	10 MHz to 26.5 GHz 3.5 mm WSMA (f)
59999/168	10 MHz to 40 GHz 2.92 mm (m)
59999/169	10 MHz to 40 GHz 2.92 mm (f)
	Supplied with
	Open/short circuit
	Return Loss Bridge
59999/170	5 MHz to 2 GHz N (f)

6230A/L Series Scalar Detectors Specification

	6230A	6230L	6232A	6233A	6233L	6234A	6234L
Frequency range	10 MHz to 20 GHz	10 MHz to 20 GHz	1 MHz to 3 GHz	10 MHz to 26.5 GHz	10 MHz to 26.5 GHz	10 MHz to 46 GHz	10 MHz to 46 GHz
Dynamic range							
AC detection:	-65 dBm to +20 dBm, typical -60 dBm to +20 dBm, guaranteed	-59 dBm to +26 dBm, typical -54 dBm to +26 dBm, guaranteed	-65 dBm to +20 dBm, typical -60 dBm to +20 dBm, guaranteed	65 dBm to +20 dBm, typical -60 dBm to +20 dBm, guaranteed	-59 dBm to +26 dBm, typical -54 dBm to +26 dBm, guaranteed	-65 dBm to +20 dBm, typical -60 dBm to +20 dBm, guaranteed	-59 dBm to +26 dBm, typical -54 dBm to +26 dBm, guaranteed
DC detection:	-50 dBm to +20 dBm, guaranteed +20 dBm	-44 dBm to +26 dBm, guaranteed +26 dBm	-50 dBm to +20 dBm, guaranteed +20 dBm	-50 dBm to +20 dBm, guaranteed +20 dBm	-44 dBm to +26 dBm, guaranteed +26 dBm	-50 dBm to +20 dBm, guaranteed +20 dBm	-44 dBm to +26 dBm, guaranteed +26 dBm
Maximum RF input VSWR							
1 to 10 MHz	------	------	1.43	------	------	------	------
10 to 40 MHz	1.4	1.4	1.14	1.4	1.4	1.58	1.58
40 to 100 MHz	1.15	1.1	1.14	1.15	1.1	1.15	1.15
0.1 to 2 GHz	1.12	1.1	1.14 (to 2.7 GHz)	1.12	1.1	1.12	1.1
2 to 5 GHz	1.17	1.1	1.2 (to 3 GHz)	1.17	1.1	1.33	1.1
5 to 18 GHz	1.29	1.15	------	1.29	1.15	1.33	1.15
18 to 20 GHz	1.5†	1.22†	------	1.5	1.22	1.5	1.22
20 to 26.5 GHz	------	------	------	1.5	1.22	1.5	1.22
26.5 to 33 GHz	------	------	------	------	------	1.5	1.31
33 to 40 GHz	------	------	------	------	------	1.95	1.31
Linearity	0.2 dB/10 dB but not >0.5 dB in total	0.2 dB/10 dB but not >0.5 dB in total	0.2 dB/10 dB but not >0.5 dB in total	0.2 dB/10 dB but not >0.5 dB in total	0.2 dB/10 dB but not >0.5 dB in total	0.2 dB/10 dB but not >0.5 dB in total	0.2 dB/10 dB but not >0.5 dB in total
Frequency Response (EEPROM corrected)	±0.2 dB	±0.2 dB	±0.2 dB	±0.2 dB	±0.2 dB	±0.2 dB (±0.4 dB >26.5 GHz)	±0.2 dB (±0.4 dB >26.5 GHz)
Connector	Precision Type N (m)	Precision Type N (m)	Precision Type N (m)	Precision 3.5 mm (m)	Precision 3.5 mm (m)	Precision 2.92 mm (m)	Precision 2.92 mm (m)
Length	89 mm	89 mm	73 mm	80 mm	80 mm	88.5 mm	88.5 mm
Width	33.5 mm	33.5 mm	33.5 mm	33.5 mm	33.5 mm	33.5 mm	33.5 mm
Weight	151 g	151 g	180 g	151 g	151 g	149 g	149 g

† Specifications involving type N connectors above 18 GHz are not traceable to national standards as these do not exist at present

Return Loss Bridges and Autotesters Specification

Model/Test Port Connector Characteristic	59999/151 GPC-7	59999/158 N (m) and 59999-159 N (f)	59999/152 WSMA (m) and 59999/166 WSMA (f)	59999/168 2.92 mm (m) and 59999/169 2.92 mm (f)	59999/170
Frequency range	10 MHz to 18 GHz	10 MHz to 18 GHz	10 MHz to 26.5 GHz	10 MHz to 40 GHz	5 MHz to 2 GHz
Directivity					
0.01 to 18 GHz	40 dB	38 dB	40 dB	35 dB	5 MHz to 50 MHz >25 dB
18 to 26.5 GHz	N/A	N/A	38 dB	32 dB	50 MHz to 2 GHz >40 dB
26.5 to 40 Hz	N/A	N/A	N/A	30 dB	
Frequency sensitivity	±1.2 dB	±1.5 dB	±2.0 dB	±3.0 dB	
Accuracy[1]					
0.01 to 8 GHz	0.010 +0.06ρ²	0.013 +0.08ρ²	0.010 +0.10ρ²	0.018 +0.15ρ²	
8 to 18 GHz	0.010 +0.10ρ²	0.013 +0.12ρ²	0.010 +0.10ρ²	0.018 +0.15ρ²	
18 to 26.5 GHz	N/A	N/A	0.013 +0.12ρ²	0.025 +0.15ρ²	
26.5 to 40 GHz	N/A	N/A	N/A	0.032 +0.18ρ²	
Insertion loss	6.5 dB Nominal	6.5 dB Nominal	6.5 dB Nominal	6.5 dB Nominal	<7.5 dB Nominal
Maximum input power	+27 dBm	+27 dBm	+27 dBm	+27 dBm	+31 dBm
Input connector	N (f)	N (f)	2.92 mm (f)	2.92 mm (f)	N (f)
Length[3]	76 mm	76 mm	54 mm	54 mm	115 mm
Width[3]	50 mm	50 mm	38 mm	38 mm	51 mm
Depth[3]	28 mm	28 mm	19 mm	19 mm	29 mm
Weight	340 g	340 g	198 g	198 g	680 g

[1] Where ρ = measured reflection coefficient - includes directivity and test port reflection effects over the specified frequency range.

6240 series
Fault Locators

The 6240 series provides Return Loss, VSWR and Fault Location measurement from a single port



- Measurement of return loss and fault location from a single port
- Available with N type, 3.5 mm and 7 mm test ports
- Seven versions cover from 10 MHz to 3 GHz up to 10 MHz to 26.5 GHz (40 GHz for fault location only)
- Small, light and rugged for field use

The 6240 series Fault Locators provide a quick and convenient method of measuring Return loss, VSWR and fault location from a single test port. Fault locators are compact and rugged making them ideal for field measurements.

Typical applications include antenna and antenna feeder testing of mobile communications base stations and waveguide feeds on microwave towers.

When used with a 6800 series Microwave System Analyzer or 6200B series MTS the display can show simultaneously on two channels, return loss and fault location traces.

As both measurements are made from a single test port, set-up time is reduced characterized without the need to make repetitive reconnections.

Fault Locators

Ordering numbers	***Versions***
6242F	10 MHz to 3 GHz, N (f)
6242M	10 MHz to 3 GHz, N (m)
6240F	10 MHz to 20 GHz, N (f)
6240M	10 MHz to 20 GHz, N (m)
6243F	10 MHz to 26.5 GHz, 3.5 mm (f)
6243M	10 MHz to 26.5 GHz, 3.5 mm (m)
6241	10 MHz to 20 GHz, 7 mm
	Supplied accessories
43138/663	1.5m DC cable (2 off)
	Open/short circuit (Not 6242)
	50 Ω load
	Optional accessories
43138/664	3.0 m DC cable (2 off necessary, for use with 3.0 m RF or microwave cable)

RF Ruggedized Cables for Fault Locators

54311/199	1.5 m, 3 GHz, N (m) to Right Angle N (m)
54311/200	3.0 m, 3 GHz, N (m) to Right Angle N (m)

Microwave Ruggedized Cables for Fault Locators

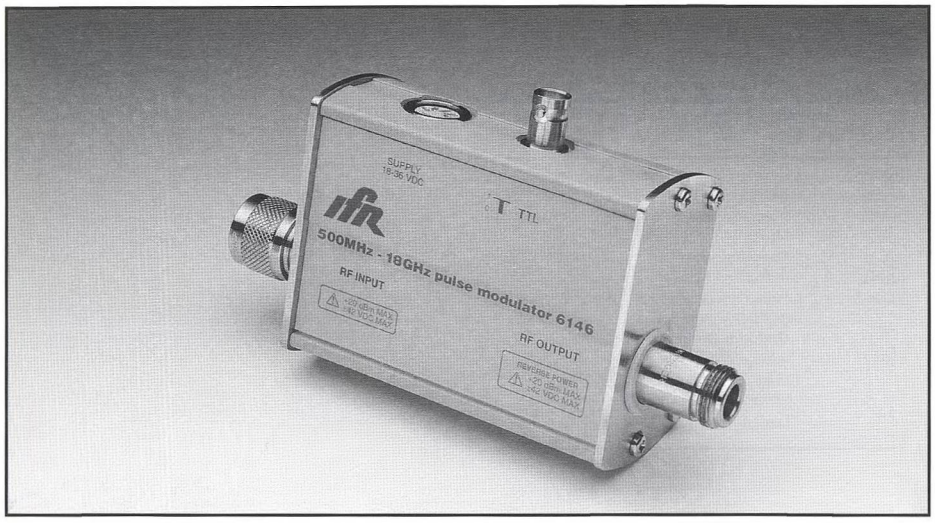
54311/197	1.5 m, 20 GHz, N (m) to Right Angle N (m)
54311/198	3.0 m, 20 GHz, N (m) to Right Angle N (m)
54311/201	1.5 m, 26.5 GHz, 3.5 mm (m) to Right Angle 3.5 mm (m)
54311/202	3.0 m, 26.5 GHz, 3.5 mm (m) to Right Angle 3.5 mm (m)

Specification

	6242F (Female Test Port) 6242M (Male Test Port)	***6240F (Female Test Port) 6240M (Male Test Port)***	***6241 (7 mm Test Port)***	***6243F (Female Test Port) 6243M (Male Test Port)***
Frequency Range				
Fault Location	10 MHz to 3 GHz	10 MHz to 20 GHz	10 MHz to 20 GHz	10 MHz to 26.5 GHz (usable to 40 GHz)
Return Loss	10 MHz to 3 GHz	10 MHz to 18 GHz	10 MHz to 18 GHz	10 MHz to 26.5 GHz
Test Port Connector	Type N	Type N	7 mm	3.5 mm
Input Connector	Type N female	Type N female	Type N female	3.5 mm female
Test Port Return Loss				
10 MHz to 3 GHz	20 dB	20 dB	20 dB	20 dB
3 GHz to 18 GHz	——	20 dB	20 dB	20 dB
18 GHz to 26.5 GHz	——	——	——	15 dB
Directivity				
10 MHz to 50 MHz	35 dB	35 dB	35 dB	35 dB
50 MHz to 3 GHz	38 dB	38 dB	38 dB	38 dB
3 GHz to 8 GHz	——	35 dB	35 dB	35 dB
8 GHz to 18 GHz	——	35 dB	35 dB	32 dB
18 GHz to 26.5 GHz	——	——	——	32 dB
Accuracy of return loss				
10 MHz to 50 MHz	$0.018 + 0.1\ \rho^2$	$0.018 + 0.1\ \rho^2$	$0.018 + 0.1\ \rho^2$	$0.018 + 0.1\ \rho^2$
50 MHz to 3 GHz	$0.013 + 0.1\ \rho^2$	$0.013 + 0.1\ \rho^2$	$0.013 + 0.1\ \rho^2$	$0.013 + 0.1\ \rho^2$
3 GHz to 8 GHz	——	$0.018 + 0.1\ \rho^2$	$0.018 + 0.1\ \rho^2$	$0.018 + 0.1\ \rho^2$
8 GHz to 18 GHz	——	$0.018 + 0.1\ \rho^2$	$0.018 + 0.1\ \rho^2$	$0.025 + 0.1\ \rho^2$
18 GHz to 26.5 GHz	——	——	——	$0.025 + 0.18\ \rho^2$
Insertion Loss	7 dB Nominal	7 dB Nominal	7 dB Nominal	7 dB Nominal
Max input power	+26 dBm	+26 dBm	+26 dBm	+26 dBm
Size	79 x 73 x 34 mm	79 x 73 x 34 mm	79 x 73 x 34 mm	79 x 73 x 34 mm
Weight	358 g	358 g	362 g	315 g

6146
Pulse Modulator

A general purpose high performance pulse modulator for radar systems testing



- Wide frequency coverage 500 MHz to 18 GHz
- Fast rise and fall times of <5 ns
- >70 dB ON/OFF ratio
- Standard TTL levels
- Suitable for use with 6800 series microwave systems analyzers or 6200B series microwave test sets
- +5 dB insertion gain, 500 MHz to 18 GHz
- Small and rugged for field use

The 6146 Pulse Modulator is ideal for modulating RF and Microwave signals to enable testing of radar systems. Its wide frequency range of 70 MHz to 20 GHz means it can test both the RF and IF performance of the radar.

Fast rise and fall times coupled with >70 dB ON/OFF ratio ensures that the 6146 can be used to test the majority of modern radars. Modulation is controlled by a TTL input. Any suitable pulse generator can be used to drive the 6146. An integral amplifier gives the 6146 an insertion gain of +5 dB. This enhances the ability to measure the dynamic range of a radar compared with traditional pulse modulators that typically have an insertion loss up to 10 dB.

The 6146 is a small lightweight and rugged package. It can be connected directly onto the output of a signal source and has type N connectors. When used with the 6200B series Microwave Test Set it is powered with the supplied lead which connects directly onto the 6200B auxiliary output. For use with other signal sources an optional AC power supply is available.

The combination of 6146 and a 6800 microwave system analyzer or 6200B microwave test set fitted with an internal attenuator forms the basis of an excellent solution for testing radar systems. The fundamental radar tests of minimum discernible signal, 1 dB compression and subclutter rejection are made simple.

Specification

Frequency Range
500 MHz to 18 GHz
useable from 70 MHz to 18 GHz

ON/OFF Ratio
>70 dB from 500 MHz to 18 GHz
35 dB 70 MHz to 200 MHz
60 dB 200 MHz to 500 MHz

Rise/Fall Time
<5 ns

Delay Time
≤20 ns

Minimum Pulse Width
50 ns

Maximum PRF
20 MHz

Pulse Width Compression
≤10 ns

Video Breakthrough
<150 mV pk-pk 500 MHz to 18 GHz
<200 mV pk-pk 70 MHz to 500 MHz

Switch Generated RF
<-35 dBm from 70 MHz to 500 MHz
<-50 dBm from 500 MHz to 1 GHz
<-70 dBm from 1 GHz to 18 GHz

Reverse Power Damage Level
+20 dBm, ±42 V DC

Harmonics
≤ -15 dBc for >10 dB output power

Power Accuracy
(After user calibration with 6800 or 6200B)
±1 dB

Insertion Gain at +23°C
>5 dB 500 MHz to 18 GHz
Gain temperature coefficient, -0.05/°C Typical

Minimum Output Power at +23°C
(with +5 dBm input power)
≥ +8 dBm

Input Damage Level
+20 dBm, ±42 V DC

Modulation Input Type
Standard TTL levels. BNC input for RF ON when logic level low.

Modulation Input Impedance
>10 kΩ.

RF Input
Connector
Type N (m) 50 Ω.
Return loss
>5 dB 70 MHz to 200 MHz Typical.
>8 dB 200 MHz to 18 GHz Typical.

RF Output
Connector
Type N (f) 50 Ω.
Return loss
>10 dB 200 MHz to 6 GHz Typical.
> 6 dB 6 GHz to 18 GHz Typical.

Electromagnetic Compatibility
Conforms with the protection requirements of the EEC Council Directive 89/336/EEC.

Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2,3,4.

Safety
Complies to IEC 348.

Rated Range of Use

Temperature
0°C to +50°C.

Humidity
Up to 93 % humidity at 40°C.

Conditions of Storage and transport

Temperature
-40°C to +70°C.

Humidity
Up to 93 % humidity at 40°C.

Altitude
Up to 4,600 metres (15,000 feet).

Dimensions and Weight
148 mm x 86 mm x 41 mm.
400g.

Supply Voltages
+12 V DC 400 mA. & -12 V DC 70 mA.
Available from the optional AC adapter.

Versions and Accessories

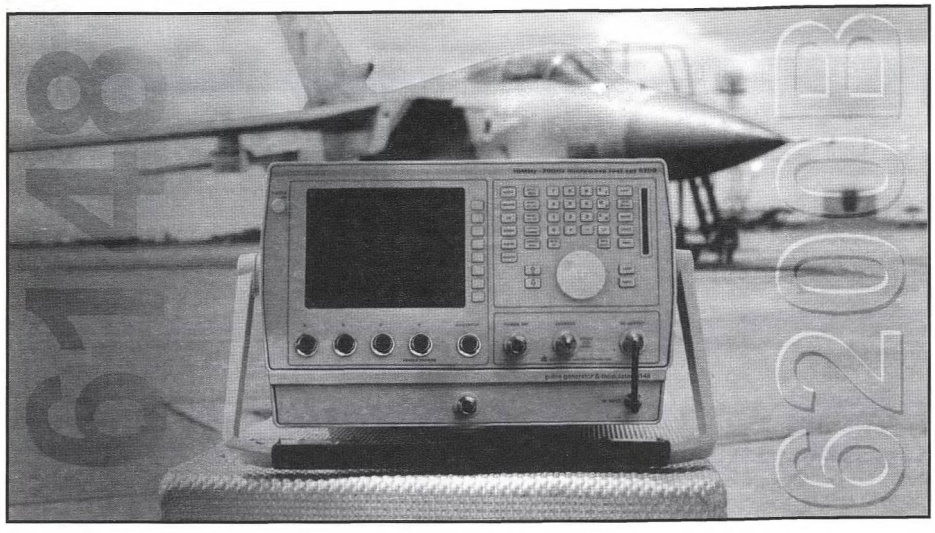
When ordering please quote full ordering number information.

Ordering Numbers	***Version***
6146	Pulse Modulator 500 MHz to 18 GHz Pulse Modulator
	Supplied with
46882/211	Instruction Manual
43138/399	Power Supply lead for use with 6200 Auxiliary Output
	Optional Accessory
54441/ 019	AC Power Supply Input 100 V to 240 V AC, 50 Hz to 60 Hz (40 Watts) Output +24 V DC 1.6A

http://www.ifrinternational.com

6148
Pulse Generator and Modulator

Low cost microwave pulse generator and modulator for simplifying the testing of aircraft early warning and radar systems



- 70 MHz to 18 GHz modulation
- Complex pulse patterns
- 100 ns -100 ms pulse parameters
- External trigger function
- Simple user interface
- Easy installation to 6200B

The IFR 6148 Pulse Generator and Modulator is an adapter unit which works in conjunction with the 6200B Microwave Test Set (MTS). It allows the user to generate pulsed microwave signals.

The 6148 comprises two parts - a pulse generator and a pulse modulator, which are located in the adapter unit situated under the 6200B MTS. The MTS acts as the system controller, RF source and user interface.

The 6148 is connected to the MTS through power and data connections at the rear, and RF input at the front. The RF output connector is located on the front of the adapter unit for connection to the user test system. In addition, pulse sync and video outputs are provided on the rear of the 6148, for visual inspection of pulse patterns using an oscilloscope.

Features

- 70 MHz to 18 GHz operation.
- Simple to use user interface.
- Up to 256 user defined pulses in a single pattern.
- 100 ms pulse PRI's.
- 100 ns edge placement resolution.
- Second pattern allows simulation of jitter and dropped pulses.
- External Trigger function.
- Store/Recall of pulse patterns on separate memory card.

Benefits

- Easy to operate.
- Allows emulation of complex waveforms.
- Can simulate pulse jitter and drop-out.
- Can test aircraft EW systems without having to take the aircraft into the air.
- Low cost approach to EW system testing.
- Accurate RF levels.
- Secure information on memory card.

Applications

- Threat simulator to test Aircraft Radar Early Warning Systems on an aircraft while still on the ground
- Radar component testing.
- Partial radar system testing

Operation

The Pulse Generator/Modulator is accessed as an application on a memory card for the 6200B. Once the application is loaded (or permanently installed in the MTS memory) the card can be removed, allowing the use of a separate memory card for store / recall functions.

The main applications screen describes the Pulse Pattern which is defined as a series of pulses in a table. Each entry represents a separate pulse in the pattern and comprises a pulse width (PW) and a pulse repetition interval (PRI). A maximum of 256 entries is allowed.

A Sync Pulse is also generated at the beginning of each pattern output, which can be used to trigger other equipment from the 6148. Alternatively, each pulse pattern can be triggered by an External Trigger, selectable for TTL/ECL level and positive/negative edge.

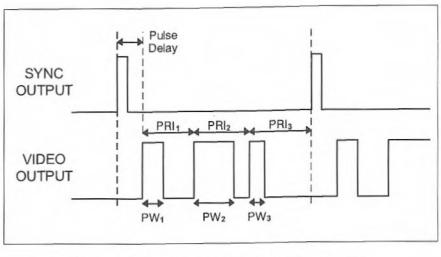


Figure 1: Internal Trigger Operation

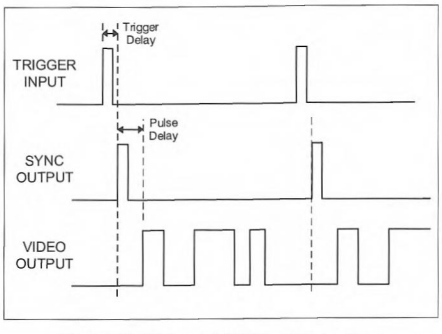


Figure 2: External Trigger Operation

Up to 256 separate pulses can be specified in the pattern, with a maximum PRI for each pulse of 100 ms. As shown in figures 1 & 2, the pulse pattern can also be offset from the sync pulse by a user-variable pulse delay.

The user can select an auto-download function, where data is updated as each parameter is changed, or use a master download key, to update major changes in one block.

A second pulse pattern can also be utilized, which alternates with the first pattern, and can be separately edited by

the user. By offsetting the timing of the second pattern to the first, the effects of jitter or dropped pulses could be seen.

If required, the pulse generator can be disabled and the external trigger input configured as a pulse input. The user can then pulse modulate the RF independently with their own pulse generator, if required.

Specification

Video Output (Rear Panel BNC)

Pulse Mode
Up to 256 user defined pulses.

Pulse Width (separately variable)
100 ns - 100 ms, resolution 100 ns.

Pulse Repetition Interval (separately variable)
200 ns - 100 ms, resolution 100 ns.

Pulse delay (from SYNC)
0 - 100 ms, resolution 100 ns.

Timing Accuracy
As for 6200B frequency standard.

Level
Pseudo TTL (Typically 0 to 5V, 0 to 2.5V into 50 Ω).

Rise/Fall time
< 10 ns Typical.

Sync Output (Rear Panel BNC)

Pulse Width
400 ns Typical.

Level
Pseudo TTL (Typ. 0 to 5V, 0 to 2.5V into 50 Ω).

Rise/Fall Time
< 10 ns Typical.

External Trigger (Pulse Input)

Characteristics
Selectable positive or negative edge, ECL or TTL level into high impedance.
Minimum Pulse Width 10 ns.

Trigger to SYNC Delay
Less then 100 ns.

Trigger to SYNC Jitter
Less than 50 ns.

Pulse Modulator

Frequency range
70 MHz to 18 GHz.

ON/OFF Ratio
> 35 dB 70 MHz to 200 MHz.
> 60 dB 200 MHz to 500 MHz.
> 70 dB 500 MHz to 18 GHz.

Rise/Fall Time
< 5 ns.

Video Breakthrough
< 200 mV pk-pk 70 MHz to 500 MHz.
< 150 mV pk-pk 500 MHz to 18 GHz.

Switch Generated RF
< -35 dBm 70 MHz to 500 MHz.
< -50 dBm 500 MHz to 1 GHz.
< -70 dBm 1 GHz to 18 GHz.

Harmonics
< -15 dBc Typical.

RF Output

Frequency
70 MHz to 18 GHz.

Minimum Output Power at 23°C
(when used with standard 6200B)
≥+2 dBm 70 MHz to 18 GHz.
+7 dBm Typical.

Return Loss
> 19 dB 70 MHz to 6 GHz Typical.
> 12 dB 6 GHz to 18 GHz Typical.

Reverse Power Damage Level
+20 dBm, ±42 V DC.

General

Electromagnetic Compatibility
(when used with standard 6200B)
Conforms with the protection requirements of the EEC Council Directive 89/336/EEC. Complies with the following standards:
EN55011:1991 (Rad. Class A, Con. Class B)
EN50082-1:1992
EN60555-2:1987

Safety
(when used with standard 6200B)
Conforms with the protection requirements of the EEC Council Directive 73/23/EEC. Complies with the following standards:
EN61010-1:1993 (IEC1010-1:1990)

Dimensions and Weight
46 mm high, 325 mm wide, 450 mm deep.
3.8 kg (including interconnecting cables and fixing kit).

RATED RANGE OF USE

Temperature
0°C to +50°C.

Humidity
Up to 93% humidity at +40°C.

Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Version*
6148	70 MHz to 18 GHz Pulse Generator & Modulator
	Supplied with
59000/326	Application Software & User Manual
46884/738	Installation Kit
	Optional Accessories
59000/182	128k Blank Memory Card
59000/186	512k Blank Memory Card

http://www.ifrinternational.com

Options and Accessories

When ordering please quote full ordering number information.

RF AND MICROWAVE SYSTEM ANALYZERS

Order numbers	Versions
6821	1 MHz to 3 GHz scalar analyzer
6822	10 MHz to 8.4 GHz scalar analyzer
6823	10 MHz to 20 GHz scalar analyzer
6824	10 MHz to 24 GHz scalar analyzer
6841	1 MHz to 3 GHz scalar analyzer with 4.2 GHz spectrum analyzer
6842	10 MHz to 8.4 GHz scalar analyzer with 20 GHz spectrum analyzer
6843	10 MHz to 20 GHz scalar analyzer with 20 GHz spectrum analyzer
6844	10 MHz to 24 GHz scalar analyzer with 24 GHz spectrum analyzer
	Supplied Accessories
46882/350	Operating manual
46882/354	Getting Started Guide
46882/360	Remote Operating Manual
43123/076	AC supply lead
37591/755	Front panel cover
	Options
002	Field replaceable precision N (f) and 3.5 mm (f) RF connectors for source output and spectrum input (not available on 6821 / 6841)
010	3 GHz 110 dB Step attenuator (only available for 6821 and 6841)
011	20 GHz 70 dB step attenuator. (not available for 6821 / 6824 / 6841 / 6844)
012	26.5 GHz 90 dB step attenuator. (not available for 6821 / 6841)
020	External mixer interface (not available on 6820 series)
	Complementary Products
6146	500 MHz to 18 GHz Pulse Modulator
54441/019	AC Power Supply (for 6146)

6230A/L SCALAR DETECTORS

6230A series	Standard Detectors (-65 dBm to +20 dBm) typical
	6230A 10 MHz to 20 GHz, N type (m)
	6232A 1 MHz to 3 GHz, N-type (m)
	6233A 10 MHz to 26.5 GHz, 3.5 mm (m)
	6234A 10 MHz to 46 GHz, 2.92 mm (m)
6230L series	Low VSWR detectors (-59 dBm to +26 dBm typical)
	6230L 10 MHz to 20 GHz, N type (m)
	6233L 10 MHz to 26.5 GHz, 3.5 mm (m)
	6234L 10 MHz to 46 GHz, 2.92 mm (m)

AUTOTESTERS AND RF BRIDGE

	Autotesters
59999/151	10 MHz to 18 GHz 7 mm
59999/158	10 MHz to 18 GHz N (m)
59999/159	10 MHz to 18 GHz N (f)
59999/152	10 MHz to 26.5 GHz 3.5 mm WSMA (m)
59999/166	10 MHz to 26.5 GHz 3.5 mm WSMA (f)
59999/168	10 MHz to 40 GHz 2.92 mm (m)
59999/169	10 MHz to 40 GHz 2.92 mm (f)
	RF Bridge
59999/170	5 MHz to 2 GHz N (f)

FAULT LOCATORS

	Fault Locators
6242F	10 MHz to 3 GHz, N (f)
6242M	10 MHz to 3 GHz, N (m)
6240F	10 MHz to 20 GHz, N (f)
6240M	10 MHz to 20 GHz, N (m)
6243F	10 MHz to 26.5 GHz, 3.5 mm (f)
6243M	10 MHz to 26.5 GHz, 3.5 mm (m)
6241	10 MHz to 20 GHz, 7 mm
	Microwave Ruggedized Cables for Fault Locators
54311/197	1.5 m, 18 GHz, N (m) to Right Angle N (m)
54311/198	3.0 m, 18 GHz, N (m) to Right Angle N (m)
54311/201	1.5 m, 26.5 GHz, 3.5 mm (m) to Right Angle 3.5 mm (m)
54311/202	3.0 m, 26.5 GHz, 3.5 mm (m) to Right Angle 3.5 mm (m)
	RF Ruggedized Cables for Fault Locators
54311/199	1.5 m, 3 GHz, N (m) to Right Angle N (m)
54311/200	3.0 m, 3 GHz, N (m) to Right Angle N (m)

TRANSMISSION LINE TEST HEADS

	Transmission Line Test Head
56581/001	10 MHz to 20 GHz Transmission Line Test Head, 6581
56583/001	10 MHz to 26.5 GHz Transmission Line Test Head, 6583
	Microwave Ruggedized Cables for Test Heads
54311/116	1.5 m, 20 GHz, N (m) to N (m)
54311/109	3.0 m, 20 GHz, N (m) to N (m)
54311/117	1.5 m, 26.5 GHz, 3.5 mm (m) to 3.5 mm (m)
54311/110	3.0 m, 26.5 GHz, 3.5 mm (m) to 3.5 mm (m)
	Fault Locator and Scalar Detector DC Cables
43138/663	1.5 m, DC Cable
43138/664	3.0 m, DC Cable
43138/665	10 m, DC Cable
43138/666	25 m, DC Cable
43138/667	50 m, DC Cable

ACCESSORIES

	Power Splitters/Dividers
54311/123	Power Splitter DC to 18 GHz, Type N
54311/124	Power Splitter DC to 26.5 GHz, 3.5 mm
54311/161	Power Splitter DC to 40 GHz, 2.92 mm
54311/187	Power Divider DC to 18 GHz
54311/188	Power Divider DC to 26.5 GHz
	RF Ruggedized Cables for Bridges and Dividers
54311/195	1.5 m, 3 GHz, N (m) to N (m)
54311/196	3.0 m, 3 GHz, N (m) to N (m)
	Fixed Loads
54421/020	7 mm Fixed Load
54421/021	3.5 mm (f) Fixed Load
54421/022	3.5 mm (m) Fixed Load
54421/023	N (m) Fixed Load
54421/024	N (f) Fixed Load
	Precision Adapters
54311/175	N (m) to N (m)
54311/167	N (m) to N (f)
54311/174	N (f) to N (f)
54311/176	N (f) to 3.5 mm (f)
54311/177	N (m) to 3.5 mm (f)
54311/178	N (m) to 3.5 mm (m)
54311/185	N (f) to 3.5 mm (m)
54311/137	N (m) to TNC (f)
54311/138	N (m) to TNC (m)
54311/139	N (f) to TNC (f)
54311/186	N (f) to TNC (m)
54311/203	7 mm to N (f)
54311/204	7 mm to TNC (m)
54311/205	7 mm to TNC (f)
54311/136	TNC (m) to TNC (m)
54311/107	3.5 mm (f) to 3.5 mm (f)
54311/165	3.5 mm (m) to 3.5 mm (f)
54311/164	3.5 mm (m) to 3.5 mm (m)
54311/162	2.92 mm (m) to 2.92 mm (m)
54311/206	2.92 mm (m) to 2.92 mm (f)
54311/207	2.92 mm (f) to 2.92 mm (f)
	Standard Adapters
54311/133	N (f) to SMA (f)
54311/134	N (m) to SMA (f)
54311/135	TNC (m) to SMA (m)
	Miscellaneous Electrical Cables
54311/170	Positive Voltage Measurement Cable
54311/112	Negative Voltage Measurement Cable
43129/189	GPIB Cable
43139/042	BNC (m) to BNC (m) 1.5 m
46884/560	Parallel Printer Interface Cable
03964/329	Autotester Adapter Cable
	Standard Microwave Cables
54351/022	0.5 m, 18 GHz, N (m) to N (m)
54351/025	0.5 m, 26.5 GHz, 3.5 mm (m) to 3.5 mm (m)
54351/027	0.5 m, 40 GHz, 2.92 mm (m) to 2.92 mm (m)
	Attenuators
56534/901	Precision Fixed Coaxial Attenuator 3 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/902	Precision Fixed Coaxial Attenuator 6 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/903	Precision Fixed Coaxial Attenuator 10 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/904	Precision Fixed Coaxial Attenuator 20 dB DC to 18 GHz 5 W, N(m) to N(f)
	Software Support
59000/327	MIPlot Software Pack

MISCELLANEOUS

46885/038	Rack Mount Kit for 6800
46880/085	Service Manual
84501	Soft Carrying Case
54152/001	3.5 mm Torque Wrench
54211/008	Compact Keyboard
52388/900	1.25 GHz Active Probe
54441/012	Power supply for 2388

6200B Ordering Numbers

Options and Accessories

When ordering please quote full ordering number information.

6200B RF AND MICROWAVE TEST SETS

Order numbers	Versions
6200B	10 MHz to 20 GHz Microwave Test Set (MTS)
6201B	10 MHz to 8 GHz MTS
6202B	10 MHz to 2 GHz RF Test Set
6203B	10 MHz to 26.5 GHz MTS
6204B	10 MHz to 46 GHz MTS
	Options
Option 001	70 dB step attenuator
Option 002	Field replaceable RF output connector (3.5 mm and N-type) (Not available on 6204B)
Option 003	3.5 in Floppy disk drive (standard on 6202B)
Option 008	8.4 GHz Frequency extension (6201B only)
Option 009	90 dB step attenuator (Not available on the 6204B)
	Supplied with
43123/076	AC Supply Lead
43138/663	1.5 m Power Sensor Cable
46882-106P	Operating Manual
6950-069V	Input socket cap
23443-822K	N(m) to SMA (f) Adapter supplied with 6203B and 6204B
	Complementary Products
6210	250 MHz to 26.5 GHz Reflection Analyzer
6255	50 to 75 GHz Millimeter Wave Reflectometer
6256	75 to 110 GHz Millimeter Wave Reflectometer

6230A/L SCALAR DETECTORS

Scalar Detectors (with EEPROM correction)

Order numbers	Versions
6230A series	Standard Detectors (-65 dBm to +20 dBm) typical
6230A	10 MHz to 20 GHz, N type (m)
6232A	1 MHz to 3 GHz, N Type (m)
6233A	10 MHz to 26.5 GHz, 3.5 mm (m)
6234A	10 MHz to 46 GHz, 2.92 mm (m)
6230L series	Low VSWR detectors (-59 dBm to +26 dBm Low VSWR) typical
6230L	10 MHz to 20 GHz, N type (m)
6233L	10 MHz to 26.5 GHz, 3.5 mm (m)
6234L	10 MHz to 46 GHz, 2.92 mm (m)

Autotesters

Order numbers	Versions
59999/151	10 MHz to 18 GHz 7 mm
59999/158	10 MHz to 18 GHz N (m)
59999/159	10 MHz to 18 GHz N (f)
59999/152	10 MHz to 26.5 GHz 3.5 mm WSMA (m)
59999/166	10 MHz to 26.5 GHz 3.5 mm WSMA (f)
59999/168	10 MHz to 40 GHz 2.92 mm (m)
59999/169	10 MHz to 40 GHz 2.92 mm (f)
	RF Bridge
59999/170	5 MHz to 2 GHz N (f)
	Fault Locators
6242F	10 MHz to 3 GHz, N (f)
6242M	10 MHz to 3 GHz, N (m)
6240F	10 MHz to 20 GHz, N (f)
6240M	10 MHz to 20 GHz, N (m)
6243F	10 MHz to 26.5 GHz, 3.5 mm (f)
6243M	10 MHz to 26.5 GHz, 3.5 mm (m)
6241	10 MHz to 20 GHz, 7 mm
	Microwave Ruggedized Cables for Fault Locators
54311/197	1.5 m, 20 GHz, N (m) to Right Angle N (m)
54311/198	3.0 m, 20 GHz, N (m) to Right Angle N (m)
54311/201	1.5 m, 26.5 GHz, 3.5 mm (m) to Right Angle 3.5 mm (m)
54311/202	3.0 m, 26.5 GHz, 3.5 mm (m) to Right Angle 3.5 mm (m)
	RF Ruggedized Cables for Fault Locators
54311/199	1.5 m, 3 GHz, N (m) to Right Angle N (m)
54311/200	3.0 m, 3 GHz, N (m) to Right Angle N (m)
	Transmission Line Test Head
Order numbers	***Versions***
56581/001	10 MHz to 20 GHz Transmission Line Test Head, 6581
56583/001	10 MHz to 26.5 GHz Transmission Line Test Head, 6583
	Microwave Ruggedized Cables for Transmission Line Test Heads
54311/116	1.5 m, 20 GHz, N (m) to N (m)
54311/109	3.0 m, 20 GHz, N (m) to N (m)
54311/117	1.5 m, 26.5 GHz, 3.5 mm (m) to 3.5 mm (m)
54311/110	3.0 m, 26.5 GHz, 3.5 mm (m) to 3.5 mm (m)

Power Sensors

	6910 Series Medium Power
56910/900	10 MHz to 20 GHz, N type (m)
56911/900	10 MHz to 20 GHz, 7 mm
56912/900	30 kHz to 4.2 GHz, N type (m)
56913/900	10 MHz to 26.5 GHz, MPC 3.5 mm (m)
56914/001	10 MHz to 40 GHz, 2.92 mm (m)
56914/002	10 MHz to 40 GHz, 2.92 mm (m) plus waveguide 22 transformer
56914/003	10 MHz to 46 GHz, 2.92 mm (m)
56919/900	30 kHz to 3 GHz, N type 75 W
	6920 Series Low Power
56920/900	10 MHz to 20 GHz, N type (m)
56923/900	10 MHz to 26.5 GHz, MPC 3.5 mm (m)
56924/001	10 MHz to 40 GHz, 2.92 mm (m)
56924/002	10 MHz to 40 GHz, 2.92 mm (m) plus waveguide 22 transformer
56924/003	10 MHz to 46 GHz, 2.92 mm (m)
	6930 Series High Power
56930/900	10 MHz to 18 GHz, N type (m) 35 dBm
56932/900	30 kHz to 4.2 GHz, N type (m) 35 dBm
56934/001	10 MHz to 40 GHz, 2.92 mm (m) 30 dBm
56934/002	10 MHz to 40 GHz, 2.92 mm (m) plus waveguide 22 transformer 30 dBm
56934/003	10 MHz to 46 GHz, 2.92 mm (m) 30 dBm
56930/002	10 MHz to 18 GHz, N type (m) 45 dBm
56932/002	30 kHz to 4.2 GHz, N type (m) 45 dBm
	Fault Locator, Scalar Detector, Power Sensor DC Cables
43138/663	1.5 m, DC Cable
43138/664	3.0 m, DC Cable
43138/665	10 m, DC Cable
43138/666	25 m, DC Cable
43138/667	50 m, DC Cable
	(For longer lengths contact your local IFR sales office).
6146	500 MHz to 18 GHz Pulse Modulator
54441/019	AC Power Supply

Accessories

	Power Splitters/Dividers
54311/123	Power Splitter DC to 18 GHz, Type N
54311/124	Power Splitter DC to 26.5 GHz, 3.5 mm
54311/161	Power Splitter DC to 40 GHz, 2.92 mm
54311/187	Power Divider DC to 18 GHz
54311/188	Power Divider DC to 26.5 GHz
	RF Ruggedized Cables for Bridges and Dividers
54311/195	1.5 m, 3 GHz, N (m) to N (m)
54311/196	3.0 m, 3 GHz, N (m) to N (m)
	Fixed Loads
54421/020	7 mm Fixed Load
54421/021	3.5 mm (f) Fixed Load
54421/022	3.5 mm (m) Fixed Load
54421/023	N (m) Fixed Load
54421/024	N (f) Fixed Load

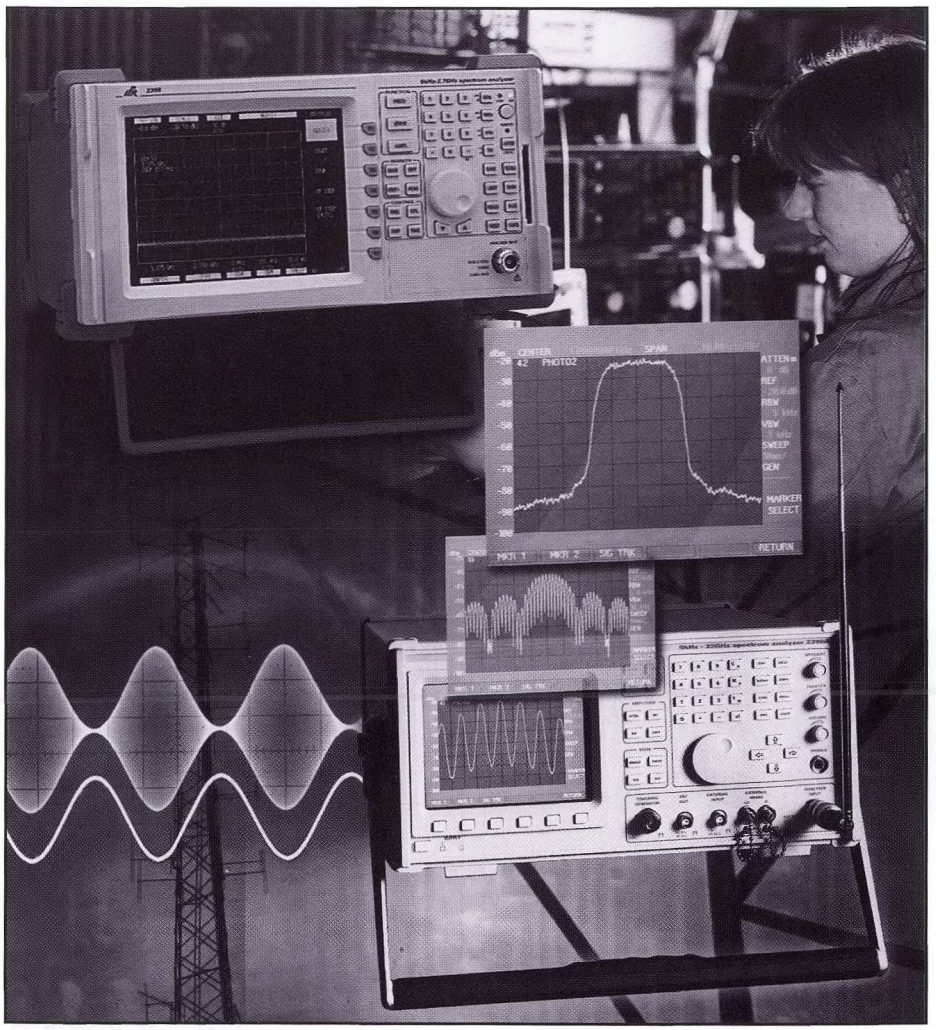
Order numbers	Versions
	Precision Adapters
54311/175	N (m) to N (m)
54311/167	N (m) to N (f)
54311/174	N (f) to N (f)
54311/176	N (f) to 3.5 mm (f)
54311/177	N (m) to 3.5 mm (f)
54311/178	N (m) to 3.5 mm (m)
54311/185	N (f) to 3.5 mm (m)
54311/137	N (m) to TNC (f)
54311/138	N (m) to TNC (m)
54311/139	N (f) to TNC (f)
54311/186	N (f) to TNC (m)
54311/203	7 mm to N (f)
54311/204	7 mm to TNC (m)
54311/205	7 mm to TNC (f)
54311/136	TNC (m) to TNC (m)
54311/107	3.5 mm (f) to 3.5 mm (f)
54311/165	3.5 mm (m) to 3.5 mm (f)
54311/164	3.5 mm (m) to 3.5 mm (m)
54311/162	2.92 mm (m) to 2.92 mm (m)
54311/206	2.92 mm (m) to 2.92 mm (f)
54311/207	2.92 mm (f) to 2.92 mm (f)
	Standard Adapters
54311/133	N (f) to SMA (f)
54311/134	N (m) to SMA (f)
54311/135	TNC (m) to SMA (m)
	Miscellaneous Electrical Cables
54311/170	Positive Voltage Measurement Cable
54311/112	Negative Voltage Measurement Cable
43129/189	GPIB Cable
43126/012	50 Ω BNC (m) to BNC (m) 1.5 m
46884/560	Parallel Printer Interface Cable
03964/329	Autotester Adapter Cable
	Standard Microwave Cables
54351/022	0.5 m, 20 GHz, N (m) to N (m)
54351/025	0.5 m, 26.5 GHz, 3.5 mm (m) to 3.5 mm (m)
54351/027	0.5 m, 40 GHz, 2.92 mm (m) to 2.92 mm (m)
	Attenuators
56534/901	Precision Fixed Coaxial Attenuator 3 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/902	Precision Fixed Coaxial Attenuator 6 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/903	Precision Fixed Coaxial Attenuator 10 dB DC to 18 GHz 5 W, N(m) to N(f)
56534/904	Precision Fixed Coaxial Attenuator 20 dB DC to 18 GHz 5 W, N(m) to N(f)
	Application and memory cards
59000/265	Gain Compression Application
59000/280	Guided Measurements Application
59000/264	Transmission Line Database
59000/182	128k Blank Memory Card
59000/186	512k Blank Memory Card
59000/190	MTS PC-Utilities Software
59000/327	MIPlot Software Pack
54211/004	Memory Card Reader/Writer Unit
54441/016	AC Adapter - UK style for Reader/Writer
54441/017	AC Adapter - European style for Reader/Writer
54441/018	AC Adapter - USA style for Reader/Writer
54127/309	Rack Mount Kit for 6200B
54127/311	Rack Mount Kit for 6200B and 6210
54124/027	Front Stowage Cover
54121/034	Detector Input Socket Cap
46880/064	Service Manual
54112/157	Soft Carrying Case
54112/160	Hard Flight Case for 6200B and 6210
54112/161	Hard Flight Case for 6200B.
54152/001	3.5 mm Torque Wrench for 6200B
54211/008	Compact Keyboard

http://www.ifrinternational.com

Spectrum Analyzers

IFR has a comprehensive range of spectrum analyzers covering frequencies from 9 kHz to 26.5 GHz. This line of analyzers is designed to provide the user, from design engineer to field service technician, fast and highly accurate RF and microwave measurements with an easy to understand user interface.

From the design lab to the production line and into the field for service applications, IFR's line of spectrum analyzers furnishes you with all the features and functions you expect in a high performance instrument, with the flexibility to meet your specific testing demands. For today's RF testing environments, IFR has the solutions that are a cut above the rest.



SPECTRUM ANALYZERS

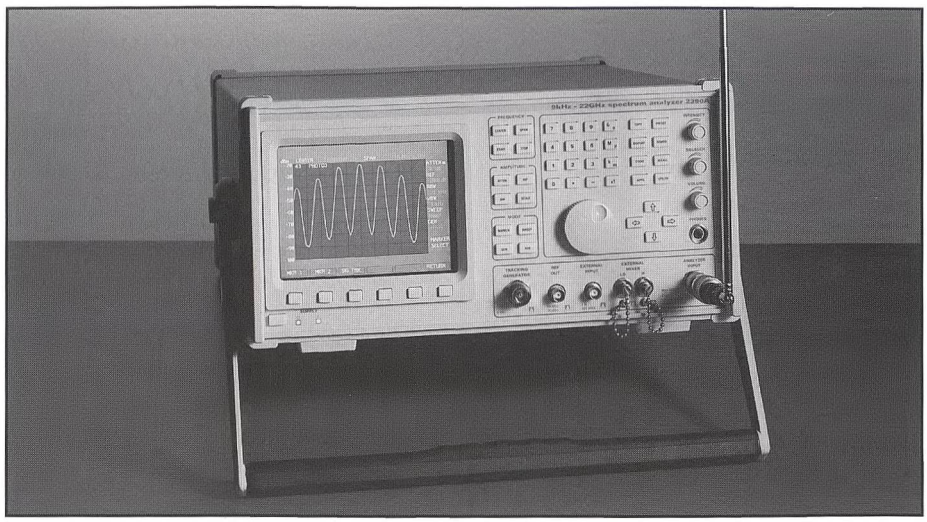
2390A series 6.2
Spectrum Analyzers

2398 6.6
9 kHz to 2.7 GHz Spectrum Analyzer

2388 6.8
1 GHz Active Probe

2390A series Spectrum Analyzer

A range of RF and Microwave Spectrum Analyzers that offer value and performance to both field and bench users



- Fully synthesized Spectrum Analyzers to 26.5 GHz
- 3 Hz to 30 MHz resolution bandwidth filters
- Excellent intermodulation performance
- +30 to -135 dBm measurement range
- Measurements to 300 GHz with external mixers
- Optional built-in tracking generator
- Receiver mode with AM and FM demodulators
- Optional quasi-peak detector and EMC filters

The 2390A series of spectrum analyzers from IFR combine exceptional performance with excellent value for money. There are three instruments in the range:-

2392A	9 kHz to 2.9 GHz
2390A	9 kHz to 22 GHz
2393A	9 kHz to 26.5 GHz

Frequency Accuracy

All three instruments are fully synthesized to give accurate frequency measurements. Even on wide spans the 2390A series gives precise frequency measurements and an integral frequency counter enables the measurement of individual signals to 1 Hz resolution.

Fundamental mixing to 12 GHz enables the microwave versions to reach their maximum frequency in only two harmonic sweeps. This gives excellent sensitivity and accuracy right up to 26.5 GHz.

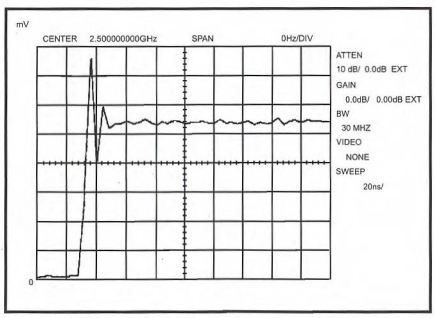
Narrow Resolution

The 2390A series all have resolution bandwidths down to 3 Hz. Narrow resolution bandwidths provide the ability to resolve closely spaced signals or sidebands.

The 3 Hz filter is also used for close in signal analysis, for example it can be used to identify 50 or 60 Hz power line sidebands on oscillators. The average displayed noise level when using a 3 Hz filter is less than -135 dBm at 2.9 GHz and below -125 dBm at 26.5 GHz. This makes 2390A series suitable for locating and identifying low level spurious and harmonic signals.

Wideband Filters for Spread Spectrum and Pulsed Signals

When analyzing signals with wide spectrum bandwidths, such as digitally modulated carriers or pulsed radar, the resolution bandwidth of the spectrum analyzer can limit the measurement. The 2390A series have 10 MHz and 30 MHz bandwidth filters. These give the best available characterization of wideband signals and have an impulse bandwidth >5 MHz. In zero span mode a minimum sweep time of 200 ns/div makes displaying radar pulses precise and straightforward.



200 ns sweep clearly shows ringing on demodulated radar pulse

AM and FM Receiver Modes

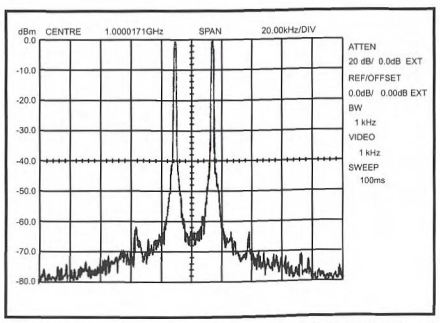
The 2390A series features built-in receivers for both AM and FM signals. Modulation detection can be set to narrowband or wideband mode.

For an FM transmission a modulation scale of 1 kHz to 5 MHz per division allows direct measurement of the modulation component of carrier signals up to ±20 MHz deviation. Frequency synthesizer settling time can be measured using the DC coupled output from the FM detector.

A high quality audio output through either a built-in speaker or headphone connector allows audible detection of noise or distortion. It can also be used to identify the source of interfering transmissions.

Harmonic and Spurious Measurements

When monitoring the frequency spectrum or installing and maintaining radio systems it is important to check the spurious and harmonic signals.



Third order intermodulation measurement of a 1 GHz amplifier

The 2390A series has fundamental mixing to 12 GHz and sweeps to 26.5 GHz in only two harmonic steps. This means that good sensitivity is maintained across the whole frequency band revealing

interfering signals that may otherwise have been lost in noise.

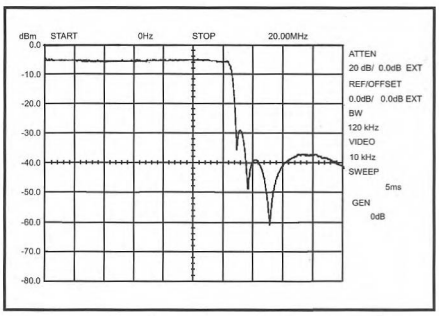
Internally generated intermodulation distorting products are minimized by the high performance input mixer. This gives more than 80 dBc intermodulation free dynamic range. As a result the user can be confident that all displayed signals are true signals even when measuring at busy transmitter sites.

Network Measurements

An optional built-in tracking generator is available covering from 100 kHz to 2.9 GHz. It is ideal for frequency response measurements on filters, amplifiers and couplers. A normalization function sets a 0 dB reference level which can be used for absolute measurements of insertion loss or gain.

If used with a bridge the return loss of devices such as antennas or loads can also be measured.

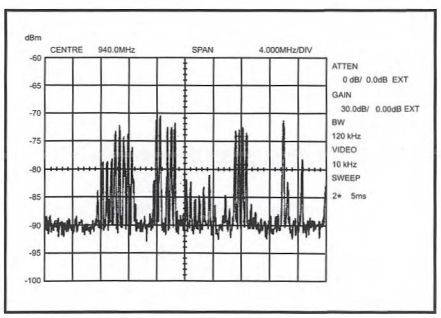
The output level of the tracking generator is adjustable from -70 dBm to 0 dBm. It can be used as a low level input for amplifiers, or in CW mode as a synthesized local oscillator.



Filters can be characterized using the optional tracking generator

Field Measurements

For measurements at remote sites in the field the 2390A series is portable and rugged. Mobile and cellular radio base stations demand 24 hour reliability. The 2392A is ideal for field measurements of spurious, harmonics and intermodulation products. Integral frequency counter and receiver modes mean that interfering signals can be identified quickly and easily.



Monitoring signals at a cellular radio base station

For microwave radio links the 2390A or 2393A offer frequency coverage to 22 GHz and 26.5 GHz respectively. A wide 30 MHz resolution bandwidth filter, and limit mask, facilitate testing of modulated point-to-point or trunk radio links.

EMC Measurements

2390A series can be used for pre-compliance testing of electronic products to meet stringent EMC specifications. Before sending a product to an expensive test house a pre-compliance test will indicate if the product is likely to pass.

Option 08 provides quasi-peak detection and five extra resolution bandwidth filters. These comply with the CISPR recommendations for measurements of RF emissions.

In-built FFT and Oscilloscope

When analyzing communications systems it is often necessary to test the audio and IF frequencies, as well as the RF signal. With its built-in 20 kHz FFT analyzer and 5 MHz oscilloscope, audio analysis and fault finding is possible. The FFT analyzer enables harmonic distortion measurements on audio signals and the scope provides a general fault finding and diagnostic tool.

Clear Operation

The 2390A series has a large 7 in TFT color display for clear viewing of signals and instrument settings. All key elements such as sweep speed, resolution bandwidth, input attenuation and IF gain are automatically set, depending on the user's span and reference level. Two markers can be used to measure signals as well as provide standard operations such as peak find, marker to center and delta marker. This speeds up and simplifies measurements.

99 traces and 99 instrument settings can be stored in the non-volatile memory of the 2390A series. In this way tests can be stored in the instrument and results saved to memory for printout at a later time. The 2390A series spectrum analyzer is also equipped with both RS-232 and IEEE-488 (GPIB) interfaces.

Applications Software

Accessory AC 1047 provides an additional 10 measurement applications to the 2390A series. The applications are:-

- Adjacent Channel Power
- Occupied Bandwidth
- Voltage Standing Wave Ratio
- Cable Fault
- Pulse Identification
- Noise Marker
- Carrier/Noise 1 Hz Normalized
- Carrier/Noise 1.23 MHz
- Normalized
- AMPS Cellular Channel Mode Increment

All applications are supplied on a single 3.5 in disk. They are downloaded into non volatile memory in the 2390A series spectrum analyzer.

EasySpan Software

The EasySpan software is a Windows based program for PCs. It facilitates viewing 2390A series traces on the PC display without the need for spreadsheets. Traces and set-ups may be recorded to disk for future reference. An interactive window allows macros to be written allowing automatic trace acquisition. The instrument may be connected to a modem allowing traces to be viewed and recorded from a remote location, for remote site monitoring.

Active Probe

The AC2388 Active Probe covers from 50 kHz to 1.25 GHz. It enables accurate measurements of devices from HF to UHF without loading the circuit. A built-in continuously variable attenuator minimizes probe distortion during measurement.

Specification

Frequency

FREQUENCY RANGE
2392A 9 kHz to 2.9 GHz
2390A 9 kHz to 22 GHz
2393A 9 kHz to 26.5 GHz
Internal Mixing (version dependent)
Band 0 0 Hz to 2.9 GHz
Band 1 2.6 GHz to 12.0 GHz
Band 2 11.5 GHz to 26.5 GHz

EXTERNAL MIXING (ALL INSTRUMENTS)
3 GHz to 300 GHz

FREQUENCY READOUT ACCURACY
±(3% of Span Width + Frequency Standard Accuracy + 50 % of RBW)

FREQUENCY SPAN RANGE
2392A 10 Hz/div to 290 MHz/div
2390A 10 Hz/div to 2.2 GHz/div
2393A 10 Hz/div to 2.65 GHz/div
All versions have continuously variable span and zero span (0 Hz)

ACCURACY
±5% of indicated span

FREQUENCY COUNTER

Resolution
1 Hz, 10 Hz, 100 Hz, 1 kHz

Accuracy
±(Frequency Standard Accuracy + Counter Resolution)

Sensitivity
(at 120 MHz with 0 dB attenuation)
<-85 dBm with 3 kHz RBW
<-65 dBm with 5 MHz RBW

FREQUENCY STANDARD

Temperature Stability (0 - 50°C)
±0.2 ppm
±0.02 ppm (Option 09)

Ageing
First year
±2 ppm/year
±1 ppm/year (Option 09)
Thereafter
±1 ppm/year
±0.5 ppm/year (Option 09)

RESIDUAL FM
(peak to peak in 20 ms, spans <1 MHz/div, 100 Hz video filter)
<10 Hz, below 6 GHz
<20 Hz, 6 GHz to 12 GHz
<40 Hz, 12 GHz to 26.5 GHz

NOISE SIDEBANDS
(Span <100 kHz/div)

	10 kHz offset	30 kHz offset
0.1 to 1.0 GHz	-97 dBc/Hz	-101 dBc/Hz
1.0 to 2.8 GHz	-92 dBc/Hz	-95 dBc/Hz
2.8 to 6.0 GHz	-93 dBc/Hz	-100 dBc/Hz
6.0 to 12.0 GHz	-88 dBc/Hz	-95 dBc/Hz
12.0 to 26.5 GHz	-81 dBc/Hz	-88 dBc/Hz

SYSTEM RELATED SIDEBANDS
(at 300 Hz RBW)
<-65 dBc below 12 GHz
<-60 dBc 12 GHz to 26.5 GHz

Sweep

TIME

Span >200 Hz/div
1 ms to 10 s/div in 1-2-5 sequence

Zero Span
200 ns/div to 10s/div in 1-2-5 sequence
(Resolution reduced <2 µs/div)

ACCURACY
±1% >1 µs/div

2390A series

TRIGGER SOURCE
Internal (Video), External (front panel), External (rear panel) or line (AC input)

TRIGGER MODE
Free Run, Auto Normal or Single

TRIGGER COUPLING
AC, DC, High-Pass Filter, Low-Pass Filter, TV line, TV field

TRIGGER BANDWIDTH
>5 MHz @ -3 dB (at EXTERNAL INPUT connector)

TRIGGER LEVEL RANGE

Video
Adjustable over 8 divisions, positive or negative polarity

Front Panel BNC
User settable threshold: -2.5 V, -1.0 V, -0.5 V, 0 V, +0.5 V, +1.0 V, +2.5 V; nominal

Rear Panel BNC
+2.5 V nominal

TRIGGER SENSITIVITY

Internal
1 division

Front Panel BNC
200 mV peak

Rear Panel BNC
+2 V (TTL)

TRIGGER DELAY (using Zero Span)
0 to ±300 divisions in time/div to a maximum of ±200 second

Amplitude

MAXIMUM INPUT LEVEL
0 V DC,
+20 dBm,
+30 dBm CW >0 dB input attenuation
+50 dBm peak; 10 µs, <1% duty cycle, >0 dB input attenuation

DISPLAYED AVERAGE NOISE LEVEL
(in 10 Hz Video Resolution Bandwidth)

	3 Hz RBW	300 Hz RBW
9 kHz to 100 kHz	<-115 dBm	<-95 dBm
100 kHz to 2.9 GHz	<-135 dBm	<-115 dBm
2.9 to 12.0 GHz	<-130 dBm	<-110 dBm
12.0 to 26.5 GHz	<-125 dBm	<-105 dBm

GAIN COMPRESSION
<1.0 dB with -5 dBm (0 dB attenuation)

AMPLITUDE UNITS
Logarithmic display
dBm, dBµW, dBmV, dBmV
Linear display
mW, µW, mV, µV

DISPLAY LINEARITY

Log
5 or 10 dB/div
±0.15 dB/dB, ≤1.5 dB over 8 divisions
1 or 2 dB/div
±0.5 dB over 8 divisions

Linear

<10 MHz RBW
±2% of Reference Level over 8 divisions
10 MHz and 30 MHz RBW
±10% of Reference Level over 8 divisions
(<10 dB IF Gain)

FREQUENCY RESPONSE
(with 10 dB attenuation, relative to REF OUT)
±1.5 dB, 9 kHz to 2.9 GHz
±2.0 dB, 2.9 GHz to 12 GHz
±3.0 dB, 12 GHz to 18 GHz
±4.0 dB, 18 GHz to 26.5 GHz

RESOLUTION BANDWIDTH

Range
3 Hz, 10 Hz, 30 Hz, 100 Hz (Digital Resolution); 300 Hz, 3 kHz, 30 kHz, 300 kHz and 5 MHz (at 3 dB);
10 MHz and 30 MHz (at 3 dB) (Linear display and FM modes)

Option 08
Additional 1 kHz and 1 MHz (at 3 dB);
200 Hz, 9 kHz and 120 kHz (at 6 dB)

Accuracy
±20%, 300 Hz to 30 kHz;
±30%, 300 kHz to 30 MHz;
±10%, 200 Hz, 9 kHz and 120 kHz

Selectivity
60 dB/3 dB ratio
<5:1, 3 kHz, 30 kHz, 300 kHz, 1 MHz, 5 MHz;
<12:1, 1 kHz;
60 dB/6 dB ratio <5:1, 9 kHz and 120 kHz;
50 dB/3 dB ratio <10:1, 300 Hz;
50 dB/6 dB ratio <10:1, 200 Hz

Switching Error
(referenced to 30 kHz RBW)
±0.5 dB, 1 kHz to 5 MHz;
±1.0 dB, <1 kHz;
±2.0 dB, 10 MHz, 30 MHz;

VIDEO BANDWIDTH

Range
10 Hz to 1 MHz in decade steps plus NONE (no Video Filter activated)

INPUT ATTENUATOR

Range
0 to 60 dB in 10 dB steps

Accuracy
Greater of ±0.5 dB or ±2%, 9 kHz to 2.9 GHz
Greater of ±1.0 dB or ±4%, 2.9 GHz to 18 GHz
Greater of ±1.5 dB or ±7%, 18 GHz to 26.5 GHz

REFERENCE LEVEL

Range
<10 MHz RBW
-95 to +30 dBm in 0.1 dB steps
10 MHz, 30 MHz, RBW
-50 to +30 dBm in 0.2 steps

Accuracy
With 10 dB attenuation and RBW <10 MHz
±0.25 dB, -20 to -40 dBm
±0.5 dB, -40 to -85 dBm
RBW 10 MHz, 30 MHz
±2.0 dB

Offset
0 to ±99.9 dB in 0.1 dB steps

SPURIOUS RESPONSES

Harmonic Distortion
<-70 dBc, 9 kHz to 2.9 GHz
(-30 dBm input and 10 dB attenuation)
<-100 dBc, 2.9 GHz and 26.5 GHz
(-10 dBm input and 10 dB attenuation)

Third Order Intermodulation Distortion
<-80 dBc (-30 dBm input and 10 dB attenuation)
<-75 dBc (9 - 12 GHz only)

Residual Response
(input terminated with 50 Ω)
<-90 dBm, 9 to 100 kHz;
<-100 dBm, 100 kHz to 26.5 GHz

Other Input Related Spurious
(-30 dBm input and -10 dB attenuation)
<-70 dBc below 18 GHz
<-60 dBc 18 GHz to 26.5 GHz

DISPLAY BANDWIDTH

Linear mode
>5 MHz (-3 dB), 30 MHz RBW;
>2.5 MHz (-3 dB), 5 MHz RBW;
at <5 µs/div Sweep Time

Log mode
>1 MHz (-3 dB), 5 MHz RBW;
at <20 µs/div Sweep Time

Receiver

FREQUENCY RANGE
2392A 9 kHz to 2.9 GHz
2390A 9 kHz to 22 GHz
2393A 9 kHz to 26.5 GHz

SENSITIVITY
5 µV at 100 MHz (30 kHz RBW, 3 kHz Video Bandwidth, 5 kHz FM deviation at 1 kHz rate, 10 dB SINAD with 10 dB IF Gain)

SELECTIVITY
Available analyzer RBW between 200 Hz and 300 MHz

DEMODULATION

AM Scales
10%, 20 %, 50 % / div

FM Scales
(in 1-2-5 sequence)
1 kHz to 100 kHz, <10 MHz RBW;
200 kHz to 5 MHz, 10 MHz, 30 MHz RBW

Memory

TRACE STORAGE CAPACITY
99 traces (including user defined traces and test limits)

RECALL TO DISPLAY AT ONE TIME
4 traces

SET-UP STORAGE CAPACITY
99 set-ups

MACRO PROGRAM CAPACITY
64 kbytes

Oscilloscope

INPUT

Type
BNC (f)

Impedance
1 MΩ and 27 pF nominal

Coupling
AC, DC, GND

Voltage Range
5 mV/div to 5 V/div (±3% of Full Scale) in 1-2-5 sequence

Frequency Range
DC to >5 MHz (-3 dB) at <5 µs/div Sweep Time

FFT Analyzer

INPUT
(as per oscilloscope)

AMPLITUDE

Attenuation
0 to 60 dB in 20 dB steps

Reference Level Range
2.23 mV to 22.3 V Full Scale
(-40 to +40 dBm/50 Ω reference voltage)

Response
+0/-3 dB (0 Hz to 20 kHz)

DYNAMIC RANGE
80 dB

Average Noise Level
<1 µV

Spurious
<7 µV

FREQUENCY

Range
0 to 20 kHz

Span
10 to 200 Hz/div continuously variable

Bandwidth
3, 10, 30 or 100 Hz

TRIGGER FUNCTION
Selectable external trigger (time-gate) capabilities

PULSE WIDTH
>100 ns

External Mixer

EXTERNAL MIXER IF INPUT

Type
SMA (f)

Frequency
410.7 MHz at -30 dBm ±3 dB for top of screen display

Compression
1 dB at >-5 dBm

EXTERNAL MIXER LO OUTPUT

Type
SMA, 50 Ω nominal (must be terminated when not in use)

Frequency
3 to 12 GHz

Amplitude
≥+8 dBm

Input/Output

ANALYZER INPUT
2392, Precision Type N (f)
2390A, Precision Type N (f)
2393, Field replaceable Planar Crown™ with 3.5 mm (f) and Type N (f) both supplied

INPUT VSWR
(>0 dB input attenuation)
<1.3:1 <2.9 GHz - (2390A, 2393A)
<1.45:1 <2.9 GHz - (2392A)
<1.5:1 2.9 GHz to 8 GHz
<2.0:1 8 GHz to 18 GHz
<2.5:1 18 GHz to 26.5 GHz

EXTERNAL REAR TRIGGER INPUT
10 kΩ nominal

EXT REF INPUT

Type
BNC (f), 1 kΩ nominal 10 MHz at 1 to 10 Vpk-pk

PHONES OUTPUT
1/8 in (3.2 mm) phone jack

REF OUT (CALIBRATOR)

Type
BNC (f), 50 Ω nominal

Frequency
100 MHz

Accuracy
Same as Frequency Standard

Amplitude
-30 dBm

Accuracy
±0.5 dB

10.7 MHz IF OUTPUT
Type BNC (f), 50 Ω nominal

410.7 MHz IF OUTPUT
Type BNC (f), 50 Ω nominal

EXT DISPLAY OUTPUT
15 pin VGA format for external color display

VIDEO OUTPUT
100 mV/div ±10% into 1 MΩ

FUNCTION CONNECTOR

External Rear Trigger, pin 8	10 kΩ nominal
Upper Limit Relay Drive, pin 13	50 V, 200 mA max
Lower Limit Relay Drive, pin 5	50 V, 200 mA max
Sweep, pin 14	0 to +5 V ramp ±0.5 V
Sweep Hold, pin 6	TTL Level
Auxiliary Video, pin 7	100 mV/div ±10% into 1 MΩ

IEEE-488 GPIB

Conforms to
IEEE-Standard 488-1987

Implemented Subsets
SH1, AH1, T1, TE0, L2, LE0, SR1, RL2, PP0, DC1, DT1 and C0

Compatibility
IEEE-488.2 Command Set.
High Speed waveform transfer supported.

RS-232

Type
Half-duplex RS-232 (operates as slave to controller [DTE])

Baud Rate
110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400

Handshake Modes
XON/XOFF (Software), CTS/RTS (Hardware)

Parity Check
Odd, Even or None

General Characteristics

DIMENSIONS (ALL VERSIONS)
40.64 cm (16 in) wide (including handle);
19.05 cm (7.5 in) high; 55.88 cm (22 in) deep

WEIGHT (WITHOUT OPTIONS)

2392	15.5 kg (34.1 lb)
2390A	16.6 kg (36.6 lb)
2393	16.7 kg (36.8 lb)

POWER REQUIREMENTS

AC Line
90 to 132 VAC, 50 to 60 Hz / 400 Hz, <170 W
198 to 264 VAC, 50 to 60 Hz / 400 Hz, <170 W

ENVIRONMENT

Operating Temperature
0 to 50°C

Storage Temperature
-40 to 71°C

Temperature Change
1°C/minute for specified accuracy

Altitude

Operational	3,048 m (10,000 ft)
Nonoperational	12,192 m (40,000 ft)

ELECTRO-MAGNETIC COMPATIBILITY
Conforms with the protection requirements of EEC Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011-1991	(Emissions)	CISPR11
EN50082-1:1992	(Immunity)	IEC801-2 1991 IEC801-3: 1984 IEC801-4: 1988
EN60555-2:	1987	IEC555-2

SAFETY
Complies with IEC 1010-1.BSEN 61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply.
NOTE: The 2390A series requires 15 minutes of warm-up time to meet specifications. Specifications only apply with TIME CALIBRATION set to ENABLE in the Analyzer Configuration Screen Option Menu or immediately after manually activating a TIME CALIBRATION.

Options

TRACKING GENERATOR (Option 02)

Frequency Range
100 kHz to 2.9 GHz

Flatness (at -10 dBm)
±2.0 dB, 100 kHz to 1 MHz
±1.5 dB, 1 MHz to 2.9 GHz

Output Level
0 to -70 dBm in 1 dB steps

Attenuator Accuracy
±1 dB or 0.05 dB/dB

Nonharmonic Spurious
<-30 dBc

Harmonics
<-20 dBc

Leakage (Dynamic range)
-120 dBm

QUASI-PEAK DETECTOR (Option 08)

Selected Bandwidth	*Freq Range*	*Charge Time**	*Discharge Time**	*Display Time**
200 Hz	10 to 150 kHz	45	500	160
9 kHz	0.15 to 30 MHz	1	160	160
120 kHz	0.03 to 1 GHz	1	550	100

* Time is given in ms ±20%

HIGH STABILITY TIMEBASE (Option 09)

Temperature Stability
±0.02 ppm/°C

Ageing
First year ±1 ppm/year
Thereafter ±0.5 ppm/year

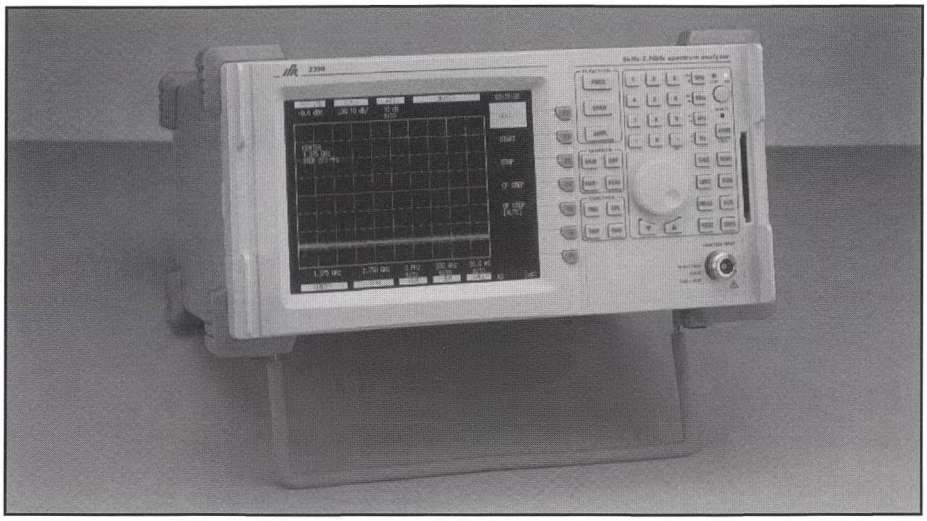
Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers	*Versions*
2392A-110	9 kHz to 2.9 GHz Spectrum Analyzer, 110 VAC
2392A-110-C	9 kHz to 2.9 GHz Spectrum Analyzer 110 VAC with certificate of calibration
2392A-220	9 kHz to 2.9 GHz Spectrum Analyzer, 220 VAC operation
2392A-220-C	9 kHz to 2.9 GHz Spectrum Analyzer, 220 VAC with certificate of calibration
2392AT-110	9 kHz to 2.9 GHz Spectrum Analyzer, Tracking generator, 110 VAC
2392AT-110-C	9 kHz to 2.9 GHz Spectrum Analyzer, Tracking generator, 110 VAC, certificate of calibration
2392AT-220	9 kHz to 2.9 GHz Spectrum Analyzer, Tracking Generator, 220 VAC
2392AT-220-C	9 kHz to 2.9 GHz Spectrum Analyzer, Tracking Generator, 220 VAC, Certificate of Calibration
2392AP-110	2392A Premium (Tracking generator; 200 Hz, 1, 9 and 120 kHz Filters; Quasi-peak Detector) 110 VAC
2392AP-110-C	2392A Premium (Tracking generator; 200 Hz, 1, 9 and 120 kHz Filters; Quasi-peak Detector) with certificate of calibration
2392AP-220	2392A Premium, 220 VAC operation
2392AP-220-C	2392A Premium, 220 VAC with certificate of calibration
2390A-110	9 kHz to 22 GHz Spectrum Analyzer, 110 VAC operation
2390A-110-C	9 kHz to 22 GHz Spectrum Analyzer, 110 VAC with certificate of operation
2390A-220	9 kHz to 22 GHz Spectrum Analyzer, 220 VAC operation
2390A-220-C	9 kHz to 22 GHz Spectrum Analyzer, 220 VAC with certificate of calibration
2390AT-110	9 kHz to 22 GHz Spectrum Analyzer, Tracking generator, 110 VAC
2390AT-110-C	9 kHz to 22 GHz Spectrum Analyzer, Tracking generator, 110 VAC, with certificate of calibration
2390AT-220	9 kHz to 22 GHz Spectrum Analyzer, Tracking generator, 220 VAC
2390AT-220-C	9 kHz to 22 GHz Spectrum Analyzer, Tracking generator, 220 VAC, with certificate of calibration
2390AP-110	2390A Premium (Tracking generator; 200 Hz, 1, 9, 120 kHz Filters; Quasi-peak Detector, 0.02 ppm high stability time base), 110 VAC operation
2390AP-110-C	2390A Premium (Tracking generator; 200 Hz, 1, 9, 120 kHz Filters; Quasi-peak Detector, 0.02 ppm high stability time base), 110VAC with certificate of calibration
2390AP-220	2390A Premium, 220VAC operation
2390AP-220-C	2390A Premium, 220VAC with certificate of calibration
2393A-110	9 kHz to 26.5 GHz Spectrum Analyzer, 110 VAC operation
2393A-110-C	9 kHz to 26.5 GHz Spectrum Analyzer, 110 VAC with certificate of calibration
2393A-220	9 kHz to 26.5 GHz Spectrum Analyzer, 220 VAC operation
2393A-220-C	9 kHz to 26.5 GHz Spectrum Analyzer, 220 VAC operation with certificate of calibration
2393AT-110	9 kHz to 26.5 GHz Spectrum Analyzer, Tracking generator, 110 VAC
2393AT-110-C	9 kHz to 26.5 GHz Spectrum Analyzer, Tracking generator, 110 VAC, with certificate of calibration
2393AT-220	9 kHz to 26.5 GHz Spectrum Analyzer, Tracking generator, 220 VAC
2393AT-220-C	9 kHz to 26.5 GHz Spectrum Analyzer, Tracking generator, 220 VAC, with certificate of calibration
2393AP-110	2393A Premium (Tracking generator; 200 Hz, 1, 9, 120 kHz filters; Quasi-peak Detector, 0.02 ppm high stability time base) 110 VAC
2393AP-110-C	2393AP-110, Cert. Cal
2393AP-220	2393A Premium (Tracking generator; 200 Hz, 1, 9, 120 kHz filters; Quasi-peak Detector, 0.02 ppm high stability time base), 220 VAC
2393AP-220-C	2393AP-220. Cert. Cal
	Accessories
AC0100M	Near Field Probe Set
AC0410	Maintenance Manual
AC1009M	EasySpan (Waveform Transfer Software)
AC 1047	Applications library
AC1600M	TMAC Programming Manual
AC2388	1 GHz Active Probe supplied with accessory power supply
AC4101T	Return Loss Bridge (5 MHz to 1 GHz)
AC4103T	Return Loss Bridge (5 MHz to 2 GHz)
AC4250	75 Ω Adapter BNC/N
AC4700	Rack Mount Adapter
AC5007	Soft Padded Carrying Case
AC5009	Type SMA PLANAR CROWN Adapter (2393A only)
AC5010	Type N PLANAR CROWN Adapter (2393A only)
AC7800	75 Ω Adapter F/N
AC8700	UHF Antenna
5900/327	MI Plot Measurement Presentation Software.

2398
9 kHz to 2.7 GHz Spectrum Analyzer

A breakthrough in high performance spectrum analysis, combining cost effectiveness and portability in a new lightweight instrument



- 9 kHz to 2.7 GHz fully synthesized frequency range
- 8.2 kg (18 lb): Lightweight, rugged and portable
- Split screen operation
- Low phase noise
- 300 Hz minimum resolution bandwidth
- Wide input range +20 to –105 dBm
- AC/DC/Battery operation
- AM/FM demodulation
- EMC measurement capability
- GPIB option

A Performance/Cost Breakthrough

The 2398 Spectrum Analyzer is the latest in a series of quality spectrum analyzers from IFR. It provides exceptional performance in a lightweight, portable unit.

Frequency Accuracy

With a fully synthesized local oscillator system, the 2398 produces highly accurate frequency measurements. The standard 1 Hz frequency counter gives high resolution measurements of any signal above –70 dBm.

Light Weight

Weighing only 8.2 kg (18 lb), the 2398 is one of the lightest spectrum analyzers available. The light weight allows measurements to be made in the lab or in the field on a variety of wireless test, troubleshooting or installation applications.

Battery and DC capabilities

An optional DC power supply or external battery allows the analyzer to be used in remote locations, with no need to access to an AC power source.

Split Screen Operation

The integral "window" or "split screen" feature allows the analyzer to view a signal in the upper zone and an entirely different signal and setup in the lower zone.

This special capability allows interfering signals to be tracked, an application that is becoming more prevalent in cellular CDMA and TDMA cellular systems.

Outstanding Spectral Purity

The 2398 offers a phase noise of –90 dBc/Hz for determining the spectral purity of modules or systems.

Standard AM / FM Receiver

A standard AM and FM demodulator allows full testing and troubleshooting of a wide range of wireless radio systems and repeaters. An internal speaker and a headphone connector are provided.

Wide Signal Measurement Range

The 2398 provides an input signal range from +20 dBm to –105 dBm. This, combined with the AC coupled RF input, allows direct testing of RF amplifiers.

With the increased deployment of cellular technologies, the 2398 gives a broad range of tools for finding the source of interfering signals in modern wireless systems.

Versatile Interfaces

The RS-232 interface and a parallel printer port are fitted as standard. The optional IEEE-488 (GPIB) port offers the additional capability of fully automated testing and data tracking. Hard copies of screen displays can be easily printed.

PCMCIA Memory

The unit can simultaneously store 20 traces and 10 setups in the internal memory at any one time. It also has an optional PCMCIA memory card slot for mass storage of traces and setups.

Enhanced Measurement Capabilities

The 2398 has user selectable internal measurement features that perform such measurements as occupied bandwidths, X dB down and more.

Versatile Markers

A full range of marker capabilities such as peak function, delta, marker noise and marker zoom are provided. When combined with the accuracy of the 2398, they allow for faster and more comprehensive measurements of the signals displayed.

Limits Capability

The 2398 gives a comprehensive limits capability that allows for the setup of a Pass/Fail line on the screen. When a signal exceeds this limit line, FAIL will be displayed on the screen.

EMC Measurements

There is an optional Quasi-Peak Detector with a 9 kHz and 120 kHz filter. With today's growing demand for EMC compliance, it is necessary to design and test to the new standards and guidelines. The 2398 is ideal for field as well as design lab pre-compliance testing.

Autoset

Autoset is a one-button solution that allows for the instant viewing of an unknown signal. The 2398 will search for the highest signal level and tune the center frequency to that signal. Then the span and resolution bandwidth are set to an optimal state for the best view of the signal.

Specification

Frequency

Tuning Range
9 kHz to 2.7 GHz

Tuning Resolution
1 Hz

Frequency Span Width
100 Hz/div to 270 MHz/div in 1, 2, 5 step selections (auto selected) plus ZERO Span, and FULL Span (9 kHz to 2.7 GHz). Manual selection of start, stop, and span.

Span Accuracy
±3% of the indicated span width

Readout Accuracy
Span accuracy + frequency standard accuracy + 50% of RBW

FREQUENCY COUNTER

Resolution
1 Hz, 10 Hz, 100 Hz and 1 kHz

Accuracy
± (Reference frequency error x marker frequency + counter resolution ± 1 count)

Sensitivity
≤-70 dBm

Stability
Residual FM
<100 Hz @ 1 kHz RBW, 1 kHz VBW
(P-P in 20 ms)

Noise Sidebands
-90 dBc/Hz @ 10 kHz offset

Amplitude

Measurement Range
+20 to -105 dBm

Frequency Range
9 kHz to 2.7 GHz

Displayed Average Noise Level
(1 MHz to 2.7 GHz, Resolution bandwidth of 300 Hz, 10 Hz video filter)
-105 dBm

1 dB Gain Compression
-10 dBm minimum (0 dB attenuation, ≥10 MHz CF)

Displayed Range
80 dB in 10 dB/div log scale
40 dB in 5 dB/div log scale
16 dB in 2 dB/div log scale
8 dB in 1 dB/div log scale
8 divisions with linear amplitude scale

AMPLITUDE UNITS

Log Scale Mode
dBm, dBmV, dBµV, V, W

Linear Scale Mode
dBm, dBmV, dBµV, V, W

Display Linearity
5 or 10 dB/div, ±0.15 dB/dB, ≤±1.5 dB over 8 divisions
1 or 2 dB/div, ±0.5 dB over 8 divisions.
Linear, ±10% of Reference Level over 8 divisions

Frequency Response
±1.5 dB (≥10 MHz CF)

ATTENUATOR

Range
0 to 50 dB, selected manually or automatically coupled to reference level

Resolution
10 dB steps

Accuracy
±0.5 dB/step up to 1 dB maximum

REFERENCE LEVEL

Accuracy
±1.5 dB

Range
-110 dBm to +30 dBm with 300 Hz filter using 1 dB/division scale

Resolution
0.1 dB Steps

Residual Response
≤-85 dBm (input terminated, 0 dB attenuation)

Harmonic Distortion
≤-60 dBc (-40 dBm input 0 dB attenuation)

Intermodulation Distortion
≤-70 dBc (-30 dBm input, 0 dB attenuation 3rd order, ≥100 MHz CF)

Other Input Related Spurious
≤-60 dBc (-30 dBm input)

Resolution Bandwidths

Selections
300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz and 3 MHz

Accuracy
±20%

Selectivity
300 Hz to 3 MHz
<15:1 60 dB/3 dB ratio
9 kHz & 120 kHz (QuasiPeak)
<15:1 60 dB/6 dB ratio

Switching Error
±1.0 dB

Video Bandwidth Selection
10 Hz to 1 MHz in 1-3-10 steps plus Full BW

Sweep

Rate (full screen)
50 ms to 1000 sec (in 1-2-5 sequence)
5 ms to 20 sec (in zero span)

Sweep Rate Accuracy
±10% of Full Scale ≥100 ms

Trigger Source
Internal, External (rear), Line

Trigger Modes
Free Run, Video, Single Sweep, Line

Coupling
DC

External Trigger Bandwidth
5 Hz HPF or 100 kHz LPF

Trigger Level
Internal: Adjustable over 8 divisions
Ext Rear: 2.5 Vp-p nominal

Trigger Delay
± one sweep time

Display

Type
(7.4 in) Monochrome LCD.

Digital Resolution
640 H x 480 V active display area

Marker Modes
2 Markers, Delta, 1/Delta Peak Search, Peak Track, Marker Track, Marker to Center, Marker to Reference and Marker Noise

Memory

Trace Storage
20 stored traces including user defined traces and test limits

Setup Storage
10 operational states

Displayed Traces
2 Traces

Inputs

RF INPUT

Connector
Type N Female, 50 Ω nominal.

Impedance
VSWR<1.5:1. (≥10 dB Attenuation)

Maximum Input Level
20 Vdc, +26 dBm
(Minimum 30 dB Attenuation)

LO Emissions
≤-70 dBm with 0 dB Attenuation

Outputs

Reference
10 MHz @ +5 dBm (rear panel)

Video
0 to 5 Vdc (rear panel)

IF out (rear panel)
10.7 MHz equivalent to RF input level

Frequency Standard

STANDARD

Temperature Stability
±2 ppm

Ageing
±1 ppm

HIGH STABILITY OPTION

Temperature Stability
±0.1 ppm

Ageing
±0.1 ppm

External Reference Input/Output

Connector
Type BNC female

Input Level
-5 dBm to +15 dBm

Output Level
+5 dBm

RS-232 Interface

Type
Null Modem (Duplex Virtual Hardware Handshake)

Baud Rate
600 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19.2 kbps

Parity Check
Odd, Even or None

Data Bits per Word
7 or 8

Stop Bits per Word
1 or 2

Printer Interface

Drivers
PCL3

Connection
Standard 25 Pin female D-Sub Parallel Printer

IEEE-448 (GPIB) Interface (Option)

Conforms to IEEE-Standard 488-1987.
Implemented Subsets
SH1, AH1, T6, L4, SR1, RL1, DC1, C0, PP0, LE0, TE0

Quasi-Peak Option

	Band B *9 kHz RBW*	*Band C* *120 KHz RBW*
Frequency Range	150 kHz to 30 MHz	30 MHz to 1 GHz
Charge Time (ms)	1 ±20%	1 ±20%
Discharge Time (ms)	160 ±20%	550 ±20%
Display Time (ms)	160 ±20%	100 ±20%

2398 & 2388

General Characteristics

Dimensions
Width: 350 mm (13.75 in)
Height: 185 mm (7.15 in)
Depth: 381 mm (14.75 in)
(Including handle)

Weight
8.2 kg (18.0 lb)

Warm-up Time
15 minutes for specified accuracy

Power Requirement

Source Voltage and Frequency
100 to 220 VAC
50-60 Hz

Power Consumption
60 W Maximum (without options)

Power Requirement Optional AC/DC Power Supply

Source Voltage and Frequency
100 to 220 VAC
50-60 Hz

DC Voltage
13 to 21 VDC

External Battery
14.4 VDC
7 AH

Operation Time
1 hour

Environmental

Operating
0 to 40°C.

Storage
-20 to 70°C.

Temperature and Humidity
Meets MIL-T-28800E for Type 2, Class 5, non-condensing

Vibration/Shock
Meets MIL-T-28800E for Type 2, Class 5

Altitude
Operation up to 3000 m (9843 ft)
Non-operational up to 12200 m (40,000 ft)

Electromagnetic Compatability

Complies with the limits specified in the following standards:
EN 55011: Group 1 Class A
EN 50082-1

Safety

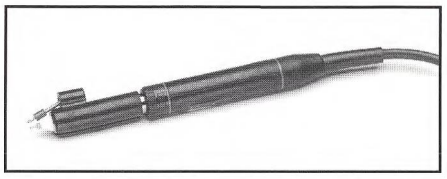
Conforms with EN 61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Versions and Accessories

When ordering please quote the full ordering number information

Ordering Numbers	*Versions*
2398	9 kHz to 2.7 GHz Spectrum Analyzer
2398-1	2398 with Quasi-peak detector and filters, high stability time base (0.1 ppm), PCMCIA card slot and IEEE-488 (GPIB)
2398-2	2398-1 with tracking generator
2398-3	2398-1 with AC/DC power supply
2398-4	2398-2 with AC/DC power supply
	Options
AC2565	Tracking generator
AC2566	High stability time base
AC2567	Quasi-peak detector
AC2568	AC/DC power supply
AC2569	GPIB
AC2570	PCMCIA card slot
	Accessories
AC0100	Near field probe set
AC2388	1 GHz Active Probe supplied with accessory power supply
AC2600	Maintenance Manual
AC2601	Soft padded carrying case
AC2603	Battery (must be used with AC/DC power supply)
AC4101	Return Loss bridge (5 MHz to 1 GHz)
AC4250	75 Ω BNC to 50 Ω type N adaptor
AC7800	75 Ω type F to 50 Ω type N adaptor
AC8700	UHF Antenna

2388 - 1 GHz Active Probe



- Wide frequency coverage: 50 kHz to 1.25 GHz, for IF, HF, VHF and UHF
- Attenuation adjustable to ensure operation at optimum dynamic range
- Continuously variable attenuator

The 2388 1 GHz Active Probe covers the frequency range 50 kHz to 1.25 GHz. It converts the 50 Ω input impedance of RF test equipment to a high impedance, providing minimal loading of the circuit under test for bridging measurements.

Intermodulation products are at least 75 dB down, permitting measurement of low-level intermodulation and harmonic distortion products.

Integral Attenuator

The design eliminates the need for clip-on voltage dividers by incorporating a variable attenuator within the probe. The adjustable 40 dB attenuator ensures that the probe can be operated at an optimum dynamic range independent of input signal level.

Supported Instruments

2388 active probe is suitable for use with 2310 TETRA signal analyzer, 2390A and 2398 series spectrum analyzers, 2945A and 2965 series radio test sets. For instruments that do not have an inbuilt probe power supply an accessory power supply is available.

Ruggedized

The probe is very rugged, and can withstand being dropped. In cases of extreme stress, however, the tip may be damaged, but is easily replaced, since a spare assembly simply screws to the probe barrel.

Accessories

The carrying case has storage space for the supplied accessories, including a spring grounding pin, terminated type N (Male) adaptor, and a spare probe tip.

The spring grounding pin incorporates a universal joint to allow the probe to be grounded to any convenient point.

The terminated adaptor may be used to check the insertion loss and frequency response of the probe allowing these effects to be measured.

Specification

Frequency Response
(When terminated in Adapter type 43149-020)
3 dB bandwidth 100 kHz to 1 GHz. Typically 50 kHz to 1.25 GHz.
Gain flatness ±0.75 dB from 500 kHz to 400 MHz.

INSERTION LOSS AT 10 MHz
Continuously variable from 0 dB ±1.5 dB to 40 dB.

INPUT IMPEDANCE

Input capacitance at 10 MHz
<2.5 pF for probe setting of 0 dB loss.
<1.5 pF for probe setting of 40 dB loss.

Input damping resistance
>250 kW at 10 MHz for probe setting of 0 dB loss.
>25 kW at 100 MHz for probe setting of 0 dB loss.

DISTORTION

Two-tone intermodulation products
>75 dB down on the level of a single tone, where each tone has a level of –30 dB at the probe output (i.e. <–105 dBm).

Output level at 1 dB gain compression
+6 dBm minimum at output.

MAXIMUM VOLTAGES

Maximum DC level
200 V.

Maximum AC level
10 V peak-to-peak at any setting.

SIGNAL TERMINATION
Type N male connector (50 Ω).

POWER REQUIREMENTS

Probe supply
900 mW maximum, either from instrument front panel socket or from the optional Accessory Power Supply.

ENVIRONMENTAL PERFORMANCE

Limit range of operation

Temperature
0 to +55°C.

Rated range of operation
+5 to +50°C.

Conditions of storage and transport

Temperature
–40 to +70°C.

Humidity
Up to 90% relative humidity at 35°C.

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential, i.e. 3.9 lbf/in²).

DIMENSIONS AND WEIGHT

Height	Width	Depth	Weight
65 mm	236 mm	190 mm	0.8 kg
9.6 in	9.25 in	7.5 in	1.8 lb

Dimensions are of carrying case, weight includes all supplied accessories.

Versions and Accessories

When ordering please quote eight digit code numbers.

Ordering Numbers	*Versions*
52388/900	1 GHz Active Probe 2388, 50 Ω
	Supplied with
41700/517	Spare Probe Tip.
41700/518	Spring Grounding Pin.
43149/020	Terminated 50 Ω Type N Male Adapter.
41700/554	Grounding Clip Assembly. Accessories
54441/012	Accessory Power Supply (for non-2380 series applications).
43149/023	Probe tip to BNC Adapter.
54349/001	Power supply adapter lead. (Hewlett Packard).
54349/002	Power supply adapter lead. (Tektronix – short).
54349/003	Power supply adapter lead. (Tektronix – long).

Counters and Power Meters

IFR offers a broad range of RF and Microwave power meters including a choice of 17 power sensors covering frequencies from 30 kHz to 46 GHz and power levels from -70 dBm to +44 dBm (25 W).

The range also includes the CPM (Counter Power Meter). A ruggedized solution for microwave frequency and power measurements in the field.

COUNTERS AND POWER METERS

CPM 20, 46 — 7.2
Counter Power Meter

6960B — 7.4
RF Power Meter

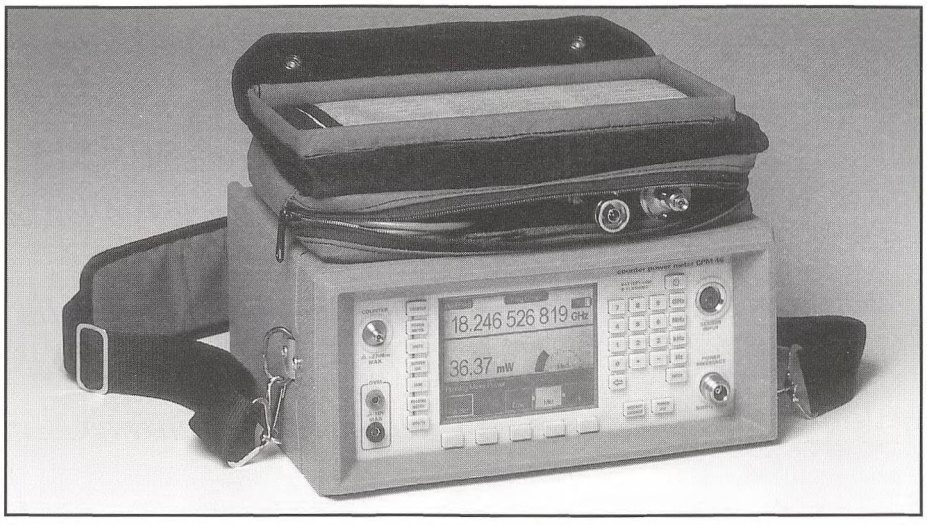
6970 — 7.7
Portable RF Power Meter

6910, 6920 & 6930 — 7.9
Power Sensors



CPM 20, 46
Counter Power Meter

A ruggedized solution for microwave power and frequency measurements in the field



- Combined frequency counter and power meter in one unit
- Two models available:
  - 10 MHz to 20 GHz
  - 10 MHz to 46 GHz
- Large, easy to read screen allows simultaneous display of both power and frequency measurements
- Built-in DVM for AGC voltage measurements
- Designed for use in the field, weighing only 4.9 kg (10.8 lb) and battery operated
- Supported by the full range of IFR power sensors

IFR's Counter Power Meter (CPM) is a portable combination of three instruments: a microwave frequency counter, true power meter and digital voltmeter. A compact instrument with internal rechargeable battery, ruggedized case and carrying strap, it can be used up a tower, on a roof top or at a field site. Digital microwave radios are commonly installed for network access to mobile radio cell sites and quick installation of business communications. The CPM is the ideal instrument for installation and maintenance engineers working on these systems.

Designed for Field Use

The CPM weighs 4.9 kg (10.8 lb), including battery, which makes it ideal for taking up radio towers or carrying on to exposed roof top sites. A supplied accessory pouch contains and protects all the required accessories. The rechargeable battery gives three hours of continuous operation. Batteries can be charged from either the supplied AC adapter or a vehicle supply. Battery life is continuously monitored and the display shows the percentage life remaining. As accessories a spare battery and desktop charger are available.

The display uses transflective LCD technology which has an integral backlight. This means that it can easily be read both outdoors in direct sunlight and indoors in low light. The user interface makes operation fast, simple and reliable. Measurements are swiftly configured, connections are clearly marked and results are easy to read.

Accuracy

Despite being lightweight and portable, there is no compromise in accuracy. The standard reference oscillator is a DTCXO, digitally controlled temperature compensated crystal oscillator. A DTCXO has no warm up time and is ready to make accurate measurements immediately after switch on, saving both time and battery life. Power measurement accuracy is guaranteed through the use of the standard IFR 6900 series of power sensors. These sensors have excellent return loss specifications which minimize mismatch errors in power measurements. Calibration and linearity factors, unique to each sensor, can also be entered into the CPM to ensure the best accuracy at all times. An integral 0 dBm, 50 MHz power reference is used for sensor calibration, ensuring measurement accuracy and traceability to national standards.

Fully Featured

Two versions of the CPM are available, CPM 20 measures frequencies from 10 MHz to 20 GHz and CPM 46 from 10 MHz to 46 GHz, through a single input. Power sensors cover the frequency range 30 kHz to 46 GHz, and when used with a CPM measure -60 dBm to +44 dBm (25 W).

The frequency counter has relative frequency and frequency offset modes for frequency drift and frequency conversion measurements. A limits function enables frequency to be measured against a specification, with pass/fail annunciator in the display. Resolution is user settable from 1 Hz to 1 MHz.



CPM is designed for radio link testing.

The power meter features pass/fail limits, dB rel, power offset and duty cycle modes. An analog peaking meter is displayed for tuning and adjusting power levels.

A built-in DVM complements the

frequency counter and power meter. Radio links are often aligned by monitoring the receiver AGC voltage. The DVM, with its clear 10 mV resolution readout and analog peaking meter, is ideally suited to this task.

Specification

Frequency Measurement

Frequency range
10 MHz to 20 GHz CPM 20
10 MHz to 46 GHz CPM 46

Sensitivity
10 MHz to 20 GHz -20 dBm (typ, below 20 MHz)
20 GHz to 26.5 GHz -20 dBm
26.5 GHz to 40 GHz -15 dBm
40 GHz to 46 GHz -10 dBm

Input Connector
Precision Type N (f) CPM 20
Precision 2.92 mm (f) CPM 46

Input Impedance
50 Ω Nominal

Maximum Input
10 MHz to 46 GHz +10 dBm (typ, below 20 MHz)

Damage Level
+27 dBm

Resolution
User selectable 1 Hz to 1 MHz

Measurement Time
1 Hz Resolution <2 s
>1 Hz Resolution <250 ms

FM Tolerance
20 MHz peak to peak, for >1 kHz rate

AM Tolerance
Any index as long as minimum level does not fall below sensitivity, at 20 kHz rate.

Amplitude Discrimination
20 dB for signals >400 MHz

Accuracy (1 Hz resolution)
Frequency standard error ±25 Hz (10 MHz to 20 GHz)
Frequency standard error ±50 Hz (20 GHz to 46 GHz)

10 MHz Frequency Standard

Features
Limit checking
Relative frequency
Frequency offset
Frequency hold

Temperature Stability
DTCXO (standard)
Better than ±5 in 10^8, 0 to 50°C
TCXO (option 001)
Better than ±1 in 10^6, 0 to 50°C

Ageing
DTCXO (standard) ±0.3 ppm/year.
TCXO (option 001) ± 1ppm/year.

External Frequency Standard Input
10 MHz, 0.7 to 5 V p-p sine or square wave into 1 kΩ nominal. AC coupled. BNC female.

Power Measurement

Frequency range (Sensor Dependent)
30 kHz to 46 GHz

Power range (Sensor Dependent)
-65 dBm (0.31 nW) to +44 dBm (25 W)

Power sensors supported
6910 series (-30 dBm to +20 dBm)
6920 series (-65 dBm to -20 dBm) *
6930 series (-15 dBm to +35 dBm)
6930 series opt 2, (-5 dBm to +44 dBm)

Power accuracy
After calibration using 0 dBm power reference: ±0.2 dB. Measuring a signal in the centre of the power sensor dynamic range, from a source with return loss better than 14 dB.

Resolution
4 digits

Units
dBm, dBW, pW, nW, µW, mW, W, kW.

Features
Limit checking Duty cycle
dB Relative Power offset
Analog Meter

Correction
Linearity Factor
Calibration Factor

Auto-Calibration
Ability to calibrate against a 0 dBm (1 mW), 50 MHz power reference.

Auto-zero
Removes DC offset from gain stages and power sensor.

Noise Floor (after Auto-zero)
6910 series < -30 dBm
6920 series < -65 dBm *
6930 series < -15 dBm

Power Reference

Frequency
50 MHz ±0.10 MHz

Power level
0 dBm (1 mW)

Uncertainty
±0.7% traceable to National Standards.

Accuracy
±1.2% worst case for one year.

Output connector
N (f), 50 Ω. Adapters are supplied with 75 Ω, 3.5 mm and 2.92 mm power sensors.

Digital Voltmeter

Voltage range
0 V to +10 V (DC only) protected to 40 V

Accuracy
±2.5% of reading.

Resolution
10 mV

Connector
4 mm banana sockets

Impedance
6 MΩ in parallel with 100 pF, -ve terminal connected to chassis via 10 kΩ resistor.

Display

LCD
1/4 VGA transflective with backlight.

Terminal Interface

Connector
9 pin D male. RS-232 (DTE) compatible.

Power Requirements

DC Input (vehicle supply or AC adapter)
10 V to 28 V, 32 VA (max).

Rechargable Battery
3 hours continuous operation minimum.

Recharge time
<4 hours

Size & Weight

285 mm (width), 130 mm (height), 210 mm (depth)
4.9 kg (10.8 lb)

Environmental

Operating temperature range
0°C to +45°C

Storage temperature range (excluding battery)
-40°C to +70°C

Storage humidity range
Up to 93% RH at +40°C

Shock and vibration
MIL-T-28800 for class 3

Drop test
IEC 68-2-32

Overall instrument protection
IEC 529 (rating IP 523)

EMC and Safety

Conforms with the limits specified in the following standards:

Emissions
EN55011:1991
AS/NZS2064.1/2 CISPR11

Immunity
EN50082-1:1992
AS/NZS4252.1 IEC801-2:1991
IEC801-3:1984
IEC801-4:1988

Safety
EN61010-1
UL3111-1 IEC 1010-1
CSA-C22.2 No. 1010.1

Versions and Accessories

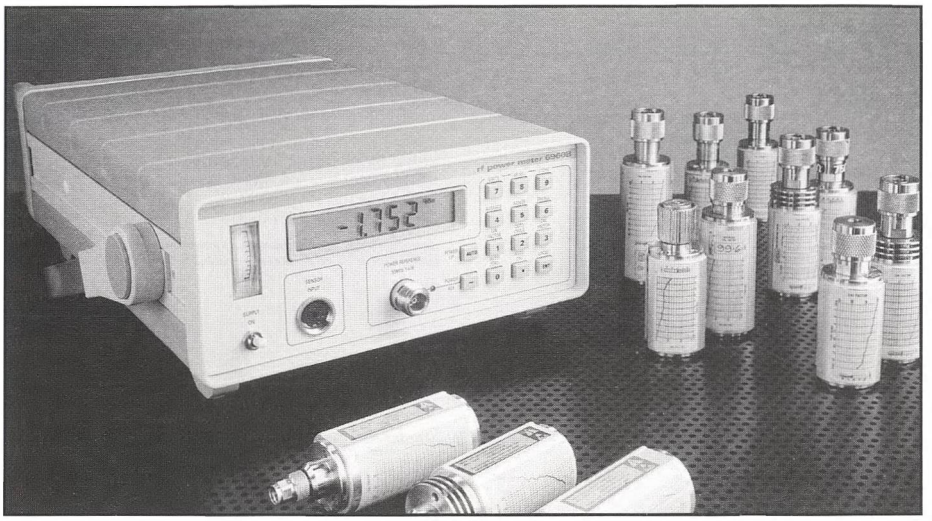
When ordering please quote the following ordering number information

Ordering Number	Version
CPM 20	10 MHz to 20 GHz Counter Power Meter
CPM 46	10 MHz to 46 GHz Counter Power Meter
Option 001	Replaces DTCXO with TCXO
	Supplied with
41690/616	Accessory pouch
41700/788	Carrying strap
43113/022	Rechargable battery
28541/213	Universal AC adapter/battery charger
	Power lead for charger
43169/039	Vehicle DC supply lead
43138/663	1.5 m power sensor cable
23443/874	DVM, BNC adapter
46882/335	Operating Manual
	Accessories
54311/219	20 GHz standard counter cable 1.5m, SMA (m) to SMA (m)
54311/134	Adapter N (m) to SMA (f)
54351/027	40 GHz counter cable 0.5m, 2.92 mm (m) to 2.92 mm (m)
43113/022	Spare battery
54464/001	Desktop battery charger
46880/084	Service Manual
	Power Sensors
	Standard (-30 dBm to +20 dBm)
56910/900	10 MHz to 20 GHz. Type N.
56911/900	10 MHz to 20 GHz. APC 7.
56912/900	30 kHz to 4.2 GHz. Type N.
56913/900	10 MHz to 26.5 GHz. MPC 3.5 mm.
56914/001	10 MHz to 40 GHz. 2.92 mm.
56914/002	10 MHz to 40 GHz. 2.92 mm plus waveguide 22 coax transition and calibration table.
56914/003	10 MHz to 46 GHz. 2.92 mm.
56919/900	75 Ω 30 kHz to 3 GHz. Type N.
	Low power (-65 dBm to -20dBm)*
56920/900	10 MHz to 20 GHz. Type N.
56923/900	10 MHz to 26.5 GHz. MPC 3.5
56924/001	10 MHz to 40 GHz. 2.92 mm.
56924/002	10 MHz to 40 GHz. 2.92 mm plus waveguide 22 coax transition and calibration table.
56924/003	10 MHz to 46 GHz. 2.92 mm.
	High power
56930/900	10 MHz to 18 GHz. (-15 to +35 dBm) Type N.
56932/900	30 kHz to 4.2 GHz. (-15 to +35 dBm) Type N.
56934/001	10 MHz to 40 GHz. (-15 to +30 dBm) 2.92 mm
56934/002	10 MHz to 40 GHz. (-15 to +30 dBm) 2.92 mm plus waveguide 22 coax transition and calibration table.
56934/003	10 MHz to 46 GHz. (-15 to +30 dBm) 2.92 mm
56930/002	10 MHz to 18 GHz (-5 to +44 dBm) Type N
56932/002	30 kHz to 4.2 GHz (-5 to +44 dBm) Type N

* - 60dBm for 6923 and 6924

6960B
RF Power Meter

A precision Power Meter with comprehensive GPIB facilities for ATE requirements and standard bench applications



- Extensive frequency coverage: 30 kHz to 46 GHz
- Wide dynamic range: -70 dBm (100 pW) to +44 dBm (25 W)
- Fast response on GPIB of 25 ms
- Auto averaging with manual override
- Both 50 Ω and 75 Ω sensors
- Low sensor VSWR reduces measurement uncertainty
- Sensor linearity correction for improved accuracy
- Maximum hold facility
- Optional DC operation
- Proven high reliability

The 6960B RF Power Meter is a high accuracy instrument which together with its associated power sensors provides measurements at frequencies from 30 kHz up to 46 GHz over a wide range of power levels. Its numeric keyboard enables easy manual control while full GPIB implementation with SRQ mask and trigger modes make it the logical choice for fast ATE systems.

Meter Accuracy

The 6960B features an instrumentation accuracy of better than ±0.5% in linear mode and ±0.02 dB in logarithmic mode. A special auto zero circuit digitally stores the zero offset for each of the five ranges, thus reducing zero carry over errors to ±0.03% and providing a zero accuracy of ±1% of FSD on the most sensitive range for any sensor type.

High Accuracy

All power sensors are provided with detailed calibration data to 0.01% resolution. In addition to Calibration Factor data, each sensor is individually calibrated for linearity. When entered into the power meter, this data reduces linearity errors to less than ±0.5% even on the highest range.

Precision Calibration Attenuators

The 6920 series of high sensitivity power sensors are supplied with a precision 30 dB attenuator for calibrating to the internal power reference. These attenuators have an accuracy of ±0.05 dB at 50 MHz to provide high calibration accuracy.

Duty Cycle Correction

Although the 6960B is a true average power measuring instrument, it may still be used for pulsed power measurements. The duty cycle of the signal to be measured may be entered in the range 100 to 0.001%. The power meter calculates the peak power by dividing the measured average power by the duty cycle.

Relative Measurements

The dB REL key enables the measurement of high powers by entering the calibrated value of an attenuator or coupler directly as a negative number. Positive relative values to account for amplifier gains can also be entered. The dB offset facility may be used with linear units so that transmitter output powers can be displayed in Watts.

Two Power-Up Modes

The instrument is provided with two power-up modes. For production line testing, or applications in power monitoring at unattended sites, power-up mode 2 returns the instrument to its previous settings after switch-off or a power failure. Power-up mode 1 sets all the instrument functions to default values.

Two Proportional Voltage Outputs

Two analog voltage outputs proportional to RF input power are provided on the rear panel. The Recorder Output offers the full 50 dB dynamic range of the instrument in the dB mode at 1 volt/decade for wide range power measurements. In the Watts mode this output provides 0 to 5 V linear voltage proportional to the RF input power.

The fast Levelling Output provides 1 V per range for effective power levelling of sweepers or signal sources. The calibration and linearity correction data from the sensor are traded off for a fast response. For semi-automated testing, a rear panel BLANKING output is provided to turn off a source or sweep generator during AUTO ZERO operation of the meter.

Ease of Use

With its conventional calculator style keyboard, changing parameters is both precise and obvious to the new user. Displayed units may be either linear (mW) or logarithmic (dBm). Applications which require circuit adjustments to optimise output or tune for a null are conveniently achieved with the analog meter. Automatic signal averaging is provided as well as auto ranging. The power meter selects the most appropriate amount of averaging in conjunction with the range in use.

External DC Operation

For operation in remote locations and

for certain military applications an optional external DC supply input is available. Any voltage within the range 11 to 32 volts can be accepted, operation from a vehicle DC supply is thus possible.

Optimum Noise Operation

For applications needing a fast response on a sensitive range, the user can trade off resolution for speed by entering a lower average number. The 6960B accepts average numbers between 1 and 256, so optimum noise reduction or required response time are always available.

Non-Volatile Memory

Nine non-volatile stores are available for storing complete instrument settings.

Maximum Hold

Long term drift measurements are easily made with the 'maximum hold' facility which enables the maximum value of a changing signal to be retained.

Automatic Sensor Recognition

The power meter contains a special sensor recognition circuit so that the correct scaling is selected automatically when the power sensor is connected.

GPIB Operation

6960B has been specifically designed with the requirements of the ATE system designer in mind. The GPIB interface has been optimized both in terms of hardware and software allowing greater speed in measurements with selectable resolution. Up to 40 readings per second are possible. The GPIB program codes feature simple mnemonics, requiring either a single digit number entry with no terminator or floating point entry requiring a terminator.

Six Trigger Modes

Specific GPIB program codes include TR-trigger mode. This sets the trigger mode or starts a measurement after a hold condition. Up to six trigger modes are available from the 6960B, from free running fast to an immediate trigger with settling time then hold.

SRQ Response

To the system user, the SRQ response is always important and in the 6960B the SRQs have been arranged to form a mask with each SRQ option having a binary weighting: 1 on end of measurement, 2 on error, 4 on end of GPIB operation. SRQ option 4 is useful to inform the controller that the requested GPIB operation such as Autozero has been executed.

Self-Test

Self-test is initiated when the instrument is switched on and the validity of the information in the non-volatile memory is automatically checked. The LCD alpha-numerics and annunciators can also be verified using a coded key press.

Reliability

The 6960 series has a proven record of high reliability. Data from service records show its actual mean time between failures (MTBF) to exceed 120,000 hours. Conservative component ratings, liquid crystal display and switch mode power supply for low internal heat generation, contribute to this excellent reliability. Consequently, a two year warranty is offered as standard with an optional third year warranty available at the time of initial order.

Fast and Easy Servicing

To make servicing easy and fast, careful thought has led to a simple arrangement of components and adjustments. Selective key switch operations can access the filter and digital to analog converters to check their operation, eliminating the need for a range calibrator. The only test equipment required to assist servicing is a counter-timer, digital voltmeter and screwdriver.

Low Cost of Ownership

Due to the modular design with good accessibility, mean time to repair (MTTR) is just 20 minutes thus keeping the cost of ownership low for the entire life of the instrument.

Specification

FREQUENCY RANGE
30 kHz to 46 GHz depending on sensor used.

POWER RANGE
−70 dBm (100 pW) to +44 dBm (25 W) depending on sensor used.

POWER REFERENCE
0 dBm (1 mW), 50 MHz, Type N female precision connector, 50 Ω. Adapters are supplied for other connectors with the power sensor as appropriate.

Uncertainty
±0.7% traceable to National Standards.

Accuracy
±1.2% worst case for one year.

DISPLAY
Four digit LCD.
Over-range, Remote, Peak, Under-range, dB, dBm, dB REL, nW to kW, Zero.

Instrumentation Accuracy

Watts mode
±0.5%.

dBm mode
±0.02 dB.

dB REL mode
±0.02 dB.

ZERO

Set
±1% of FSD on most sensitive range.

Carryover
±0.03% of FSD (when zeroed on most sensitive range).

Drift
±0.1% of FSD (±2% 6920 series) on range 1 (most sensitive) over 1 hour at constant temperature after 24 hour stabilization.
Decrease by factor 10 for each higher range.

NOISE
Less than 1% of FSD (2% for 6920 series) for most sensitive range with an average factor greater than 19.

OUTPUTS (BNC socket)

Fast levelling
0 to 1 V each range, 1 kΩ impedance, excludes correction for Cal Factor, Linearity Factor and Average Number. (For external levelling of RF source.)

Recorder
±1%.
dB mode: 1 V/decade, 7 V maximum on range 5
Watts mode: 5 V linear.
Fully corrected for Cal Factor, Linearity Factor and Average Number (For plots of the full 50 dB dynamic range).

Blanking
Maximum voltage: 25 V Maximum current: 50 mA, open collector, short circuit for blank.

RESPONSE TIME

Range 1 (most sensitive)
1 s, selectable.

Ranges 2 to 5
250 ms (display update), selectable 25 ms using GPIB.

General

GPIB INTERFACE
GPIB unit built into instrument if option 001 is ordered.
All front panel functions are remotely programmable except for test modes.

KEY FUNCTIONS

Units
Selects either linear (mW) or logarithmic (dBm) units with toggle action.

dB Rel
Displays current offset which may be entered in range -99 to +99 dB.

Store & Recall
Stores up to 9 complete instrument settings for any set-up condition (eg Cal Factors at different frequencies); store 0 contains instrument settings prior to last power down.

Max Hold
Retains maximum reading of changing signal. When enabled, units annunciators flash.

Range
Displays current range in use; 'Au' denotes auto ranging, 'Hd' indicates held range. Any range may be selected and held at any time.

Averaging
Enables any integer number in the range 1 to 256 to be set. In Auto Averaging mode the following response times are obtained:

Range	*Average No.*	*Response Time*
5	1	0.25 s
4	1	0.25 s
3	4	1 s
2	20	5 s
1	50	12.5 s

Power Up
Displays power-up mode currently in use. In power-up mode 1, instrument assumes default settings. Power-up mode 2 reinstates the settings in use at power down.

Linearity Factor
Provides data entry for individual sensor linearity data to improve accuracy.

Duty Cycle
Enables entry of duty cycle of pulsed signal in range 100% to 0.001%. The 6960B calculates the peak value of the pulsed signal from the average power measured by the sensor.
'Peak' annunciator displayed when duty cycle <100%.

Calibration Factor
Allows entry of sensor calibration factor in range 100% to 0.001 %.

Local
Returns instrument to 'local' front panel operation when remotely addressed unless 'local lock out' is employed.
In manual operation, displays current GPIB address.

Auto Zero
Initiates zero routines to store zero offset for each of the 5 ranges.

Auto Cal
Initiates self-calibration routine after connection of sensor to Power Reference.

Power Ref
Toggles internal 0 dBm (50 MHz) power reference on and off.

Resolution
Resolution may be changed by altering the Average Number in the following format:-

Range	*Resolution (dB)*	*0.1*	*0.01*	*0.001*
	Average Number			
5 (highest power)		1	4	4
4		1	1	4
3		1	1	4
2		1	4	20
1 (lowest power)		4	20	50

LIMIT RANGE OF OPERATION

Temperature
0°C to 55°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
–40°C to +70°C.

Humidity
Up to 95% relative humidity at 35°C.

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential, i.e. 3.9 lb/in²).

ELECTRO-MAGNETIC COMPATIBILITY
Conforms with the protection requirements of Council directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2, 3, 4
EN60555-2	IEC 555-2

SAFETY
Complies with IEC 348 , HD 401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

POWER REQUIREMENTS

AC supply
Switchable voltage ranges: 105 to 120 V ±10%, 210 to 240 V ±10%, 45 to 440 Hz.
25 VA maximum.
15 VA typical.

DC SUPPLY (option 004 only)

Input voltage
Operates from 11 V to 32 V DC.
The instrument resets below 11 V.
Input fuse 3.15 A time-lag.

Power consumption
Less than 15 W.

DIMENSIONS AND WEIGHT (over projections)

Height	Width	Depth	Weight
108 mm	256 mm	369 mm	3.3 kg
88 mm‡	216 mm‡		

‡excluding feet and handles.

Versions and Accessories

When ordering please quote the full ordering number information

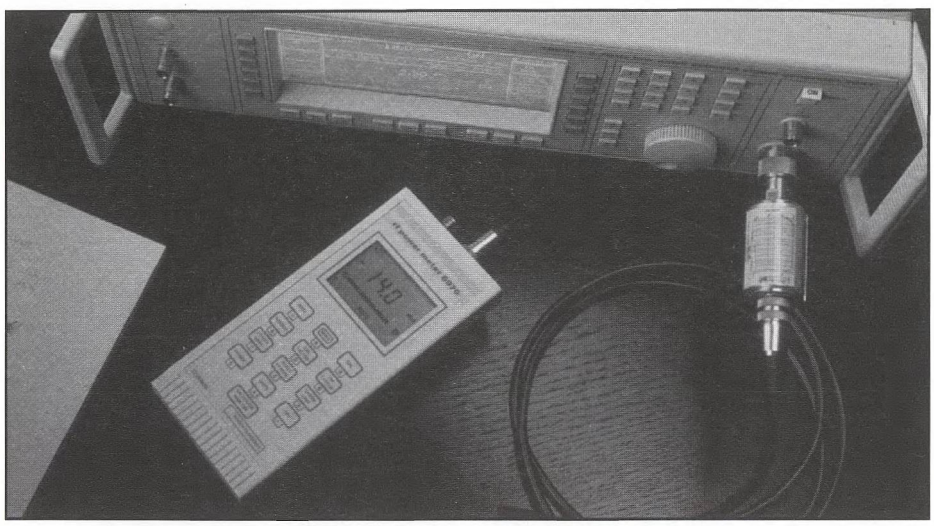
Ordering Numbers	*Versions*
6960B	RF Power Meter
	Options
	Options must be specified at the time of ordering.
Option 001	GPIB.
Option 002	Rear sensor input.
Option 003	Storage pouch mounted on top of instrument.
Option 004	External DC operation.
	Supplied with (all versions)
	AC Supply Lead.
46882/124	Instruction Manual H6960B (Vol. 1).
46882/123	Summary Card.
43138/663	1.5 m Power Sensor Cable.
	Supplied with (Option 004 only)
43138/154	DC Supply Lead.
	Accessories
54417/002	Waveguide 22 to 2.92 mm coax transition.
43138/664	3 m Power Sensor Cable.
43138/665	10 m Power Sensor Cable.
43138/666	25 m Power Sensor Cable.
43138/667	50 m Power Sensor Cable.
46884/501	Rack Mounting Kit (Double Unit –3U High).
46884/500	Rack Mounting Kit (Single Unit – 2U High).
54124/022	Stowage Cover.
46881/365	GPIB Manual H54811-010. (contains details of general GPIB protocols).
46882/125	Service Manual (H6960B Vol. 2).

POWER SENSORS

Ordering Numbers	*Power Sensors*
	Standard
56910/900	RF Power Sensor 10 MHz to 20 GHz (-30 dBm to +20 dBm) Type N.
56911/900	RF Power Sensor 10 MHz to 20 GHz (-30 dBm to +20 dBm) APC 7.
56912/900	RF Power Sensor 30 kHz to 4.2 GHz. (-30 dBm to +20 dBm) Type N.
56913/900	RF Power Sensor 10 MHz to 26.5 GHz. (-30 dBm to +20 dBm) MPC 3.5.
56914/001	RF Power Sensor 10 MHz to 40 GHz (-30 dBm to +20 dBm) 2.92 mm.
56914/002	RF Power Sensor 10 MHz to 40 GHz (-30 dBm to +20 dBm) 2.92 mm plus waveguide 22 coax transition and calibration table.
56914/003	RF Power Sensor 10 MHz to 46 GHz (-30 dBm to +20 dBm) 2.92 mm.
56919/900	RF Power Sensor 75Ω 30 kHz to 3 GHz (-30 dBm to +20 dBm) Type N.
	Low power
56920/900	RF Power Sensor 10 MHz to 20 GHz. (-70 dBm to -20 dBm) Type N.
56923/900	RF Power Sensor 10 MHz to 26.5 GHz. (-70 dBm to -20 dBm) MPC 3.5
56924/001	RF Power Sensor 10 MHz to 40 GHz. (-70 dBm to -20 dBm) 2.92 mm.
56924/002	RF Power Sensor 10 MHz to 40 GHz. (-70 dBm to -20 dBm) 2.92 mm plus waveguide 22 coax transition and calibration table.
56924/003	RF Power Sensor 10 MHz to 46 GHz. (-70 dBm to -20 dBm) 2.92 mm.
	High power
56930/900	RF Power Sensor 10 MHz to 18 GHz (-15 dBm to +35 dBm) Type N.
56932/900	RF Power Sensor 30 kHz to 4.2 GHz (-15 dBm to +35 dBm) Type N.
56934/001	RF Power Sensor 10 MHz to 40 GHz (-15 dBm to +30 dBm) 2.92 mm
56934/002	RF Power Sensor 10 MHz to 40 GHz (-15 dBm to +30 dBm) 2.92 mm plus waveguide 22 coax transition and calibration table.
56934/003	RF Power Sensor 10 MHz to 46 GHz (-15 dBm to +30 dBm) 2.92 mm
56930/002	High Power Sensor 10 MHz to 18 GHz (-5 dBm to +44 dBm) Type N
56932/002	High Power Sensor 30 kHz to 4.2 GHz (-5 dBm to +44 dBm) Type N

6970
RF Power Meter

The world's most portable RF and Microwave Power Meter, designed for accurate power measurements in the field



- Hand-held for portability
- Battery powered for field use
- Wide frequency range: 30 kHz to 46 GHz
- Analog bargraph
- Excellent accuracy traceable to National Standards
- Power levels from -70 dBm (100 pW) to +44 dBm (25 W)
- Internal power reference
- Audible Pass/Fail limits alarm
- Rugged case
- Four digit display

The 6970 RF Power Meter provides precision microwave power measurements in a hand portable battery-powered package. A wide range of user features, including duty cycle, relative power measurements and limit checking make the 6970 Power Meter highly versatile. The same wide range of power sensors used with the IFR 6960 Power Meters and the 6200B series Microwave Test Set are used by the 6970.

Field and Bench Use

The 6970 is designed for both field and bench use. For the installation and maintenance engineer the instrument replaces large and expensive meters with no loss of measurement performance. Rechargeable batteries mean that there is no need for an AC supply; this greatly eases measurements at remote sites such as an antenna tower.

Additional benefits of the 6970 are lower cost and portability. An optional soft carrying pouch with both belt loop and shoulder strap enable the 6970 to be easily carried in field environments

For bench operation the instrument takes up little bench space and it can be powered from the AC adapter.



Battery operation is ideal for field operation

High Accuracy

The 6900 series power sensors all have an excellent return loss specification to minimise mismatch errors in power measurements. Correction for power sensor frequency response and high power non-linearity is also provided by entry of calibration factor and linearity factor values into the 6970.

All the power sensors are individually calibrated and supplied with a calibration data chart.

The auto ZERO function reduces offset errors on each of the 6970 ranges. This increases measurement accuracy at low power levels and improves the measurement sensitivity.

Built-In Power Reference

The built-in power reference provides an accurate 0 dBm (1 mW) 50 MHz calibration signal. Power sensors can be calibrated against this reference for improved measurement accuracy and traceability.

The power reference is automatically switched on during a CAL procedure or it can be enabled at any time to provide a traceable 0 dBm signal for verification.

Operation

The instrument front panel consists of a keyboard and a four digit LCD with annunciators. Power levels are clearly displayed on a digital readout with an analog bargraph to facilitate peaking and nulling. Power levels may either be displayed in logarithmic units such as dBm or dBV or in Watts.

To save battery life, the unit powers down six minutes after the last key press. 6970 will operate for 7 hours from a full battery charge. When the instrument powers down the last operator set-up is stored and this will be the state the 6970 assumes when it is next switched on.

Upper and lower power limits can be set. An audio and visual alarm alerts the user of a measurement that is out of limits. This is useful to set a power to a pre-determined level as well as for monitor-ing purposes.

The 6970 is fully auto-ranging but manual range hold is also possible. Manual range selection is used when measuring modulated or unstable signals. The display indicates either AUTO or MAN as appropriate and will also provide information of over/under-range conditions.

Wide Range of Power Sensors

The 6970 uses the same rugged IFR

power sensors that have been developed for the 6960 Power Meter and 6200B series Microwave Test Set. A wide range of 17 sensors is available covering the frequencies from 30 kHz to 46 GHz. Power level measured depends on sensor type, sensors cover from -70 dBm (0.1 nW) to +44 dBm (25 W).

To cater for the different frequency ranges connector types include N type, PC 3.5 mm, 2.92 mm and N type (75 Ω).

Specification

Frequency range
30 kHz to 46 GHz
Depending on sensor used.

Power range
-70 dBm (0.1 nW) to +44 dBm (25 W).
Depending on sensor used.

Power sensors supported
6910 series (-30 dBm to +20 dBm).
6920 series (-70 dBm to -20 dBm).
6930 series (-15 dBm to +35 dBm).
6930 series opt 2 (-5 dBm to +44 dBm).

Instrumentation accuracy including carryover
±1% range 0, 1, 2.
±5% range 3.

Power accuracy
After calibration using 0 dBm power reference:
±0.2 dB.
Measuring a signal in the centre of the power sensor dynamic range, from a source with return loss better than 14 dB.

DISPLAY

Resolution
4 digits for positive readings.
3 digits for negative readings.

Units
dBm, nW, µW, mW, W, mV, V, dBV.

Annunciators
Analog bargraph
Battery low indicator
Indication of auto-ranging or manual range
Upper and lower limits.

CORRECTION

Linearity Factor
Ability to enter in range 0.01 to 15 with 0.01 resolution.
Defaults to standard setting.

Calibration Factor
Ability to enter in range 0.01% to 200%
Resolution: 0.01 to 99.99%
0.1 100% and above.

Auto-Calibration
Ability to calibrate against a 0 dBm (1 mW), 50 MHz power reference.

Auto-zero
Removes DC offset from gain stages and power sensor.
Set
<400 nW (6910 series)
<100 pW (6920)
<200 pW (6923/6924)
<12 µW (6930 series)

Drift
When measured over one hour at constant temperature.
±10 nW (6910 series)
±100 pW (6920 series)
±300 nW (6930 series)

NOISE
Averaged over 5 s.
±100 nW (6910 series)
±100 pW (6920 series)
±3 µW (6930 series)

FACILITIES

Averaging
Selected automatically.

Audio limit
Produces audible tones when the measured power is above or below programmed limits.

Batteries
3 rechargeable NiCd AA size.
Operating time
>7 hours from full charge when new.

Operating time
>7 hours from full charge when new.

Time to recharge
<14 hours.

Power consumption
250 mW.

DC input requirement
9 V to 21 V, 120 mA via a 2.1 mm power connector.

GENERAL

Operating temperature range
0°C to +55°C

Storage temperature range
-40°C to +55°C

Storage humidity range
Up to 85% RH at +40°C.

Storage altitude range
Up to 4600 m (15000 ft).

Safety
Complies with IEC 348 , HD 401 for class 3 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 supply.

DIMENSIONS AND WEIGHT

Height	Width	Depth	Weight
50 mm	88 mm	190 mm	550 g
1.9 in	3.5 in	7.5 in	

ELECTROMAGNETIC CAPABILITY
Conforms with the protection requirements of EEC Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:
EN55011:1991 Class B (Emissions)
CISPR 11
EN50082-1:1992 (Immunity)
IEC 801-2:1991
IEC 801-3:1984
IEC 801-4:1988.

POWER REFERENCE

Frequency
50 MHz ±0.05 MHz.

Power level
0 dBm (1 mW).

Uncertainty
±0.7% traceable to National Standards.

Accuracy
±1.2% worst case for one year.

Output connector
N (female), 50Ω. Adapters are supplied with 75 Ω, 3.5 mm and 2.92 mm power sensors.

Versions and Accessories

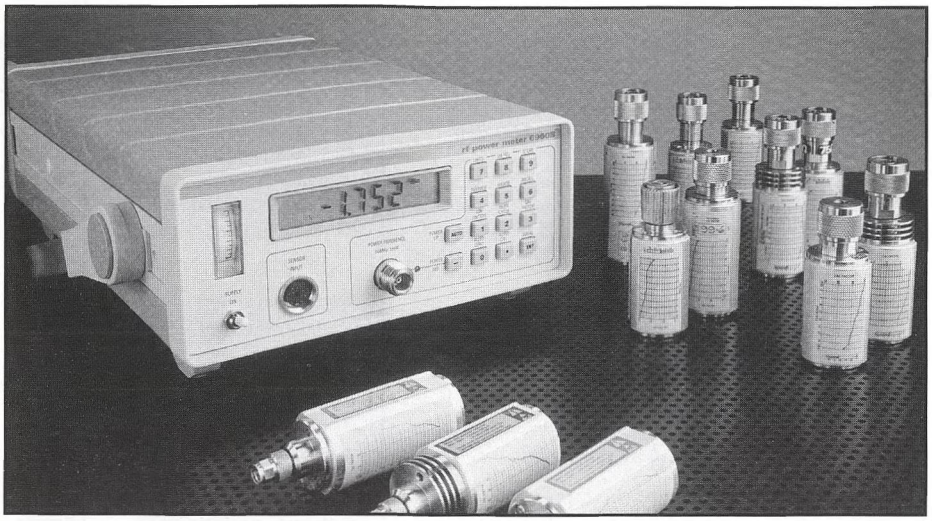
When ordering please quote the full ordering number information

Ordering Numbers	Versions
6970	RF Power Meter with built-in power reference. 6970 RF Power Meter must be used with one of the AC Adapters listed below. One Adapter must therefore be ordered with each instrument.
54441/016	AC Adapter - UK Style
54441/017	AC Adapter - European Style.
54441/018	AC Adapter - USA Style.
	Supplied with
43138/663	1.5 m power sensor cable.
46882/182	Operating manual.
46882/183	Summary card.
23421/641	2.1 mm power connector plug.
	Accessories
54112/159	Carrying pouch.
54311/171	DC Supply lead.
46882/207	Service manual.
54417/002	Waveguide 22 to 2.92 mm transformer.
POWER SENSORS	
	Standard
56910/900	RF Power Sensor 10 MHz to 20 GHz (-30 dBm to +20 dBm) Type N.
56911/900	RF Power Sensor 10 MHz to 20 GHz (-30 dBm to +20 dBm) APC 7.
56912/900	RF Power Sensor 30 kHz to 4.2 GHz. (-30 dBm to +20 dBm) Type N.
56913/900	RF Power Sensor 10 MHz to 26.5 GHz. (-30 dBm to +20 dBm) MPC 3.5.
56914/001	RF Power Sensor 10 MHz to 40 GHz (-30 dBm to +20 dBm) 2.92 mm.
56914/002	RF Power Sensor 10 MHz to 40 GHz (-30 dBm to +20 dBm) 2.92 mm plus waveguide 22 coax transition and calibration table.
56914/003	RF Power Sensor 10 MHz to 46 GHz (-30 dBm to +20 dBm) 2.92 mm.
56919/900	RF Power Sensor 75W 30 kHz to 3 GHz (-30 dBm to +20 dBm) Type N.
	Low power
56920/900	RF Power Sensor 10 MHz to 20 GHz. (-70 dBm to -20 dBm) Type N.
*56923/900	RF Power Sensor 10 MHz to 26.5 GHz. (-70 dBm to -20 dBm) MPC 3.5
*56924/001	RF Power Sensor 10 MHz to 40 GHz. (-70 dBm to -20 dBm) 2.92 mm.
*56924/002	RF Power Sensor 10 MHz to 40 GHz. (-70 dBm to -20 dBm) 2.92 mm plus waveguide 22 coax transition and calibration table.
*56924/003	RF Power Sensor 10 MHz to 46 GHz. (-70 dBm to -20 dBm) 2.92 mm.
	High power
56930/900	RF Power Sensor 10 MHz to 18 GHz (-15 dBm to +35 dBm) Type N.
56932/900	RF Power Sensor 30 kHz to 4.2 GHz (-15 dBm to +35 dBm) Type N.
56934/001	RF Power Sensor 10 MHz to 40 GHz (-15 dBm to +30 dBm) 2.92 mm
56934/002	RF Power Sensor 10 MHz to 40 GHz (-15 dBm to +30 dBm)2.92 mm plus waveguide 22 coax transition and calibration table.
56934/003	RF Power Sensor 10 MHz to 46 GHz (-15 dBm to +30 dBm) 2.92 mm
56930/002	High Power Sensor 10 MHz to 18 GHz (-5 dBm to +44 dBm) Type N
56932/002	High Power Sensor 30 kHz to 4.2 GHz (-5 dBm to +44 dBm) Type N

* Note: When used with 6970 RF Power Meter, 6923 and 6924 power sensors are useable down to -60 dBm.

6910, 6920 & 6930 Series RF Power Sensors

A range of 17 power sensors available for use with 6200B series MTS, CPM, 6960B and 6970 power meters



- Wide frequency coverage 30 kHz to 46 GHz
- Power levels from -70 dBm (100 pW) to +44 dBm (25 W)
- 50 Ω and 75 Ω sensors
- Low VSWR reduces measurement uncertainty
- Linearity correction data supplied
- Field replaceable RF assembly
- High overload capability

These stable and accurate power sensors operate at frequencies up to 46 GHz. They are for use with the 6960B and 6970 Power Meters as well as the CPM 20, 40 Counter Power Meter and the 6200B series Microwave Test Set.

High Measurement Accuracy

High measurement accuracy over a wide frequency range is ensured by low input VSWR - the result of innovative design.

Fully Interchangeable

The sensors are fitted with precision connectors. They have a multiway socket for cable connection to the Power Meter, and are interchangeable.

Small and Lightweight

The small size and light weight of these sensors makes them very adaptable for use anywhere without requiring additional mechanical support.

Rugged Construction

Rugged mechanical construction makes them ideal for both bench and field use. Minimum down-time is ensured by using a pre-calibrated field replaceable RF sensing assembly. Unit lifetime is enhanced by high overload capabilities. Seventeen different sensors are currently available covering a range of frequencies from 30 kHz to 46 GHz. Type N, APC-7, MPC 3.5 and 2.92 mm connectors are available from -70 dBm (100 pW) to +44 dBm (25 W). A 75 Ω sensor is also available.

For the 40 GHz sensors (6914, 6924 and 6934) a waveguide 22 transformer is optionally available. By ordering version '/002' the transformer (54417/002) is supplied as well as a calibration table to give both accurate waveguide and coaxial measurements. The calibration information is traceable to national standards.

6910 series: Medium Power Thermocouple Power Sensors

	6910	6911	6912
FREQUENCY RANGE	10 MHz - 20 GHz	10 MHz - 20 GHz	30 kHz - 4.2 GHz
POWER RANGE	-30 dBm to +20 dBm (1 µW to 100 mW)	-30 dBm to +20 dBm (1 µW to 100 mW)	-30 dBm to +20 dBm (1 µW to 100 mW)
MAX RF INPUT	+25 dBm (300 mW) CW +42 dBm (15 W) peak for 2 µs	+25 dBm (300 mW) CW +42 dBm (15 W) peak for 2 µs	+25 dBm (300 mW) CW +42 dBm (15 W) peak for 2 µs
SENSING ELEMENT	Semiconductor thermocouple	Semiconductor thermocouple	Semiconductor thermocouple
VSWR	1.25 10 MHz - 30 MHz 1.1 30 MHz - 2GHz 1.18 2 GHz - 16 GHz 1.28 16 GHz - 18 GHz 1.4 typical 18 GHz - 20 GHz †	1.25 10 MHz - 30 MHz 1.15 30 MHz - 2 GHz 1.18 2 GHz - 16 GHz 1.28 16 GHz - 18 GHz 1.4 typical 18 GHz - 20 GHz †	1.6 30 kHz - 100 kHz 1.2 100 kHz - 300 kHz 1.1 300 kHz - 4.2 GHz
LINEARITY FACTOR	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	±0.5% at 25°C between +10 and +20 dBm Improves by a factor of 10 for each lower range	±0.5% at 25°C between +10 and +20 dBm Improves by a factor of 10 for each lower range	±0.5% at 25°C between +10 and 20 dBm Improves by a factor of 10 for each lower range
CALIBRATION FACTOR	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor
Resolution	0.01%	0.01%	0.01%
RF CONNECTOR	Precision N-type, male 50 Ω	APC-7, 50 Ω	Precision N-type, male 50 Ω
SIZE & WEIGHT	87 mm long, 33.5 mm dia. 140g	87 mm long, 33.5 mm dia. 140 g	87 mm long, 33.5 mm dia. 140 g
ORDER CODES	56910/900	56912/900	56911/900

† specifications involving APC-7 and type N connectors above 18 GHz are not traceable to national standards as these do not exist at present

Power Sensors

6910 Series: Medium Power Thermocouple Power Sensors (continued)

	6913	6914	6914S	6919
FREQUENCY RANGE	10 MHz - 26.5 GHz	10 MHz - 40 GHz	10 MHz - 46 GHz	30 kHz - 3 GHz
POWER RANGE	-30 dBm to +20 dBm (1 µW to 100 mW)	-30 dBm to +20 dBm (1 µW to 100 mW)	-30 dBm to +20 dBm (1 µW to 100 mW)	-30 dBm to +20 dBm (1 µW to 100 mW)
MAX RF INPUT	+25 dBm (300 mW) CW +42 dBm (15 W) peak for 2 µs	+25 dBm (300 mW) CW +42 dBm (15 W) peak for 2 µs	+25 dBm (300 mW) CW +42 dBm (15 W) peak for 2 µs	+25 dBm (300 mW) CW +42 dBm (15 W) peak for 2 ms
SENSING ELEMENT	Semiconductor thermocouple	Semiconductor thermocouple	Semiconductor thermocouple	Semiconductor thermocouple
VSWR	1.4 10 MHz - 40 MHz 1.15 40 MHz - 100 MHz 1.1 100 MHz - 2 GHz 1.15 2 GHz - 12.4 GHz 1.2 12.4 GHz - 18 GHz 1.25 18 GHz - 26.5 GHz	1.58 10 MHz - 40 MHz 1.15 40 MHz - 100 MHz 1.1 100 MHz - 2 GHz 1.15 2 GHz - 12.4 GHz 1.21 2.4 GHz - 18 GHz 1.43 18 - 40 GHz (vers. /001) 1.55 26.5 - 40 GHz (vers. /002)	1.58 10 MHz - 40 MHz 1.15 40 MHz - 100 MHz 1.1 100 MHz - 2 GHz 1.15 2 GHz - 12.4 GHz 1.43 12.4 GHz - 33 GHz 3.6 40 GHz - 46 GHz†††	1.4 30 kHz - 100 kHz 1.15 100 kHz - 300 kHz 1.1 300 kHz - 2 GHz 1.2 typical 2 GHz - 3 GHz
LINEARITY FACTOR	Provided with sensor	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	±0.5% at 25°C between +10 and +20 dBm. Improves by a factor of 10 for each lower range	±0.5% at 25°C at 100 mW, decreasing by 0.005% per mW	±0.5% at 25°C at 100 mW, decreasing by 0.005% per mW	±0.5% at 25°C between +10 and +20 dBm. Improves by a factor of 10 for each lower range
CALIBRATION FACTOR	Provided with sensor	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor
Resolution	0.01%	0.01%	0.01%	0.01%
RF CONNECTOR	MPC 3.5 mm, male 50 Ω	MPC 2.92 mm, male 50 Ω†	MPC 2.92 mm, male 50 Ω†	Precision N-type, male, 75 Ω
SIZE & WEIGHT	80 mm long, 33.5 mm dia. 140g	88.5 mm long, 33.5 mm dia. 140g	88.5 mm long, 33.5 mm dia. 140g	89 mm long, 33.5 mm dia. 140g
ORDER CODES	56913/900	56914/001 56914/002 includes waveguide 22 coax transition and cal table	56914/003	56919/900
Supplied with	Adapter part no. 23443/822 for connection between 6913 and 0 dBm Power Reference.	Adapter part no. 23443/822 for connection between 6914 and 0 dBm Power Reference.	Adapter part no. 23443/822 for connection between 6914 and 0 dBm Power Reference.	Adapter part no. 23443/842 for connection between 6919 and 0 dBm Power Reference.

†2.92 mm connectors mate non-destructively with 3.5 mm and SMA connectors.

6920 Series: High Sensitivity Diode Sensors

	6920	6923	6924	6924S
FREQUENCY RANGE	10 MHz - 20 GHz	10 MHz - 26.5 GHz	30 kHz - 40 GHz	10 MHz - 46 GHz
POWER RANGE	-70 dBm to -20 dBm† (0.1 nW to 10 µW)	-70 dBm to -20 dBm†* (0.1 nW to 10 µW)	-70 dBm to -20 dBm†* (0.1 nW to 10 µW)	-70 dBm to -20 dBm†* (0.1 nW to 10 µW)
MAX RF INPUT	+26 dBm (300 mW) CW +30 dBm (1 W) peak for 2 µs	+26 dBm (300 mW) CW +30 dBm (1 W) peak for 2 µs	+26 dBm (400 mW) CW +30 dBm (1 W) peak for 2 µs	+26 dBm (300 mW) CW +30 dBm (1 W) peak for 2 µs
SENSING ELEMENT	Shottky barrier diode	Shottky barrier diode	Shottky barrier diode	Shottky barrier diode
VSWR	1.4-1.2 10 MHz - 40 MHz 1.2 40 MHz - 10 GHz 1.35 10 GHz - 18 GHz 1.4 typ 18 GHz - 20 GHz††	1.4 10 MHz - 40 MHz 1.15 40 MHz - 100 MHz 1.12 100 MHz - 2 GHz 1.17 2 GHz - 8 GHz 1.3 8 GHz - 18 GHz 1.5 18 GHz - 26.5 GHz	1.58 10 MHz - 40 MHz 1.15 40 MHz - 100 MHz 1.12 100 MHz - 2 GHz 1.33 2 GHz - 18 GHz 1.51 8 GHz - 33 GHz 1.95 26.5 - 40 GHz(vers./001) 1.97 26.5 - 40 GHz(vers./002)	1.4-1.2 10 MHz - 40 MHz 1.15 40 MHz - 100 MHz 1.12 100 MHz - 2 GHz 1.33 2 GHz - 18 GHz 1.5 18 GHz - 33 GHz 1.95 33 GHz - 40 GHz 3.6 40 GHz - 46 GHz†††
LINEARITY FACTOR	Provided with sensor	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	±1% at 25°C between -30 and -20 dBm. Improves by a factor of 10 for each lower range	±1% at 25°C between -30 and -20 dBm. Improves by a factor of 10 for each lower range	±1% at 25°C between -30 and 20 dBm at 23°C	±1% at 25°C between -30 and -20 dBm at 23°C
CALIBRATION FACTOR	Provided with sensor	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor
Resolution	0.01%	0.01%	0.01%	0.01%
RF CONNECTOR	Precision N-type, male 50 Ω	MPC 3.5 mm, male 50 Ω	MPC 2.92 mm, male 50 Ω†	MPC 2.92 mm, male 50 Ω†
SIZE & WEIGHT	104 mm long, 33.5 mm dia. 180 g	87 mm long, 33.5 mm dia. 180 g	88.5 mm long, 33.5 mm dia. 150 g	88.5 mm long, 33.5 mm dia. 150 g
ORDER CODES	56920/900	56923/900	56924/001 56924/002 includes waveguide 22 coax transition and calibration table	56924/003
Supplied with	Precision Attenuator part no. 23448/873. 30 dB ±0.05 dB at 50 MHz at 25°C	Precision Attenuator part no. 23448/873 30 dB ±0.05 dB at 50 MHz at 25°C Adapter part no. 23443/822 for connection between 6923 and 0 dBm Power Reference.	Precision Attenuator part no. 23448/873. 30 dB ±0.05 dB at 50 MHz at 25°C Adapter part no. 23443/822 for connection between 6924 and 0 dBm Power Reference.	Precision Attenuator part no. 23448/873. 30 dB ±0.05 dB at 50 MHz at 5°C Adapter part no. 23443/822 for connection between 6924 and 0 dBm Power Reference.

* Lower limit is -65 dBm (0.3 nW) when used with 6970 & -60 dBm when used the Counter Power Meter
† Lower limit is -65dBm (0.3 nW) when used with Counter Power Meter
†† specifications involving type N connectors above 18 GHz are not traceable to national standards as these do not exist at present
††† specifications involving 2.92 mm connectors above 40 GHz are not traceable to national standards as these do not exist at present

6930 Series: High Power Thermocouple Sensors

	6930	6932	6934	6934S
FREQUENCY RANGE	10 MHz - 18 GHz	30 kHz - 4.2 GHz	10 MHz - 40 GHz	10 MHz - 46 GHz
POWER RANGE	-15 dBm to +35 dBm (30 µW to 3 W)	-15 dBm to +35 dBm (30 µW to 3W)	-15 dBm to +30 dBm (30 µW to 1W)	-15 dBm to +30 dBm (30 µW to 1 W)
MAX RF INPUT	+37 dBm (5 W) CW +50 dBm (100 W) peak for 2 µs	+37 dBm (5 W) CW +50 dBm (100 W) peak for 2 µs	+33 dBm (2 W) CW +45 dBm (32 W) peak for 2 µs	+33 dBm (2W) CW +45 dBm (32 W) peak for 2 µs
SENSING ELEMENT	Semiconductor thermocouple	Semiconductor thermocouple	Semiconductor thermocouple	Semiconductor thermocouple
VSWR	1.1 10 MHz - 2 GHz 1.18 2 GHz - 16 GHz 1.28 16 GHz - 18 GHz	1.1 30 kHz - 4.2 GHz	1.12 10 MHz - 100 MHz 1.1 100 MHz - 2 GHz 1.15 2 GHz - 12.4 GHz 1.2 12.4 GHz - 18 GHz 1.25 18 GHz - 26.5 GHz 1.43 26.5 - 40 GHz (vers./001) 1.55 26.5 - 40 GHz (vers./002)	1.12 10 MHz - 100 MHz 1.1 100 MHz - 2 GHz 1.15 2 GHz - 12.4 GHz 1.2 12.4 GHz - 18 GHz 1.25 18 GHz - 26.5 GHz 1.43 26.5 GHz - 40 GHz 2.3 40 GHz - 46 GHz†††
LINEARITY FACTOR	Provided with sensor	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	-1% to +5% between +25 and +35 dBm. Improves by a factor of 10 for each lower range.	-1% to +5% between +25 and +35 dBm. Improves by a factor of 10 for each lower range.	-1% to +5% between +25 and +30 dBm, less on other ranges.	-1% to +5% between +25 and +30 dBm, less on other ranges.
CALIBRATION FACTOR	Provided with sensor	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor
Resolution	0.01%	0.01%	0.01%	0.01%
RF CONNECTOR	Precision N-type, male 50 Ω	Precision N-type, male 50 Ω	MPC 2.92 mm, male 50 Ω†	MPC 2.92 mm, male 50 Ω†
SIZE & WEIGHT	93 mm long, 33.5 mm dia. 190g	93 mm long, 33.5 mm dia. 190g	87 mm long, 33.5 mm dia. 150g	87 mm long, 33.5 mm dia. 150g
ORDER CODES	56930/900	56932/900	56934/001 56934/002 includes waveguide 22 coax transition and calibration table.	56934/003
Supplied with			Adapter part no. 23443/822 for connection between 6934 and 0 dBm Power Reference.	Adapter part no. 23443/822 for connection between 6934 and 0 dBm Power Reference.

†2.92 mm connectors mate non-destructively with 3.5 mm and SMA connectors.

††† specifications involving 2.92 mm connectors above 40 GHz are not traceable to national standards as these do not exist at present

	6930 (Option 002) *(Comprises standard 6930 plus calibrated precision 10 dB attenuator)*	6932 (Option 002) *(Comprises standard 6932 plus calibrated precision 10 dB attenuator)*
FREQUENCY RANGE	10 MHz - 18 GHz	30 kHz - 4.2 GHz
POWER RANGE	-5 dBm to +44 dBm (0.3 mW to 25W)	-5 dBm to +44 dBm (0.3 mW to 25W)
MAX RF INPUT	+45 dBm (30 W) CW +60 dBm (1 kW) peak for 2 µs	+45 dBm (30 W) CW +60 dBm (1 kW) peak for 2 µs
Sensing element	Semiconductor thermocouple	Semiconductor thermocouple
VSWR	1.2 10 MHz - 8 GHz 1.25 8 GHz - 12.4 GHz 1.35 12.4 GHz - 18 GHz	1.2 30 kHz - 4.2 GHz
LINEARITY FACTOR	Provided with sensor	Provided with sensor
Accuracy	-2% to +6% between +35 and +44 dBm. Improves by a factor of 10 for each lower range	-2% to +6% between +35 and +44 dBm. Improves by a factor of 10 for each lower range
CALIBRATION FACTOR	Provided with sensor	Provided with sensor
Accuracy	Uncertainty provided with sensor	Uncertainty provided with sensor
Resolution	0.01%	0.01%
RF CONNECTOR	Precision N-type, male 50 Ω	Precision N-type, male 50 Ω
SIZE & WEIGHT	228 mm long, 64 mm dia. 533 g	228 mm long, 64 mm dia. 533 g
ORDER CODES	56930/002	56932/002

Ordering numbers	*Power Sensor Pre-Calibrated Front End Field Replacement Modules*
44991/008	For 6910 Power Sensor
44991/009	For 6911 Power Sensor
44991/010	For 6912 Power Sensor
44991/011	For 6913 Power Sensor
44991/012	For 6919 Power Sensor
44991/013	For 6920 Power Sensor
44991/014	For 6930 Power Sensor
44991/015	For 6932 Power Sensor
44991/224	For 6914 Power Sensor
44991/225	For 6934 Power Sensor

Automatic Test Equipment

The IFR range of Automatic Test Equipment spans a wide range of test philosophies, from In-Circuit to functional, MDA to optical inspection. With a proven track record as a supplier to the world's PCB manufacturers, IFR is well placed to provide the most advanced equipment backed by the support infrastructure demanded by today's customers.

AUTOMATIC TEST EQUIPMENT

4200 series 8.3
Advanced Manufacturing Test Systems

4800 series 8.9
Automatic Optical Inspection Systems

5200 series 8.11
Power Manufacturing Defects Analyzers

5300 series 8.13
Combinational Board Testers

FABmaster 8.27
CAD Conversion Software

ATE Support 8.28
Support Services

ATE Support 8.29
Programs, Fixtures and Services



Introduction

The Automatic Test Equipment Philosophy

Automatic Test Equipment (ATE) is used within manufacturing as a measure of the quality achieved by the process. It can verify product at a number of stages ranging from printed circuit board through to final test prior to shipping. The diagnostics of ATE are such that repairs can be quickly and effectively made to product which then retakes its place in the overall production line flow. An essential element to the ATE philosophy is trapping faults at the earliest possible stage, reducing a rework cost which increases as product flows down the line towards the end customer.

When used in conjunction with test area management software, test and repair data can be analyzed to provide feedback to the complete production process, thus improving the overall yield. Since yield is a measure of the efficiency of a production facility, any improvement has an immediate bearing on economic performance. In essence, ATE monitors quality, reduces rework and enables an increase in yield, all of which save money.

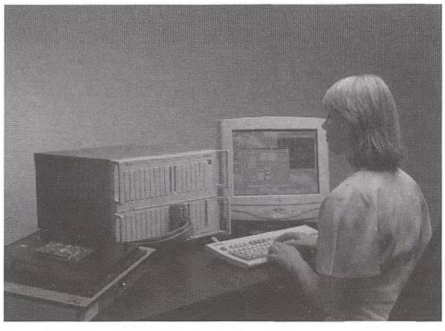
What types of ATE are available?

A range of ATE systems are available, all suitable for inclusion within the varied phases of the production process. Test is now generally viewed as an essential element of manufacturing, although the key to success is the selection of the right equipment within the right stage of the overall process.

The simplest form of ATE system is the Manufacturing Defects Analyzer, or MDA. The test philosophy is to measure each component present on the Printed Circuit Board (PCB) against a nominal value with appropriate tolerances. In addition, track measurements are taken to ensure that there are no short or open circuits present. Assuming that all the individual measurements are successful, the PCB is considered to have been correctly manufactured. The MDA is predominantly used as a pre-screener or for final PCB test where the majority of the product is analog in nature. Recent MDA systems have enhanced the level of fault coverage by powering up the PCB and by providing a basic level of digital device testing.

An extension of the MDA approach is the In-Circuit system. A similar philosophy of individual component testing is used, but the digital capability is enhanced by memory behind the system testpoints. This approach allows digital devices to be tested by applying a range of digital stimuli, success being achieved by measuring the appropriate response. The nature of this type of testing ranges from simple truth tables for individual gates through to extensive lines of vectors for complex processors and Application Specific (ASIC) devices. Extensions to In-Circuit include functional testing, boundary scan, and more recently FLASH device programming, all adding to the cost effectiveness of the In-Circuit stage of the process.

Functional test systems use a completely different philosophy to MDA and In-Circuit. Instead of measuring individual components, the functional system tests the complete PCB or unit, usually accessing through edge connectors. The actual test is much closer to operating the subject under real-world conditions, and is therefore the ideal test to be performed before final shipping. Often the MDA/In-Circuit approach is combined with functional in a platform known as a Combinational tester.



A more recent alternative to In-Circuit is the Automatic Optical Inspection system. Instead of electrically testing each component in turn, the AOI system uses cameras to measure parameters such as size, orientation and colour, amongst others. A range of camera positions such as overhead, side and angled can be used to check all of the visual parameters associated with a product. Diagnostics are similar to an In-Circuit tester, with the exact component and fault being reported. This type of system is particularly useful where electrical access is a limitation, for instance small surface mount boards.

It is quite common to see all of the ATE platforms within a single manufacturing facility. For example, consider an engine control unit for a car or truck. After the first stage of automatic pick and place where analog components are applied to the PCB, an MDA test is performed. At a later stage, once digital components have been added, In-Circuit can provide a complete test and program any memory devices present. Alternatively, if access is limited, an optical inspection system could be used. These two test processes provide confidence that the PCB has been built correctly. Assuming that this is the case, both before and after packaging, the functional tester ensures that the product is operating as an engine controller, applying the relevant stimuli and taking appropriate measurements.

The IFR Range

In terms of platforms, the IFR range includes all of the categories of ATE systems. This wide range ensures that the most suitable platform can be selected for the product under test, at the most suitable position within the manufacturing process :

4200 series - In-Circuit Test System
4800 series - Automatic Optical Inspection System
5200 series - Power Manufacturing Defects Analyzer
5300 series - Functional and Combinational Test System

In addition to the test systems, there are also two software packages designed to enhance the productivity of the platforms.

Since the majority of today's product is designed using Computer Aided Design (CAD) systems, the source for all processes within manufacturing are the CAD files. The IFR FABmaster software interfaces to all of the common CAD systems to ensures that the necessary programs and fixtures are sourced quickly and accurately.

The *i*-Base test area management software takes both test and repair data, and through real-time analysis feeds information back to the manufacturing stages. In essence, the ATE system indicates which component is at fault, whilst the repair process gives an indication of why. Both are of vital importance to fine tuning the process. It is this combination of test management software and ATE platform that can make significant improvements to the overall yield.

The IFR Solution

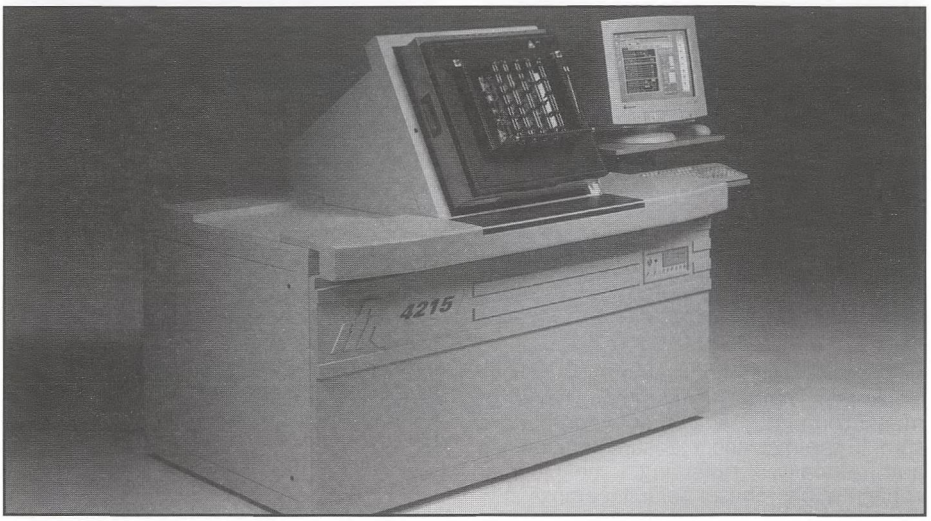
The function performed by the ATE system is critical to the economic success of a manufacturing plant. It is therefore vital that the system is operating whenever the plant is operating. The worldwide support and service capability offered by IFR ensures that this occurs.

It is important to note that an ATE system is an investment that will be used for a number of years after purchase. Over this period the system will be used to test a wide range of different product types, each requiring a test program and a dedicated fixture. These 'applications' can be produced by the customer or out-sourced to a third-party. IFR caters for both, offering the necessary training and technical support or through the provision of a turnkey solution from a number of worldwide applications bureau.

In summary, IFR provide the complete ATE solution, covering a range of platforms backed by a worldwide service, applications and support infrastructure. IFR views every order as an element of a close supplier-vendor partnership, the goal being delivery of quality product to our customer's customer.

4200 series
Advanced Manufacturing Test Systems

A range of advanced manufacturing test systems offering a wide range of test methods and high throughput capability



4200 - ADVANCED MANUFACTURING TEST SYSTEM

- Maximum of 2048 pins
- Windows 95 or NT operating system
- Automatic program generation software
- Graphical program debug capability
- Autodebug facility
- Inductive and capacitive vectorless test
- ISP and FLASH programming

Introduction

The 4200 series is the flagship of the IFR range of automatic test equipment. Designed to be the fastest manufacturing test system on the market, it is ideally suited to high volume manufacturing operations where throughput is of paramount importance. With an established customer base, the system tests a wide variety of printed circuit boards covering applications such as telecoms, automotive and consumer electronics, amongst others.

By achieving the highest level of fault coverage, and testing product in the shortest possible time, the 4200 series reduces capital investment by providing a single test station within the beat rate of the production line. Quite simply, a single 4200 series tester can perform a task which would require several competitive systems.

Architecture

The 4200 series is controlled by an industry standard PC with a choice of Windows 95™ or NT™ operating systems. The graphical user interface has been designed to provide a familiar environment allowing new users to quickly progress along the learning curve.

Within the range, there are currently two systems, the 4215 and 4220. The differences lay in the testpoint and power supply capacity:

4215 Maximum of 1152 universal testpoints & 3 user power supplies

4220 Maximum of 2048 universal testpoints & 6 user power supplies

Both systems use a cardcage architecture and can be fitted with a range of cards selected from the following list to provide the most appropriate configuration:

Analog In-Circuit card
Universal In-Circuit card
General Purpose Input/Output card
Instrument Access card

Analog and Digital Testing

The key to low test times is the optimization of analog tests, including contact, shorts and opens. The 4200 series offers a combination of high speed and exceptional accuracy through innovative pipeline and parallel processing techniques. A further factor is the utilization of advanced DSP measurements.

High guarding ratios and multiwire measurements ensure component isolation and accurate diagnostics during In-Circuit tests. The ability to change all parameters associated with a measurement is vital to achieving the highest possible accuracy.

For mixed signal testing, such as ADC, DAC and CODEC devices, the 4200 series fully integrates its analog and digital capability. Every pin is backed by analog and digital resources, and their ability to be used in conjunction with each other is a vital element in testing this important category of devices.

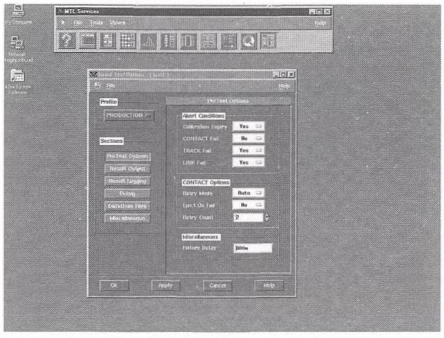
Every pin is provided with terminators to enable the testing of tristate buses and open collector devices. Slew-rate controlled pin drivers ensure that vectors delivered to the testpoint are high integrity and load tolerant. Where necessary, full backdriving protection is provided.

For the testing of free running devices, 50 MHz clock synchronization and phase locking is provided. Vector rates of 5 MHz with 20 ns edge placement ensure that dynamic devices maintain keep-alive speed. Testing the most complex VLSI devices requires a range of advanced features such as hardware triggers, pin formatting and variable timing sets. On-the-fly jumps allow for program flow decisions to be made not only within the test program but also within individual digital tests.

The effectiveness of the 4200 series is further enhanced by the ability to program FLASH devices and utilise the capability of Xilinx™ or Lattice™ ISP chips. In the case of FLASH programming, this negates the need to invest in further equipment, adding extra value to the In-Circuit stage of the process.

Test Language

The test language provided with the 4200 series provides the user with a high level structured programming environment with fully integrated edit and debug facilities. The structure offers the twin benefits of top level simplicity whilst also allowing the control of all system parameters at a lower level.



Test Executive

Simple language statements specify 'packaged' tests for common types of measurement, selecting appropriate stimuli settings and measurement ranges automatically, reflecting the circuit configuration. These default settings can be altered by adding modifiers to the standard command.

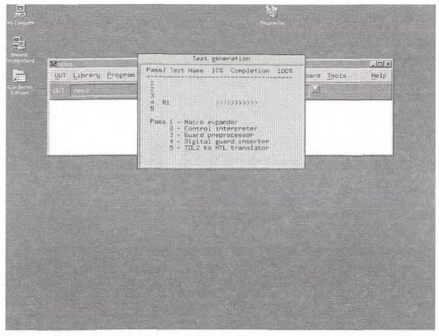
Although a compiled language, full interactive edit and debug is achieved through a high speed incremental compilation process. The overall effect is the speed and power of a compiled language combined with the interactive nature of an interpreted language.

The graphical user interface features a menu system providing control of input/output and peripherals such as barcode readers and printers. Numeric data can be expressed in decimal, hexadecimal, octal and binary. Electrical engineering notation (e.g. 10 mV) is also fully supported for applications orientated manipulation of test parameters and results.

Test Program Generation

Test programs are normally generated from the CAD data used to describe the board under test. The IFR FABmaster package is used to link to a wide range of CAD formats, producing a .CB format circuit description file and enabling fixture customization. The .CB file is then used to create a program using the IFR CAPG (Computer Assisted Program Generation) package.

This approach ensures that time-to-market is maintained by quick and accurate creation of fixture and program data. In order to reduce the subsequent debug time, CAPG uses a simulator to apply the necessary guards to the test program.



Computer Assisted Program Generation

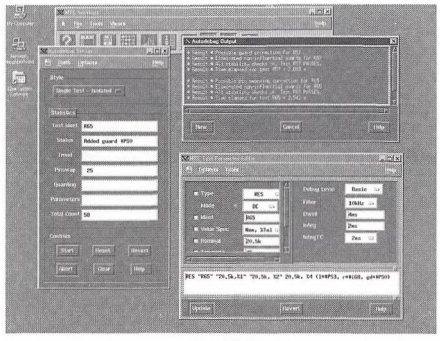
All of the test methods supported by the 4200 series are fully integrated into CAPG. The interface is designed to allow the test engineer the maximum flexibility in using the most appropriate test for each device present on the board.

Graphical Debug Tools

A suite of debug tools is used to quickly commission the test program and fixture, again reducing the time-to-market aspects to the test process. In the case of analog measurements, a histogram display is used to dynamically display results with reference to nominal values and tolerances. Digital tests show state and timing information across the whole of the pinface in use during a particular test. Flow trace and test structure diagrams are also provided, fully integrated into the test editors. Each tool within the graphical debug suite gives point and click access to the whole range of parameters applicable to the test.

Autodebug

This facility is designed to improve time-to-market by using automatic debug algorithms, independent of the programmer. By altering the range of measurement parameters and analysing the subsequent results across a number of re-iteration modes, the autodebug facility is able to quickly commission a high proportion of analog In-Circuit tests. The graphical user interface allows user selection of all parameters to ensure the best results in the time available. Essentially, the autodebug facility mimics the actions of a human programmer without the programmer being present, for instance overnight.



Autodebug

The 4200 series fully supports the IEEE 1149.1 boundary scan standard for overcoming access and testability limitations. Automatic test generation is provided for boundary scan devices appearing singly or within scan paths. These tests are derived from the CAD data describing the board and the BSDL (Boundary Scan Description Language) file pertaining to each device. The process is automatic and fully integrated into the IFR CAPG facility.

Functional Cluster Testing

The cluster test facility is used to define and test the functionality of a number of components as a single logical entity. For instance, the individual components of an amplifier circuit could be tested individually using the In-Circuit capability, followed by a test to ensure that the full amplifier circuit is performing correctly.

Usually, the requirement to perform a cluster test is stimulated by one of two circumstances. Firstly, cluster testing is a useful method of overcoming test access, allowing test to be performed from the access points provided. Alternatively, the throughput capability of the 4200 series often leaves extra time within the beat rate that can be utilized by performing the functional tests that would otherwise necessitate further test system investment.

Third-Party and System 80 Compatibility

By selection of the appropriate fixture adapters and program conversion software, the 4200 series can effectively test using applications initially written for third-party competitive test systems.

A specific example of this capability is the ability to use System 80 programs and fixtures. The translation software has been written to preserve the parameters and guards associated with each test in the older program, minimizing the time taken to move to the new platform.

Fixturing

In order to offer the maximum flexibility and reliability, the 4200 series uses the full range of IFR vacuum and pneumatic fixtures. Where necessary, more esoteric applications can be accommodated using the customised fixture capability of IFR's Production Test Services facility.

In addition to IFR's fixturing capability, a wide range of third party suppliers also offer fixtures for the 4200 series.

Vectorless Testing

IFR Limited is unique in offering both inductive and capacitive vectorless techniques, ensuring wide test coverage across a range of components from complex ASICs to connectors. Inductive probing is performed using the IFR patented Q-test II technique, whilst capacitive tests use the industry standard HP TestJet™ probe. The presence of two alternatives for vectorless testing allows the test engineer to use the most appropriate for a given application, essentially matching the pros and cons of each technique to the devices under test. These two techniques contribute to the system's ability to generate tests for

devices quickly, and to accurately diagnose faults to enhance productivity and quality.

Production Line Integration

The 4200 series is designed to easily integrate into a high volume production line or to be used by manually by an operator.

By selecting the horizontal interface, in conjunction with the correct height setting, the 4200 series conforms to both SMEMA and de-facto European standards for manufacturing automation. A number of in-line handlers, from a variety of suppliers, have been integrated with the system, supported by the necessary communication protocols.

Specification

General Test Capabilities
Full in-circuit test (analog/digital/mixed signal)
Boundary-Scan test
Bus emulation
Partitioned functional test
Q-Test
Analog functional

Computer System (minimum)
Pentium PC (200 MHz)
17 in, 44 cm SVGA 1024 x 768 monitor
PCI Bus
32 Mbytes RAM
Windows NT/95
IEEE 488 interface (option)
Serial ports
Tape streamer option
Bar Code Reader option

Testpoint Count

4215	128-1152 analog or universal testpoints
4220	128-2048 analog or universal testpoints

Multiplexing ratio 4:1
128 testpoints per card

Analog Test Facilities

Contact test	<100 kΩ
Shorts test	1-100 Ω
Link test	1-100 Ω
Resistance DC	0 W-10 MΩ
Resistance AC	0 W-1 MΩ
Capacitance AC	0 pF-100 mF
Capacitance DC	1 µF-100 mF
Inductance	0 H-100 H
Diode	ON OFF
Zener	Voltage
FET	ON OFF RDS
LED	ON OFF
Transformer	Ratio 0.001-100
Opto-isolator Transistor	ON OFF HFE

General Purpose Analog Facilities

DC stimulus (2 off)	1 mV-25 V 0 A-100 mA
AC voltage stimulus	0.1 V-20 V pk-pk
Frequency	0.1 Hz-20 kHz
Noise	<10 mV pk-pk 20 MHz b/w
Waveshapes	sine, square, triangle, ramp up/down
DC voltage measurement	0 V-±50 V
DC current measurement	0 A-±100 mA
AC voltage measurement	0 V-50 V
Frequency measurement	0.02 Hz-5 MHz
Period measurement	10 µs-65 s
Programmable resistor	0 Ω, 1 Ω-10 MΩ in decade steps voltage limiter

1149.1 Boundary-Scan Facilities (Option)
Any standard testpin may be used to perform Boundary-Scan tests. A configurable memory is accessible to all testpins providing the serial data needs for Boundary-Scan testing and permitting support for multiple scan paths.

Serial data memory	128 kbit (reloadable)
Input/Output levels	Uses standard digital drives (see below)
Tests supports	Integrity tests Interconnection tests Virtual in-circuit tests Cluster tests Device self tests

Digital Testing
Digital testing is full parallel drive, parallel sense.

Pattern rate	5 MHz – multiple transitions per test step
Internal clock frequency	50 MHz
Clock divider	1-256
Test step period	200 ns min with phase set movements
Phase step period	20 ns
Timesets	4
Formats per time set	6
External clock phase lock	50 MHz
Hardware Event Triggers	4
Phase lock multiplier	1-16
External sync up to 50 MHz	
Pattern generators (shift, rotate, increment) accessible to all pins	
Flow control Instructions	NOP, IF(NOT), CALL, RETURN, JUMP DELAY, LOOP, EXITLOOP, ENDLOOP, REPEAT, UNTIL, STOP, PAUSE
Max Input Volt	–50 V-+50 V (logic relay open)
Control RAM depth	8 K
Flow trace RAM	64 K
Signature analysis	per pin
Logic Families	1 per board
Drive high voltage range	–1.0 V-+14 V
Drive low voltage range	–6.0 V-+1.0 V
Sense levels	–8.0 V-+15 V
Drive high/low current	500 mA (forcing) 50 mA (non-forcing)
Slew rate	50 V/µs (slow) 150 V/µs (fast)
Output impedance	2 Ω (forcing) 10 Ω (nonforcing) nominal
Backdrive timeout	10 µs-650 ms
Relaxation timer	1 ms-10 s
Testpin RAM depth	8 K
Pin face skew	20 ns
Digital Guarding	2 static guards per TP board one high one low

Debug Facilities
Manual probe for in-circuit debug and reverse trace functional test diagnostics
Pin scan and search
Bugprobe

Busfail

UUT Power Supplies

4215	Maximum 3 supplies
4220	Maximum 6 supplies

2 types available:
0.15V-6.0V, 25A voltage and current programmable
1.0V-30.0V, 7A voltage and current programmable

System Software

MTL Test Language
High level, function based, structured programming language
Interactive edit and debug facilities
System self check
System self calibration

CAPG (Computer Assisted Program Generator) Option
PC WIN 95/NT
Generic device library
CAD or manual input
Safe check digital backdriving analysis software
Extensions for bus emulation
Boundary-Scan test generation
Reverse trace for partitioned functional testing

FABmaster CAD interface (Option)

***i*-Base Information Management System (Option)**

Operating Conditions

Mains supply	180-265 volts, 47 Hz-63 Hz, single phase
	13 A
Power consumption	2 kVA
Operating temp range	+10°C-+35°C
Humidity range	25% RH-75%RH

Dimensions

Height	Depth	Width
1.255 m	1.095 m	1.5 m

Weight
227 kg

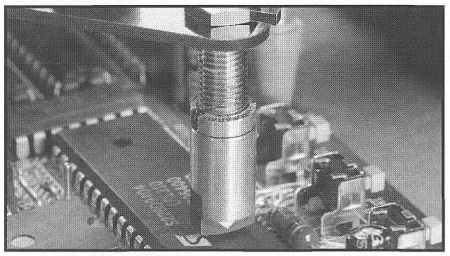
Vacuum Actuation
–20 in Hg (–0.66 Bar) to –28 in Hg (–0.94 Bar)

System Compatibility
System80/M530 fixture adaptor for cannon style fixture.
INCITE test program conversion software

Fixturing
Vacuum operated interface

System interface life	>30,000 operations
Fixture to interface life	>5,000 operations

Q-Test II Vectorless Test



- Simplified vectorless testing
- Inductive or capacitive signal pickup for broad applications
- Graphical user set-up
- Flexible mounting for detection circuitry

Introduction

After being the first ATE vendor with a vector-less test solution for IC opens IFR has enhanced the capability of the Q-Test probe along with a graphical user interface. Q-Test II includes an enhanced inductive probe including the option of fitting proprietary capacitive probes if required.

The techniques allow integrated circuit devices (analog or digital) plus connectors to be tested for pin connectivity without detailed information on the device under test. In practice only pin list data is required to generate, debug and test, even for high pin out devices.

Inductive Probes

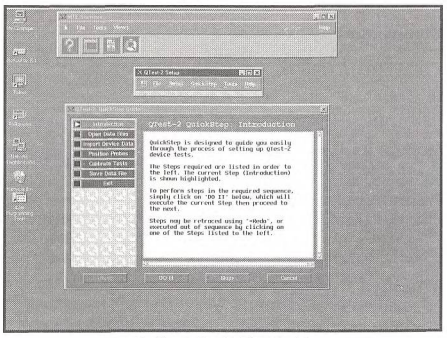
The original Q-Test probe has been enhanced to improve sensitivity, positioning accuracy and reduce the cost per probe. A new probe mounting kit has improved ease of positioning and debug.

The revised design of inductive pick-up gives the probe greater low level resolution and more focused detection window giving improved dry joint detection.

Capacitive Probes

Commercially available capacitive probes can be used on the 4200 series fixtures using a mounting kit available from

IFR. Capacitive probes are particularly useful for the testing of connectors.



Q-Test QuickStep Menu

Interface Board

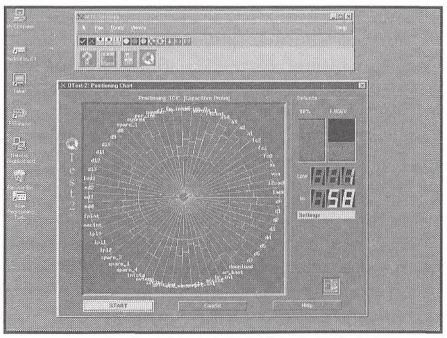
Both inductive and capacitive probes require an interface board for connection to a 4200 series tester. The interface board is known as the Q-Mux card and can be located within the tester for use on a number of fixtures or for specific applications within the fixture itself.

The fixture mounted card can accept up to sixteen probes while the system card, which is mounted on the General Purpose Input Output (GPIO) card, can accept up to ten probes. Up to four Q-Mux cards can be fitted to a single GPIO card giving forty probe connections per GPIO.

The Q-Mux card not only conditions the input signals but also provides gain and sensitivity control for both the inductive and capacitive probes. The card also provides stimulus in place of a standard driver/sensor.

Graphical User Interface

A graphical user interface has been added to the software which includes automatic calibration of pins and devices under test. These tools further reduce the program debug time. The standard debug environment gives mouse control of all parameters that may need to be modified or invoked to position and calibrate inductive or capacitive probes.



Q-Test Probe Positioning Chart

The software has self-learn algorithms built-in to aid debug and automatically calibrate each pin on a known good board. The steps to go through to position and debug a Q-Test II probe are shown on the example screen shot. One of the automatic calibration graphics is also shown opposite.

Specification

Card Performance

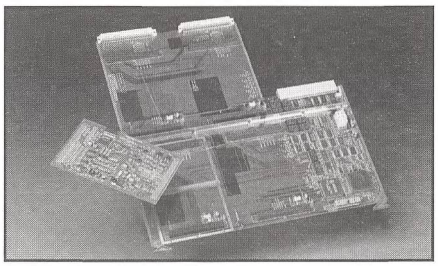
Power supply requirements
+5 V, 200 mA
-15 V, 200 mA
+24 V, 200 mA

Drive levels
Three stimulus levels available
Stimulus frequency 455 kHz

Gain levels
Ten detection levels available

Board connections
GPIO Q-Mux
10 probes per board
Fixture Q-Mux

GPIO Card



- Allows custom circuitry to be interfaced with 4200 series
- Interface rack mounted
- Eight 50 Ω lines from interface to custom circuitry
- Runtime control

Introduction

In the Test environment, there is often the requirement to use special custom circuitry to achieve success in testing a particular application.

The General Purpose Input/Output (GPIO) card provides the facility to add any custom circuitry into the 4200 series tester, allowing greater scope for test capabilities.

The card is located in the standard testpoint slots in the interface rack. The card includes backplane interface circuitry as standard and a prototyping area with connectors to allow for the addition of up to four plug-in daughter boards.

Eight 50 Ω high quality connections are provided from the daughter board connectors to the interface. This gives the facility to provide high quality signals to the unit under test.

The GPIO card also supports the Generator/Detector card (QMUX), used with the Q-TEST II facility. This card is of single-euro size and can be plugged onto the GPIO card.

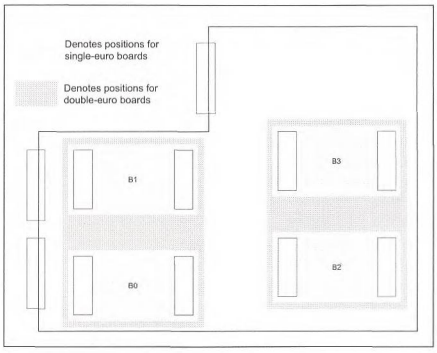
Daughter Board Connections

It is possible to include up to either four single-euro size daughter boards with limited functionality or two double-euro size daughter boards with full functionality, including signals provided for runtime control.

The single-euro size boards will have 8-bit data available with 6 address bits. The double-euro size boards will have 16 bit data available and 19 address bits allowing a 1 MByte address space. Signals for runtime control are provided for the double-euro size.

Eight 96 way sockets are provided with signals connected to allow read/write access to the daughter boards. Spare connections are also available for user signals.

These connectors also include a JTAG Boundary Scan port and a five-wire port used for the programming of ISP devices.



Q-TEST II Support

The new Q-TEST II facility requires a generator/detector card (the QMUX card), to allow for the interfacing to Q-TEST II probes. The QMUX card can be used standalone in a test fixture, or it can be plugged into the GPIO card.

The obvious advantage of using the QMUX card on the GPIO card is that it becomes an integral part of the test system and hence can be used for all fixtures without the need for extra circuitry in each test fixture (other than the probes themselves). Used standalone, the QMUX card is fitted into each individual fixture.

When the QMUX card is used on the GPIO card, it supports a maximum of 10 Q-TEST II probes as oppose to 16 when used standalone. However, since the QMUX card is of single euro-card size it is possible to fit 4 QMUX cards per GPIO card. This then allows a maximum of 40 Q-TEST II probes per GPIO card.

Software Control

To provide support for the GPIO card within the MTL test environment, new software modules have been included. These modules provide all the control signals necessary to control the GPIO card and any daughter board modules fitted.

The new modules provide all the controls needed for read/write activities and also includes facilities to enable any runtime activity which is available if the double-euro size cards are used.

New software modules have been included into MTL to provide control for the custom circuitry. This provides all control for the read/write activities required to the plug-in daughter boards.

Specification

GPIO Board

Power Consumption

	Typ	Max
+24 V	10 mA	20 mA
+5 V	150 mA	1 A
-15 V	10 mA	20 mA

Power Rating (Max. Current)

+24 V 5 A
+5 V 10 A
-15 V 5 A

NB. +5 V rail separately fused at 3.5V to each daughter board.

Electromagnetic Compatibility

The General Purpose Input/Output card complies with the following:

EMC: EN55011:1991 Class A
EN50082-1:1992
EN60555-2:1987

and therefore conforms with the protection requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility.

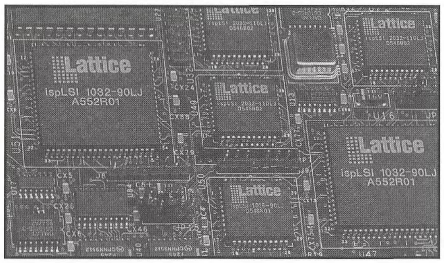
Environmental Conditions

The following apply to the General Purpose Input/Output card:

Operating:
Temperature 10 to 35°C
Humidity 25% to 75% rh, non-condensing at 30°C

Storage and Transport:
Temperature -40°C to +70°C
Humidity up to 93% rh, non-condensing at 36°C max

Testing ISP Devices



- On-board device programming and verification
- Handles single or multiple devices
- Supports Lattice 1000 and 2000 series
- Supports Xilinx XC95XX series
- No additional 4200 series hardware required

Introduction

ISP, or InSitu programmable devices can be programmed, erased and then re-programmed. This allows special test code to be used during the manufacturing process to simplify test. The 4200 ISP programming option allows the 4200 series manufacturing test systems to program and verify these devices as part of a normal in-circuit test.

By using the 4200 series of testers to perform the production programming of ISP devices, it eliminates the need for stand-alone device programming stations. This provides a great saving in terms of both time and money.

The programming code can be produced for a single ISP device or a daisy chain of ISP devices. To achieve this the software requires a JEDEC file describing the configuration of the device.

A generic vector file is produced via the appropriate vector generation software, for example Lattice's ispTEST and Xilinx's EZTag. This generic vector file can then be converted into a format required for the 4200 series of testers.

The Computer Aided Program Generation software (CAPG) is used to create an In-Circuit test program which contains all the necessary converted ISP programming code.

CAPG may be run either on the test system or on any other supported platform

System Requirements

The ISP programming option for the 4200 series of testers is a software only option and hence is very simple and cost effective to implement.

No extra hardware is needed for the implementation of this option as the 4200 has all the required hardware already as standard on the system.

4200 series ISP Software

To create a test for ispLSI devices there are two main stages to follow.

The first is to create a generic vector file using ispTEST. The input files required for this process are a JEDEC file (describing the fuse map information for the particular device) and also a .DLD file which describes an ISP chain, including the order of the devices in the chain. The generic vector file produced from the ispTEST software is then used as the input for the second stage.

This generic file is in ASCII format and needs to be converted into a binary format suitable for programming ispLSI devices during the testing of a PCB. The generic vector file goes through two converters, firstly avgen which converts the ASCII generic file into an ascii file in an IFR format. This file is then converted using bvgen which converts the file into a binary format ready to use during board test.

CAPG is used in the normal way to generate the test program for the board. An MTL library module is provided which is used to control the state machine of the device. This module is included into the test program by CAPG and uses the data from the binary data file to program and verify the devices.

At runtime the binary programming data is loaded into the 4200 series pattern generators and this is used to shift the data into the device chain. Any errors in programming (such as a verification failure) will be reported by the existing software in the usual way.

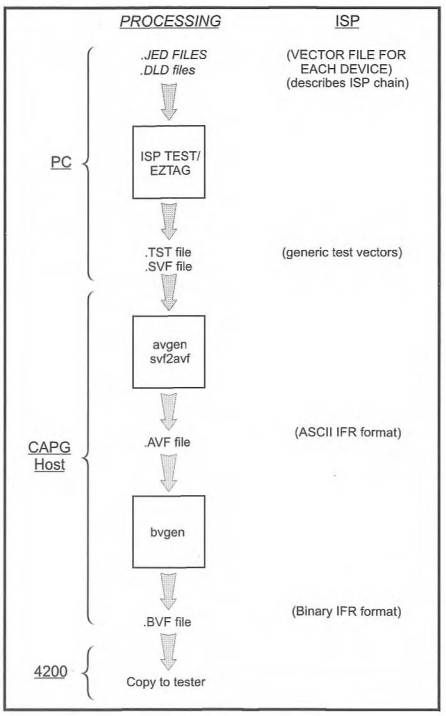
Results may also be logged in the usual way to the Test Area Management system, *i*-Base, as this option is fully supported.

Test Strategy

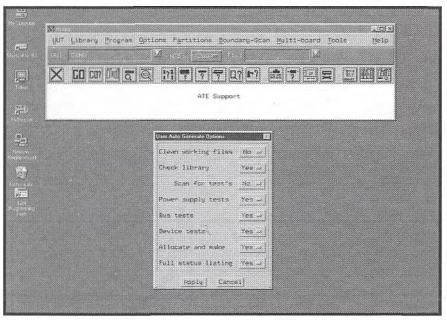
Whilst programming the ispLSI device is reduced to a simple task by the use of this software, testing a correctly programmed device can be more of a complicated procedure, depending on the device's functionality.

Therefore, to greatly simplify the testing of these devices, a two stage test strategy would be used thus increasing board level quality and reliability.

The device would first be configured as a simple series of digital gates or in a NAND Tree structure. These devices would then be tested along with the other digital devices on the board. If the In-Circuit test proves successful, the device would be re-programmed using the final functional design data to complete the board test.



Computer Assisted Program Generation



- Program generation software
- PC Windows 95
- PC Windows NT
- Site license

Computer Assisted Program Generation (CAPG) software is the method for generating programs and fixture build information for the 4200 series of

manufacturing test systems.

PC Platform

The CAPG software requires an industry standard PC running Windows 95 & NT. For full graphics capability use Hummingbird's EXCEED software. Although a 486 based PC would be viewed as an absolute minimum, a higher Pentium specification would give a corresponding reduction in program generation time.

FABMASTER

The CAPG software processes a circuit description file that has been generated from Computer Aided Design (CAD) files. The recommended method of producing this file is the IFR FABmaster CAD interface software.

CAPG

Using the circuit description file, CAPG will make tests for each component on the board. Circuit configuration will be accounted for by combining parallel resistors or capacitors and adopting different digital tests depending on tied modes. At this point different test methods can be requested, for instance, integrated circuit (IC) devices can use standard device models, Boundary Scan or Q-Test II depending on availability of information.

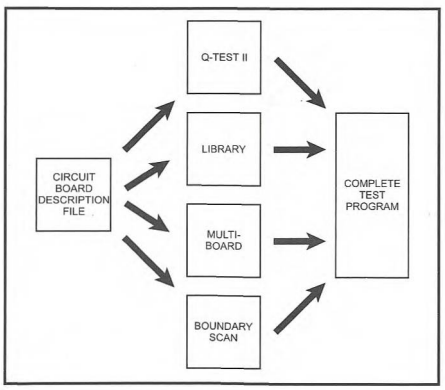
CAPG will then take information about the resource available in the target system and a skeleton file and create a complete test program and fixture build wire and drill files.

Panelization

If a panel of boards is to be tested the multi-board option can be used to create a single program for each unique board which makes up the panel. Only when the program is loaded onto the test system will multiple programs exist in memory with the correct testpoint offsets. This means that only one program must be debugged therefore shortening time to market.

Boundary Scan

As referred to earlier, CAPG can process Boundary Scan Description Language (BSDL) files and device configuration files to create either stand-alone scan tests, or daisy chained scan tests for multiple devices. When used with the MTL run-time Boundary Scan software a 4200 series tester can obtain pin level diagnostics.



Instrumentation Access Card

- 50 Ω access to unit under test
- Co-axial connection to GPIB instruments
- Interface rack mounted
- 26 way general purpose connector
- Buffered, floating and grounded signal lines
- AC or DC coupling

Introduction

The Instrumentation Access Card provides high quality, 50 Ω connections to the unit under test. Single or multiple cards can be located in the standard testpoint card slots of the interface rack and which allow the user to connect external instruments directly to the unit under test, bypassing the analog bus circuitry.

SMB co-axial termination is provided on the card for screened cable connection between tester and instrument.

A 26 way connector is also provided on the card for other signals, for example, a serial port. A further two SMB connectors provide support for cross-triggering signals for control of external instruments.

All operations can be performed either in analog or during digital tests to create mixed signal tests. A comprehensive library of control is built into the standard test environment.

The flexible switching matrix of the card allows a single instrument to be connected to any one of eight nodes on the unit under test while maintaining the 50 Ω termination.

50 Ω terminators are provided at the fixture side of the line, predominantly for self-check purposes, but also available to the user. Comprehensive self-check facilities have been included to give confidence in the operation of the card.

Primary uses for the card allow the connection of external instruments to allow highly accurate measurements to be made on the unit under test via external instruments under control of the test system.

Floating Signals

Four signals are available at the output of the card which can be routed from one of two points on the unit under test. Though the connections are intended for floating measurements all can be referenced to system ground.

Grounded Signals

Four connections can be made to the card from one of two points on the unit under test which are referenced to system ground permanently. A number of options exist for the routing of these signals, for example, all eight can be DC or AC coupled, the latter via 100 nF capacitors. Four signals can be routed via buffer amplifiers if high impedance measurements are required.

The outputs in the two diagrams figures 2 & 3 are the same four connectors. The top diagram shows the AC and DC coupled options available on the card.

The second diagram shows the remaining four referenced signals which can not only be AC or DC coupled but also be routed via buffer amplifiers.

Specification

Instrument Access Card

CARD PERFORMANCE

Power supply requirements
+5 V, 1.5 A (100 mA typical)
+24 V, 100 mA (10 mA typical)
-15 V, 100 mA (10 mA typical)

Board connectors

Eight SMB connectors on signal lines
Two SMB connectors for cross-triggering

Terminator characteristics

Value	50 Ω nominal
Power	1 W max (7 V DC)

DC isolation capacitor characteristics

Value	100 nF nominal
Voltage	50 V DC

Buffer amplifier characteristics

Gain	1 nominal, no load
Input impedance	1M Ω
Output impedance	50 Ω nominal
Output swing into 50 Ω	±5 V pk ±3 V continuous
Bandwidth -3 dB	DC to 80 MHz

GENERAL CHARACTERISTICS

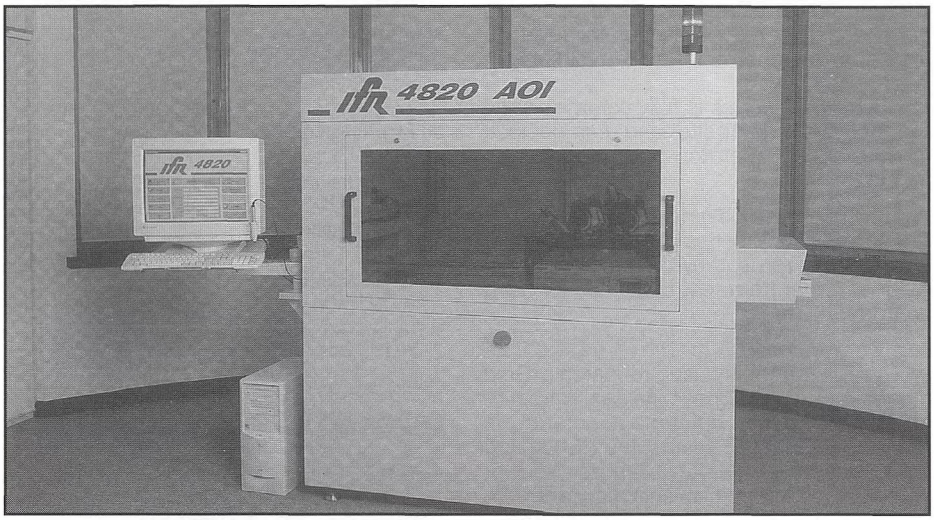
Electromagnetic compatibility

The Instrumentation Access Card complies with the following:

EMC: EN55011:1991 Class A
EN50082-1:1992
EN60555-2:1987 and therefore conforms with the protection requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility.

4800 series
Automatic Optical Inspection Systems

Automatic Optical Inspection Systems (AOI) offering extended inspection and process monitoring to the electronic manufacturing industry



- Detection of reversed and incorrect components
- Detection of solder shorts and blow holes
- Detection of bent or missing connector pins
- Detection of mechanical devices
- Allows for acceptable component variations in manufacturing
- Search, blob, caliper, position, OCR and Laser height tools available
- Up to 12 camera positions
- Color camera option available
- Networked repair and off-line programming stations
- In-line and off-line handling versions
- Manual and In-line versions available
- Easy to programme using a point and click user interface

Introduction

The 4800 series of Automatic Optical Inspection (AOI) systems are designed to complement IFR's series of electrical test systems in order to offer the user even more choice in terms of test strategy and process monitoring.

The AOI systems are available in four versions, the 4805, 4810, 4820 and 4830. Each variant of the range is targeted at a different manufacturing requirement and inspection problem from small batch production to high volume. The use of AOI machines complements the traditional electrical inspection process and extends confidence in the build quality to cover areas such as: connector type and color, bent or missing connector pins, color of LEDs, heatsinks, nuts, bolts, screws, labels and other mechanical parameters.

4805

The 4805 is an in-line fixed camera position unit with up to 12 cameras. This system is mainly used in low and medium volume applications.

4810

The 4810 is a manually loaded X-Y system with up to 12 cameras above, below and on the sides of the unit under test. This is a very flexible system which allows for board sizes up to 0.6 m square and it is a simple task to change product types.

4820

The 4820 is a fully automatic in-line version with up to 12 cameras above, below, and at angles to the test subject.

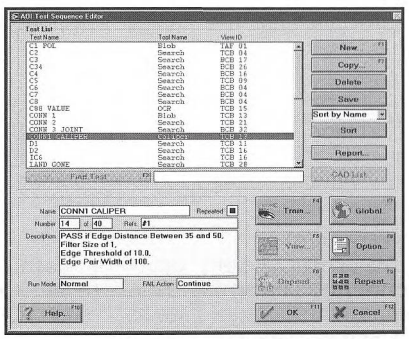
4830

The 4830 is a distributed system which is intended for factory floor use in many areas of industry. Up to 12 cameras with one controller are distributed in the production line for any type of inspection

System Overview

The 4800 series control executive is written in National Instruments LabVIEW and integrates industry standard vision libraries. The operator and programmer interfaces have been designed to make the operation of the 4800 series as simple but as powerful as possible.

The 4800 series can accept input from CAD data if available. However an important distinction is that (unlike many other vision systems), CAD information is not essential in order to generate the test program. The benefit is the 4800 can test for any object and is not restricted to objects in the CAD data. Also components such as conventional capacitors which can have acceptable differences in color, markings and angle of placement can be tested using the 4800 series multi-accept test to allow for such differences. This enables the programmer to keep the test limits high without causing false failures.



Programming Interface

A full SQL database for Pass/Fail data collection is standard on the 4800 series. Bar-code readers, off-line programming and repair stations as well as a full SPC package are available as options.

The 4800 series is quickly proving to be an industry leader due to its high speed, reliability, robust performance, ease of programming and use coupled with an extremely competitive price. All the 4800

series users so far have reported outstanding results and are now generating and supporting their own vision test programmes.

The 4800 series operator interface is very simple to use and no previous vision or software experience is required. It is totally 'point and click' based with the only text input being the name and value of the component you wish to test. Password control allows different levels of operation from testing only at the operator level, to programme generation at the supervisor level.

Each 4800 series is fully commissioned on the customers site and can include maintenance, operator and programmer training.

Vision Inspection Tools:

The 4800 AOI series provides vision test tools which are used by the programmer in order to generate a test sequence for each board type.

The Search Tool

The Search tool is used to match a 'Gold model' to the test image inside the Search Area. A result percentage match is returned and tested against the test limited for a pass or fail output. Can be used for detection of missing, misplaced, reversed, incorrect and wrong color of components.

The Blob Tool

The Blob tool is used via a simple interface to test for various errors including shorts, missing or bent sockets and pins, labels and reversed components.

The Caliper Tool

The Caliper tool is a gauge, it is used to measure distances between and across objects. It can also be used for component height measurements (if side cameras are used) and for detecting bent connector pins.

Position Tool

The position tool returns the X - Y co-ordinates. Its main use is to detect component placement error or slew and to ensure labels or mechanical components are located in the correct place.

OCR

The OCR tool (Optical Character Recognition) is available on the 4800 series as an option. This tool is used for 'true' character recognition when testing for correct labels and component types.

Laser Height

The Laser Height option is used to accurately measure the height of components and items such as connectors, washers, nuts, bolts, etc.

Specification (Example 4820)

General

Dimensions including conveyer
2065 mm wide, 1460 mm deep, 1700 mm high.

Footprint excluding conveyer
1480 mm wide, 1460 mm deep, 1700 mm high.

Weight
700 kg.

Power requirements
Single Phase 220-240 Vac @ 13 A.

Operating temperature
5 to 35°C

Storage temperature
-20 to 60°C

Operating humidity
RH 75% or less.

Storage humidity
RH 75% or less.

MTBF (measured)
>2000 hours.

Maximum UUT size
480 mm long x 320 mm wide.

CE Marked

PC Configuration

200 MHz Pentium, 128 MB Ram, 800 x 600 resolution graphics card with 65,536 colors, x8 CD ROM, 2 GB hard drive, Windows 95.
PC configuration recommend 450 MHz Pentium II, 256 MB Ram, 800 x 600 resolution graphics card with 65,536 colors, 8 GB hard drive on D:, 2 GB hard drive on C:, x32 CD ROM, Windows 95.

Hardware Features

Service
Easy access electronics service tray. Easy to remove interlocked front panel with viewing window. Removable rear panel.

Status
4 position light tower indicating machine status

Viewing
1050 mm x 525 mm removable window.

Cooling
3 off mains operated fans.

Safety
3 off emergence stop buttons, front panel interlock, hardware and software motion limit switches, 4 RCD trips.

Other
Modem, Network card, Light pen, Parallel printer port, Zip drive, CDROM, 19 in color monitor, monitor and keyboard support arm.

Cameras
Monochrome 2/3 in CCD chip, 760 x 576 pixels.

Lens type
50 mm lockable, C mount, F1:1.8

Area of PCB acquired per move
25 mm x 20 mm x No. of cameras.

Resolution
33 µm per pixel.

Number off
Up to 12, 8 as standard.

Image memory size (high res)
440 kb per image. Image memory size (low res) 110 kb per image.

CONVEYOR

Conveyor type
3 stage, left to right feed, front rail fixed. SMEMA International Standard 1.2

Positioning
Automatic board stop and alignment system. Control PLC and PC logic.

Safety
Fully interlocked and emergency stop buttons.

Load/unload time
<4 seconds maximum.

UUT requirements
5 mm clearance on two parallel under side sides.

MOTION

Motion type
X-Y linear.

Speed
2 m/second maximum, 0.5 m/second as supplied.

Control
BAi controller/amplifier via PC serial ports.

Positioning accuracy
2 µm repeatable per stage, <20 µm in X-Y configuration.

Ramp rates
Programmable, factory set to suit camera load.

Safety
Hardware and Software limit switches plus emergency stop buttons.

Software

Standard vision tools
Search, Blob, Caliper, Position, Fiducial realignment and Prompt.

Optional vision tools
OCR, Laser height.

Calibration
Calibration hardware and software supplied.

Databases
SQL test and machine fault databases, Calibration manager, Event view logger.

Operation
Test executive, Test executive editor, Option scheme editor, Step and repeat editor, Global parameter editor.

Utilities
File backup, HyperTerminal, PC Anywhere.

System Performance

Fault detection capabilities
Component absence, Solder excess, Solder lack off, Solder short, Solder ball, Solder dry/non wetted, Lifted leg, Tombstone, Blow hole, Reversed component, Placement error, Mechanical component damage, Raised components, Incorrect part, Component Slew, Component value (OCR), Component height (Laser), Incorrect Color of component (Color camera required).

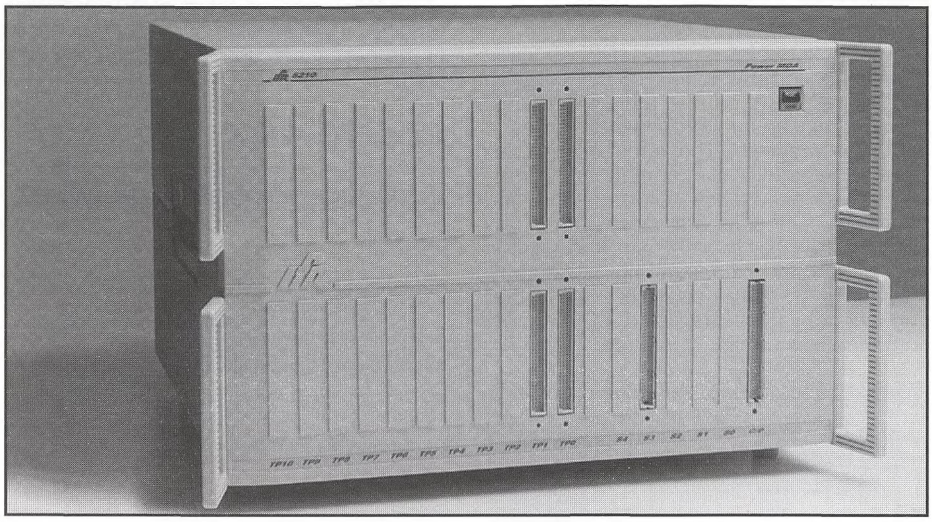
Speed by area
25 mm x 20 mm x number of parallel cameras per second.

Speed by test
1-40 tests per second, typically 10-20 per second.

OPTIONS
Additional monochrome cameras
Networked quickfind Repair Station (excluding PC)
Networked Programming Station (excluding PC)
SPC Tool
OCR Tool
Laser height measurement upgrade
i-Base information management system

5200 series
Power Manufacturing Defects Analyzers

A range of Power Manufacturing Defects Analyzers offering the highest throughput capability to the electronics manufacturing industry



- 1200 components/sec test speed
- Maximum of 2112 pins
- Windows NT operating system
- Power-up testing with programmable supply option
- Automatic program generation software
- Graphical program debug capability
- Autodebug facility
- Optional functional test capability
- Inductive and capacitive vectorless test
- 19 in rack mountable

Introduction

The 5200 series is the fastest analog test system available, combining high speed and the ability to accurately test a wide range of component types, effectively blurring the line between MDA, or analog In-Circuit, and full digital In-Circuit. This capability minimizes the investment in test systems by reducing the number of platforms required to achieve throughput, and providing the highest level of test coverage within a single manufacturing stage.

The system is controlled by an industry standard PC, with a Windows NT™ operating systems. The 5200 series has a small footprint allowing simple integration into automated in-line manufacturing facilities. The worldwide support and service capability offered by IFR Limited places the 5200 series as the preferred solution for analogue In-Circuit testing.

Within the range, there are two systems, the 5210 with fixed unit under test (UUT) power supplies and the 5220 offering programmable versions.

Architecture

The testframe of the 5200 series is 19 in rack mountable containing eleven slots for testpoint cards, and a further three to take a range of functional resources. Each testpoint card offers 192 pins, interfaced to the test fixture through interconnection cabling. This approach provides the user with the ability to integrate the system into an in-line handler or use a range of fixturing with a human operator.

Advanced Test Techniques

Test techniques such as analog In-Circuit, boundary scan and functional ensure the highest level of fault coverage. Although by definition, a Manufacturing Defects Analyzer does not provide digital device testing through testpoint memory, the 5200 series features a digital capability through the use of boundary scan and vectorless tools.

Vectorless Test Capability

IFR Limited is unique in offering both inductive and capacitive vectorless techniques, ensuring wide test coverage across a range of components from complex ASICs to connectors. Inductive probing is performed using the IFR patented Q-test II technique, whilst capacitive tests use the industry standard HP TestJet™ probe. These two techniques contribute to the systems ability to generate tests for complex devices quickly, and to accurately diagnose faults to enhance productivity and quality.

Power-Up Testing

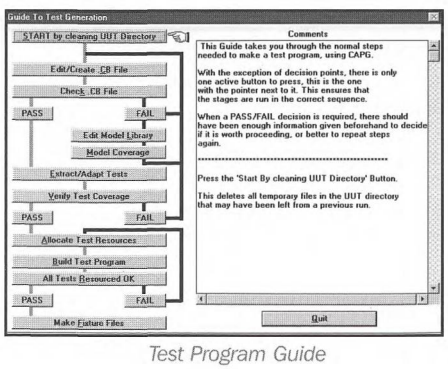
Boards are powered-up using either the programmable or fixed supplies. This enables the system to test a wide range of components, such as relays and op-amps, which would otherwise remain untested. This approach gives a vast advantage over conventional MDA systems, detecting a higher level of faults before further costs are incurred by allowing faulty product to progress along the production process.

Links to Computer Aided Design

Test programs are generated from CAD data or through a manual input tool for PCBs without electronic design data. The IFR FABmaster package acts as the link to CAD formats, providing a quick and effective conversion process to improve time-to-market issues.

Automatic Program Generation

The 5200 series' program generation software enables fixtures to be manufactured using an automated drilling and wiring process, and minimizes the test commissioning time through the use of a guarding simulator.



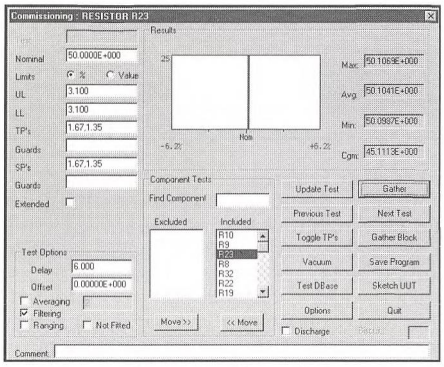
Test Program Guide

Autodebug

This facility is designed to improve time-to-market by using automatic debug algorithms, independent of the programmer. By altering the range of measurement parameters and analyzing the subsequent results across a number of re-iteration modes, the autodebug facility is able to quickly commission a high proportion of analog In-Circuit tests.

Graphical Program Debug

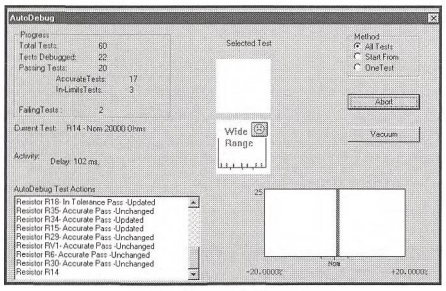
A simple 'point & click' GUI is used during the commissioning of the program and fixture. Tests can be run for individual devices, blocks of components, or as a complete program. The interface enables simple selection of component values, limits, test and sense points, delays and frequencies. Results are shown graphically allowing the user to determine the stability and accuracy of each measurement. Measure stability analysis is further enhanced by the integrated CGM facility demanded by quality standards.



Commissioning Window

Component Failure Identification

A graphical representation of the unit under test provides visual positioning for each component during the debug phase. User selectable options provide, amongst others, the facility to rotate and flip the board representation.



Autodebug Screen

Functional Capability

A range of functional test cards can be fitted to the 5200 series, further enhancing the high level of fault coverage provided. In many cases, this functional capability will negate the use of further test equipment within the production line by trapping faults at an early stage. The 5200 series throughput capability often allows this approach to be used as the pure MDA test is well within the beat rate of the production facility.

Upgrade Options

As is common across the range of IFR test systems, the 5200 series offers a wide range of upgrades for both new and existing customers. Users of the earlier 5200 system can upgrade to 5220 through the fitting of a new backplane. Customers who select a 5210, but later require programmable supplies, can easily fit the necessary modules to achieve 5220 status.

Specification

Measurements

Test Points
Base system, 384 pins core, expandable to 2112

Component Test Speed
Up to 1200 components / second

Capacitor discharge

Shorts & opens continuity test

DC Voltage measurement
10 mV - 50 V

DC Current measurement
10 nA - 100 mA

AC Voltage measurement
10 mV - 50 V

Resistance
20 mR - 200 MR

Capacitance
2 pF - 20 mF

Reversed Capacitor Detection

Inductance
2 µH - 200 H
200 mR - 20 MR

Diode Tests
up to 20 V

Zener Diodes
up to 60 V

Transistors
on, off, leakage

FETs
on, off

Other components
Relays, Op-amps, Opto-isolators, Fuses, Links, LEDs
Potentiometers, Thermistors, Switches, Thyristors
Transformers, Voltage Regulators, Voltage References

Opens Detection
Capacitive, Inductive

Stimulus

Two independent stimulus channels, AC or DC

DC
-10 V to +20 V, four quadrant, programmable
0 to 200 mA, programmable

AC
0 to 3.8 V pk-pk, programmable
Programmable DC offset -10 V to +10 V,
0 to 200 mA source or sink

Frequency range
0 to 100 kHz

UUT Power Supplies

5210
One fixed 5 V, 5 A
One fixed +15 V, 2 A
One fixed -15 V, 0.5 A

5220
One fixed 5 V, 6 A
Two Programmable 0.25 V to 30 V, 0.5 A to 2 A

General

POWER REQUIREMENTS
The 5200 mains power requirements are as follows;-
Single phase AC supply

Mains input
Auto range select

Nominal 220 V/240 V
198 V to 264 V

Nominal 100 V/120 V
99 V to 132 V

Supply frequency
47 Hz to 63 Hz

Power
0.5 kVA, maximum

Electromagnetic Compatibility
The 5200 complies with the limits specified in the following standards.
EN50081-1, Class A
EN50082-1
EN61000-3-2

Safety
The 5200 complies with IEC 1010, BSEN 61010-1 for class 1 equipment and is for use in a pollution degree 2 environment. The tester is designed to operate from an installation category 2 supply.

ENVIRONMENTAL CONDITIONS
The following temperature and humidity, operating and non-operating, conditions apply to the 5200.

Operating Temperature
10 to 35°C

Humidity
25% to 90% rh, non-condensing

Non-operating (Storage & Transport)

Temperature
-40 to +70°C

Humidity
Up to 93% rh, non-condensing

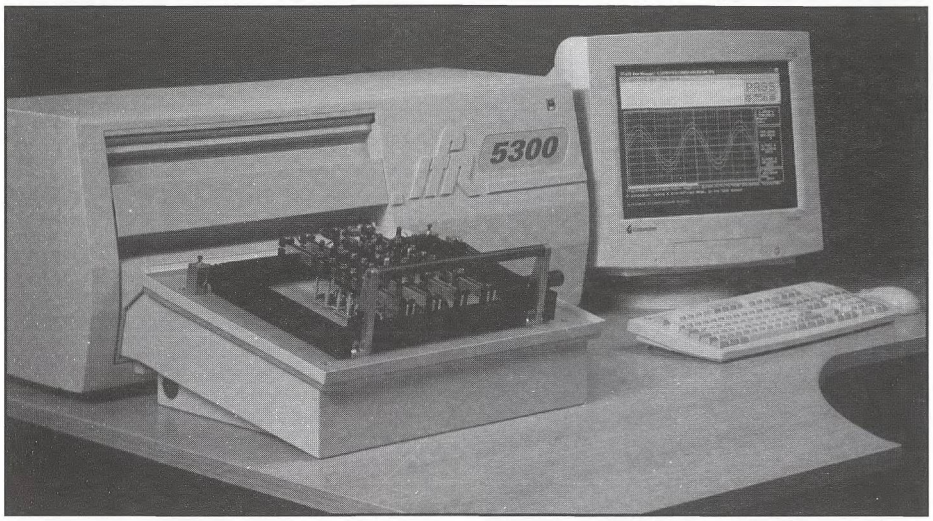
DIMENSIONS AND WEIGHT

Dimensions
445 mm wide x 317 mm high x 494 mm deep

Weight
Typically 32 kg, pin configuration dependent

5300 series Combinational Testers

Combinational testers offering multi-strategy solutions to handle the simplest through to the most complex test requirements



COMBINATIONAL TESTERS

- Analog and digital functional
- Analog and digital In-Circuit
- Reverse trace diagnostics
- Windows NT operating system
- Automatic program generation software
- Graphical program debug capability
- ISDN and Telecoms capability
- Inductive and capacitive vectorless test

Introduction

Traditionally, a single strategy tester was adequate to test the majority of conventional printed circuit boards. However, advances in technology and demands on board real estate necessitate a multi-strategy approach to ensure that the required level of fault coverage is maintained. This multi-strategy approach is achieved by the combinational tester, offering a wide range of test methods including In-Circuit, functional, boundary scan and a wide range of specialized techniques. Using this type of tester, the challenges presented by today's boards can be overcome.

Analog and digital In-Circuit test provides rapid program generation and accurate fault diagnosis, eliminating a wide spectrum of manufacturing faults. Alternatively, analog and digital functional testing detects dynamic faults and provides a high degree of confidence that the board will operate as the designer intended in the working environment.

The 5300 series provides two combinational platforms suitable for a wide range of applications throughout manufacturing test. They use a range of plug-in test card resources to reflect a multi-strategy test approach.

Architecture

The kernel of an ATE system is the card-cage which accomodates the plug-in test card resources and power supplies. Within the 5300 series, there are two systems offering two distinct styles of card-cage:

5305
A compact benchtop unit which has 14 slots within the card-cage for inclusion of test resources. The system can easily be mounted within a 19 in rack.

5300
A benchtop unit with a 21 slot capacity.

The test resources can be configured in a wide variety of combinations to provide the functionality required. Each card resource has it's own connector for interfacing to test fixtures, optimizing wire lengths and maintaining signal integrity.

Both systems use a industry standard Pentium based PC acting as a system controller. System software runs under the Windows NT operating systems, providing a high level of familiarity to users.

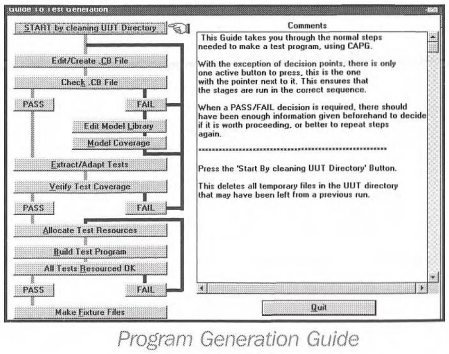
System Software

A range of software is available to meet the varied requirements of the different test methods found within the 5300 series combinational systems. To provide test programs, a Computer Aided Program Generation (CAPG) package takes CAD data to produce test programs and fixture build data. Within the program debug environment a range of graphical tools are provided to quickly and accurately commission tests. Further extensions are available to support such methods as boundary scan.

Test Methods

Each system within the 5300 series range is capable of accepting the full range of test resources. From an In-Circuit perspective, each system can be configured for analog and/or digital testing. For functional test, a wide range of stimulus and measurement cards can be fitted, enabling both analog and digital testing. The inclusion of a GPIB/VXI card within the system controller further enhances this range of tests to include commercially available instruments.

There are also dedicated cards for the testing of specific applications such as telecommunications and ISDN protocols. These can be mixed and matched with all of the other cards to maximize test coverage.



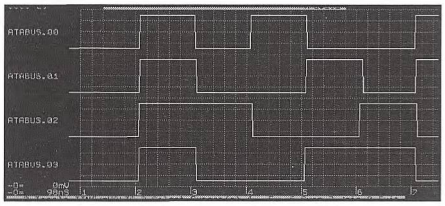
Program Generation Guide

Fixturing

The test subject is usually connected to the tester via a bed of nails vacuum or pneumatic fixture, routing each probe to a test resource within the system. For In-Circuit testing, providing access is available, it is usual to place a probe on each electrical node present within the circuit. In the case of functional test it is common to use fewer probes, allocated to the edge connectors.

Future Proofing

The modularity of the 5300 series combinational test systems makes them highly configurable. Although the initial requirement normally specifies the functionality of the tester, the modular approach allows for future changes and extensions of role. It is not uncommon to see a 5300 series tester configured several years after purchase to enable a completely different test philosophy.



Digital Debugging Tool

Specification

GENERAL SYSTEM

Controller	Pentium PC
Software	Windows NT
User controls	Keyboard and footswitch input.
Test fixturing	Bed-of-nails or plain platten.

UUT POWER SUPPLIES

5305	
Standard	5 V, 10 A DC fixed supply.
Optional	Dual 0-30 V, programmable supply, current limit 2A.
5300	
Standard	5 V, 10 A DC fixed supply.
Dual	0-30 V, 45 W (5 A max), programmable supply.

CONDITIONS OF OPERATION WITHIN SPECIFICATION

Temperature	10°C to 35°C.
Humidity	20% to 75% RH (non-condensing).

CONDITIONS OF STORAGE & TRANSPORT

Temperature	–25°C to +70°C.
Humidity	0% to 95% RH (non-condensing).

POWER REQUIREMENTS

AC Supply Single phase AC supply,
198 V to 264 V or 99 V to 132 V, 47 Hz to 63 Hz.

DIMENSIONS & WEIGHT

(Testframe only, i.e. excludes PC controller)

5305

Height	Width	Depth	Weight
344 mm	534 mm	500 mm	38 kg

(Typical and configuration dependent)

5300

Height	Width	Depth	Weight
375 mm	927 mm	343 mm	75 kg

(Typical and configuration dependent)

ANALOG IN-CIRCUIT TEST (AIC) FACILITY

A comprehensive, fast analog in-circuit test option providing full 6-wire measurement capability for testing the most complex circuit networks on printed circuit boards.

The analog in-circuit test facility is a multi-card configuration which uses the following cards.

- In-Circuit Measurement & Stimulus Card (IMS)
- Serial Digital Controller Card (SDC)
- In-Circuit Relay Card (ICR96)

The AIC option features the following capability.

- 1200 components / s test speed
- Power on test
- Unique graphical program debug
- Auto program generation software
- Up to 1824 test pins
- Inductive and capacitive vectorless test

The AIC test resource is a fast analog in-circuit test facility which combines high speed test, the ability to test a wide range of component types and ease of use. It is supported by auto program and manual entry program generation. The test resource provides economic test facilities for high speed component test and accurate manufacturing defects identification.

Vectorless Test Capability

IFR Limited is unique in offering both inductive and capacitive vectorless techniques, ensuring wide test coverage across a range of components from complex ASICs to connectors. Inductive probing is performed using the IFR patented Q-test II technique, whilst capacitive tests use the industry standard HP TestJet™ probe. These two techniques contribute to the systems ability to generate tests for complex devices quickly, and to accurately diagnose faults to enhance productivity and quality.

Power-on Test Techniques

Using power-on test techniques means the AIC is able to test devices such as operational amplifiers as well as the traditional range of analog passive components including fuses and links.

Auto Program Generation

The AIC is supported by an auto program generation software package which permits fast, high quality test program generation. This auto program generation software minimizes test program development / commissioning times and speeds the product time-to-market sequence. Data can be input from CAD, netlists or keyed in manually.

Contact Test

Contact test is a high speed test fixture to unit-under-test contact verifier. The contact 'map' can be learned and saved to a file. This file can be edited to add or ignore pins. The learned data can be used as a reference thereafter.

Test Point Search

Test point search is a test fixture debugging facility for verifying correct wiring or detecting which test pins are connected to a particular node on the unit under test.

Graphical Program Commission / Debug

A unique, graphical commissioning / debug facility provides the AIC with a powerful yet simple to use test program debug environment minimizing program commissioning times. The test block commissioning display identifies all components, by type, within the test program. Facilities for component block selection, the ability to run individual blocks, all program blocks, data logging control and access to the commissioning / debug facility are all controlled by simple selections.

The component test debugging facility provides 'point & click' access for editing component values, upper / lower limits, test and sense points, guards, delays, test and mode options. Also included within this environment is the graphical component debug tool. This interactive tool provides a graphical display of test results allowing the user to determine the stability and accuracy of the measurement.

Users can modify device measurement conditions and quickly see the effect on the stability of the measurement. The effects of filtering, averaging, measurement configuration and guard placement on a component test can be assessed virtually instantaneously. The facility allows users to optimize test speeds by allowing the user to reduce the delay on stable measurements until the measurement collapses. The optimum delay value is then displayed on a graphical plot. These comprehensive test program debug software tools minimize test program commissioning and debug times.

Component Failure Identification

This facility provides a graphical representation of the unit under test (UUT). The facility is user selectable and provides a visual identification of the position on the UUT of the failed or defective component. A selection of user controls are provided with the facility.

In-Circuit Check Card

An in-circuit check (ICC) card is provided with the AIC test resource for the 5300 and 5305. This allows the user to perform confidence checks on the stimulus and measurement facilities of the system. In addition test programs for the ICC card are provided with the AIC / system software which permits users to quickly become familiar with the system. The AIC user documentation package includes a user guide which is based on the ICC card as well as comprehensive hardware and software reference manuals.

Specification

Test Points
5300: up to 1824
5305: up to 1152

Component test
Up to 1200 components / s speed

Capacitor Discharge Voltage Monitor
Constant current,
200 mA limited, 30 V

Continuity (Shorts & Opens)

Stimulus level	200 mV
Threshold	10 Ω (default), 100 Ω or programmable

DC Voltage

Ranges	10 mV - 100 mV 100 mV - 1 V 1 V - 10 V 10 V - 50 V
Input impedance	10 MΩ

DC Current

Ranges	0 -100 nA 100 nA - 1 µA 1 µA - 10 µA 10 µA - 100 µA 100 µA - 1 mA 1 mA - 10 mA 10 mA - 100 mA

Resistance (2/3 Wire)

Ranges	0.2 Ω - 2 Ω 2 Ω - 20 Ω 20 Ω - 200 Ω 200 Ω - 2 kΩ 2 kΩ - 20 kΩ 20 kΩ - 200 kΩ 200 kΩ - 2 MΩ 2 MΩ - 20 MΩ
Stimulus level	0.2 Ω - 2 Ω range, 20 mV / 200 mA
All other ranges	200 mV / 200 mA

Resistance (4/6 Wire)

Ranges	0.2 Ω - 2 Ω 2 Ω - 20 Ω 20 Ω - 200 Ω 200 Ω - 2 kΩ 2 kΩ - 20 kΩ 20 kΩ - 200 kΩ 200 kΩ - 2 MΩ 2 MΩ - 20 MΩ
Stimulus level	0.2 Ω - 2 Ω range. 20 mV / 200 mA
All other ranges	200 mV / 200 mA

Resistance (Extended 2/3 Wire)

Ranges:	200 kΩ - 2 MΩ 2 MΩ - 20 MΩ 20 MΩ - 200 MΩ
Stimulus level:	All ranges, 2 V / 200 mA

Resistance (Extended 4/6 Wire)

Ranges	200 kΩ - 2 MΩ 2 MΩ - 20 MΩ 20 MΩ - 200 MΩ
Stimulus level	All ranges, 2 V / 200 mA

Capacitance (2/3 Wire)

Ranges	2 pF - 20 pF 20 pF - 200 pF 200 pF - 2 nF 2 nF - 20 nF 20 nF - 200 nF 200 nF - 2 µF 2 µF - 20 µF 20 µF - 200 µF 200 µF - 2000 µF
Stimulus level	2 pF - 200 pF (2 ranges), 300 mV pk-pk / 200 mA 200 pF - 2 µF (4 ranges), 120 mV pk-pk / 200 mA 2 µF - 2000 µF (3 ranges), 50 mV pk-pk / 200 mA
Stimulus frequency	2 pF - 200 pF (2 ranges), 5.2 kHz 200 pF - 2 µF (4 ranges), 1.3 kHz 2 µF - 2000 µF (3 ranges), 325 Hz

Capacitance (4/6 Wire)

Ranges	2 pF - 20 pF 20 pF - 200 pF 200 pF - 2 nF 2 nF - 20 nF 20 nF - 200 nF 200 nF - 2 µF 2 µF - 20 µF 20 µF - 200 µF 200 µF - 2000 µF
Stimulus level	2 pF - 200 pF (2 ranges), 300 mV pk-pk / 200 mA 200 pF - 2 µF (4 ranges), 120 mV pk-pk / 200 mA 2 µF - 2000 µF (3 ranges), 50 mV pk-pk / 200 mA
Stimulus frequency	2 pF - 200 pF (2 ranges), 5.2 kHz 200 pF - 2 µF (4 ranges), 1.3 kHz 2 µF - 2000 µF (3 ranges), 325 Hz

Inductance (2/3 Wire)

Ranges:	20 µH - 200 µH 200 µH - 2 mH 2 mH - 20 mH 20 mH - 200 mH 200 mH - 2 H 2 H - 20 H 20 H - 200 H
Stimulus level	20 µH - 200 mH (4 ranges), 260 mVpk-pk / 200 mA 200 mH - 200 H (3 ranges), 160 mVpk-pk / 200 mA
Stimulus frequency	20 µH - 200 mH (4 ranges), 5.2 kHz 200 mH - 200 H (3 ranges), 1.3 kHz

Inductance (4/6 Wire)

Ranges	20 µH - 200 µH 200 µH - 2 mH 2 mH - 20 mH 20 mH - 200 mH 200 mH - 2 H 2H - 20 H 20 H - 200 H
Stimulus level	20 µH - 200 mH (4 ranges), 260 mVpk-pk / 200 mA 200 mH - 200 H (3 ranges), 160 mVpk-pk / 200 mA
Stimulus frequency	20 µH - 200 mH (4 ranges), 5.2 kHz 200 mH - 200 H (3 ranges), 1.3 kHz

Impedance (2/3 Wire)

(Unresolved Z)

Ranges:	0.2 Ω - 2 Ω 2 Ω - 20 Ω 20 Ω - 200 Ω 200 Ω - 2 kΩ 2 kΩ - 20 kΩ 20 kΩ - 200 kΩ 200 kΩ - 2 MΩ 2 MΩ - 20 MΩ
Stimulus level	0.2 Ω - 2 Ω range, 40 mVpk-pk / 200 mA
All other ranges	400 mVpk-pk / 200 mA
Stimulus frequency	Programmable 0 - 50 kHz

Impedance (4/6 Wire)

(Unresolved Z)

Ranges	0.2 Ω - 2 Ω 2 Ω - 20 Ω 20 Ω - 200 Ω 200 Ω - 2 kΩ 2 kΩ - 20 kΩ 20 kΩ - 200 kΩ 200 kΩ - 2 MΩ 2 MΩ - 20 MΩ
Stimulus level	0.2 Ω - 2 Ω range, 40 mVpk-pk / 200 mA
All other ranges	400 mVpk-pk / 200 mA
Stimulus frequency	Programmable 0 - 50 kHz

Impedance (2/3 Wire)

(Resolved Z)

Ranges:	0.2 Ω - 2 Ω 2 Ω - 20 Ω 20 Ω - 200 Ω 200 Ω - 2 kΩ 20 kΩ - 200 kΩ 200 kΩ - 2 MΩ 2 MΩ - 20 MΩ
Stimulus level	0.2 Ω - 2 Ω range,

Impedance (4/6 Wire)

(Resolved Z)

Ranges	0.2 Ω - 2 Ω 2 Ω - 20 Ω 20 Ω - 200 Ω 200 Ω - 2 kΩ 2 kΩ - 20 kΩ 20 kΩ - 200 kΩ 200 kΩ - 2 MΩ 2 MΩ- 20 MΩ
Stimulus level:	0.2 Ω - 2 Ω range, 40 mVpk-pk / 200 mA
All other ranges	400 mVpk-pk / 200 mA
Stimulus frequency	Programmable 0 - 50 kHz

Diode Tests

Test modes	Diode forward voltage measurement (Diode 'ON'), Diode reverse test (Diode 'OFF') Diode leakage measurement
Current source	Up to 200 mA
Compliance voltage	Up to 30 V

Zener Diodes
Voltage measurement 1 V to 54 V

Transistor Tests

Test modes	Transistor on test (minimum gain), transistor off test & transistor leakage measurement (i.e. emitter - base and collector - base)
Base drive	Current range 0 - 200 mA
Collector drive	Compliance voltage 5 V

Other Components
FETs, transformers, electrolytic capacitors, relays, op-amps, opto-isolators, thermisters, fuses, links, SCRs, varistors.

Stimulus
Two stimulus channels which can be either DC or AC, independent of each other.

DC	-10 V to +20 V, four quadrant, programmable 0 - 200 mA, programmable, source or sink
AC	0 to 4 V pk-pk, programmable Programmable DC offset, -10 V to +10 V 0 - 200 mA, programmable, source or sink Frequency range, 0 to 100 kHz

In addition a DC source with a compliance voltage of up to 54 V (current limited) is available for testing Zener diodes.

UNIVERSAL IN-CIRCUIT TEST FACILITY

- Analog In-Circuit
- Digital In-Circuit
- Digital Functional
- Vectorless Test

A high performance facility providing the fault isolation benefits of in-circuit test combined with the dynamic capabilities of functional test.

The Universal In-Circuit (UIC) test option integrates both digital/analog in-circuit and functional test hardware and software into a single facility within the ATE system. Computer assisted program generation facilities supported by a comprehensive device library provide the ease of programming and fault detection benefits of in-circuit test. The UIC facility is further supported by sophisticated test program debug tools including the system's unique

TruView™ software debug tool. The UIC test suite comprises the following card types:

- Control & Sequencer Card (CAS2)
- Resistance, Continuity & Control Card (RCC4)
- Capacitance, Inductance & Impedance Card (CLZ)
- Dual Voltage Source Card (DVS)
- Drive/Sense Card fitted with the Universal Test Pin Daughter Card (DAS/UTP).

A CAS, RCC4, CLZ and DVS card is required per system and up to 17 DAS/UTP cards may be fitted.

MODES OF OPERATION

The UIC facility has two modes of operation.

In-Circuit Test Mode

Primarily for the detection of connectivity, manufacturing and component faults, this mode provides facilities for testing both digital and analog devices and board tracking.

Functional In-Circuit Test Mode

This mode of operation provides a dynamic, digital functional facility with a test pattern rate of 10 MHz. In this mode the full facilities of the ATE's Digital Test System option are available with maximum pulse widths of 60 ns with edge plane to 20 ns.

BACKDRIVING TIMEOUT & RELAXATION FACILITIES

To prevent overheating of sensitive devices due to prolonged backdriving, the standard system software contains facilities to control timeout and relaxation hardware. The UIC test facility can be set to provide a test program timeout and to tristate the pinface in the event of a test program execution exceeding the timeout period. The relaxation facility is used to limit the test/no test ratio to prevent overstressing. In addition to being able to program the duration of the backdriving current, the backdrive duty cycle can also be programmed.

TEST PROGRAMMING & SOFTWARE DEBUG TOOLS

In addition to the standard system software which provides the facilities for programming all aspects of the UIC test capability, a range of sophisticated test programming and program debug tools are provided.

Computer Assisted Program Generation

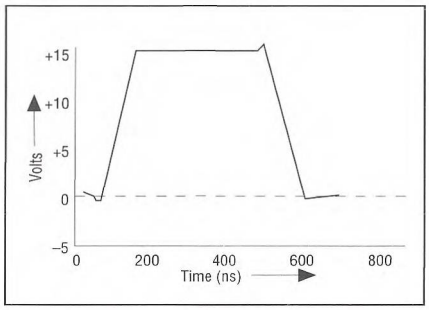
Computer Assisted Program Generation (CAPG), is a computer assisted program generation software package and is supported by a comprehensive device library. Facilities for digital and analog network analysis, dynamic guarding and pin allocation are provided by CAPG. To minimise back-driving requirements CAPG will automatically allocate static and/or dynamic guards as required.

TruView

TruView is a real-time debugging tool with an effective bandwidth of 300 MHz. It eliminates the need for external instrumentation, interconnection probes, special pods and additional fixture wiring when commissioning in-circuit or functional test programs. TruView's 800 MHz equivalent time sampling capability operating independently on every test pin, enables a true display of nodal activity, timing and analog behaviour of stimulus/response signals. Four display modes are provided.

Vectorless Test Capability

IFR Limited is unique in offering both inductive and capacitive vectorless techniques, ensuring wide test coverage across a range of components from complex ASICs to connectors. Inductive probing is performed using the IFR patented Q-test II technique, whilst capacitive tests use the industry standard HP TestJet™ probe. These two techniques contribute to the systems ability to generate tests for complex devices quickly, and to accurately diagnose faults to enhance productivity and quality.



Typical DAS/UTPHV Waveform

Contact Test

Contact test is a high speed test fixture to unit-under-test contact verifier. The contact 'map' can be learned and saved to a file. This file can be edited to add or ignore pins. The learned data can be used as a reference thereafter.

Test Point Search

Test point search is a test fixture debugging facility for verifying correct wiring or detecting which test pins are connected to a particular node on the unit-under-test.

Bugprobe

Bugprobe is a facility which detects whether or not device pins are making contact with the unit-under-test board tracks. Running this option generates a graphical representation of the device. Initially all pins on the device displayed appear as filled blocks. When a pin is probed, which is making contact with the unit-under-test board track, the display changes to an outline block and if no contact is made the display remains a filled block.

Specification

Digital In-Circuit Testing

Test points	Up to 1088 (384 on 5305) 64 per DAS/UTP card multiplexed 1:4.
Pattern rate	10 MHz maximum.
Test rate	Average 15 components per second.
Pinface drive & sense skew	Typically 25 ns.
Timing resolution	20 ns.
Backdrive time	400 µs default, user programmable 192 µs to 65 ms with automatic relaxation and timeout facilities.

Guarding

Static	All pins, selectable High or Low.
Dynamic	Allocated automatically by CAPG.

Drivers

Voltage	Programmable drive high and drive low.
Range	±5 V.
Resolution	39 mV.
Accuracy	±200 mV.
Driver current	750 mA source, 500 mA sink, current limited.
Driver voltage	Programmable drive high and drive low.
Slew rate	150 V/µs, ±10%.

Sensors

Threshold	Dual.
Range	–5 V to +4.961 V.
Resolution	39 mV.
Accuracy	±200 mV.
Sensor voltage	Programmable sense high and low per 64 pin card.
Detection	High, Lo or Tristate.

Analog In-Circuit Testing

Test points	Up to 1088 (384 on 5305) 64 per DAS/UTP card.
Test rate	Average 30 components per second.

Capacitor Discharge

Capacitor range	Up to 10,000 µF max.
Discharge time	4 ms/10 µF.

Continuity (Shorts & Opens)

Stimulus level	100 mV.
Threshold	5 Ω, 10 Ω, 20 Ω, 50 Ω or 100 Ω. (selectable)

DC Voltage

Ranges	0 V to 100 mV. 100 mV to 1 V. 1 V to 10 V. 10 V to 50 V.
Accuracy	±0.3% to ±1.5%.*
Input impedance	10 MW.

DC Current

Ranges	0 to 100 nA. 100 nA to 1 µA. 1 µA to 10 µA. 10 µA to 100 µA. 100 µA to 1 mA. 1 mA to 10 mA.
Accuracy	±1% to ±2% .*

Resistance (DC)

Stimulus level	≤ 100 mV.
Ranges (2 &4-terminal)	1 Ω to 10 Ω. 10 Ω to 100 Ω. 100 Ω to 1 kΩ. 1 kΩ to 10 kΩ. 10 kΩ to 100 kΩ. 100 kΩ to 1 MΩ. 1 MΩ to 10 MΩ.
Accuracy	±1% to ±2%.*

Resistance (DC extended range)

Stimulus level	≤1 V.
Ranges (2 & 4-terminal)	100 Ω to 1 kΩ. 1 kΩ to 10 kΩ. 10 kΩ to 100 kΩ. 100 kΩ to 1 MΩ. 1 MΩ to 10 MΩ. 10 MΩ to 100 MΩ.
Accuracy	±1% to ±2%.* (10 MΩ to 100 MΩ range accuracy unspecified)

Resistance (AC)

Stimulus level	≤100 mV rms.
Stimulus frequency	100 Hz, 1 kHz & 10 kHz.
Ranges (2 & 4-terminal)	16 Ω to 160 Ω. 160 Ω to 1.6 kΩ. 1.6 kΩ to 16 kΩ. 16 kΩ to 160 kΩ.
Accuracy	±3%. (16 kΩ to 160 kΩ range, accuracy unspecified if 1 kHz or 10 kHz stimulus used)

Capacitance

Stimulus level	≤100 mV rms.
Stimulus frequency	100 Hz, 1 kHz & 10 kHz.
Ranges (2 & 4-terminal)	20 pF to 1 nF. 1 nF to 10 nF. 10 nF to 100 nF. 100 nF to 1 mF. 1 mF to 10 mF. 10 mF to 100 mF. 100 mF to 1000 mF.
Accuracy 2-terminal accuracy	±5 pF ±(2% to 3.5%) †. (100 mF to 1000 mF range, unspecified)
Accuracy 4-terminal	±2%. (20 pF to 10 nF ranges, accuracy unspecified)

Inductance

Stimulus level	≤100 mV rms.
Stimulus frequency	100 Hz, 1 kHz & 10 kHz.
Ranges (2 & 4-terminal)	25 µH to 250 µH. 250 µH to 2.5 mH. 2.5 mH to 25 mH. 25 mH to 250 mH. 250 mH to 2.5 H. 2.5 H to 25 H.
Accuracy 2-terminal	±4%. (25 mH to 250 mH range, accuracy unspecified)
Accuracy 4-terminal	±4%. (250 µH to 25 µH ranges, accuracy unspecified)

Impedance

Stimulus level	≤100 mV rms.
Stimulus frequency	100 Hz, 1 kHz & 10 kHz.
Ranges (2 & 4-terminal)	16 Ω to 160 Ω. 160 Ω to 1.6 kΩ. 1.6 kΩ to 16 kΩ. 16 kΩ to 160 kΩ.
Accuracy	±5%. (Accuracy dependent on complex impedance under measurement)

Diode Tests

Diode forward voltage measurement (Diode 'ON').
Diode reverse test (Diode 'OFF').
Diode leakage measurement.

Current source	Up to 25 mA.
Compliance voltage	Up to 25 V.
Zener diodes	1 V to 24.6 V.

Transistor Tests

Transistor on test (Minimum gain).
Transistor off test.
Transistor leakage measurement
(i.e. emitter to base and collector to base).

Base drive	Current range 0.25 mA to 8 mA.
Collector drive	Compliance voltage 5 V.

* Dependent on range and test mode
† Dependent on range
System Residual Impedance.
Series resistance, +2 Ω±1 Ω.
Series inductance, +3 µH±2 µH.
Shunt capacitance, ±5 pF (2-wire), +40 pF±30 pF (4-wire).

BOUNDARY SCAN

- Stand-alone device testing
- Full scan path capability
- Virtual In-Circuit option
- Fully integrated into program generation software

A range of cards and software providing rapid test generation for PCBs with boundary scan implemented.

Boundary Scan Overview

The increasing use of high density complex surface mount devices, coupled with the reduction in nodal access has resulted in an increase in test development costs. The need to provide alternate methods of test access resulted in the adoption of the IEEE 1149.1 standard which defines the boundary scan architecture.

Boundary scan permits access to a device via four dedicated pins known as the Test Access Port (TAP). This TAP can be used for the testing of an individual device or, through daisy-chaining, a group of devices connected together.

Test Strategies

A typical boundary scan test strategy often has six elements associated with it :

- boundary scan path integrity check
- device identification check (IDCODE)
- interconnect tests
- device internal tests (INTEST)
- device built-in self test (BIST)
- external tests (EXTEST)

Scan Software

Each device supporting boundary scan has an associated Boundary Scan Description Language (BSDL) file. This file defines the extent of the boundary scan test strategies supported and the physical characteristics of the TAP element of the device.

'Virtual In-Circuit'

Where devices with and without the boundary scan capability are mixed together, a technique known as Virtual In-Circuit provides a high level of fault coverage to areas which were previously untestable. This technique requires an In-Circuit capability and the embedding of boundary scan test code within the test program generation software.

Boundary Scan Card Options

The 5300 series boundary scan facility consists of two dedicated cards and associated software. Single devices featuring a TAP can be tested using a single card, Virtual In-Circuit requires additional Universal In-Circuit cards to be fitted within the system.

The Boundary Scan Card (BSC) provides a solution to most boundary scan requirements, offering the following features :

- Three isolated boundary scan channels per card for multiple scan chains.
- Multiple external and internal clock, trigger and handshake facilities.
- 48 parallel, bi-directional I/O lines for stand alone testing of individual devices.
- Synchronization to the Universal In-Circuit option for high speed mixed mode testing.
- Full isolation of all interface signals for combined In-Circuit operation.

The Boundary Scan Input/Output card (BSIO) extends the capability of the BSC card by providing 77 additional bi-directional digital I/O channels.

Test Programs

The 5300 series boundary scan software enables the user to perform standard EXTEST, INTEST, BYPASS and SAMPLE modes. Special device specific options are can also be supported by the software. Test programs are generated using CAD information and individual BSDL files within the Computer Assisted Program Generation (CAPG) software used by all 5300 series testers. Two levels of software are provided, supporting basic stand alone boundary scan or a fully integrated Virtual In-Circuit capability.

The program generation software includes all of the executable code required to perform the boundary scan tests, and handles the necessary testpoint allocation. This facility permits the detection of 100% of pin-level faults including stuck-at-1, stuck-at-0, broken bond wires, shorts and incorrect or missing components. No probing is required and clear diagnostic messages are automatically provided by the test system.

5300 series Boundary Scan Options

- Level 1 CAPG Boundary Scan software,
- Level 2 CAPG Boundary Scan software
- Boundary Scan Card (BSC)
- Boundary Scan Input/Output Card (BSIO).

DIGITAL FUNCTIONAL

- Digital Functional Testing
- Conditional/Unconditional Branching
- Algorithmic Pin Control micro-instructions

Digital Test System (DTS)

A 10 MHz, dynamic digital test facility capable of providing economic solutions to complex test requirements.

The architecture (APC-SLICE™) of the DTS option provides 10 MHz, dynamic digital test capabilities. One DTS control card is required to support up to 20 DTS stimulus/response cards providing up to 320 digital test channels. The micro-program controller on the DTS control card can change program flow in real time depending on UUT events and control the execution of Algorithmic Pin Control micro-instructions.

The DTS controls timing set selection, sampling mode selection, results logging, start/stop control of CRC registers, sequencing of APC-SLICES and external synchronizing facilities.

Each DTS stimulus/response card provides 16 individually controllable, protected drive-sense channels, a 2 x 64-bit APC microcode memory and a 16-bit APC-SLICE. Hardware support on a per channel basis is also implemented for data

formatting, signature analysis, pattern recognition, results logging, pinface deskew, isolation and switchback relays.

Data compression and re-usable test vector techniques coupled with fast, flexible pattern generators enable the DTS to store 'test instructions' as opposed to actual test patterns. This means that the APC-SLICE architecture requires much less high speed RAM behind each digital test channel compared with traditional architectures.

Dynamic timing facilities are provided through the use of timing sets and data formatting techniques. Timing information is derived from a timing set generator and 'overlayed' on the APC test patterns by the data formatter. Variable length timing sets, incorporating selectable 'on-the-fly' facilities enable the DTS to switch between emulating a Write test cycle and a Read test cycle dynamically.

An extensive range of software commands allow conditional/unconditional branching, looping and subroutine calling within the test patterns at full test rate.

Specification

TIMING

Reference clock	50 MHz.
Sub-cycle	20 ns, or n x 40 ns, or n x 500 ns
interval	(n = 1, 2, 3, ..., 16).
Main-cycle	n x sub-cycle interval
Interval	(n = 5, 6, 7, ..., 64).
External frequency/ clock inputs	50 MHz maximum, TTL,/ either or both edges.
External clock divider	1, 2, 3, ..., 16. (Maximum single step rate is 6.67 MHz or 3.33 MHz if using both edges.)
External clock delay	0 to 245 ns in 5 ns increments.
External sync	By use of external clock/frequency inputs. Test rate max.10 million patterns per second (unformatted, unmultiplexed).
UUT timing	9 lines : 4 Keep alive Clock output Handshake acknowledge Keep alive 1 Keep alive 2 5 Hold User timing lines.
Drive or sense phases	4 variable length timing sets (selectable 'on-the-fly') with 6 timing phases per timing set. Selectable per pin, giving edge placement of drive and sense windows to 20 ns resolution.
Sensor strobe	Programmable in sub-cycle steps (20 ns resolution).
Wait Flag	Active flag holds DTS and UT1-UT5 timing signals; CLOCK, ACK and KA1, KA2 signals continue. Active position of flag controlled to within 20 ns.

MICROPROGRAM CONTROLLER

Microprogram memory	4K steps.
Control commands	DELAY n as integer (231-1) REPEAT n/ENDREPEAT, LOOP n/ENDLOOP, JUMP_TO, CALL/RETURN, STOP, WAIT_FOR HANDSHAKE.
Control condition	UNCONDITIONAL, NEVER, IF_FAULT, IF_NO_FAULT, IF_CHECK_PASS, IF_CHECK_FAIL, IF_EXTERNAL_HI, IF_EXTERNAL_LO, IF_HANDSHAKE_PRESENT, IF_NO_HANDSHAKE, Register Condition.
User Registers	8 (General purpose or address registers).

16-bit APC-SLICE

APC microcode memory	2K x 64 bits with data compression, reusable instructions and individual tristate control per pin.
APC configurations	1 to 320 APC pins (in 16-bit slices).
APC pattern instructions	INCREMENT, DECREMENT LOGICAL, ARITHMETIC, SHIFT etc.
APC instructions	DMH (Drive and Monitor HI), DML (Drive and Monitor LO), DRH (Drive HI), DRL (Drive LO), MNH (Monitor HI), MNL(Monitor LO), MNZ (Monitor Tristate) *, INH (Inhibit), SDH (Simulation Drive HI), SDL (Simulation Drive LO), SMH (Simulation Monitor High), SML (Simulation Monitor LO), SMZ (Simulation Monitor Tristate) *, TOG (Toggle), KEE (Keep) * Not available TTL/+5 V CMOS daughter card.
Effective test vector depth	Typically 4K for SRC and simulation modes, virtually unlimited for functional modes.

DATA FORMATTER

Data formats	NRZ, DNRZ, RZ, R1, RI, RC.

PATTERN RECOGNISER

Test for logic high, low, tristate, mask

Sense modes	Edge, window, accumulate, open.

RESULTS LOGGER

4K deep per pin. (Log all results, failed tests, failed checks, or all failures.)

SIGNATURE ANALYZER

Separate, maskable 16-bit CRC register per pin.

AUTO PINFACE DESKEW

Per pin via the pinface. Any pin to any other pin, skew is ±5 ns.

DRIVERS/SENSORS

High speed TTL/+5 V CMOS daughter card.

Driver/sensor channels	16 bidirectional channels/DAS card up to max 320 (144 on M505).
Drive levels	TTL and 5 Volt CMOS compatible.
Sense levels	TTL compatible.
Drive current	Symmetrical ±10 mA.
Auxiliary monitors	16 channels to internal sensors or auxiliary buffered outputs.
Multiplexed outputs	16 channels multiplexed to two outputs - MUX A or MUX B.
Protection	Drive/sense overvoltage, –1 V to +6 V.
Isolation	Relay isolation per channel.
Switchback path	Switch back relay to pinface per channel.

For details of other daughter cards contact IFR Ltd.

OTHER FACILITIES

Programmable timeout	192 µs to 65535 µs in 64 ms steps to tristate the pinface after a programmed interval has elapsed.
Stop modes	Stop on end of test, or Stop on failed test, or Stop on failed monitor, or Stop on any failure. Plus option to tristate the pinface on failure or end of test.
Failure reporting	Display/print 'x' number of test failures after test 'y'.
Size of tests	Multiple compiled blocks allowed in one test program.
Compilation	Either compile during test or compile to disc i.e. 'source' may be optionally held in the program or externally.
Other outputs	Trigger & fail signals.
Other inputs	External handshake.

LOGIC ANALYZER

- An instrument providing 100 MHz timing and 10 MHz state analysis across 64 channels.

The Logic Analyzer provides facilities for high performance timing and state analysis. It can be used in either the ATE or interactive display modes of operation. In the ATE mode all the setup and analysis functions are fully automated, effectively deskilling the instrument environment set-up. In the interactive mode the user is free to display and examine results on the tester's monitor.

Providing up to 64 channels with a 10 ns (100 MHz) sampling resolution it contains facilities for both timing and state analysis. Interactive timing/state measurements can be made using the cross linking facility between the trigger and acquisition sections of the logic analyzer cards. Asynchronous and sequential triggers, magnification, signal name allocation, cursors and trigger event markers are all provided as standard.

Specification

Inputs

Data	64.
Clock qualifier	8 channels; 1 clock & 7 qualifiers.
Ext. frequency	One channel.
Logic threshold	TTL.
Impedance	1 x TTL FAST load.
Setup time	Data to clock: 23 ns.
Qualifier to clock	30 ns.
Hold time	Zero.

Data Acquisition - Timing Analysis Mode

Internal Clock	
Sample rate	98 kHz to 100 MHz.
Sample interval	10 ns, 20 ns to 5120 ns in 20 ns steps. 5120 ns to 10240 ns in 40 ns steps.
No. of samples	1016.
External Frequency	
Sample rate	DC to 50 MHz.
No. of samples	1016.

Data Acquisition - State Analysis Mode

External Qualified Clock	
Sample rate	DC to 10 MHz.
Clock qualifier	8 channels, 1 clock & 7 qualifiers.
Edge	Positive or negative.
No. of samples	1016.

Trigger Control

Asynchronous Trigger	
Trigger word	64 bits, selectable 1, 0 or X in any combination with or without filter. Trigger on equal or not equal.
Filter	20 ns to 300 ns. Resolution, 20 ns. Accuracy, –0 ns/+30 ns.
Arm	Auto or manual.
Trigger delay	Linkage to delay modes.
Sequential Trigger	
No. of levels	250.
Trigger word	Find word A. Find word A B C ....Z.

	Find sequence A B C ....Z.
	Delay n cycles (n = 1 to 4095).
	Trigger on sequence break.
	Goto label.
	Goto label if word.
	Goto label if sequence.
	Trace on & off.
	Trigger.
Trigger delay	Linkage to delay modes.

Trigger Delay Modes

Time	Selectable from 40 ns to 667 ms.
Ext. frequency	0 to 65535 cycles.
Ext. qualified clock	0 to 65535 cycles.
Asynchronous trigger word event	0 to 65535 occurrences.
Sequential trigger events	0 to 65535 occurrences.
ATE events	0 to 65535 occurrences.

Trigger Position
Selectable from 4 to 1008 in steps of 4.

ACTIVE DIAGNOSTIC PROBE AND CARD

- Analog measurement & stimulus capability
- Captures digital signals for reverse trace diagnostics

A comprehensive diagnostic facility using reverse trace techniques for rapid fault location.

The Diagnostic Probe Card (DPC) can interface active or passive probes to capture digital signals and to source or measure analog voltages. Each DPC contains unique firmware providing recognition, status and self test capability.

The Diagnostic Probe Card Kit comprises:

- Diagnostic Probe Card (DPC)
- Reverse Trace Compiler Disc.

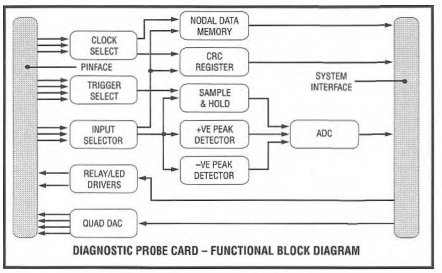
The Active Diagnostic Probe (ADP) is connected to the DPC card using a connector fitted to the rear of the card. The ADP provides direct and, via a X1 or a X10 range selection, buffered signal inputs. Three coloured LEDs on the ADP provide logic level and pulse indicators.

The DPC has both digital and analog resources to support probing functions on faulty printed circuit cards and features an optimizing reverse trace algorithm providing digital diagnostic back tracing facilities. This algorithm ensures that faulty nodes are identified with a minimum of probing actions. Analog facilities include DC and AC voltage measurement, positive and negative peak detection and switching to identify faults in the analog sections of printed circuit cards.

Digital Facilities

The DPC has the facility to capture nodal data, up to a depth of 64 k patterns, necessary for reverse trace activity. In addition it is able to perform CRCs on circuit activity. These facilities provide the benefits of accurate digital diagnostics on printed circuit cards containing complex designs involving, for example, digital feedback loops and bus controlled circuitry.

Nodal data can be learned from a known good UUT or imported from a digital simulator. During the learn, verify and diagnose phases, nodal data can be displayed in a logic analyzer style display for comparison with previously learned data. An error trace highlights differences between any two selected traces aiding both test program commissioning and fault finding. Any combination of node and test number can be masked by entering 'don't cares' (X's).



DIAGNOSTIC PROBE CARD – FUNCTIONAL BLOCK DIAGRAM

Analog Facilities

The following facilities are supported:

- DC and AC peak voltage measurement, ranges ±10 V and ±100 V.
- DC volts can be measured either under test program control or on an external trigger event utilizing the on-board sample and hold facilities. Four internal, four external hold trigger options and four arming options are available.
- External triggering facilities.
- Positive and negative peak voltage detection/measurement.
- Four independently programmable output voltages are available using the on-board quad DAC*.
- User/software controllable, general purpose relays for input signal routing.

Specification

Nodal Data Capture

Results Store	64 k x 2 RAM, linear.

CRC Capability

Register	16-bit CRC.

Digital Input

Level	TTL/5 V CMOS compatible.
Impedance	2 ACT loads.

Analog Input

Impedance	1 MΩ/50 pF.
Pull up	10 kΩ to programmable voltage using DAC1.

Voltage Measurement

Ranges	±10 V and ±100 V DC or AC peak
Accuracy	±0.5%full scale +(0.5% of reading).
Bandwidth	20 kHz.

Sample And Hold Facilities

Arming	Internal arming. Arm on an external edge, level, arm active (Software polling function).
Triggering Facilities	Internal trigger. Trigger on a digital test step, probe digital signal input. External trigger (Three sources). Inverted external trigger. Inverted external trigger.
External Control Signals	TTL compatible.
Measurement Accuracy	±0.5%full scale +(0.5% of reading).

Peak Detectors

Droop Rate	0.2 mV/ms.
Measurement Accuracy	±0.5%full scale +(0.5% of reading).

Digital To Analog Converter

DAC 1	Output range ±10 V. Resolution 80 mV. Accuracy ±600 mV. Output current, 25 mA maximum.
DAC 2*,3* &4	Output range ±5 V. Resolution 40 mV. Accuracy ±100 mV. Output current, 25 mA maximum.

ADP Specification

Sensor range	±5 V (X1) & ±50 V (X10).
Sensor threshold resolution	40 mV (X1) & 400 mV (X10)
Sensor threshold accuracy	±100 V (X1) & ±[1 V + 2% of reading] (X10).
Sensor delay	–20 ns.
Input impedance	5 MΩ (X1) & 30 kΩ (X10).
Input capacitance	10 pF.
Input protection	±100 V.
Bandwidth	140 MHz.

Hysteresis60 mV (X1) & 600 mV (X10).
Probe Skew (Skew figures using the ADP are relative to a 1.5 V threshold.)

Probe Type	Deskewed	Undeskewed
Passive	±5 ns	±10 ns
Active (ADP)	±5 ns	±15 ns

* DACs 2,3 and relay drivers not available when an active diagnostic probe is used.

DUAL VOLTAGE SOURCE

- A dual channel, fully floating, programmable source configurable to provide voltage stimuli or to operate as a current controller.

The Dual Voltage Source (DVS) can be used as a programmable source or used in conjunction with the in-circuit test cards as an integral part of the dynamic, universal in-circuit test resource.

The DVS provides stimuli for functional testing, in-circuit active component testing and external instrumentation programming. It provides two sources per card, each completely isolated from both the system and user power supplies and the other channel.

Voltages of up to 25.6 V can be supplied or currents of up to 25.6 mA per source can be controlled. Each source can be configured as a programmable current controller or a voltage source.

Specification

Output
Dual output, voltage or current programmable.

DC Voltage Ranges (Full Scale)
1.28 V with 1.25 mV resolution (each source).
12.8 V with 12.5 mV resolution (each source).

Voltage Accuracy
±0.4% of demand, ±0.1% of range.

DC Current Range
25.6 mA each source with 25 mA resolution.

Current Accuracy
±0.6% of demand, ±0.1% of range.

Configurations
Each source can be configured as a two-terminal floating source (0 V to 25.6 V at up to 25.6 mA) or a three-terminal bipolar twin source, twin tracking, with each rail capable of supplying 0 V to 12.8 V with symmetry about the common rail.
Using both channels the DVS can be configured as a floating, programmable current source with programmable voltage compliance.

WAVEFORM SYNTHESIZER

- A fully independent two channel, programmable instrument
- Facilities to generate sine, square, triangle, pulse, ramp and user defined waveforms.

The Waveform Synthesizer Card (WSC) comprises two fully independent output channels with individually programmable waveform amplitude, offset, relay isolation and output protection. Fully independent gating and triggering facilities are provided for each channel. Frequency is crystal controlled using the internal clock or an external reference clock may be used.

Features

- Two fully independent channels per card.
- Sine, square, pulse, triangle and ramp outputs.
- Arbitrary/user generated waveforms.
- Fully independent trigger on each channel.
- Programmable phase shift/delay between channels.
- Single shot, multiple shot and continuous operation.
- Relay isolation and full output protection on true and complement outputs.
- Gain control (amplitude modulation) inputs.
- Channel A modulated by channel B via internal path.

The two channels provided by the WSC can be separately configured in one of four operating modes, each of which is optimized for the type of waveform to be generated.

PLL Mode

In this mode the WSC provides waveform generation facilities for varying types of waveforms. The phase shift between channels in PLL mode is dependent on the number of samples per cycle in the waveform. The phase shift can be any multiple of one sample.

DDS Mode

In DDS (direct digital synthesis) mode the WSC provides sine waveforms with frequency resolution of better than 1.25 MHz across the full frequency range of 1.25 MHz to 312.5 kHz. In this mode the initial phase shift is programmable in steps of less than 0.0125_.

PULSE mode

PULSE mode allows pulse widths to be stepped in 200 ns steps from 1 ms to 1 s. In PULSE mode the channels can be delayed relative to each other by 200 ns steps up to a maximum of 835 ms.

ARB MODE

This allows arbitrary waveforms to be generated from user supplied data files. In ARB mode the phase shift can be any multiple of one sample.

Specification

Analog Signals

Source impedance:	50 Ω ±5%.
AC amplitude:	0 V to 20 V peak-to-peak into an open circuit.
AC resolution:	8 bits (78 mV into an open circuit with gain control disabled).
DC amplitude:	−5 V to +5 V.
DC resolution:	8 bits (40 mV).
AC+DC accuracy:	±80 mV at 20 V peak-to-peak signal into an open circuit.
Output protection:	Relay isolated, all channels. Overvoltage protection to ±30 V DC. Short circuit and thermal overload protected. Automatic isolation of outputs in event of fault condition.
Gain control range:	0 V to −10 V. Scaling − 2 V peak-to- peak of AC waveform per control Volt, ±10%.
NOTE:	Control voltage must be offset by −10 V.

Digital (TTL) Signals

Master clock output:	1.2 MHz to 2.4 MHz in PLL mode, 2.5 MHz in DDS mode, 5 MHz in PULSE mode, 2.5 MHz in ARB mode and buffered external clock input.
External clock frequency input:	5 MHz max. (Actual frequency is mode dependent), duty cycle 50%, ±5%.
External trigger:	Positive edge controlled, single and multiple cycles, re-triggered single and multiple cycles.
External gate:	AC part of waveform disabled when pulled low.
NOTE:	All digital inputs are pulled up via 4.7 kΩ to +5 V).

Internal Timebase
Accuracy: ±100 ppm.

OPERATING MODES

PLL Mode
Frequency range (sine and square):
0.15 Hz to 300 kHz in 21 ranges.

Frequency range (triangle and ramp):
0.6 Hz to 300 kHz in 19 ranges.

Frequency ranges:
Range 1 – 150 kHz to 300 kHz,
Range 2 – 75 kHz to 150 kHz,
Range n – 1.2 MHz ÷ $2^{(n+2)}$ to 2.4 MHz ÷ $2^{(n+2)}$.

Frequency resolution:
Range 1 – 1 kHz,
Range 2 – 500 Hz,
Range n – 8 kHz ÷ $2^{(n+2)}$.

Harmonic Distortion (sine wave):
50 dB down.

Phase shift resolution:
Range 1 – 45_ [150 kHz to 300 kHz],
Range 2 – 22.5_ [75 kHz to 150 kHz],
Range n – 360_ ÷ $2^{(n+2)}$ [1.2 MHz ÷ $2^{(n+2)}$ to 2.4 MHz ÷ $2^{(n+2)}$].

NOTE:
Minimum phase resolution is 0.05_ for triangle and ramp and 0.0125_ for sine and square waveforms.

Master clock output:
1.2 MHz to 2.4 MHz in 8 kHz steps, phase locked to either internal or external 8 kHz reference.

NOTE:
Figures quoted for this mode assume default table length of 8192 samples and full scale output into a 50 Ω load.

DDS Mode

Frequency range:
1.25 MHz to 312.5 kHz.

Frequency resolution:
Better than 1.25 MHz.

Harmonic distortion:
Largest harmonic >50 dB down.

Phase shift:
0_ to 360_ in 0.0125_ steps.

NOTE:
Figures quoted for this mode assume default table length of 32768 samples and full scale output into a 50 Ω load.

PULSE Mode

Rise time:
250 ns.

Fall time:
250 ns.

Pulse width (mark or space):
1 ms to 835 µs.

Pulse repetition rate:
<1 Hz to 500 kHz.

Resolution:
200 ns.

Phase shift/delay:
Equivalent of 200 ns steps.

NOTE:
Parameters quoted assume that an internal clock and a 50 Ω load are used.

ARB mode

Sample length:
5 samples to 8 k samples.

Master clock:
Internal – 2.5 MHz, external – 2.5 MHz maximum.

Sample clock frequency:
Integer divisions of master clock.

Waveform generation:
Using standard functions and WSC profiles.

ANALOG SAMPLING CARD

- An instrument with embedded digital signal processing providing sampling oscilloscope, low frequency spectrum analysis, DVM and signal generation facilities.

The Analog Sampling Card (SAM[HR]) is a single channel instrument combining the functions of a sampling oscilloscope, low frequency spectrum analyzer, DVM and signal generator on a single card for applications requiring high accuracy measurements in the time and frequency domains over the range DC to 50 kHz. The card features on-board, 5 MHz digital signal processing and a 12-bit ADC to provide the following signal processing and

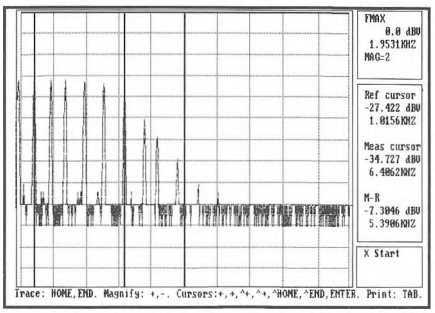
measurement facilities.

Time Domain

Single value at reference cursor
RMS value of record data
Peak value at cursor position
Average, max. and min. peak value in record
Peak to peak value
Proximal (10%), Mesial (50%) & Distal (90%) values

Time Domain Trace Processing

Rise and fall times



Analog Sampling Card Spectrum Analyzer Display

Mark duration
Space time
Period and frequency
Slope (positive and negative)
Pulse count
Cursor positioning
Proximal, Mesial and Distal occurrence time from trigger

Time Domain Trace Post Processing

Waveform mask testing (UL, LL envelope)
Add, subtract, multiply, square, square root and invert waveform
Convert waveform to dB
Fast Fourier Transform (FFT)
Discrete Fourier Transform (DFT)
Block floating point FFT
Load/save waveform to disk

Frequency Domain Trace Processing

Power spectrum calculation
Phase/magnitude spectrum
Window function selection
Frequency (reference cursor, measurement cursor)
Level (reference cursor, measurement cursor)
Test waveform against mask
Find peak level, frequency and width
Fundamental, harmonic and noise power
Count peaks in waveform
dB relative to reference level
dB relative to reference power level into specified termination

Frequency Domain Trace Post Processing

Add, subtract reference waveform
Multiply by reference waveform
Inverse transform (frequency to time domain)
Load/save waveform to disk

Specification

General
Number of channels: 1.
Inputs: Main (1), differential (1) and auxiliary (6).

Main Input
Input coupling: AC or DC, selectable.
Input impedance: 1 MΩ/25 pF.
Sensitivity: 100 mV full scale to 100 V full scale (10 divisions in 1-2-5 steps).
DC accuracy: 100, 200, 500 mV full scale - ±0.5% of reading ±0.25 mV. 1, 2, 5, 10, 20, 50, 100 V full scale - ±0.1% of reading ±0.1% of full scale range.
Resolution: 12-bits (0.024%) of full scale.
Position (DC offset): Adjustable over ±5 divisions with 12-bit resolution.
Maximum input voltage: 100 V (DC + AC peak).
Small signal bandwidth (–3 dB points): DC - 0 Hz to 425 kHz, AC - 1 Hz to 425 kHz.
Large signal bandwidth: DC - 0 Hz to 50 kHz, AC - 1 Hz to 50 kHz.

Differential Input
Input coupling: AC or DC, selectable.
Input impedance: 600 Ω or user supplied.
Sensitivity: 100 mV full scale to 10 V full scale (10 divisions in 1-2-5 steps).
DC accuracy: 100, 200, 500 mV full scale - ±0.5% of reading ±0.5 mV. 1, 2, 5, 10 V full scale - ±0.2% of reading ±0.1% of full scale range.
Resolution: 12-bits (0.024%) of full scale.
Position (DC offset): Adjustable over ±5 divisions with 12-bit resolution.
Maximum input voltage: ±12 V (DC + AC peak).
Large signal bandwidth: DC - 0 Hz to 60 kHz, AC - 120 Hz to 60 kHz.
Small signal bandwith (–3 dB points): DC - 0 Hz to 150 kHz, AC - 120 Hz to 150 kHz.
Reduced bandwidth using internal filter (–3 dB points): DC - 0 Hz to 4.8 kHz, AC - 120 Hz to 4.8 kHz.

Auxiliary Inputs
Input coupling: AC or DC, selectable.
Input impedance: 1 MΩ/25 pF.
Sensitivity: 5 V full scale.
DC accuracy: ±0.75% of full scale.
Resolution: 12-bits (0.024%) of full scale.
Position (DC offset): Adjustable over ±5 divisions with 12-bit resolution.
Maximum input voltage: 10 V (DC + AC peak).
Large signal bandwidth: DC - 0 Hz to 50 kHz, AC - 1 Hz to 50 kHz.
Small signal bandwidth (–3 dB points): DC - 0 Hz to 425 kHz, AC - 1 Hz to 425 kHz.

Analog Trigger Input
Input coupling: AC or DC, selectable.
Input impedance: 1 MΩ/25 pF.
Sensitivity: 5 V full scale, AC+DC peak (x1). 50 V full scale, AC + DC peak (x10).
Maximum input voltage: 100 V (DC + AC peak).
Large signal bandwidth: DC - 0 Hz to 50 kHz, AC - 1 Hz to 50 kHz.
Small signal bandwidth (–3 dB points): DC - 0 Hz to 425 kHz, AC - 1 Hz to 425 kHz.

Timebase (Time or Frequency Domain)
Horizontal sweep: 10 divisions in 1-2-5 sequence, 10 ms to 10 s/division, 10 kHz to 10 Hz/division, user defined sampling frequency or period.
Sample period resolution: 1 cycle of master clock (200 ns nominal).
Sample period range: 10 ms to 1 s/sample.
Sample frequency range: 100 kHz to 1 Hz.
Sample clock: Output - 1 Hz to 100 kHz (TTL levels, internal clock). Input - 1 Hz to 100 kHz (TTL levels, user supplied external clock).
Master clock: Internally generated 5 MHz clock, user supplied external master clock.
Mixed timebase: Runs after user defined number of samples of main timebase or externally switched via TTL input. (Not available in all modes of operation.)
Vernier delay (Trigger holdoff): Programmable in steps of master clock (0 to 65535).
FFT length: 64 to 1024 samples in binary sequence.
FFT window functions: Rectangle, Hann, Hamming, 3 term Blackman-Harris, 4 term Blackman-Harris.

Trigger - Analog
Sources: Internal (using signal derived from selected input. Range, ± full scale). External x1 (5 V full scale AC + DC peak), AC or DC coupled. External x10 (50 V full scale AC + DC peak), AC or DC coupled.
Resolution: 12-bits.
Accuracy: ±0.5% of full scale.
Bandwidth: DC - 0.1 Hz to 50 kHz, AC - 1 Hz to 50 kHz.
Internal and external analog trigger only. Measured using full scale sine wave as trigger signal, no offset, 0 V trigger point.

Trigger - Digital
Sources: Line (internally derived). Internal (Free run). External (TTL input), n-bits of an 8-bit TTL byte (1≤N≤8, individual bits and sense programmable. May also be used as a trigger qualifier). Cross trigger bus. Video line sync (line number selectable). Video field sync (even or odd field, PAL/NTSC system).

Trigger - General
Polarity: +ve or –ve slope, level or edge sensitive.
Output: Buffered TTL level.
Pre-trigger delay: Delay≤number of samples in trace, programmable up to 32768.
Post-trigger delay: ≤65536 x sample period or trigger events, programmable.
Arm signal: Internal or externally generated, TTL.
Holdoff: 0 to 10 ms in steps of one cycle of master clock.
Propagation delay: 100 ns, typical. (Measured from the rising edge of the external TTL trigger input to HOLD of analog waveform).

Acquisition Modes
Time domain: Single trace. Time averaging. Envelope. (max/min hold over specified number of traces or continuous).
Frequency domain: Single trace. Frequency averaging (specified number of traces or continuous). Max hold (specified number of traces or continuous).
Display zoom: x1 to x128 in binary steps (horizontal only).
Cursors: Reference, measurement, position programmable.
Interactive: Interactive control of vertical and horizontal settings, magnification, display area, cursor positions and plot modes.

Waveform Generation
Amplitude: ±10 V max into 600 W, source resistance <1 Ω.
Resolution: 5 mV (12-bits of full scale value).
Accuracy: ±10 mV.
Clock source: Internal - 1 MHz maximum, 100 kHz. default, 100 Hz minimum. External - 1 MHz maximum, 100 kHz default, 1 Hz minimum, TTL levels.
Timing resolution: Internal - 1 cycle of master clock. External - 1 cycle of external clock signal, ±200 ns.
Frequency accuracy: As main timebase accuracy.
DC level and offset: –10 V to +10 V.
Sine: Frequency - clock frequency ÷ 2^{16} to clock frequency ÷ 2. Frequency step size - better than clock frequency ÷ 2^{12}. Harmonics of full scale waveform (excluding clock related components) >40 dB down on fundamental.
Square: Frequency - clock frequency ÷ 2^{16} to clock frequency ÷ 2. Duty cycle - 0 to 1. (Minimum output pulse width is one clock cycle.)
Triangle: Frequency - clock frequency ÷ 2^{16} to clock frequency ÷ 2. Duty cycle - 0 to 1. (Minimum duration of each slope is one clock cycle).
Pseudo random noise: Peak level programmable.
User defined waveform: 1 to 32768 samples. If generation and sampling overlapped, maximum length is 32768 less sample length.

Waveform Memory
Memory size: 32768 x 16-bit words.
Sample record length: 32768 samples (16-bit words) maximum. Sample record length user selectable from 1 to 32768 words.
Reference waveforms: As sample record length.

DIGITAL MULTIMETER

■ A versatile instrument providing DC volts, AC volts and resistance measurement facilities and a current source.

5300 series

The Digital Multimeter (DMM) provides facilities for DC voltage, AC voltage and resistance measurement. The instrument card also contains a current source with five fixed outputs.

Specification

DC Volts – Ranges (Full Scale)/Resolution
±200 mV/0.05 mV. ±200 V/50 mV
±2 V/0.5 mV. ±350 V/500 mV
±20 V/5 mV.

DC Volts Accuracy
All ranges to 200 V: ±0.12% of reading, ±0.1% of range.
±350 V range: ±0.12% of reading, ±0.5% of range.

AC Volts – Ranges (Full Scale)/Resolution
200 mV rms/0.05 mV. 200 V rms/50 mV.
2 V rms/0.5 mV. 250 V rms/500 mV.
20 V rms/5 mV.

AC Volts Accuracy
All ranges to 200 V: ±1.2% of reading, ±1.22% of full scale.

Frequency Range
50 Hz to 50 kHz.

Input Impedance
10 MΩ in parallel with 50 pF.

Isolation
±350 V (DC + AC peak).

Resistance Ranges (Full Scale)/Resolution
200 Ω/0.05 Ω. 200 kΩ/50 Ω.
2 kΩ/0.5 Ω. 2 MΩ/500 Ω.
20 kΩ/5 Ω. 20 MΩ/5 kΩ.
20 MΩ/5 kΩ.

Resistance Accuracy
200 Ω range: ±0.35% of reading, ±0.3% of range.
2 kΩ, 20 kΩ and 200 kΩ ranges: ±0.35% of reading, ±0.1% of range.

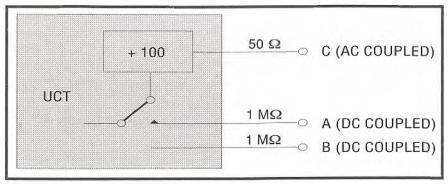
Current Sources (Fixed Outputs)
100 nA, 1 mA, 10 mA, 100 mA and 1 mA.

Current Source Accuracy
±1%.

UNIVERSAL COUNTER TIMER

- A multi-channel instrument which supports a wide range of measurement functions up to 150 MHz.

The Universal Counter Timer (UCT) provides facilities for frequency measurement, period, time interval measurement, event counting and frequency ratio measurement.



UCT Configuration

The UCT is a two-channel (A & B) instrument operating to 10 MHz on-channel and 2.5 MHz between channels A and B. A 'third channel' operates from 10 MHz to 150 MHz with an input impedance of 50 Ω acting as a 100:1 pre-scaler.

Programmable attenuators are provided on channels A and B allowing input levels of up to 30 V peak. DC coupling is provided, with provision for input offset of up to 25 V.

Specification

Frequency Measurement
Range DC to 150 MHz.

Period Measurement
Range 500 ns to 10 s with averaging.

Time Measurement
Range 500 ns to 10 s.

Event Counting
Range DC to 10 MHz.
Up to 10 million counts.

Input Impedance
Channels A & B Dual 1 MΩ inputs, DC coupled.
Channel C 50 Ω pre-scaler, AC coupled.

Inputs
Threshold Up to 30 V peak.
Trigger level Up to 24 V.
Resolution Down to 20 mV.

Timebase Accuracy
10 ppm ±0.5 ppm

GENERAL PURPOSE SIGNAL ROUTING CARD

- Software controlled
- Supports VXI and GPIB external instrumentation

A function card which provides a combination of matrix and tree switching facilities for general purpose signal routing between internal or external instruments/resources and UUTs.

The General Purpose Signal Routing Card (GPSR) provides software controlled interconnections between the UUT, other configured ATE test resources and external instrumentation including GPIB or VXI controlled facilities. The card provides connections to/from the test fixture, the in-circuit analog bus (ICAB) used on the universal in-circuit test resource and an external I/O connector.

Features

- Eight single pole I/O relays.
- Two, 1:4 mux groups.
- Four, 1:2 mux groups.
- Connection of ICAB, via isolating relays to the test fixture.
- Connection of ICAB to 6 X 8 matrix, which permits routing to the ATE pinface or external I/O.
- Two poles of the 2:8 mux pairs with 200 V isolation characteristics.
- Sixteen I/O pairs, relay isolated, between external I/O and pinface.
- Six pseudo "twisted pair" I/O connections for low noise or controlled impedance applications.

External I/O and ICAB Connectors

In addition to the ATE system pinface connector, the card contains two external connectors. One 40-way connector provides access for external input/output resources and the second, a 16-way, provides access to the in-circuit analog bus used on the universal in-circuit test resource.

The 40-way header connector provides connection to all external I/O lines/user facilities. Some lines are tracked on the GPSR card as pseudo "twisted pairs" with their associated return path. The characteristic impedance of this tracking is approximately 100 Ω and can be used in low noise or controlled impedance applications.

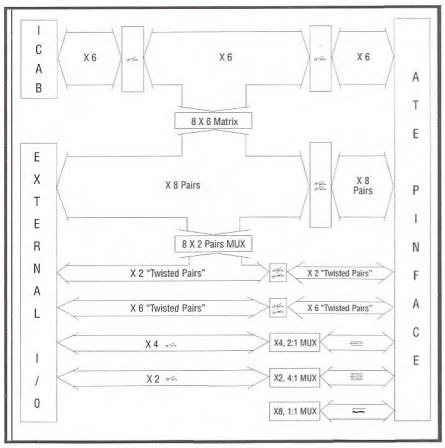
The 16-way header connector pinout matches that of the DAS/UTP and ICR69 card and can be used to connect to the ICAB. By 'extending' the ICAB in this way means that access can be gained to any test point on the in-circuit pinface. Alternatively, this can be used as a general purpose 6-wire highway.

The ICAB lines can also be routed via a 6 X 8 matrix which will take any of the 6-wire bus lines and connect them to any of the eight external I/O lines. These in turn can be connected to the pinface.

The external I/O connector provides access to sixteen signal pairs which can be routed via double pole isolating relays to the pinface. Also access, via isolating relays, to the common line of each of the 2-way and 4-way MUX groups.

Two signal pairs from the external I/O connector can be routed via an 8 X 2 Pairs MUX to the pinface.

On 5305, a ribbon cable connector is provided on the rear breakout panel. It can be used for connection to the GPSR 40-way connector for external I/O routing.



GPSR Block Diagram

Specification

Voltage Switching Capability
100 V DC or AC peak.
(200 V DC or AC peak for 2:8 MUX pairs.)

Current Switching Capability
0.5 A.

Power Switching Capability
10 W.

Carry Current
1 A.

Path Resistance
External I/O to pinface : 0.5 Ω max.

MUX I/O to MUX I/O : 0.6 Ω max.
MUX I/O to common : 0.8 Ω max.

Isolation Voltage
100 V DC or AC peak.
(200 V DC or AC peak for 2:8 MUX pairs.)

Bandwidth
10 MHz.

GENERAL PURPOSE RELAY CARD

- Provides power and signal switching
- Software controlled
- Switchable for external instrumentation

Two cards providing software controlled interconnections between the Unit Under Test (UUT) and instrument or function cards.

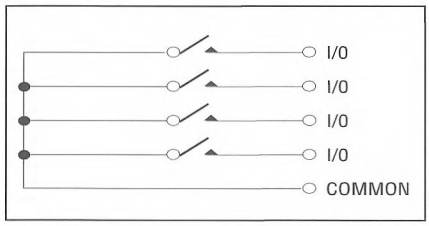
The General Purpose Relay card provides software controlled interconnections between the UUT and instrument or function cards. Two versions of the GPR are available:-

- Dry reed switching card (GPR[D]).
- Mercury wetted relay switching card (GPR[W]).

The mode of operation is similar and the hardware of each type differs only in the type of relays fitted.

Each GPR card contains 32 individually-controllable relays arranged in eight groups, each group consisting of a 1 x 4 matrix. The relays are capable of switching analog signals or power to parts of a circuit under test.

Software support for symbolic variables is provided enabling multiple relay operations. The choice between the use of a GPR(D) or a GPR(W) card depends on the nature of the loads/signals to be switched and the switching characteristics.



GPR Relay Group

Specification

Voltage Switching Capability
150 V DC or AC peak.

Current Switching Capability
GPR(D): 0.75 A.
GPR(W): 1 A.

Power Switching Capability
GPR(D): 10 VA.
GPR(W): 50 VA.

Carry Current
2 A DC or AC rms.

Frequency Range
DC to 10 MHz.

Open Switch Isolation
Not less than 125 MW.

Isolation Voltage
150 V DC or AC peak.

TELEPHONE TEST SUITE

A suite of cards providing line interface, ringing supply, dialling and acoustic interface facilities for testing telephones and their associated PCBs.

The telephone test suite of cards consists of the following four dedicated cards for telephone printed circuit board and telephone testing.

- Telephone Line Interface Card (TLI)
- Telephone Ringing Supply Card (TRS)
- Telephone Dialling Card (TDC)
- Telephone Acoustic Interface Card (TAI)

To complete the stimulus, measurement and switching requirements for both telephone printed circuit cards and complete telephones additional cards are required from the standard range of 5300 series test resource cards.

These are as follows:

- Waveform Synthesizer Card (WSC)
- Digital Multimeter Card (DMM)
- Analog Sampling Card (SAM[HR])
- General Purpose Relay Card (Dry Reed or Mercury Wetted Relays) (GPR[D] or [W])

The TLI card connects the telephone or associated PCB under test to the ATE and provides all of the switching required for the waveform source and measurement instruments.

The TRS card provides a ringing supply and a constant current source. The frequency and amplitude of the ringing signal can be programmed or preset values may be used. A set of four presets allow different combinations of frequency and amplitude to be set up on the card. The output is differential from the transformer output stage. The constant current source output current can be set to four preset currents for recall by software as required. A programmable current is also provided. The source is powered from an external 48V supply normally (up to 60V maximum) and is isolated from the ATE 0V.

The TDC card provides a facility for testing the dialling functions. It provides a tone detection and analysis circuit for tone dialling. The detection facility consists of circuitry which can detect a valid DTMF tone and signal the digit dialled. The circuitry provides tone separation so that the level and frequency of each tone can be measured. Sequences of digits can be detected to test telephone memories and last number redial up to 40 digits.

A measurement facility is provided to detect a dialled digit from a telephone under test.

The card can measure a large number of parameters for dialling including make time, break time, make voltage, break voltage, IDP, make current, break current etc. Sequences of digits can be detected to test telephone memories and last number redial up to 40 digits.

The TAI card provides three microphone pre-amplifiers. The amplifiers provide an interface between external microphones to a DMM or SAM(HR) card for measurement. The amplifier gains are user preset via potentiometers to allow calibration against external instruments.

Specification

TELEPHONE LINE INTERFACE CARD

Telephone Feed Characteristics

Types	Voltage and current.
Voltage Source	30-60 V, programmable
Polarity	Normal & reversed, programmable.
Feed impedances	DC Direct. DC via 400 Ω. DC via 1500 Ω DC via 1900 Ω.
Constant Current Source	
Current	5mA to 125 mA, fully software programmable or user preset-able currents selected by programming.
Voltage limit	30-60 V.
Line interface	
Telephone line impedances are programmable as follows.	
High impedance	>200 kΩ.
600 Ω	600 Ω resistive load.
ZREF1	370 Ω + 620 Ω in parallel with 310 nF ZREF (UK).
ZREF2	220 Ω + (820 Ω in parallel with 115 nF).
Ring load	800 Ω + 3 µF.
Balance load	300 Ω + 300 Ω + center tap.
Short circuit	2 Ω.
Coupling	DC coupling to loads: 2 µF + 2 µF capacitor in A and B lines (Non polarised). 220 µF + 220 µF capacitors in A and B lines (Polarised electrolytic).
Line simulators	0 km, 0.5 km, 7.0 km, 7.5 km & external.

TELEPHONE RINGING SUPPLY CARD

Voltage	10-100 V rms.
Resolution	Better than ±1 V rms.
Accuracy	Better than ±2 V rms, ±2% of value.
Frequency	20-25 Hz at 10-80 V, programmable. 25 Hz at 10 V-100 V, programmable.
Resolution	Better than 1 Hz.
Accuracy	Better than ±2 Hz, ±2% of value.
Cadencing	2 ON and 2 OFF times, presettable.
Range	Programmable from 1ms to 999 ms.
Accuracy	Better than ± (5 ms+5% of value).
Series	Direct, 1500 Ω, 5100 Ω, resistance 6600 Ω.

TELEPHONE DIALLING CARD

Pulse (Loop Disconnect) Dialling Measurement

Pulse measurement	Up to 1999 ms.
Make, break accuracy	Better than 0.1 ms.
Volts accuracy	Better than 100 mV.
Inter digit pause (IDP) time	2000 ms max.
IDP accuracy	Better than 0.1 ms.
Sequence length	40 digits maximum.

DTMF Dialling Measurements

Tone Splitting Using TDC Card	
Frequency accuracy	Better than 0.1%.
Amplitude accuracy	± 0.5 dBm.
IDP time	1-1999 ms.
IDP accuracy	Better than 3 ms.
Accept frequency	Within 2.5% of nominal.
Reject frequency nominal.	Greater than 3.5% from
Minimum tone	30 ms.

duration	
Max. allowable dropout	20 ms.
Max. allowable twist	±10 dB.
Memory testing	40 digits maximum.
Fourier Analysis Using	SAM(HR) Card
Frequency accuracy	Better than 0.1%.
Amplitude accuracy	±0.1 dBm.
Twist accuracy	±0.1 dB.
Tone duration	Better than 1 ms.
IDP time	1-1999 ms.
IDP accuracy	Better than 1 ms.

TELEPHONE ACOUSTIC CARD

Acoustic Interface	
Loudspeaker Drive	
No of interfaces	2.
Gain	Presettable.
Total maximum power	2 W.
Loudspeaker impedance	8 Ω Minimum.
Microphone Interface	
No. of interfaces	3.
Gain	Presettable.
Typical microphone Z	600 Ω nominal.
Microphone power	0-10 V DC adjustable by preset.

ISDN TEST SUITE

- Key layer 1 test facilities at all interfaces
- Data link setup control (layer 2) and basic call setup functions (layer 3)
- Protocol standards include EDSS1, VN4 and customized versions
- Direct programmable access to B-channel data for Bit Error Rate testing

The ISDN test suite consists of a number of cards which provide the functional hardware and software to test S-interface and U-interface (Basic Rate) and S(2M) (Primary Rate) ISDN equipment at layers 1, 2 and 3 of the OSI reference model.

The key layer 1 test features include activation/de-activation, pulse shape verification and INFO signal debug. The latter provides time-stamping and event sequence checking of the activation/ deactivation processes. Pulse shape verification enables checking that a pulse on a specific interface is within the defined limits.

Layer 2 and 3 testing includes D-channel protocol handling for basic call setups to CCITT or AT&T standards. Non-standard D-channel protocols can also be programmed to provide analysis and debugging of the D-channel data transfer.

Direct access to B-channel data is available with the ability to re-route it to other ATE system test resources – for example for digital-to-analog or analog-to-digital testing of an ISDN telephone, the B-channel can be routed to the ATEs SAM(HR) [High Resolution sampling card] which can provide both analog and digital data generation and analysis. A-law and μ-law encoding/ decoding is available. In the case of completely digital products, B-channel bit error rate testing can also be performed.

Test configurations for interface power consumption, voltage reversal, phantom power feed characteristics are provided.

Features

- Activation/de-activation (Layer 1)
- Pulse mask comparison
- Power feed characteristics
- Power consumption characteristics
- Data link setup control (Layer 2)
- Basic call setup functions AT&T, CCITT (Layer 3)
- Incoming call / Outgoing call setup
- Info analysis/time stamping
- Customized D-channel protocol facilities
- B-channel access
- BERT testing of B-channels
- B-channel loopback facility
- External line simulator access

ISDN Control Card

The ISDN Control (ISDNC) card provides the protocol handling for layers 1, 2 and 3. Activation/ de-activation functions are held in EPROM and actioned by one of the three resident microprocessors.

Higher level protocols are handled by either hardware or firmware. Programming facilities to enable customizing protocols are available. Clock circuitry and control is provided for the ISDN Load card via a standard interface. Provision has also been made for accepting external synchronization, a programmable gate array design provides the ideal flexibility for dealing with a variety of test configurations.

The B and D-channels can be routed to different functions on board plus interfaced directly to other ATE resource cards. When performing A/D, D/A half channel tests, the SAM(HR) card can provide the digital data generation and measurement for the 64 kbit/s data stream from a B-channel. Clocks and timing are sourced by the ISDN Control card. Similarly, if a BERT test is being performed, the B-channel data can be accessed by one of the on board micro-processors and suitable error checking or data verification actioned.

The D-channel data is automatically stored for analysis either during program run time, or at a later time during program generation debug. Similar facilities are available for analyzing the activation and de-activation functions; 'INFO' states can be time stamped and the sequence checked for correct operation.

Interface Cards

The interface to the ISDN lines is provided by various ISDN Load cards, each with the associated test and termination loads fitted. One card (ISDNS) is of the S-interface type, and three cards (ISDNU-2B1Q, ISDNU-Up0 and ISDNU-4B3T) are of the U-interface type. Switching, buffering and routing of signals to other ATE test resources for parametric tests are available under high level software control.

A programmable supply path with reversal relays, power feeding transformers and current consumption measurement facilities can be utilised, the ATE's internal user supply being the power source. Switching is available for adding in external loads or external line simulators.

Together with the ISDNC card, the interface cards can be configured, under program control, to interface to the various ISDN configurations TE, NT and LT equipment.

When testing ISDN linecards, extra load cards could be added to the system (up to four per ISDNC card) to test channels in parallel.

High Speed Sampling

To perform the ISDN parametric tests at layer 1, the ISDN test facilities requires a high speed sampling facility. This test resource is provided by the SAM(HS) card which can capture and analyze the ISDN interface waveforms, perform mask generation, waveform measurement and analysis.

Applications

The following is a set of examples of ISDN test solutions provided by IFR

S-Interface ISDN phone.

Specified Tests:-

- Simulation of NT side
- Activation / Deactivation
- Overlap outgoing call setup
- Key press verification
- En Bloc outgoing call setup
- Incoming data call setup
- Rx Sensitivity (including BERT)
- S pulse mask test

S/U-2B1Q Interfaces ISDN Network Termination Unit

Specified Tests:-

- Simulation of LT and TE.
- Activation / Deactivation
- Wiring Polarity Integrity
- S and U pulse shape
- U Total power
- Maximum range (BERT over U line length max.)
- Return Loss
- Current Feed

S/U-4B3T Interfaces ISDN Network Termination Unit

Specified Tests:-

- Simulation of LT and TE.
- Activation upstream/ downstream
- Deactivation
- S-interface voltage measurement
- Current limit tests - for various loads on S-interface.
- BERT over U maximum line length.
- S-interface emergency power

U-2B1Q Interface ISDN Line Termination Unit

Specified Tests:-

- Simulation of NT and PCM 2M interface.
- Activation / Deactivation
- Wiring Polarity Integrity
- Power feed loading
- U pulse shape

- U Total power
- Maximum range (BERT over U line length max.)
- Return Loss
- Current Feed

PABX Testing

Interfaces tested:-

- Analog (voice)
- S (Basic rate)
- T (Basic rate)
- Up0 (Basic Rate)
- S(2M) Primary rate

Specified Tests:-

- Activation / Deactivation (layer1)
- Data link setup (layer2)
- Call setups - Incoming and Outgoing.
- BERT - both B channels simultaneously.

Call setup combinations:-

- S ↔ S, S↔ Analog
- T↔ S, T↔ Analog
- S (2M) ↔ S, S(2M)↔ Analog
- Up0 (DECT)↔ S

Protocols used:-

- EDSS1, VN4 over S and S(2M).
- Proprietry over S.
- DECT proprietry over Up0 interface.

Primary Rate Interface Testing

A configuration using the ISDNC, TDI & PEC provides a solution for interfacing to the ISDN Primary rate (2M) interface.

Specification

S (B23514)

S-bus Interface Input
AMI to I.430, 2B+D channels, 2-wire.

S-bus Interface Output
AMI to I.430, 2B+D channels, 2-wire.

Loads
No load, 5.6 Ω, 100 Ω, 400 Ω. Power load 200 Ω/2 Ω and external.

Terminations
Termination resistor 100 Ω and no termination.

Line Simulator
Switched access for external line simulator.

Buffer Amplifier
X1 and X10.

Switching
DC power routing for UUT and current monitoring.

U-2B1Q (B23512)

Interface
U, 2-wire to ITU G961.

Linecode
2B1Q.

Channels
2B + 1D.

Loads
No load, 135 Ω , 135 Ω balanced, AC/DC coupling.

Power Load
2 x 4k7 2W.

Termination
135 Ω, no termination.

Line simulator
Switched access for external line simulator.

Buffer Amp.
X1 and X10.

Switching
DC power routing for UUT, voltage and current monitoring.

Up0 (B23516)

Interface
U, 2-wire Half-duplex burst mode ("ping-pong")

Linecode
AMI

Channels
2B + 1D.

Loads
No load, 100 Ω , 100 Ω balanced, AC/DC coupling.

Power Load
2 x 4k7 2W.

Termination
100 Ω, no termination.

Line simulator
Switched access for external line simultor.

Buffer Amp.
X1 and X10.

Switching
DC power routing for UUT, voltage and current monitoring.

U-4B3T (B23517)

Interface
U, 2-wire to FTZ Guideline 1 TR 220

Linecode
4B3T

Channels
2B + 1D.

Loads
No load, 150 Ω , 150 Ω balanced, AC/DC coupling.

Power Load
2 x 4k7 2W.

Termination
150 Ω, no termination.

Line simulator
Switched access for external line simultor.

Buffer Amp.
X1 and X10.

Switching
DC power routing for UUT, voltage and current monitoring.

ISDNU-2B1Q INTERFACE CARD

2B1Q- B23512/2

This card is used to interface to the ISDN 2-wire U-2B1Q interface (ITU-G691). It is configurable either as a network terminator (NT) or as a line terminator (LT).

The U-interface features are controlled via the IOM interface by the ISDNC card which routes B and D channel data to and from the U-interface. The other load and test features of the card are controlled via the M5300 interface.

The 2B1Q card provides a number of loads and terminations for various test configurations and parametric tests on the U-interface. This includes both phantom and normal power feed facilities. Stimulus and measurement paths are used to route signals to and from the other instrumentation cards in the M5300 system.

The card consists of the following functional blocks :

- U-interface circuitry
- Power feed circuitry
- Termination and measurement loads
- Differential to single-ended amplifier buffer
- Line simulator access

U-Interface Circuitry

The U-interface contains a 15.36 MHz crystal for a local clock source, and a phase locked loop circuit to synchronize with the incoming 2B1Q signal. It also contains line conditioning components and the interface transformer, which can provide a DC phantom voltage feed.

The U-interface circuitry can be isolated from the rest of the card under software control.

Power Feed Circuitry

This takes an external voltage supply from the pinface and routes it either as a phantom feed over the U-interface or as a power source_2 via the pinface. The circuitry can also provide voltage reversal, in-line chokes, current monitoring resistor and internal and external feed loads. Connections from suitable monitoring points can be routed to a single pair of wires on the pinface for onward routing to, for example, the system DMM.

Termination and Measurement Loads

The power feed and the U-interface transceiver circuitry are routed into the 2-wire test bus load block which provides both terminations and test loads. The DC termination can be 135 Ω or open circuit, and the AC termination can be either 135 Ω or a balanced 135 Ω in the U test bus block.

The card also contains balanced loads and a return loss bridge required for measuring Longitudinal Conversion Loss and return loss.

Amplifier Buffer

The differential signal of the U-interface has to be conditioned before routing to single-ended measurement instruments in the M5300. This amplifier buffer can do this. It has a x1 and X10 gain setting for improved resolution for performing parametric gain measurements.

Line Simulator Access

An external line simulator can optionally be inserted in the signal path of the U-interface test bus. Connections are made at the pinface. Alternatively the same connections can be used for the insertion of a line attenuator.

Specification

Maximum phantom supply feed rating
60 mA

Maximum termination resistance rating
0.5 W

MATRIX SWITCH CARD

MSC - B23108/2

The Matrix Switching Card (MSC) contains two relay matrices, each of which is configured to provide a 16 x 4 selection.

The card can be configured to provide either two 16 x 4 matrices or one 32 x 4 matrix. The MSC cards bandwidth, isolation, switching capability and crosstalk performance make it ideally suited to most applications requiring a true matrix.

Specification

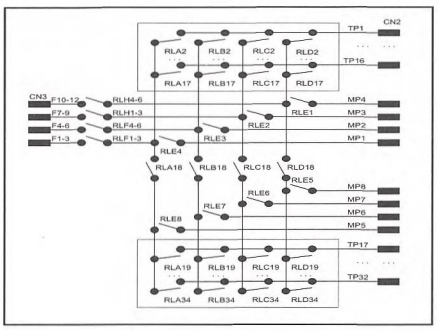
Bandwidth
20 MHz

Max Switching Voltage
200 V DC and AC peak

Max Switching Current
0.5 amp

Max Carry Current
1 amp

Max Switchable Power
10 VA per channel



MSC Card - Switching Diagram

PROTOCOL EMULATION CARD

PEC - B23540/2

The PEC card provides both serial and parallel interfaces capable of a wide range of uses for communications with UUTs.

The card contains a high performance, integrated multi-protocol processor (68302) incorporating three versatile serial communications controllers each independently capable of supporting UART, HDLC, BISYNC and DDCMP modes or variants of these.

The digital interface provides 16 parallel drive / sense lines with input / output protection. The serial interface facility supports RS232C, RS422A, V10, V11 and TTL level interfaces. The telecommunications highway comprises 3 x RS485 bi-directional links for interconnecting with ISDN and telecommunications data interface test resources.

Hardware Features

- High performance Motorola 68302 Integrated Multi-protocol Processor (IMP) running at 16.384 MHz.
- IMP incorporates 3 versatile Serial Communications Controllers (SCC's) each independently capable of supporting UART, HDLC, BISYNC and DDCMP modes or variants of these. Some ISDN functions including rate adaption to V.110 are also supported.
- Memory includes 256 kbytes ROM and 1 Mbyte RAM with 0 wait state operation. There is also 32 kbytes of RAM for interfacing to the ATE system.
- Serial Interface System supports RS232, V10, V11 and TTL level interfaces independent of SCC protocol selected.
- Telecommunications highway comprising 3 x RS485 bi-directional links.
- Digital Interface with 16 parallel drive / sense lines with output / input protection.

Software Facilities

The software to control the PEC features are TPG based through profiles with the additional capability to store PEC information in disk files for fast re-load and execution.

Customization of the PEC is achieved by loading application specific information in the form of FPGA files and code overlays to support those interfaces not readily achieved with the standard features.

A single Xilinx FPGA site on the PEC supports 3042 type devices as standard. Larger scale FPGAs can be accommodated if required by customer applications.

INTERFACE LOGIC

RS-232C
Four outputs and four inputs which can be routed to any SCC. Maximum rate is 38.4 kbaud.

RS-422A
Four output pairs and four input pairs which can be routed to any SCC. Outputs have a global tri-state control, maximum rate 6.5536 MHz.

TTL
Four outputs or four inputs in pairs. Each pair has a tri-state control, maximum rate is 6.5536 MHz.

RS-485
Three pairs for inter-instrument communication.

Parallel
16-bit I/O, low / high bytes have individual tri-state control.

Isolation
With the exception of the RS485, all interfaces are relay isolated.

MIL-STD-1553 BUS

1553 - B23087/2

The 1553B card allows the tester to interface with units under test which use the MIL-STD-1553 bus.

The card provides two data buses (BUS A and BUS B) via DIN 41612 mixed contact coaxial connectors. More than one card can be used in the tester.

The 1553B card DDC MIL-STD-1553 Advanced Integrated Mux (AIM) BUS-61553 hybrid device. This is a complete MIL-STD-1553 Bus Controller (BC), Remote Terminal Unit (RTU) and Bus Monitor (BM). It provides dual low power transceivers and complete BC / RTU / MT protocol logic, and MIL-STD-1553 to host interface unit and a fully memory mapped 8k x 16 RAM.

The card provides coupling transformers to both BUS A and BUS B and provision is made for direct coupling resistors on each bus.

Three modes of operation are available with the 1553 card. In all cases any response is stored for future comparison :

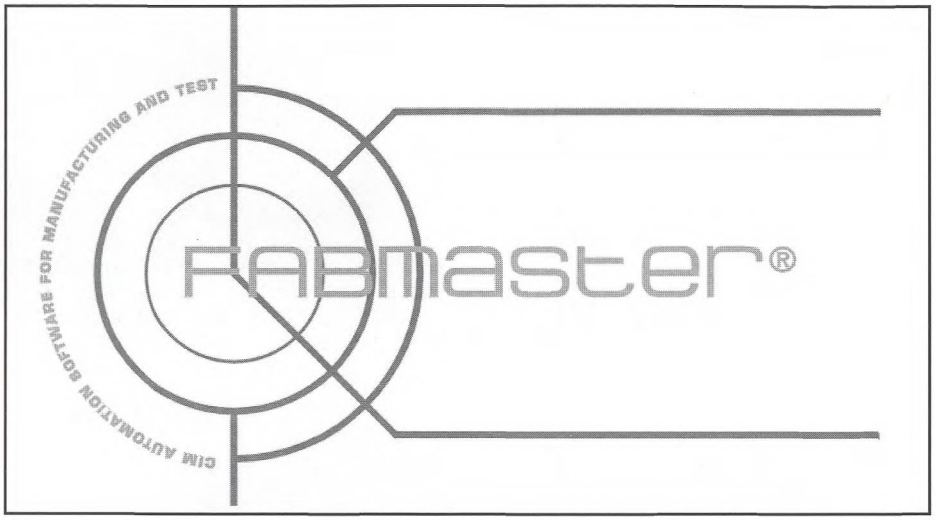
- Single, which transmits a single message or block of messages once.
- Run 'n' times, which transmits a single message or block of messages for a specified number of times.
- Continuous, which transmits a single message in a continuous loop and control is returned to TPG to continue execution of the main test program. A STOP command must be sent to halt the transmission. In this mode a replace command can be used to update a command or data word 'on the fly'.

Command messages can be written out in full, or loaded from predefined string arrays or downloaded from an external file containing arrays.

Specified words can be read back and compared individually (a data mask is available) or blocks of words can be loaded into a specified array.

FABmaster
CAD Conversion Software

Software integration of design and test to reduce fixture and program time-to-market



The Design Process

The vast majority of today's Printed Circuit Boards (PCBs) are designed on a Computer Aided Design (CAD) workstation. This approach offers a number of significant benefits, for instance the ability to simulate the design and analyze a board layout for any potential conflicts. The result is that design cycle times have been reduced with a corresponding increase in quality.

There are now upwards of thirty different CAD packages in use within the electronics industry, with a matching number of CAD formats in which data is stored.

Manufacturing Links

The CAD files used to describe the design are essential within the manufacturing process. Each of these processes typically requires a subset of the data held within the CAD files, from basic board layout through to component selection and placement.

The test process is no exception. In-Circuit and Manufacturing Defects Analyzers test each component in turn, taking measurements against a nominal value or truth table. Computer Aided Repair uses a graphical representation of the board to identify component failures. All of the information regarding the type and value of each component, the connectivity and the physical location is contained within the CAD file. The key is accessing the data.

The IFR Solution for Test

Given that there are over thirty different CAD systems in common use today, it is difficult for each platform within the production process to accept the ever changing formats outputed by these systems. The link is an integrated software solution converting and manipulating data for use by each element of the process.

The market leader in this sector is FABmaster™, based in France. IFR use a dedicated version of the software to link to various CAD systems and convert data into a format suitable for the range of Automatic Test Equipment (ATE). This data format is then taken by IFR's Computer Assisted Program Generation Software (CAPG) to produce the fixtures and programs required by the ATEs.

This combination of software offers a number of significant improvements over previous methods. Firstly, it is quicker, achieving a lower time-to-market. Secondly, it is accurate. IFR FABmaster ensures that the data used to manufacture the board is the same data as that used for testing. By improving both time-to-market and quality, test costs are reduced and the effectiveness of the ATE platform is improved.

FABmaster Extensions

The basic IFR FABmaster software can be extended to support other elements of the manufacturing process. The time-to-market and quality benefits that FABmaster brings to the creation of ATE fixtures and programs are also relevant to surface mount and automated placement systems.

Specification

Core IFR Package

IFR .CB FABmaster Station for Windows (requires Windows 95, NT or 3.1 with Win32 extension)

Includes :
- 1 CAD Input Processor (must be specified from list below)
- FABmaster Graphics Engine
- Job Screen
- ASCII Text Editor
- Attribute Library Management
- HPGL Plot File Output
- Bed of Nails Fixture Design
- IFR .CB Output Processor

CAD Input Processors

ACADEMI
CADENCE ALLEGRO
CADES-G
CADNETIX Versions E & F
CADSTAR for Windows
CALAY V04
CASE VANGUARD
COMPUTERVISION AUTOBOARD/THEDA
DDE ECAD (IPL format)
DEDALE
DIF (Clink)
DOCICA (Alcatel)
ENCORE PCB (Xynetix)
GENCAD (Mitron)
H.P. PCDS
I.B.M. CBDS Version 4
I.B.M. CBDS Version 5
INTERGRAPH AT Designer (EIF)
MENTOR
ORCAD (DOS)
ORCAD (Windows)
PADS
P-CAD PDIF
PRISMA
PROTEL
REDAC - Cadstar (CDI), Maxi & Redboard
SCICARDS
THEDA - Incases
TOPCAD
ULTIBOARD
UNICAD
VERIBEST (FATF)
VISULA (CADIF)
VUTRAX
ZUKEN CR 3000

Other Options

MRP/BOM Input Setup
HPGL Schematics Viewer
IFR INCITE Output Processor

ATE Support Services

A comprehensive & dedicated network of Support & Service providing a key element of IFR's automatic test equipment capability



- Comprehensive World-wide Support
- Telephone & On-site Applications Support
- Dedicated Training Facility
- Standard Scheduled Product Training Courses
- Ad-hoc Special Courses
- Field Service Calibration and Repair

From many years experience in the supply of ATE, IFR Ltd is aware that a well designed and reliable product is only a part of the package that must be offered to customers.

To provide a responsive and professional support service, IFR Ltd operates a Customer Services (CS) organization designed to interface and focus our customer care environment. CS covers all aspects of customer support (technical and sales) providing an unrivalled service to all its users world-wide. A software HelpDesk logs and tracks all queries to ensure a controlled response to our customer enquiries.

Part of CS is the ATE Support & Training group whose prime task is to provide a total support environment on all aspects of our ATE products.

User Support

Teams of experienced ATE Engineers are available to provide technical support on all applications and aspects of our ATE products. Support can be provided over the telephone or Engineers can visit our customer sites world-wide to ensure a rapid response and maximum utilization of our systems.

The group also organizes regular User Group meetings to ensure customers are kept up-to-date with new developments, information and test modules. Similarly Usernet provides a 24 hour a day dial-up service where users can obtain and exchange information and application notes over a modem link. This service is complemented by the CS Web site.

Training

A comprehensive range of training courses is structured to meet the needs and demands of ATE users. These practical courses are designed to ensure users derive maximum benefit from their ATE in the shortest possible time. Courses are run at our Stevenage Training Centre, our overseas offices or can be located on customer sites. As well as the range of scheduled courses, special Ad-Hoc courses to meet particular customer requirements can be prepared.

Scheduled courses cover system operation, basic maintenance, program writing, fixture build and debugging techniques.

Service & Maintenance

A further aspect of customer support is the ability to provide a dedicated service organisation for the responsive repair to ATE systems through module exchange or on-site customer visits. Extensive experience in the field of measurement technology has resulted in an organization structured in the calibration and maintenance of ATE and proprietary test equipment.

The UK service organisation has accreditation to BS 5750 (ISO 9000) and AQAP 4. Safety testing to meet the requirements of IEC348, 950 or 1010 can also be carried out with full certification.

Our NAMAS calibration laboratory is one of the largest accredited laboratories in the country specializing in electrical, electronic and communication system parameters. In addition, IFR Ltd is accredited to UKAS for EMC testing in compliance with the EC directive.

The prime UK service centres are located in Luton, Stevenage in England and Donibristle, Scotland.

All IFR ATE are covered by an initial 12 month's warranty that can be extended by a range of flexible and cost effective maintenance agreements designed to meet the requirements of individual customers.

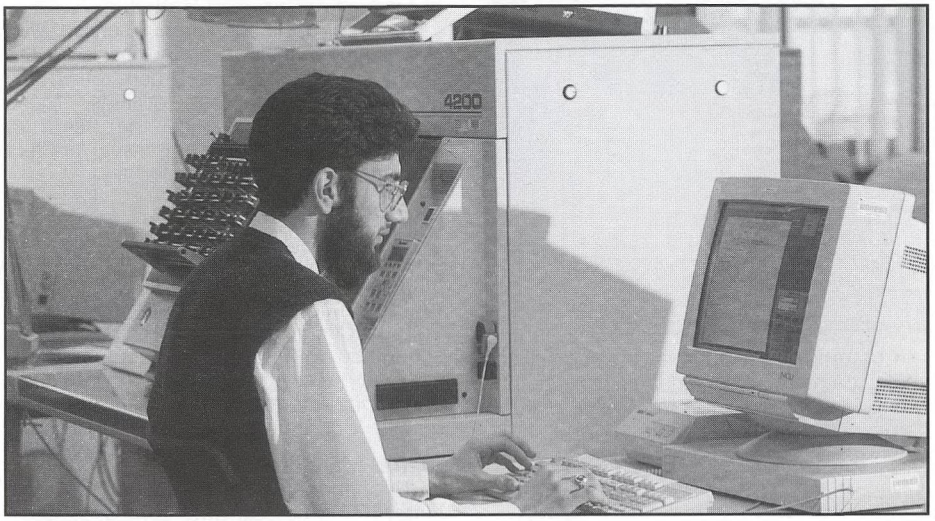
Overseas Support

Our local representative backed by the UK service organisation will carry out the overseas support of the IFR ATE. Each representative will hold a full spares package for first line maintenance and in most cases will provide repair and calibration facilities.

Alternatively, the user can be provided with a complete support package to enable a high level of self sufficiency in the general maintenance and care of the equipment supplied. The package consists of a maintenance training course tailored to the customer's system configuration, a comprehensive spares package and if needed the services of a support engineer on-site.

ATE Programs, Fixtures and Services

Comprehensive test solutions from Europe's largest test bureau, from fixture kits to turnkey test solutions, including test management



- Comprehensive design to build solutions from MDA to System Test
- Fixturing solutions including kits, customization, and turnkey projects
- State-of-the-art techniques: Boundary Scan, Q-Test, and simulation
- Designs from circuitry and instrument cards to custom ATE.
- Design for Test consultancy, installation and training
- Software tools include CAD data handling, and PAL to ICT modelling

Introduction

IFR delivers unrivalled Automatic Test Equipment (ATE) support services from the largest fixturing and programming bureau in Europe. Three sites located in Donibristle (Scotland), Stevenage (England) and Gunding (Germany) provide professional test services meeting every customer need.

The bureau has a unique close involvement with IFR' ATE development and support groups. This experience is coupled with extensive knowledge of PCB and equipment manufacture and test requirements. Teams of experienced and professional engineers hold an industry and technical knowledge that is supported by a broad range of state-of-the-art tools and techniques. These ensure innovative and cost-effective solutions to the challenging test requirements in today's market.

Supporting all IFR's ATE, a wide variety of service options are available. These include fixture kits and parts, data preparation, test fixture/program development, consultancy and turnkey fixture, tester and test system development.

Capabilities and Services

The comprehensive range of ATE support includes:

- Fixture, program design and build
- MDA, in-circuit (ICT), functional, combinational and system test
- Fixture kits and customization
- Specialist/turnkey fixturing
- In-line or automated handling
- CAD data conversion
- Digital simulation support
- Boundary scan, Q-Test™
- PAL (JEDEC) to ICT modelling
- User instrument card design
- Instrument drivers
- Test consultancy (design for test)
- Complete test solutions, including custom ATE design
- Board test and repair, engineering outsourcing
- Installation and training

Extensive use of computer-assisted techniques ensures cost-effective hardware and software solutions.

Test Solutions

Part of the IFR Customized Applications and Systems business unit, the bureau has over 1,000 man years of experience in hardware and software. This experience delivers wide-ranging capabilities in the complex areas of electronics test.

IFR test solutions are to be found throughout the international spectrum of industry applications. Working closely with the customer ensures appropriate definition of specific needs, and project managers oversee every stage of an order until is it complete. For larger systems, the bureau can provide solutions to every aspect of a project, including planning, hardware, software, and mechanical design and integration.

Fixtures and Programs, from MDA to System Test

A structured level of service is offered from basic fixture design, through continuity and passive testing, to full powered-up functional or system test. In-circuit solutions can be derived from manual lists or CAD/CAM. For functional or combinational test, solutions can be developed from test or design specifications, or from working with the customer.

Automated data handling, including CAD conversion and CAPG (Computer Assisted Program Generation) maximizes accuracy and test program fault coverage. These techniques also produce designs for precision-drilled fixtures with optimized lead lengths.

Test programs can link to IFR *i*-Base Information Management System for data logging/analysis.

Annual agreements for test partners ensure cost-effective test solutions.

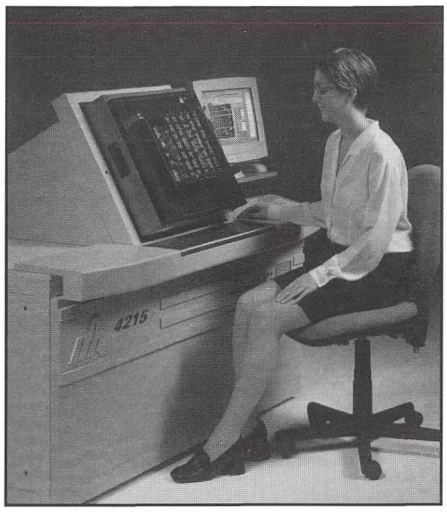
Fixtures kits and Customization

High quality fixture kits and adaptors for IFR ATE and all other popular ATE systems. Fast turnaround, low costs, and 'right first time' are ensured by the use of networked systems and semi-automated wire-wrapping machines.

4200/System 80 fixture adapters, for

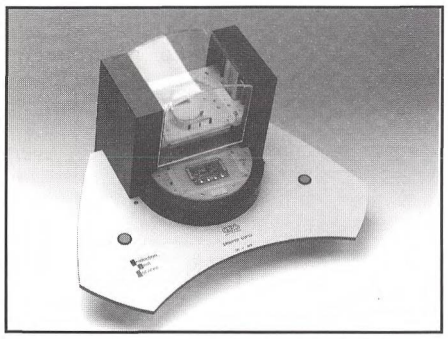
ATE Programs, Fixtures and Services

example, protect fixturing investment for System 80 users moving to 4200 series.



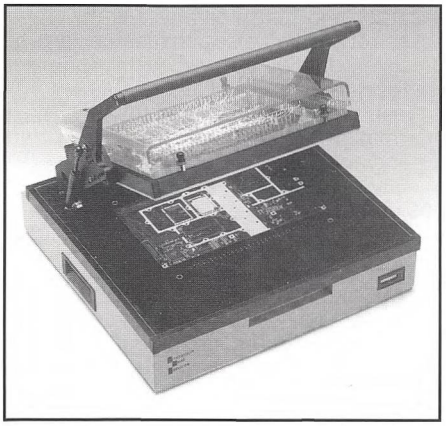
Customization options include silicon seals, carriage plate legends, twisted pair wiring, ground screens, removable circuitry cards, operational counters, and hold-down gates.

Specialist Fixturing



In addition to standard vacuum fixtures, the bureau offers specialist or turnkey solutions, including pneumatic fixtures. Project examples include: in-circuit or functional fixturing for use with the customer's own test equipment, and fixtures for flexible printed circuit boards, dual-height, double sided probing, and dual bay pneumatic applications.

On standard fixtures, the bureau provides hold-down gates, interfaces for in-line test facilities, and pneumatic actuators for button pressing or switch toggling. These techniques minimize manual intervention during automatic testing.



Safety critical applications include live mains testing or high power (e.g. 8000 VA), including adjustment or access with power applied.

In-Line or Automated Handling

IFR offer a full consultancy service, with test engineering on a project basis for the design and implementation of (fully) automated in-line test facilities. These solutions typically reduce the need for operator intervention, improving product flow, feedback, and test reliability.

CAD Data Manipulation

For ICT programs, data can be supplied as CAD/CAM, or manually derived information. Translation capabilities ensure that data can be used from a wide range of Printed Circuit Board (PCB) layout and schematic capture systems. Automatically generated test programs and fixture drilling and wiring information improves accuracy, quality, and time to market.

Digital Simulation Support

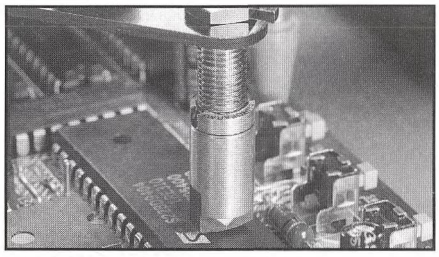
Through the use of its SIMlink™ software suite, IFR is able to offer simulation post-processing facilities for loading industry standard digital simulators, including LASAR, HILO, and MENTOR, as well as older simulators such a CADAT. SIMlink's open file formats allow it to be customized to other simulators, either by the user or by IFR simulation experts.

Boundary Scan

Automatic test generation is available for interconnect testing of boundary scan devices. Test generation may be for device level testing and mixed, real, and virtual pin circuit test.

IFR 4200, 5200 and 5300 series testers fully support the IEEE 1149.1 Boundary Scan standard for overcoming access and device testability problems.

Q-Test



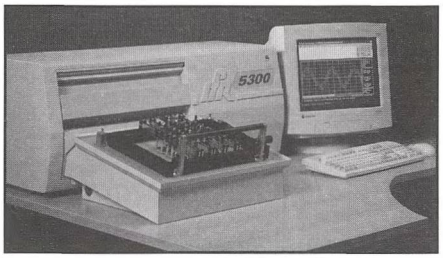
Open-circuits form a large category of manufacturing faults. The Q-Test technique is supported across the IFR ATE range. Developed and patented in-house, Q-Test detects open-circuits on custom or complex devices for which no access or data is available (for full test generation). Q-Test probes fitted to fixtures that incorporate a top-hat allow the technique to be fully exploited, cutting program development time and improving test coverage.

PAL (JEDEC) To ICT Modelling

For special custom devices including PALs, GAL, FPLAs, and ASICs, test modules are developed using PAL-link PLD test program generator. These modules supplement the standard library for in-circuit test.

Instrument Design

Where off-the-shelf test capability is not readily available, IFR offers an instrument design service for the 5300 series tester family.



A number of cards are available, forming the basis of cost-effective solutions. Instruments can be created using the core facilities of the GPIO and GPINST cards. Previous solutions include MIL STD 1553B bus testing, ARINC 429, dual programmable resistance, high performance switch matrices, telecom applications, I^2C, and ISDN testing.

Test Consultancy

A comprehensive consultancy service is offered based on the extensive test and design experience in the bureau. Support ranges from advice on the suitability of a board for fixturing, to in-depth Design for Test analysis and reports.

Complete Test Solutions

Complete test solutions are developed with the customer to ensure the most effective solution within budget. Solutions may include design, management, labor outsourcing, test, networking and information management components.

The basis of any solution will be industry standard items. For hardware and software this may include PC cards, GPIB/ VXI instruments, and test language control software. This ensures full support over the life of the system.

Instrument Drivers

The bureau has many years experience in writing software drivers for test and measurement instrumentation. This includes third-party equipment in addition to IFR hardware. Many drivers already exist in the IFR drivers library. New drivers can be written in any major control language.

Board Test and Repair

For ATE users with a temporary overload of their test facilities, a board test and repair service is offered using the customer's own programs and fixtures. IFR is ISO 9000 accredited, and has anti-static test facilities.

Outsourcing test engineering provides access to fully supported test solutions from a wide expertise base, at the same time reducing overhead costs.

Installation and Training

The ATE training department provides an extensive range of ATE related courses. The bureau can supplement these courses, including information on test techniques. On-site installation or acceptance is an option with deliverable items.



Systems and Service

The Systems and Service Group in IFR provide a range of value added services in the test and measurement market. With local centers around the UK the service operation offers customers a fast turn-around capability for calibration and repair, handling over 20,000 different types of equipment. Specialized solutions to meet specific customer needs are addressed by the Systems Group based on a wide experience in hardware and software design.

By working in partnership with its customers, the Systems and Service Group is committed to providing access to the highest levels of technical and project support.



SYSTEMS AND SERVICE

i-Base 9.2
Information Management System

TPG 9.6
Software Programming System

Atlas 9.7
Software Programming System

Calibration and Repair 9.8
Service

EMC Testing 9.10
NAMAS Accredited Test Facility

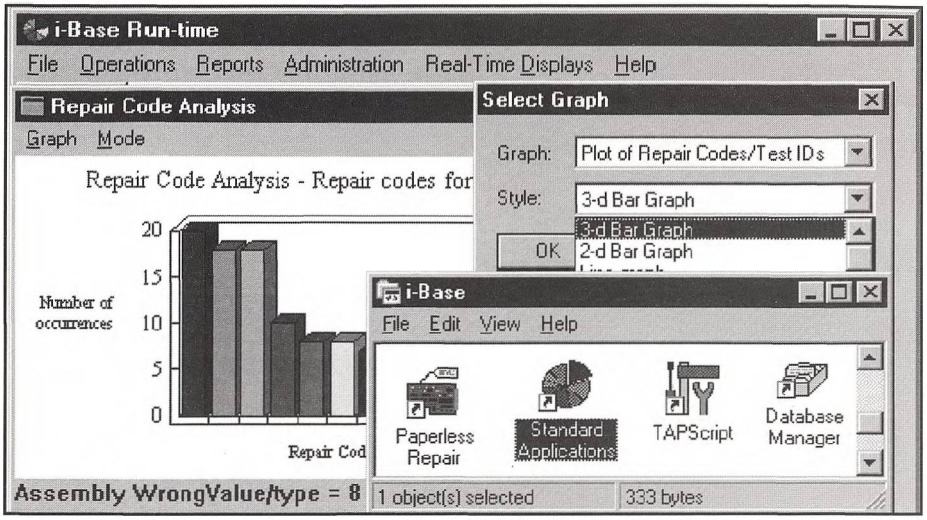
Power Sensor Calibration 9.11
Automated Calibration System

MPT 1327 9.13
Bulk Call Generator

Turnkey Systems 9.14
Solutions Tailored to Your Needs

i-Base
Information Management System

i-Base delivers solutions to meet wide-ranging manufacturing, test or repair requirements



- Real time information, on-line
- Interactive reporting
- Paperless repair, with repair hints
- Extensive off-the-shelf capability
- Transform data into information
- Process, management intelligence
- Increase rework/repair effectiveness
- Ready to run from day one

Introduction

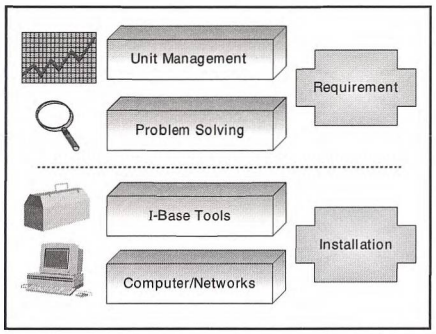
The *i*-Base Information Management System is an environment and tool set for managing process and product data. It releases the appropriate, relevant and timely information vital for competitive advantage in today's marketplace.

For organizations that manufacture, test or repair, *i*-Base delivers a diverse range of solutions: long-term traceability, day to day production and process reporting, line control and assisted repair. A central, flexible database provides real time data collection, reporting and multi-user access. Paperless, Assisted Repair adds value to historic information. Extensive reporting makes appropriate information available on any desktop.

Feature Summary

An *i*-Base tool set is ready to run on day one. It delivers accurate, reliable, real-time management and problem solving information, when and where needed.

Capabilities and off-the-shelf functionality are the result of long experience in industry, listening to customer requirements in test and manufacturing.



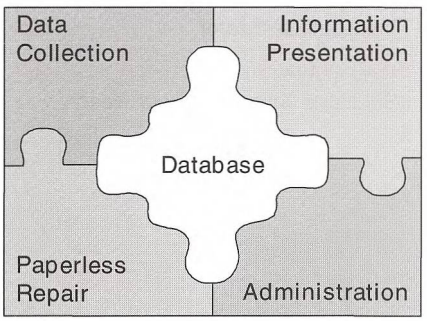
The tools for automating data handling and presentation include:

- data collection
- information presentation
- Paperless Repair
- administration

Powerful real-time database technology makes information available on-line, and data is stored without summarization. Units (for example Printed Circuit Boards) are uniquely identified by type and serial numbers, ensuring accuracy.

Paperless Repair shares information and intelligence between users, with full unit histories and repair hints on-line, This reduces both time to repair, and the number of repairs necessary.

The comprehensive report set includes trend, process status, and performance analysis as standard. Flexible options mean that potential problem areas can be identified and targeted at the earliest possibility. ASCII text reports produced on request are ready for printing, or, if preferred, for importing into a presentation package. A full graphical user interface, with graphical report reframing and data visualization, is available with the PC version running under Windows.



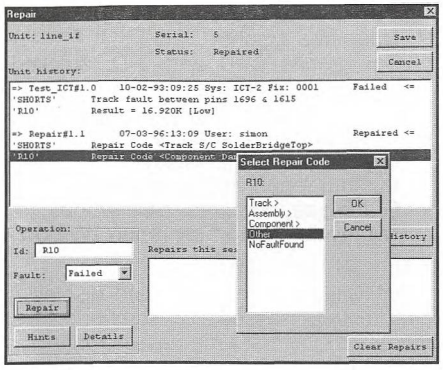
Database management tools include archive and restore. Configuration options include system set-up, repair codes, time windows, and data groups.

In systems that include IFR Automatic Test Equipment (ATE), *i*-Base supports file serving where available. Test programs, controlled and stored on a host, are transferred between tester and host when required.

Data Collection

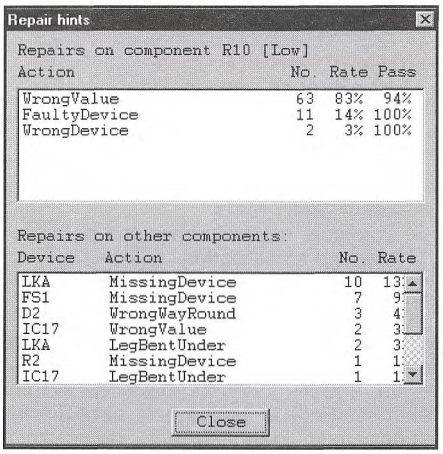
Data relevant to the Units Under Test (UUTs) can be logged automatically (for example from test equipment), or entered at a screen (for example, Paperless Repair). Each unit type has a database containing data on individual units. There are no restrictions on the amount of data that can be stored, nor on the sequence or type of events recorded.

Paperless Repair



This is an interactive environment where operators enter a unit identifier to view and analyze full unit histories on screen. Fault and optional device information (stock codes, nominal values) is displayed. Users may be grouped (for example) as Repairer or Inspector, and allocated Repair Codes or Fault Categories. These codes, used to classify test failures, are entered from bar-code or on-screen lists. Comments can be added per repair session, or (depending on user configuration) per repair.

Assisted Repair



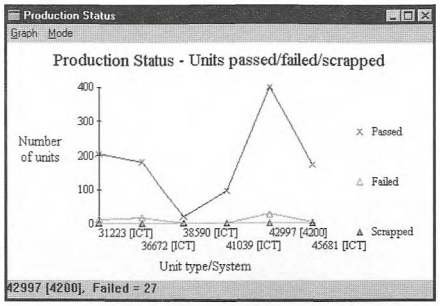
Repair Hints, or Assisted Repair is integral to Paperless Repair. Actions that successfully resolved an identified test failure are displayed in two ordered lists.

In above example, R10 on unit Line_IF failed low. The first list shows repairs to R10, the second shows repairs to other components. In each case, the number of attempts and the corresponding success rate are shown in order of success.

Computer Aided Repair

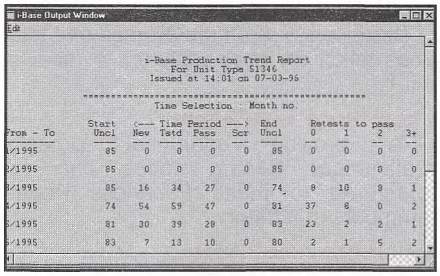
The CAD data for the UUT can be processed for use by the Computer Aided Repair module. This presents the repair technician with a layout of the UUT. Fault information from the Paperless Repair can be used to highlight the location of faulty components, thus improving repair times.

Reporting



Standard Reports provide management and problem-solving information at process and unit levels. ASCII text reports are produced, scrolled to the screen, and saved to a file. Analysis can focus on batches or time windows, and on individual or groups of unit types. Repair analysis focus on individual or groups of Repair Codes. Options are common across all platforms. Graphical report reframing is an additional feature available under Windows.

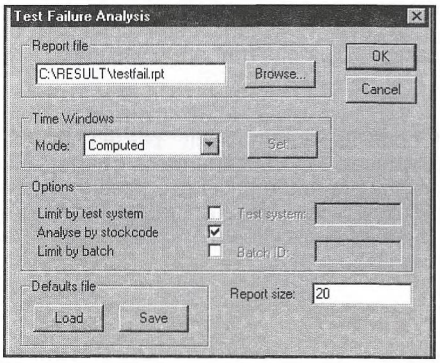
Production Status



Status information on units repaired or tested within a time window is displayed:

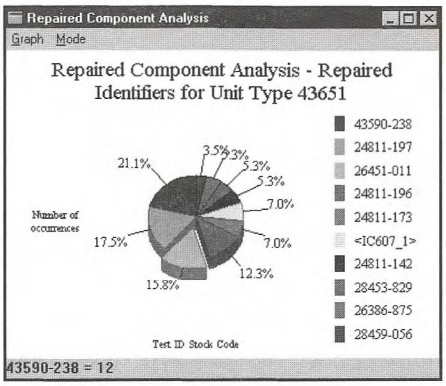
- UUTs outstanding (tested, but not yet passed or scrapped) at the start and end of the time window.
- Units passed/failed (quantity or %)
- Re-tests to pass
- Units scrapped (quantity or %)
- First time passes (quantity or %)

Production Trends

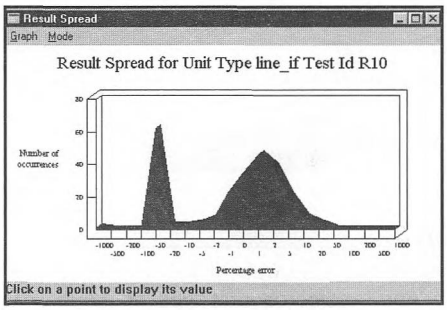


Production status information, for up to twelve equal or arbitrary time periods is presented. The initial report can be re-formatted to provide a number of period-based graphs, according to the categories listed above in production status.

Test Failure Analysis

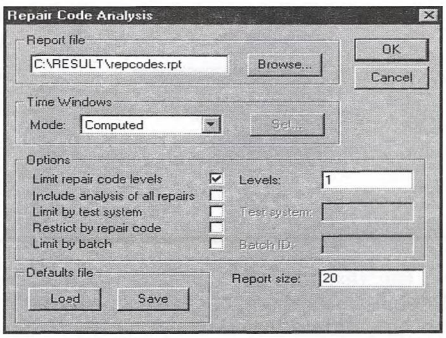


For a number of reports, including test failure analysis, data selection options include test system, batch, stock code (for example 24811/142), and component name (R1, R2).



Test failures are in four ordered lists: analog, digital, opens/shorts, and all failures, each with individual and cumulative percentages. This quickly identifies components (typically four or five out of several hundreds) causing the majority (typically 90%) of failures.

Result Spread

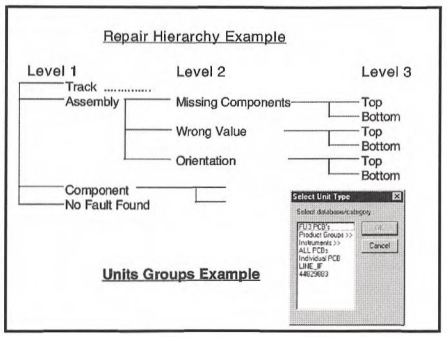


This report shows the spread of values measured during test for a specified analog component and unit type. The histogram auto-scales around the component's nominal value and tolerance.

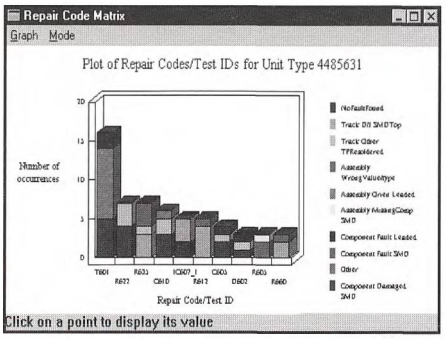
Repair Code Analysis

Repair Codes and hierarchies, and unit groups and hierarchies are fully user

definable. Data options for repair-based analysis include code levels, test system, batch and repair code selection.



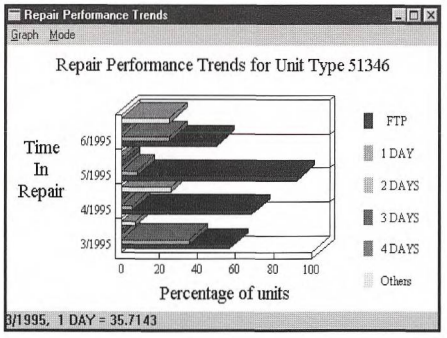
Repair code analysis shows how often Repair Codes or group of codes (for example Assembly/SMD/Top_Side) has been used. The ordered list shows individual and cumulative percentages.



Repaired Component Analysis

For a selected unit type or group, this report displays how often components (identifier or stock code) have had repair action. The ordered list shows individual and cumulative percentages.

Repair Code Matrix

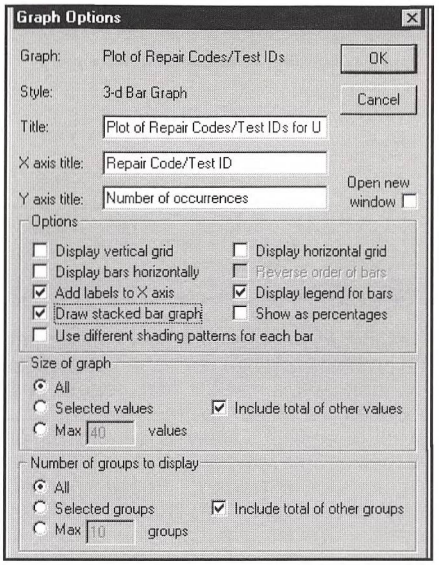


The text form of this report correlates Repaired Components and Repair Codes as an ordered two-dimensional matrix. Unit and Repair Code inclusion options are available.

Repair Performance

Performance is defined by first time pass rates and time to repair. Data for each selected unit type is categorized by the number of time periods in repair. These periods are user configurable, for example minutes, hours, or days.

Repair Performance Trends



Repair performance information, for up to twelve equal or arbitrary time periods is presented.

Repair Time Analysis

This displays both the average and total times taken (by each repairer) to repair a unit type.

Repair Code Text Dump

To provide additional process intelligence, Repair Codes can be configured to make Paperless Repair comments mandatory.

Repair Comment Dump

At the end of a session where a unit has been repaired, a comment can be added at the Paperless Repair screen. These comments provide additional feedback, leading to improved repair performance.

UUT Time in Test

For each individual unit, this shows:

- date and time of first test
- if or when it passed or was scrapped
- elapsed time since first test record

In particular, this report lists and locates units that are stuck in-process. Work in Progress control is improved by identifying units that have not been scrapped or passed, i.e. units that are uncleared.

REPORT REFRAMING

Windows ONLY. ASCII information from reports is automatically passed to the graphical report generator. Charts and graphs are automatically re-sized to fit the Window, can be transferred to other Windows applications, or printed directly to a suitable printer.

Specific styles and reframing options depend on the report, but can include:

- Line, area graphs
- Bar graphs (2-D and 3-D, stacked, vertical or horizontal)
- Pie charts (normal and expanded)
- Grids, patterns, shading
- Legend and label display
- Custom report and axes titles
- Graph size, contents, data groups
- Over-write/create new report Window

REAL TIME INFORMATION

Bar Charts (all platforms): displaying units tested, passed, or scrapped, first time passes, % first time passes, units in a repair loop, and repair codes. Options include update intervals, analysis by test system, and repair code.

UNIX, displaying units tested first time, and first time pass rate. Alarm messages are displayed if user-defined thresholds are breached.

DATABASE MANAGEMENT

The Database Manager provides:

- Data archive by age, status, or selective data, and database restore
- Database export/rebuild, optimization
- Database optimization
- Database creation, deletion
- Selected data record extraction
- Database information listing
- Database option setting

SYSTEM ADMINISTRATION

Administration tools include:

- Overview database contents
- List unit test and repair history
- Configure system and user details
- Learn repair hints
- Configure time windows and defaults
- Manage stock codes
- Change administration password

Critical features are password-protected. System details include printer definition, bar code and test data format set up, and file location specification. For Paperless Repair, passwords, data display options, unit identifier, and repair code input methods can be defined.

Time periods may be configured to suit business periods and weeks, and stored as defaults. Stock code management includes editing or creating stock files, and converting IFR .cb (CAD) data.

Units, batch and Repair Code (or Fault Category) configuration ensures reports provide information relevant to the process and units being monitored.

Repairs can be learned from an entire database, or from a time/date window. Using 'repeat at intervals' keeps intelligence up to date for Repair Hints.

Specification

i-Base running under Windows features a graphical user interface, with report reframing. Windows 3.1, Windows for Workgroups, Windows 95, and Windows NT (Intel) are supported.

PC's running under Windows

An *i*-Base system is typically divided into several main operational functions:

- Database host
- Data collection (datalogging) host
- Paperless Repair workstations
- Reporting and Administration workstations

The database host is a central location for databases and configuration information. Paperless Repair, Adminstration and Reporting station users log into the database host. A datalogging host collects data from test equipment.

In a small system, all functions may be on a single PC or IFR Tester. In a larger multi-user system, Paperless Repair is often separate from Administration and Reporting. Similarly, data-logging and database hosts may be separate, although a datalogging host will transfer all information to the central database host.

Windows can be used to share data between PCs, as can other standard networking solutions.

IFR supplies *i*-Base software on 3.5 in disks, with a parallel port security dongle for each licence. Other hardware and software is typically supplied by the customer.

REPAIR, REPORTING, AND ADMINISTRATION

Software Licences per PC used

Microsoft Windows (NT, 95, Workgroups, 3.1)
i-Base - specify 59000/288
Option for user application development:
i-Base TAPScript - specify 59000/289
For Ethernet networking support:
Windows sockets interface, for example:
PCTCP (Windows 3.1)
Microsoft TCPIP (Windows 3.11 for Workgroups)

Hardware

Typical PC specification
486/66 or higher
8 MB RAM, 500 MB Hard Disk
Parallel Port
VGA or higher video adapter
Mouse recommended
For handling bar-coded units:
Wedge interface Bar Code Reader
For Ethernet networking support
3-Com 3C509 Combo-card/other network card

DATALOGGING/DATABASE SERVER

Software Licences per PC used

Microsoft Windows (NT, 95, Workgroups, 3.1)
i-Base - specify 59000/288
For Ethernet networking support:
Windows sockets interface, for example:
PCTCP (Windows 3.1)
Microsoft TCPIP (Windows 3.11)

Hardware

A typical PC for up to 6 datalogging processes:
486/66 or higher
8 MB RAM, 500 MB Hard Disk
Parallel Port
VGA or higher video adapter
Mouse recommended
This datalogging PC may also be used as the central database server for lower volume applications, typically up to 6 logging devices.
For up 25 datalogging processes, including database serving, or for separate database serving:
Pentium/100 MHz or higher
16 MB RAM, 1 GB Hard Disk
Parallel Port
VGA or higher video adapter
Mouse recommended
For Ethernet networking support
3-Com 3C509 Combo-card/other network card

IFR ATE

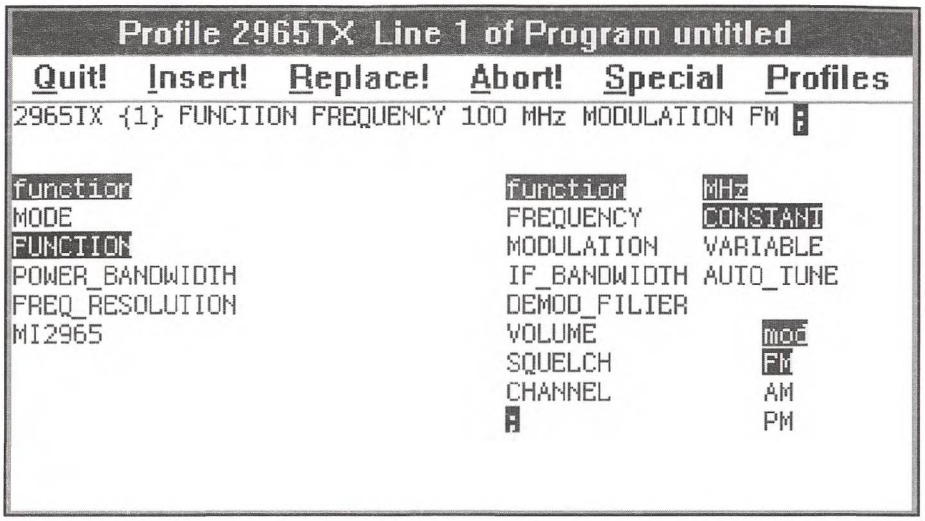
All IFR automatic test systems are *i*-Base capable, either as a host or through a network connection. Older test systems can also be used with *i*-Base, directly or via a serial connector.

Other Equipment Connection

Other equipment is typically connected for data collection and analysis via serial lines.

TPG
Software Programming System

Reduce program development and maintenance costs for GPIB/VXI, IFR 5200 and 5300 series testers



- Instrument drivers and macros
- Reduced programming development costs
- GPIB / VXI control software
- Generates syntactically correct statements

Although normally used independently the 29XX series of radio test sets can be combined with a PC running the windows based TPG software to form a powerful system which can be programmed and controlled in a similar way to ATE.

IFR's TPG Software language consists of high-level, natural language statements. It is not ASCII-text based. Test programs are built up from 'profile' statements which consists of a series of options which go to build a complete statement. For example, the figure shows part of the 'IFR 2965' profile and a sample statement produced by it. Depending on the option chosen for one field, TPG presents the appropriate set of options for the next field.

Because TPG guides the programmer through the profile selections, TPG statements are always syntactically correct and there is no need to compile the test program. It also means that statements can be executed 'live'. This is a tremendous aid for program development and debugging because instrument set-ups can be tried out very quickly. Changes can be tried 'in-situ' without modifying the test program. If a larger change is required you can execute it immediately without having to wait for a compilation to finish.

One of the key advantages of TPG for use as a GPIB controller is that you can define your own profiles. User (or 'Macro') profiles are easy to design and generally only take a few hours to make, from creation to working. The profile editor lets you set out the various selection options and define which selections lead into which others. You can write a 'mini' TPG program which is run every time a profile selection is executed. By using this facility you can create profiles for your own GPIB instruments, or simply customize the language. However you don't have to write all your own GPIB profiles. IFR maintains a library of instrument profiles. This contains profiles for the most popular IFR units and includes the 2945A and 2965A series test sets. The library also includes profiles for instruments from third party manufacturers which can be written on request.

TPG is written in C++ and runs on a PC under Windows. Minimum PC requirements are 386, 4 Mb, VGA, National Instruments PCIIA or PCMCIA GPIB cards.

Features

- Sets up the instruments repeatedly
- Profile based
- Natural language statements
- Generates syntactically correct statements
- No compilation required
- Profiles can be executed 'live'
- Profiles can be customized
- Language compatible with 5200 and 5300 series ATEs.

Benefits

- Accurate instrument set-up
- Consistent instrument set-up
- Less time wasted generating test programs
- Test programs are easily understandable
- No time wasted debugging syntax errors
- No time wasted compiling
- Quick test program debugging
- New instruments can be easily added
- Easily upgraded to the 5200 and 5300 series ATEs.
- Reduced program development and maintenance costs

Applications Software - Radio Testing

Two radio applications software programs using TPG are available for testing radios using the 2965A and 2966A radio test sets. The first, RADIO65, tests PMR radios. The software provides an on-screen configuration menu which allows the test limits and parameters to be fully (and simply) programmed by the user. (This facility can be password protected). The second, GSM66, tests both analog and digital cellular radios. This supports TACS and GSM protocols. The two applications also provide links to IFR's *i*-Base Information Management Software for full results analysis and archiving.

Features

- Allows radios to be tested using low skilled operators
- Supports PMR and cellular radios
- Sets up the instruments repeatably
- Easily configured for different radio types
- Results optionally logged to *i*-Base Information Management System

Benefits

- Reduced running costs
- Accurate instrument set up
- Consistent instrument set up
- Automatic results gathering

http://www.ifrinternational.com

ATLAS
Software Programming System

ATLAS standard IEEE Std 716-1989. Automatically creates correct ATLAS syntax

```
C          ================================================== $
 C         ================================================== $
 C         Tests on the DVS1-A load resistor R6 (1K8) using MSC. $
 C         ================================================== $
 C         ================================================== $
  001625  OUTPUT, C'Testing Resistor R6   \CR\' $
  001629  VERIFY, (RES INTO 'MEAS_RES'), DC SIGNAL USING 'DMMDC', NOM
          1800 OHM UL 2000 OHM LL 1600 OHM, RES MAX 2000 OHM, CNX HI
          J1-C25 LO COM $
  001633  IF, NOGO, THEN $
 C          Resistance (B1) test failed $
  001641    OUTPUT, C'Resistance test result  (R6)   =        ',
            'MEAS_RES': 5 :   2, C' OHM   FAIL\LF\\CR\' $
  001645    CALCULATE, 'PASS_RESULT' = FALSE $
  001649  ELSE $
 C          Resistance (B1) test passed $
  001657    OUTPUT, C'Resistance test result  (R6)   =        ',
           'MEAS_RES': 5 :   2, C' OHM   PASSED\LF\\CR\' $
  001661  END, IF $
```

- Reduced programming development costs
- GPIB / VXI control software
- Automatically generates syntactically correct statements
- IEEE Std 716-1989 Standard ATLAS

The Abbreviated Test Language for All Systems (ATLAS) is a high level structured language for Automatic Test Equipment capable of expressing test specifications and test procedures independent of any specific test system. It is an internationally recognized standard from the IEEE which is widely used for military and avionics testing.

A variant of the IFR test language TPG, IFR-ATLAS, is available which provides a cost-effective edit and run-time system for programmers using the ATLAS language. IFR-ATLAS is based upon the ATLAS IEEE standard 716-1989.

Program debugging is simplified with IFR-ATLAS. Different statement types are displayed in different colors - black for ATLAS statements, green for ATLAS comment statements, blue for TPG instrument commands and red for unrecognized statements.

ATLAS test programs can be imported from or exported to other ATLAS systems using ASCII text files. Imported test programs are automatically checked for syntax errors.

IFR-ATLAS reduces the time wasted compiling test programs because, like TPG statements, IFR-ATLAS statements are 'tokenized' and can be executed 'live'. The benefit of this is that no compilation is required and debug times are drastically reduced.

Other programming and debug features include the ability to renumber automatically lines of code including any GOTO or BRANCH statements, a task normally performed laboriously by hand, and the ability to use any existing TPG facilities and features.

IFR-ATLAS also simplifies the task of communicating with instruments. When ATLAS talks to a resource using a multi-function verb (e.g. APPLY, MEASURE, VERIFY, etc.) the resource will have to perform a series of single-action verbs in a predefined order. IFR-ATLAS uses the TPG macro commands to perform this hierarchical software, which allows the programmer to mix ATLAS and TPG instrument statements in a form acceptable to the ATLAS rules.

The IFR-ATLAS system can link with virtually any hardware which can be connected to a standard PC. Many common interfaces, including GPIB, VXI and RS-232, are supported as standard, while the software has been developed to allow easy integration of totally new devices using Windows DLL calls. Communications can be made over Ethernet using TCP/IP protocols to external logging facilities. IFR-ATLAS has in-built links to the IFR *i*-Base information management system.

The ATLAS program extract shown here shows a section of a program which uses an ATLAS defined resource (DMMDC) to make a RESISTANCE measurement on the Unit Under Test.

System Requirements

Minimum Recommended PC Requirements
386, 4Mb, VGA, Windows 3.1

Recommended PC Requirements
486, 8 Mb, SVGA, Windows 3.1

Disk Usage
5 Mb for ATLAS and Profiles

Supplied Software Format
3.5 in DOS Compatible Floppy Disks

GPIB Interface
National Instruments PCIIa or PCMCIA

Language Standard
IEEE Std 716-1989

Features

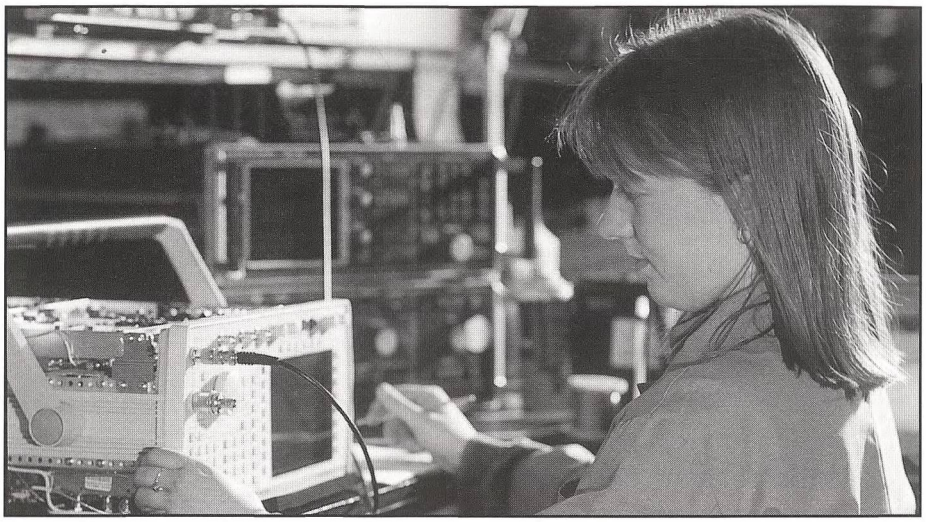
- Microsoft Windows Application
- Always creates programs with the correct ATLAS syntax.
- No compilation required
- Modify and run immediately
- Statements can be executed 'live'
- Language can be customized
- Able to import ATLAS ASCII programs from third party vendors
- Language compatible with 5300 series
- Same 'look and feel' as TPG
- Can interface to 5300's open architecture or to international standard GPIB and VXI buses.

Benefits

- Eliminates time wasted debugging syntax errors
- No time wasted compiling
- Reduced program maintenance costs
- Low cost of training and ownership
- Quick test program debugging
- Can create, edit, debug and execute an ATLAS test program in one environment
- New instruments can be easily added
- Users are not locked into proprietary hardware standards.
- Requires no other software add-ons

Calibration and Repair Service

One of the largest third party ISO and NAMAS calibration facilities in the UK



- Full instrument calibration and repair to BS5781, ISO 10012, conditions traceable to National Standards
- NAMAS calibration
- Service over 20,000 different products from over 450 manufacturers
- IFR ATE field service calibration and repair
- Calibration and maintenance agreements
- All repairs carry 90 days warranty with the option to extend
- Full service and spares support for IFR products

The IFR calibration and repair service is one of the largest organizations of its kind in the UK.

We provide a fast, efficient calibration and repair service for over 20,000 different types of equipment from a wide range of manufacturers around the world. These range from older systems to the latest technology, and cover from DC to Microwave.

Our service includes full maintenance and calibration contracts as well as express calibration with a choice of three day turnaround, 24 hour service or 'while you wait' calibration and repair service for IFR products.

To ensure a fast turnaround, we hold over $1,5 million worth of spares on site, which are also available to customers who wish to undertake their own repairs. We have also installed an advanced computerized management and progress system to ensure that equipment turnaround is minimized and calibration or repairs are undertaken promptly.

Competitive Maintenance Contracts

IFR is able to provide competitive maintenance agreements that will cover all your equipment calibration and repair needs, whatever the make.

These come in three levels of Maintenance Agreement from calibration only to calibration plus full repair.

The benefits to you are:

- Reduced administration
- Reduced costs
- Inventory management
- Priority service

All calibrations include certification and results. All repairs carry a 90 day warranty.

Normal cover is based on a seven day turnaround door-to-door service. However, a 'while-you-wait' repair facility, together with an express service offering a three day turnaround on IFR products is also available at a small premium. For equipment requiring repair, turnaround is typically 7 to 14 days.

In addition, there is an ad hoc service for companies who do not require a formal maintenance agreement.

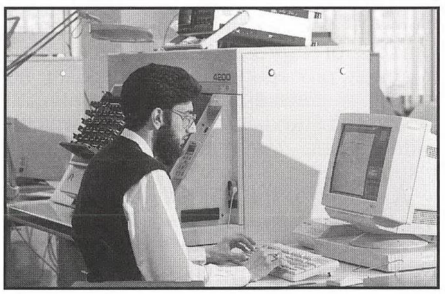
Extended Warranties

On IFR equipment we are able to offer warranties that extend the standard cover – up to seven years – with or without calibration. If you want to take advantage of this service, please ask your IFR sales engineer for a quotation at the time of purchase.

Advanced ATE Service

The IFR ATE Service team is the largest in the UK and provides calibration and repair on IFR ATE systems throughout the world.

A full range of spares is carried for all systems, and upgrades can be undertaken on-site.



There is also a choice of maintenance contracts with guaranteed next day response times covering both hardware and software. An ad hoc customer calibration and repair service is also available.

NAMAS Calibration

Our NAMAS calibration laboratory Lab. 006, located at Stevenage, has now been in operation over 25 years.

It is one of the largest commercial accredited laboratories in the UK and specializes in electrical, electronic, communication and microwave system parameters covering DC to microwave frequencies.

NAMAS EMC Testing

European Community regulations require effective testing for EMC emissions and immunity. IFR is able to provide a full range of tests at our Stevenage site.

The resources available include an outdoor Open Area Test Site (OATS), a GTEM cell for RF susceptibility, and a full range of ESD, transient and burst testing equipment. The depth of tests available run from simple testing through to full reports and consultancy.

Accreditation to National and International Standards

We have BS5750 Part 2 approval which is also equivalent to the International Standard ISO9002 and European Standard EN29002. All calibrations comply with BS5781 conditions.

In addition, our Quality Management has been assessed by the MoD in accordance with BS5750 Part 2, ISO9002 and EN29802 (MOD registration CNAC 13LM01).

Safety testing to meet the requirements of IEC 348, 950 and 1010 can be carried out with full certification including engineers' reports and test results.

In-Depth Service Experience

IFR has many years experience in working with a wide range of organizations from one-man repair shops to multi-national companies.

As a large service organization, our staff offer in-depth experience and specialist knowledge covering a wide range of technology from over 500 manufacturers' products. This ensures that the highest standards are maintained for every product that we receive. We service all types of products and systems covering the total spectrum from DC to optical, analog, digital and microwave technology.

A Complete Door-to-Door Service

Our own fleet of purpose-built vans will collect and deliver all your equipment (UK mainland only). These vans have special racking installed with padding and strapping to eliminate the need for the customer to individually pack any item of equipment.

In the UK (mainland) the IFR Service organization operates from four major locations, namely Luton, Chelmsford, Portsmouth and Dunfermline, Scotland. All UK customers' enquiries should be made to Luton (telephone 01582 33866) or Dunfermline, Scotland, (telephone 01383 824057).

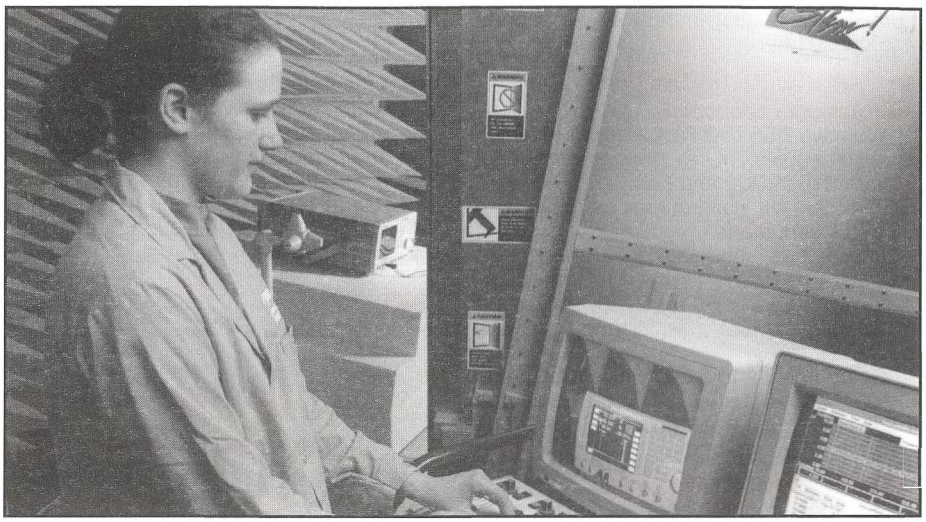
A comprehensive range of measurement parameters are undertaken by the IFR Service Business Unit.

These include:

- DC Voltage, DC Current, DC Ratio
- AC Voltage, AC Current, AC Ratio
- Resistance, Inductance
- Capacitance, Dissipation Factor
- AC Power, Phase Angle, Power Factor
- AC/DC Transfer
- Frequency
- Time Interval
- Radio Frequency Voltage
- RF Admittance, RF Impedance
- Amplitude & Frequency Modulation
- Attenuation Measurement
- Radio Frequency Power
- VSWR, Voltage Reflection Coefficient
- Waveform Analysis

EMC Testing

Fast time to market for new products



- NAMAS accredited test facility
- Indoor and outdoor test sites
- Helpful advice and consultancy
- CE compliance testing

More Than Just a Test House

Having carried out many hundreds of EMC product certification tests, we at IFR have the necessary experience and expertise to give you the test support you need.

But testing is only a part of the service we offer. Our consultant engineers will work with you to determine the reasons for any noncompliance and implement remedial actions to save you the time and frustration associated with a failure - an important factor when time to market issues are critical.

Cost Saving Service

Our competitively priced packages range from short pre-compliance tests offering quick testing at a minimum cost through to full NAMAS approved testing with free certification.

Details of results are provided with each package and a more comprehensive report covering full details of the tests and the results is offered as an optional part of the package.

Test Capability

A pass certificate from IFR is all you need to validate your CE marking for EMC.

Our NAMAS accredited EMC test capability (laboratory number 1215) offers you indoor and outdoor test sites capable of handling a full range of tests on electrical and electronic equipment to the requirements of EN 50081-1, EN 50082-1, EN 55011, EN 55014, EN 55022 and EN 60555-2.

Responsive, Personal Service

We recognize that EMC testing is vital to your product development and, depending on our workload, we can usually arrange for testing to start within a few days of your initial enquiry.

Our EMC test manager will discuss your requirements with you and offer friendly advice on test procedures and expert practical guidance on EMC related techniques such as grounding, shielding, etc.

Over 60 Years Experience

Our 60 years experience in designing and testing electronic equipment to meet national and international standards is available to you at no extra charge when you use our EMC testing service.

EMC Test Capabilities

EMC Emissions

Conducted Emission
9 kHz to 30 MHz
AC Supplies to 13 A/250 V
DC Supplies to ±250 V

Absorption Clamp
30 MHz to 1 GHz

Magnetic Field Strength
9 kHz to 30 MHz

Open Area Test Site
30 MHz to 1 GHz
3 m and 10 m site

AC Harmonics
Current to 6 A
Harmonics to 2 kHz

EMC Immunity

RF Susceptibility
GTEM Cell (1 MHz to 1 GHz)

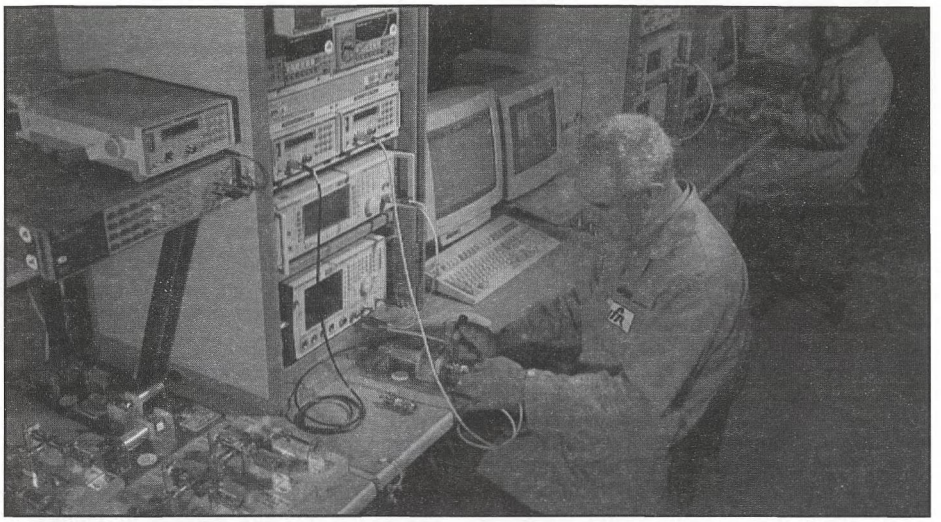
Electrostatic Discharge
Up to ±17 kV air discharge
Up to ±8 kV direct discharge

Fast Burst Transient
Pulse with 5 ns rise time, 50 ns duration between ±0.25 and ±4 kV
Capacitive clamp and ground plane

Combination Wave Surge
Pulse with 1.2 ms rise time, 50 ms duration, 0 - 6 kV open circuit voltage.
Pulse with 8 ms rise time, 20 ms duration, 0 - 3 kA short circuit current.

Power Sensor Calibration System

Automated calibration system for IFR and third party power sensors



- Based on the IFR factory calibration system
- Modular system covering frequencies 30 kHz to 46 GHz
- Results traceable to national standards
- Measures Cal Factor, VSWR and Linearity Factor

The Microwave Power Sensor Calibration system designed by IFR is based on the system that is in operation at its own production facility. The system is modular, and can be configured to calibrate a variety of power sensors and detectors, including the IFR EEPROM detectors and sensors from third party vendors.

The System

The core of the modular system has been designed to calibrate power sensors and detectors in the range 10 MHz to 26.5 GHz. Additional options are available for frequencies outside this range. A list detailing the sensors and detectors that can be calibrated is contained in the Specification section at the end of this data sheet.

The parameters provided by the system are detailed below. Where appropriate, they are measured against frequency and a printed table is produced for each device calibrated. In addition, the Cal Factor information is supplied on a label on the side of the sensor.

Calibration Factor (Cal Factor)

The Cal Factor gives an indication of the variation of the sensitivity of the device with frequency. It is used to provide a correction factor to compensate for the errors due to power dissipated within the sensor. This dissipation could be caused by, for example, the layout within the detector, or the errors due to reflections caused by mismatch at the source and device input. Both of these sources of error are frequency dependent. The Cal Factor is expressed as a percentage of the reference Cal Factor, measured at a defined frequency. The values of Cal Factor are normalized to the maximum value as 100%.

VSWR (Return Loss)

VSWR is a measure of the mismatch of the input of the device, and again is frequency dependent.

Uncertainty

The uncertainty, normally expressed as a percentage, is an indication of the maximum error associated with the measurements. It is mainly caused by the imported uncertainties from the audit sensor and from the instrumentation accuracy. Some uncertainty can also come from multiple reflections between source and device input.

Linearity Factor

In addition to using the standard power sensor calibration information, the IFR microwave test sets and power meters can make use of a sensor's linearity factor to further increase the accuracy of measurements.

Measurement Techniques Employed

The conventional method for establishing the Cal Factor is to use a substitution method. This is generally time consuming and very labor intensive. To ease these problems and yet maintain highly accurate calibration with very low uncertainties, an alternative method has been developed.

The technique used measures the Cal Factor relative to a reference head. With this method, the power from the source is passed through a splitter. One output of the splitter goes to the sensor under test (the test port), the other to a reference head. The combination of splitter and reference head is known as a splitter fixture. This is supplied with an initial set of calibration data (traceable to national standards) which characterizes it, and with documented uncertainties associated with it, supplied by the calibration laboratory.

In the IFR system, the device used for splitting the power is a 2 resistor splitter. For a 50 Ω system, both of these resistors are 50 Ω resistors. One option when using this method is to feed back the level detected by the reference head to keep the splitter output constant. The splitter resistor junction then acts as a virtual earth and makes the test port input appear as a perfect match. An alternative method used by IFR is not to keep the splitter output power constant but to measure the output from the reference head at the same time as the output from the device under test is measured. Calculations show that the expressions derived for matching for this ratio-based system are identical to those derived for the levelling system.

The system is fully automated and runs under software control, with the only manual intervention being the connection and disconnection of the device being calibrated.

Sensor Calibration

Under ratio conditions, the Calibration Factor of the device under test, CF, is given by:

$$CF = \frac{PI@f \,.\, PR@50MHz}{PR@f \;\; PI@50MHz} \,.\, C(f)$$

Where:

PI	=	Indicated power at frequency f
PR	=	Reference indicated power at frequency f
C(f)	=	Cal Data at frequency f for standard head (Splitter / Reference Detector combination)
CF	=	Measured calibration factor for DUT at frequency f

The normalized Cal Factor is given:

$$CF = \frac{Cal@f}{Max\ Cal\ Factor\ in\ range} \times 100$$

Basic System Configuration

For frequencies from 10 MHz to 26.5 GHz, the signal source is an IFR Microwave Test Set, 6203B. This feeds the relevant test fixture. This is a precision mechanical design to hold the splitter fixture rigidly. The power measurements are made using two IFR power meters, one for each signal path. Each power meter is used to feed a DMM, for a more accurate reading.

For VSWR measurements for frequencies from 250 MHz to 26.5 GHz, the IFR Reflection Analyzer, 6210, is used in conjunction with the 6203B Microwave Test Set. Using the 6210 gives advantages over the conventional autotester as it makes return loss measurements with a much smaller measurement uncertainty. In addition, the test port match and directivity are significantly better, giving improved accuracy and reduced uncertainty. For frequencies from 10 MHz to 250 MHz VSWR measurements are made with 6203B and an autotester.

Linearity Factor

The linearity factor facility is implemented by the addition of a precision programmable attenuator, IFR type 2186.

Optional Configurations

To cover the lower frequency range 30 kHz to 10 MHz, additional instrumentation is required for measuring the Cal Factor. The power source in this range is the IFR signal source type 2030. In addition, for VSWR measurements, a network analyzer and reflection analyzer are used.

26.5 GHz to 46 GHz

To cover the higher frequency range, 26.5 GHz to 46 GHz, the IFR Microwave Test Set type 6203B is replaced by IFR Microwave Test Set type 6204B.

System Housing

The system is housed in a two bay 19 in desk/console. It is based on proprietary equipment and not specifically designed to meet any special environmental specifications.

The standard core system covers the frequency range 10 MHz to 26.5 MHz for Cal Factor and Return Loss measurements. It consists of:

- IFR Microwave Test Set, type 6203B
- IFR Reflection Analyzer, type 6210
- IFR Power Meter, type 6960B (2 off)
- IFR Autotester
- Digital Multimeter (2 off)
- PC (Pentium), Controller, Printer
- Cal Kits

Traceability of Measurements

The power sensors and power splitter fixtures used on this system can be NAMAS calibrated in IFR NAMAS calibration laboratory. The company has operated a NAMAS calibration laboratory (Reg. No LAB0006) since 1968, offering NAMAS calibration for 28 parameters covering DC to 40 GHz.

A suitable range of calibrated splitter fixtures/detector/sensor jigs and audit standards is offered as accessories.

Supplied Software

The system software is written in Visual BASIC and is based on the software system used in the IFR production facility at Stevenage. The software provides a graphical man-machine interface characteristic of Windows applications, and guides the operator actions. In addition to printing a full set of measurement results, the system will print labels for attaching to the devices under test.

Specification

Basic System - 10 MHz - 26.5 GHz

IFR				
Sensors	6910	6911	6913	6920
6923	6930			
Detectors	6230	6230A	6230L	6233
6233A	6233L			

Low Frequency Option: 30 kHz - 10 MHz

IFR			
Sensors	6912	6932	6232A

High Frequency Option: 26.5 GHz - 46 GHz

IFR			
Sensors	6914	6914S	6924
6924S	6934	6934S	
Detectors	6234	6234A	6234L

Linearity Factor Option

IFR	
Sensors	All listed Sensors

MPT 1327 Bulk Call Generator

Test MPT 1327 base stations under fully loaded traffic conditions



- Low cost solution
- Non-intrusive - does not inconvenience other users
- Uses the 2945A Communications Service Monitor
- Initiates Traffic and Data calls
- Checks the whole system, not just the hardware
- Background Call Logging mode logs all received messages and responses

Normally base stations are installed or updated at off-peak times so that inconvenience to users is minimized. However this has the drawback that the system is not then tested under high loading conditions until a peak usage time, and any problems found then could affect users. The MPT 1327 Bulk Call Generator allows newly installed base station systems to be tested under full loading conditions at off-peak times.

Based on the IFR 2945A Communications Service Monitor, the Bulk Call Generator does not simply load up the system with voice calls. It allows you to, for example, program up data calls at a specific rate to check the call stacking, or to send invalid call IDs to check for the correct response. It also allows different call types to be used to present the base station with different 'worst case' situations. The solution is non-intrusive, so it does not inconvenience existing users.

Features

- Mimics MPT 1327 mobiles
- Initiates Traffic and Data calls
- Call repeat rates programmable between every slot and every 999th slot
- Option for Background Call Logging
- Allows programmability of calling party ident, calling party prefix, called party ident, including lower limit, upper limit and increment
- Windows user interface available, providing filtering of results

Benefits

Non-intrusive - does not inconvenience other users, checks the whole system, not just the hardware and a low cost solution.

Operation

The test set will commence sending calls starting at the low end of each identity and prefix range. If the high identity range is reached either on the called or calling idents, then the next prefix is used. When the highest prefix and identity are reached the test set will loop back to the first prefix and identities which have been specified.

Applications

The bulk call generator can be used in a variety of applications to verify MPT 1327 Base Stations. For example each time the system software changes it can be verified to ensure that no faults have been introduced.

- Base Station operators
- Base Station manufacturers

Specification

RF

RF Output Level
-141 dBm to -21 dBm (N-Type output)
-115 dBm to +5 dBm (BNC socket)

RF Off Level
40 dB below the On level (typical)

Data Level
Programmable in the range 0 kHz to 8 kHz

Input Level
0 dBm minimum (N-type port)
-30 dBm minimum (Antenna port)

Programmable Parameters

Calling Party Identity
Lower Limit:
1 to 8100 (Default 800)
Calling Party Identity Upper Limit:
1 to 8100 (Default 8100)
Calling Party Identity Increment:
0 to 8100 (Default 1)

Calling Party Prefix
Lower Limit:
0 to 127 (Default 39)
Calling Party Identity Upper Limit:
0 to 127 (Default 127)
Calling Party Identity Increment:
0 to 127 (Default 1)

Called Party Identity
Lower Limit:
1 to 8100 (Default 1)
Calling Party Identity Upper Limit:
1 to 8100 (Default 1)
Calling Party Identity Increment:
0 to 8100 (Default 1)

RQS Call Rates
0 to 999 (0 = Never, 999 = Once every 999 calls)

Call Types
RQS, RQQ (off-hook), RQR, RQC, RQQ (to RU)

PABX Extension Number
Lower Limit:
1000 to 8999 (Default 1000)
Upper Limit:
1000 to 8999 (Default 8999)
Increment:
1 to 7999 (Default 1)

General

PC Communications Interface
RS-232, 9600 Baud

Frequency Standard, Dimensions & Weight, Power Supply, Battery Pack, Remote Interface, Options & Accessories, Environmental, RF Output Impedance
See 2945A Data sheet

Turnkey Systems Solutions

Instant access to the highest level of test expertise, fully supported solutions tailored to suit your needs



- Instant access to the highest levels of expertise
- Fully supported solutions
- Tailored to suit your needs
- Working in partnership

In addition to providing standard production test programming capabilities and services, the IFR systems business unit is also able to deliver turnkey systems solutions for more specialized applications. The system group have been supplying customized test solutions for a wide variety of customers' special requirements for many years.

Expertise

Expertise and experience includes electronic circuit and mechanical design, software design and project management. The group's experience in hardware design includes the following areas.

- System analysis
- Requirement specification definition
- Circuit design – Digital, analog, mixed technology, microprocessor, communications
- FPGA design
- PCB layout and prototyping
- Prototype card manufacture
- Design validation and debug
- Full manufacturing drawing packages

Software

The software design expertise ranges from applications test programming to the design and development of executive software facilities. The group's experience in software design includes the following areas.

- System analysis
- Requirement specification definition
- Graphical user interface design
- Instant access to the highest levels of expertise
- Fully supported solutions
- Tailored to suit your needs
- Working in partnership
- C, C++, PASCAL code generation
- Visual C++, Microsoft, Quick C- development environments
- Visual Basic™
- LabWindows™, LabView™ and HPVee™ (IFR is a member of the National Instruments Alliance Program) Microsoft
- Windows, MSDOS, UNIX, Sun OS operating system support
- Code debug and validation
- Training

Mechanical

The system group is also able to offer mechanical design facilities. The group's experience in mechanical design includes the following areas :

- System analysis
- Requirement specification definition
- Design including CAD
- Prototype manufacture
- Prototype validation
- Full manufacturing drawing package
- Life test rigs

Experience of the integration of special to type solutions is vital when dealing with complex solutions. These solutions may comprise any one or a combination of automatic test equipment, electronic instrumentation, special to type hardware and software.

Solution Definition

To ensure that a customer understands the solution which is being offered, IFR will discuss the detailed requirements with the customer. IFR will then analyze the customer's requirement in detail.

As a result of the analysis a quotation and the proposed strategy for the solution will be prepared. This provides the opportunity for the customer to agree the proposed solution or alter it as required. This will also ensure the provision of optimum solutions and ensure that the solution is tailored to the customer's needs.

The size and complexity of the project will determine whether a detailed proposal is required.

Solution Design

The choice of the correct hardware, software and other component parts which comprize the solution needs careful assessment. The basis of the solutions could be standard IFR products but where this is not appropriate third party equipment will be considered.

Requirements which necessitate the design of special to type circuits or hardware can be accommodated simply. The customized cards can be designed to the requirement and integrated, including software control, within the system.

The IFR test and measurement solutions can include the integration of VXI facilities with one of IFR standard products. Alternatively, if required, the test solution can be totally VXI based.

http://www.ifrinternational.com

Successful Solutions

As well as the traditional in-circuit and functional test requirements IFR provides test solutions for test programming, building fixtures, telecommunications and radio communications solutions covering ISDN, CT2, GSM and PCN as well as analog telephones, and test area management.

Integration of VXI and GPIB instrumentation is also another area of IFR's expertise. Specialized software routines can also be written in IFR is proprietary test program generation language, TPG, or in industry standard languages such as Visual Basic, LabView, LabWindows, HPVEE, ATLAS and C/C++.

As a systems integrator with a wide range of commercial test experience IFR has supplied special test solutions to many areas of industry. These include:

- Test and manufacturing throughput and fault monitoring systems, including all software and hardware
- Test area management systems including paperless repair
- Avionics system support equipment, including ILS monitor testing
- VXI and GPIB based solutions
- Radio test systems for production and maintenance of private, cellular and military radios
- RF and microwave test systems for aircraft antennae and systems
- Broadcast communications and monitoring equipment
- Telecommunications, ISDN and analog, CPE and exchange equipment testing including digital communication analysis and monitoring
- Comprehensive test programming for both functional and in-circuit test, including IEEE 1149.1 boundary scan techniques
- Control software for avionics signal sources to test aviation authority instrument landing systems
- Development of special test solutions including executive and application software
- Testability consultancy
- Smartcard test applications
- Network monitoring applications
- ATLAS test language applications
- Specialized training
- Test Management
- Software drivers to VXIplug&play standards





For further information please contact your nearest IFR Instruments sales and support center.

IFR Ltd.
Longacres House
Norton Green Road
Stevenage
Hertfordshire
United Kingdom
SG1 2BA
Tel: +44 (0) 1438 742200
Freephone: 0800 282388 (UK only)
Fax: +44 (0) 1438 727601
E-mail: info@ifrinternational.co.uk

IFR Americas, Inc.
10200 West York Street
Wichita
Kansas
67215-8999
USA
Tel: +1 (316) 522 4981
Toll Free: 1 800 835 2352 (US only)
Fax: +1 (316) 522 1360
E-mail: info@ifrsys.com

Benelux
Tel: +31 (13) 463 9540
Fax: +31 (13) 463 9663

China
Beijing
Tel: +86 (10) 6467 2716
Fax: +86 (10) 6467 2821

Guangzhou
Tel: +86 (20) 8755 4016
Fax: +86 (20) 8755 4312

Shanghai
Tel: +86 (21) 6247 4722
Fax: +86 (21) 6247 4719

France
Tel: +33 (1) 60 79 96 00
Fax: +33 (1) 60 77 69 22

Germany
Tel: +49 (8131) 2926-0
Fax: +49 (8131) 2926-130

Hong Kong
Tel: +852 2832 7988
Fax: +852 2834 5364

Latin America
Tel: +1 (817) 430 5842
Fax: +1 (817) 430 5843

Spain
Tel: +34 (91) 640 1134
Fax: +34 (91) 640 0640

http://www.ifrinternational.com

As we are always seeking to improve our products and services, the information in this document gives only general indications of product capacity, performance and suitability, none of which shall form part of any contract. We reserve the right to make design changes without notice.
All trademarks are acknowledged.
Parent company: IFR Systems, Inc.
© IFR Ltd. 1998.

Revision A. 11/98
Ref. No. 46891-807

Printed in United Kingdom
PAI/AK