2399A *9 kHz to 3 GHz Spectrum Analyzer*

A spectrum analyzer with outstanding performance and a user friendly visual interface simplifying many complex measurements

- *9 kHz to 3 GHz fully synthesized frequency range*
- *Lightweight, portable and rugged construction at 9.4 kg*
- *Excellent TFT color display*
- *Comprehensive marker facility*
- *Wide input signal range +30 dBm to -110 dBm*
- *Optional full range tracking generator*
- *Semi-automated measurements*
- *Low floor noise*
- *Floppy disk drive*
- *Extremely user friendly MMI reduces risk of operator error*
- *Auto-Tune facility*
- *GPIB as standard*
- *AM/FM demodulation*

A "Value for Money" Product

The 2399A is the latest in the range of spectrum analyzers from IFR providing exceptional performance at an exceptional price.

Frequency Accuracy

The local oscillator system in the 2399A is fully synthesized thus providing accurate frequency measurements with 1 Hz resolution.
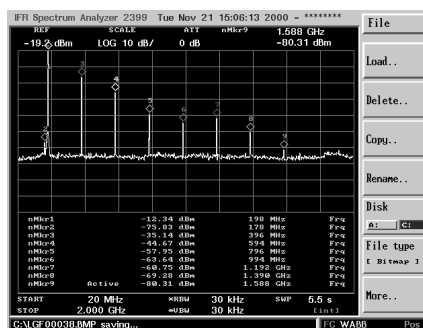
Portability

With a weight of only 9.4 kg (20.7 lbs.) the 2399A is one of the lightest spectrum analyzers available. A truly portable unit!

Color Display

The 6.4 inch TFT color LCD in the 2399A provides a clear, bright, sharp display with a 640 x 480 pixel active display area viewable in high ambient light conditions.

Comprehensive Marker System

Marker Table

The marker system allows up to a maximum of 9 markers to be displayed on the screen at any one time. A marker table shows the frequency and level of each marker selected thus allowing multiple signals to be evaluated simultaneously. In addition to the Normal markers 2399A provides Delta, Peak Search, Peak Track, 1/Delta, Marker Track, Marker to Center and Marker to Reference capabilities.

Measurement Limits

The Limits facility allows an Upper and/or a Lower Limit to be set on the screen of the 2399A. Should the signal being displayed fall outside either limit a message will appear on the screen showing which limit has been exceeded and how many times this has happened.

Wide Signal Measurement Range

The 50 ohm input on the 2399A can accept signals between +30 dBm and -110 dBm while providing protection to ±50 Vdc.

Semi-Automated Measurements

The MMI on the 2399A has been designed to simplify many of the measurements required for the evaluation of today's sophisticated communications systems. These include Adjacent Channel Power, X dB Down, Occupied Bandwidth, Channel Power and Harmonic Distortion.

Auto-Tune Function

Use of this function allows an unknown signal to be quickly captured and displayed on the screen. The 2399A will search its complete frequency range for the highest level signal, capture it and display it in the center of the screen with both the span and resolution bandwidths being automatically set to the optimal state for best viewing.

Spectral Purity

The phase noise on the 2399A is specified at -90 dBc at 10 kHz offset which allows its use for evaluating the spectral purity and noise performance of systems and sub-systems.

Signal Demodulation

Demodulation of both AM and FM signals allows full testing on a wide range of communications systems. The demodulated signal can be viewed on the screen and is also available on the internal loudspeaker and on headphones via a connector on the front panel. The FM peak deviation and AM modulation depth can be measured using the markers provided in the 2399A.

Information Storage

The 2399A is provided with the capability of internally storing up to 1,000 screen traces and 2,000 operational states. The spectrum analyzer is also fitted with a 3.5 inch FDD (Floppy Disk Drive) for bulk storage.

Interfaces

IEEE 488-2, RS-232 and Printer (PCL5) interfaces are provided as standard on the 2399A allowing its integration into automated test systems and the print out of screen displays.
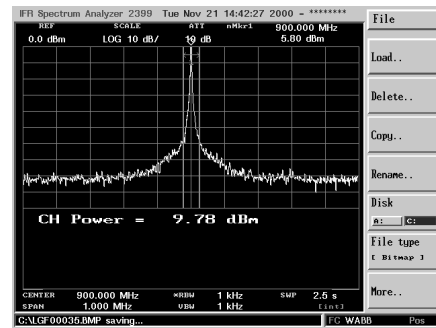
The 2399A has been designed with future flexibility and expansion in mind. The operating system and system memory have the capability to incorporate additional facilities.
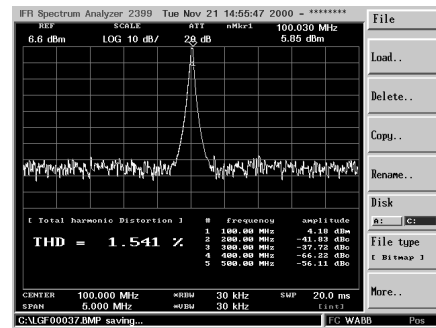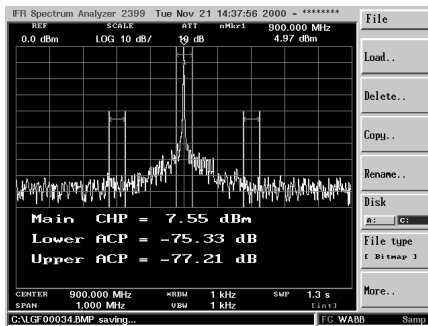

X dB Down
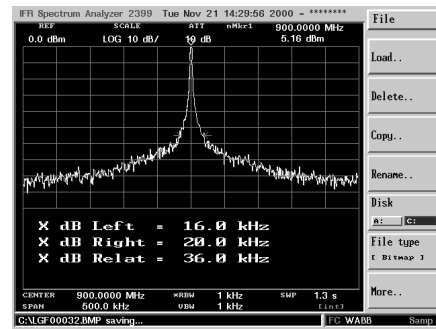
Occupied Bandwidth
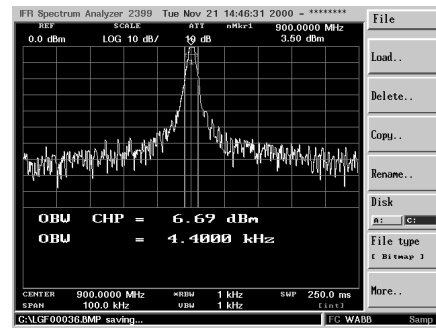
Channel Power

Adjacent Channel Power

Harmonic Distortion

DISTANCE TO FAULT SOFTWARE OPTION

The IFR 2399A spectrum analyzer is widely used by field installation and maintenance engineers for monitoring the spectral output from cell site transmitters. The new Distance to Fault (DTF) option allows measurement of VSWR of the RF feed cables and, in the event of failing test limits, will then perform a DTF (TDR) measurement to identify the faulty part of the feed system.

Experience shows that one of the biggest causes of degradation or failure of RF communications systems is the transmission line from the base station transceiver to the antenna.

Testing the Transmission Line

When a new cell site is installed, the key measurement to test the quality of the installation is the VSWR (return loss) of the feed cable when terminated with the antenna system. Poor installation will result in unacceptable return loss (VSWR), reducing the quality of the system.

Even a system that is well within specification when installed may degrade with time due to the effects of weather, corrosion or accidental damage.

Fast Fault Location (DTF)

The IFR 2399A spectrum analyzer DTF option is designed to enable users to measure VSWR (return loss) routinely and quickly. In the event of failure, switching to DTF mode pinpoints the problem area so that corrective action can be taken.
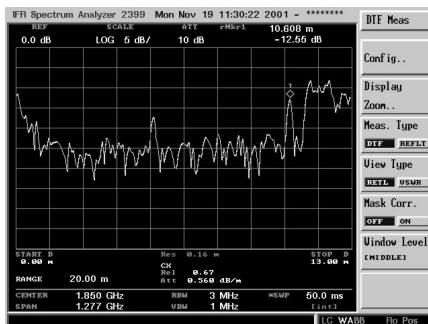
Distance to Fault

Identifying the faulty component in the system and initiating a repair is simplified, resulting in less system down time. The 2399A DTF measurement is real time so it can identify even intermittent faults.

Built-in Features

The DTF software option comes with a built-in Transmission Line Database that contains the characteristics of the most commonly used coaxial cables. This eliminates the need to refer to manufacturers' data sheets when configuring the 2399A for DTF operation.

SPECIFICATION

FREQUENCY

Tuning Range

9 kHz to 3 GHz

Resolution

1 Hz

Frequency Span Width

100 Hz/div to 300 MHz/div in 1, 2, 5 step selections (auto-selected)
Zero span and Full span (9 kHz to 3 GHz)
Manual selection of Start, Stop and Span

Span Accuracy

±3% of indicated span width

Readout Accuracy

±(span accuracy + frequency standard accuracy + 50% of RBW)

Stability

Residual FM <100 Hz p-p at 1 kHz RBW, 1 kHz VBW, (p-p in 20 ms)

Noise Sidebands

-90 dBc/Hz at 10 kHz offset measured at 2.9 GHz
-98 dBc/Hz at 100 kHz offset measured at 2.9 GHz

FREQUENCY COUNTER

Resolution

1 Hz, 10 Hz, 100 Hz, 1 kHz

Accuracy

±(Reference frequency error + frequency readout accuracy + counter resolution ±1 count)

Sensitivity

<-70 dBm from 50 kHz to 3 GHz

AMPLITUDE

Measurement Range

+30 dBm to -110 dBm

DANL

	Amp Out (typ)	Amp In (typ)
50 kHz to 100 kHz ≤-95 dBm amp out,	-105 dBm	-117 dBm
100 kHz to 3 GHz ≤-105 dBm amp out,	-115 dBm	-127 dBm
300 Hz RBW, 10 Hz VBW		

1 dB Compression Point

-10 dBm minimum 100 kHz to 3 GHz at 0 dB attenuation

Displayed Range

100 dB in 10 dB/div log scale
50 dB in 5 dB/div log scale
20 dB in 2 dB/div log scale
10 dB in 1 dB/div log scale
10 divisions with linear amplitude scale

Amplitude Units

Log scale mode dBm and dBmV

Linear scale mode V (µV, mV, etc.) or dBV (dBmV only)
Quasi-Peak mode dBµV, dBmV or dBm

Display Linearity

5 and 10 dB/div, ±0.15 dB/dB, ≤±1.5 dB over 10 divisions
1 and 2 dB/div, ±0.5 dB over 10 divisions
Linear, ±10 % of Reference Level over 10 divisions

Frequency Response

±1.5 dB from 10 MHz to 3 GHz and ±2 dB from
9 kHz to 10 MHz with 10 dB RF attenuation

ATTENUATOR

Range

0 dB to 50 dB in 10 dB steps selected manually or automatically coupled to the Reference Level

Accuracy

±0.5 dB/step up to a 1.5 dB maximum

REFERENCE LEVEL

Range

-110 dBm to +30 dBm with 1 kHz filter using 1 dB/div scale

Accuracy

±1.5 dB (50 kHz to 3 GHz)

Resolution

0.1 dB steps

Residual Spurious

≤-85 dBm (input terminated, 0 dB attenuation)

Harmonic Distortion

≤-60 dBc (-40 dBm input at 0 dB attenuation)

Intermodulation

≤-60 dBc (100 MHz to 2.9 GHz at -30 dBm input)

Other Spurious

≤-60 dBc (10 MHz to 2.9 GHz at -30 dBm)

RESOLUTION BANDWITH

Selection

300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz + 10 Hz, 30 Hz, 100 Hz (option 05)

Accuracy

±20%

Selectivity

60 dB/3 dB ratio <15:1
except 3 MHz filter 50 dB/3 dB ratio <15:1
60 dB/6 dB ratio <12:1 for 9 kHz and 120 kHz Quasi-Peak filters

Switching Error

±1.0 dB

Video Selection

10 Hz to 1 MHz in 1-3-10 sequence plus full BW

SWEEP

Rate (full screen)

50 ms to 1000 s in 1-2-5 sequence, 25 µs to 20 s in Zero Span

Sweep Rate Accuracy

20% for <100 ms, 10% for all other sweep rates

Trigger Source

External, Line, Video, Free Run

Trigger Modes

Continuous, Single

Trigger Level

Internal Trigger: Adjustable over 10 divisions
External Trigger (Rear): TTL Level

Trigger Delay

±One sweep time

DISPLAY

Type

6.4 in. TFT Color LCD

Digital Resolution

640 H x 480 V active display area

MARKERS

Number

Up to 9 colored Markers available with 9 Delta Markers

Modes

Normal, Delta, Peak Search, Peak Track, 1/Delta, Marker Track, Marker to Center, Marker to Reference
All Markers to peak

Marker

Marker track
Marker to center
Marker to reference
Marker to peak

MEMORY

Trace storage

Up to 1,000 stored traces stored internally

Setup Storage

Up to 2,000 operational states stored internally

External

3.5 in. FDD for bulk storage

Display Traces

2 max.

INPUTS

RF Input

Type "N" 50 Ohm female connector

Input VSWR

<1.5:1 from 150 kHz to 3 GHz with 10 dB attenuation

Maximum Input

+30 dBm with 30 dB attenuation, 50 Vdc

LO Emissions

≤-70 dBm with 10 dB attenuation

OUTPUTS

IF Output

10.7 MHz nominal

Video Output

0 to 5 Vdc, VGA output

Printer Drivers

PCL5 compatible via standard 25-pin female D-Sub Parallel Printer

Probe Power

+15 V, -12 V and Ground

FREQUENCY STANDARD (NORMAL STABILITY - SEE ALSO OPTION 03)

Frequency

10 MHz

Output Level

+5 dBm nominal

Temperature Stability

±2 ppm

Ageing Rate

±1 ppm/year

Connector

BNC female

External Input

-5 dBm to +15 dBm

INTERFACES

GPIB

Conforms to IEEE 488.1 – 1987, 488.2 – 1992

Subsets

SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, C0, LE0, TE0

RS-232C

Full Duplex

Baud Rate

110 bps, 300 bps, 600 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19.2 kbps, 38.4 kbps, 57.6 kbps, 115.2 kbps

Parity Check

Odd, Even or None

Data Length

7 or 8 bit selectable

Stop Bits

1 or 2 bit

Protocol

None, Xon-Xoff, RTS-CTS, DTR-DSR

ENVIRONMENTAL

Operating

0 to 40°C

Storage

-20 to +70°C

Temperature & Humidity

Meets MIL-T-28800E for Type 2, Class 5, non-condensing (85 % operating, 90 % storage)

Vibration/Shock

Meets MIL-T-28800E for Type 2, Class 5

Altitude

Operational up to 3,000 m (19,842 ft.), non-operational to 12,200 m (40,026 ft.)

PRODUCT SAFETY

Conforms to 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 II.

ELECTROMAGNETIC COMPATABILITY

Complies with the limits specified in the following standards: EN 55011: Class A and EN 50082-1

GENERAL CHARACTERISTICS

DIMENSIONS

350 mm (13.78 in.) W, 185 mm (7.28 in.) H, 381 mm (15 in.) D including handle

Weight

9.4 kg (20.7 lbs.)

Warm-up Time

15 minutes for specified accuracy

POWER REQUIREMENTS

Voltage

100 to 240 Vac ±10%

Frequency

50 to 60 Hz

Power Consumption

90 W max. w/o options fitted

HARDWARE OPTIONS

TRACKING GENERATOR

Frequency Range

100 kHz to 3 GHz

Output Level

0 to -70 dBm

Output Level Resolution

0.1 dB step

Absolute Level Accuracy

≤±1.0 dB at 0 dB

Frequency Flatness

≤2.0 dB at -10 dBm

Signal Purity

Harmonics	≤-15 dBc
Non-harmonics	≤-25 dBc
Sub-harmonics	≤-25 dBc

Leakage

≤-90 dBm

HIGH STABILITY TIMEBASE (OPTION 03)

Temperature Stability

± 0.2 ppm

Ageing Rate

±0.1 ppm/yr.

QUASI-PEAK DETECTOR (OPTION 04)

Quasi-Peak detector and EMC filters

RBW	9 kHz Band B	120 kHz Band C
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%

DIGITAL RESOLUTION BANDWIDTH FILTERS (OPTION 05)

Bandwidths

100 Hz, 30 Hz, 10 Hz

Bandwidth accuracy

±20%

Selectivity (-60 dB/-3 dB)

<5:1

Maximum span

1 MHz

Sweep times for 10 kHz span

RBW	100 Hz	<0.9 sec.
	30 Hz	<3 sec.
	10 Hz	<4.5 sec.

Displayed Average Noise Levels (DANL) between 1 MHz and 2.4 GHz reduces DANL by typically 5 dB from the values in the 300 Hz resolution bandwidth filter.

SOFTWARE OPTIONS

OPTION 11 - DISTANCE TO FAULT (DTF)

DISTANCE TO FAULT SPECIFICATIONS

DTF Measurement

Measurement Range

Up to 99 km (324,720 ft.) depending on cable loss

Units

Meters or Feet

Minimum Resolution

For two equal amplitude discontinuities using maximum span:

13.24 x Vr cm

Where Vr is the relative velocity factor for the cable.

Maximum Measurement Update Rate

20 ms for 500 points

Dynamic Range

>60 dB

Distance Accuracy

0.78 m for a single fault

Transmission Line Database

Data for common cables supplied as standard

VSWR or Return Loss Measurement

Calibration

Open circuit or Short circuit

Linearity

As spectrum analyzer: <0.15 dB/dB, <1.5 dB over 10 divisions

Accuracy

Linearity + directivity + test port mismatch

For Bridge 59999/170 at frequencies >50 MHz:
Accuracy $<0.01 + 0.032\rho^2$ + linearity

Where ρ is reflection coefficient of system under test.

ACCESSORY OPTIONS TO MAKE THE MEASUREMENTS

The user can choose from a range of accessories to suit the test regime required.

In order for the DTF option to operate, the 2399A must be fitted with the optional tracking generator (2399A/1) and the DTF software, option 011.

Hardware Configurations

1. VSWR (Return Loss) only

Comprises:

RF Bridge (5 MHz to 3 GHz)	*59999/170*
RF cable, 0.5 m [type N (male) to type N (male)]	*54351/022*
Adapter type N (male) to type N (male)	*54311/175*

2. DTF only

Comprises:

Power Divider (type N)	*54311/187*
RF cable, 0.5 m [type N (male) to type N (male)]	*54351/022*
Calibration Load (50 Ohm)	*54421/023*

3. VSWR (return loss) and DTF

Comprises:

RF Bridge (5 MHz to 3 GHz)	*59999/170*
RF cable, 0.5 m [type N (male) to type N (male)]	*54351/022*
Adapter type N (male) to type N (male)	*54311/175*
Power Divider (type N)	*54311/187*
Calibration Load (50 Ohm)	*54421/023*

OPTION 12 - MARKER LABEL EDIT

This software option allows the user to change the marker label from the normal numeric format to a user defined 4 digit alpha-numeric label.

OPTION 13 - EMC

This software option, which must be used in conjunction with option 04 (Quasi-peak detectors and filters) provides the user with some of the facilities required for EMC pre-compliance testing. Features include:

Entry of correction factors for:	*Test Antenna*
	Cable loss
	Transducer characteristics

Addition of limit lines

Choice of Log or Linear frequency scales

Semi-automated operation of quasi-peak functions

VERSIONS, OPTIONS AND ACCESSORIES

Versions

2399A/0	9 kHz to 3 GHz basic spectrum analyzer
2399A/1	2399A/0 with tracking generator

Options

03	High stability timebase
04	Quasi-peak detectors and filters
05	Digital resolution bandwidth filters
11	Distance to fault (DTF) software
12	Marker label edit software
13	EMC software

Supplied Accessories

	Front cover
	Operation manual
	Programming manual
	AC supply lead
	RS-232 cable
	2 x 250 V, 3.15 A fuses
AC2618	Soft carry case

Optional Accessories

	Maintenance manual
AC2621	Rack mount kit
59999/170	Return loss bridge 5 MHz to 3 GHz, type N (f)
AC4250	50 Ω N to 75 Ω BNC
AC5008	DC block N type
AC8700	UHF antenna
AC2618	Soft carry case

IFR - "Working together to create solutions for the world of communications."

IFR is a world leader in developing leading edge test and measurement equipment. The priority at IFR is to understand your communications test needs and respond to them. IFR has the flexibility and expertise to create just the right test solution for you. We understand that just as you are the expert in designing wireless products, we are expert in wireless test.

Combining the quality of our test products with their reliability, excellent price/performance ratio and minimal requirements for maintenance, every IFR test system represents an outstanding lifetime value.

IFR - "Working together with our customers to be flexible and innovative in providing effective test solutions for the rapid design, manufacture and maintenance of communications systems."

The added value IFR includes with each and every test set we sell will make you more productive. We offer a two-year standard warranty on all products and we will continue to support your product for five years beyond its final production. Our outstanding Customer Service Department offers calibration, out-of warranty repairs and consulting. Our Sales and Training Departments offer clear and concise product information with realistic performance specifications, technology training and application training. Our experienced engineers will help you develop application software and through continuous improvement programs, upgrades are always available.

IFR will continue to build upon our technology resources with an aggressive commitment that will enable you to excel in some of the world's most dynamic, high growth markets.

CHINA
Tel: [+86] (10) 6467 2823
Fax: [+86] (10) 6467 2821

EUROPE NORTH
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601

EUROPE SOUTH
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] (8131) 29260
Fax: [+49] (8131) 2926130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

LATIN AMERICA
Tel: [+1] (972) 899 5150
Fax: [+1] (972) 899 5154

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UNITED KINGDOM
Tel: [+44] (0) 1438 742200
Toll Free: [+44] (0800) 282 388 (UK only)
Fax: [+44] (0) 1438 727601

USA
Tel: [+1] (316) 522 4981
Toll Free: [+1] (800) 835 2352 (US only)
Fax: [+1] (316) 522 1360

email **info@ifrsys.com**

web **www.ifrsys.com**

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