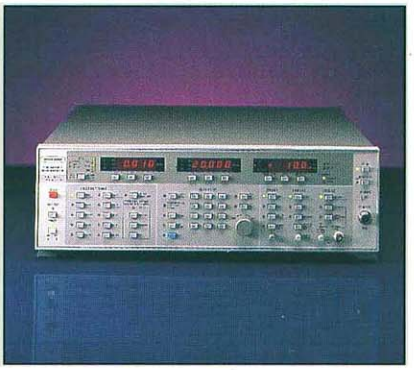
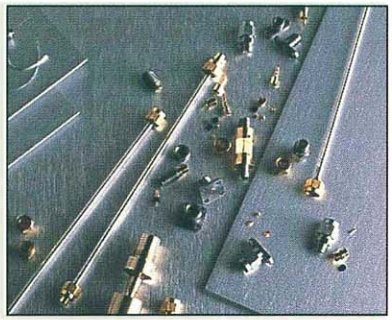
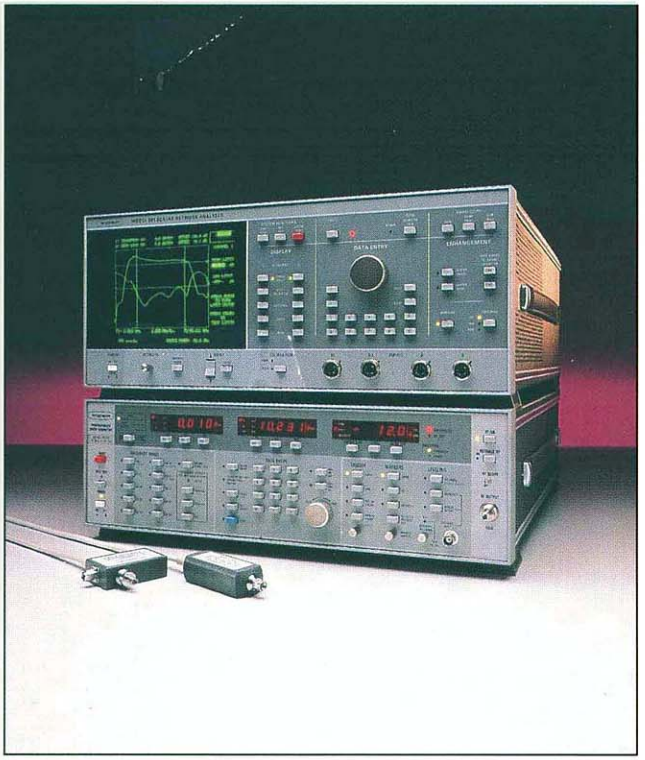
WILTRON

1988 Catalog

Vector Network Analyzers
Scalar Network Analyzers
Swept Frequency Synthesizers
Measurement Components
Sweep Generators
K Connectors
RF Analyzers







Your Wiltron Catalog

Dear Customer:

For 28 years, Wiltron has been dedicated to the development and manufacture of microwave measurement equipment. In this catalog you will find over 300 of our latest products, every one of which is designed to improve the accuracy, speed, and convenience of your microwave measurements. Our newest products, shown on page 2, continue our tradition of advancing microwave technology while bringing down the cost of hardware and software.

This Wiltron blending of technology and value is demonstrated beautifully in each of our new test systems:

- Model 360 Vector Network Analyzers, 500 MHz to 40 GHz
- Model 5600B Automated Scalar Network Analyzer System, 10 MHz to 40 GHz
- Model 561 Scalar Network Analyzer, 10 MHz to 40 GHz
- Model 6700A Swept Frequency Synthesizers, 10 MHz to 40 GHz
- Model 6400 RF Analyzers, 1 to 2000 MHz

We also introduce in this catalog the 6600B Series Sweep Generator with significant improvements over its predecessor, the popular 6600A Series. In addition, we include the K Connector™ product line with its exceptional performance up to 46 GHz, in coax. On page 76, the new coaxial fixed attenuators are described.

With the introduction of these new products, we renew our commitment to serve you well, before and after the sale. To bring our service "next door," we have established six *primary* service centers in Morgan Hill, California; Boston, Massachusetts; Crowthorne, England; Toyko, Japan; Munich, Germany; and Paris, France. All of Wiltron's sales offices and representatives are also at your service. Our production facilities in the USA and Europe now exceed 220,000 square feet. Because of your support, Wiltron is recognized as a leader in microwave measurements and has expanded to serve customers in many parts of the world. International orders now comprise 45% of total sales.

Thank you for using our catalog. We look forward to serving you further.

Sincerely,

William E. Jarvis
President

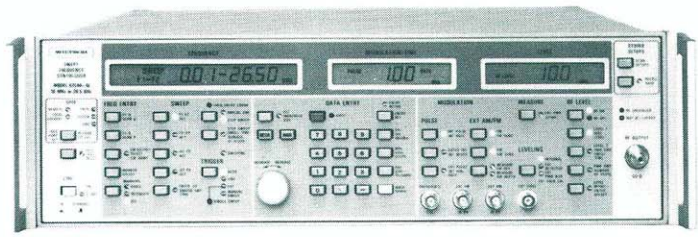
New Product Summary

NEW

Vector Network Analyzers, 0.5 to 40 GHz

In contrast to other systems, the 360 brings speed and accuracy, simultaneously, to network analysis—with up to 30% cost savings. Now you have a choice—a choice for a greater dynamic range, a large color screen with up to eight data traces along with limit lines and markers, a "real time" display to speed the tuning of your device, and savings through lower initial cost and improved productivity. And you get the measurement accuracy for which Wiltron is renowned. Please see page 8.

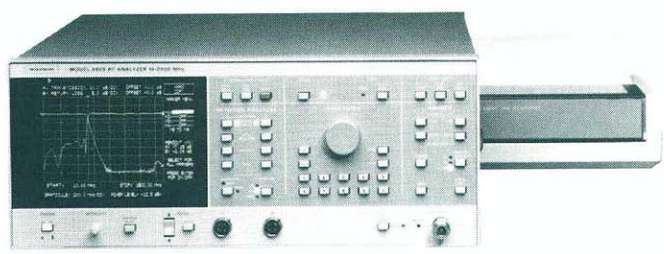
NEW



Swept Frequency Synthesizers, 0.01 to 40 GHz

The 28 models in the 6700A Series produce phase-locked CW or digital step-sweep signals, as well as a true analog sweep. With high output power, 15 ms switching speed, less than 10 ns pulse rise time, 1 kHz resolution, and metered AM, FM, and pulse modulation, these units come closest to being the universal signal source. Wide and narrow frequency ranges are available from 0.01 to 40 GHz. All models include a built-in pulse generator/modulator and an internal power meter. In every aspect of synthesizer performance—accuracy, signal purity, modulation—this series is exceptional. Please see page 46.

NEW



RF Analyzer Systems, 1 to 2000 MHz

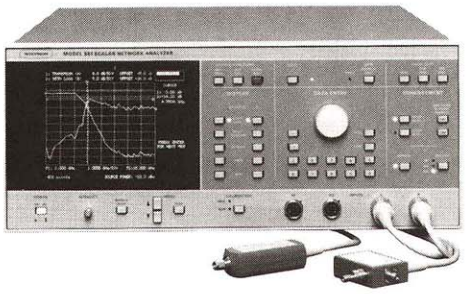
The 6400 Series combines in one instrument a broadband, high-resolution signal source, and a precision scalar network analyzer. Here is a rare blend of RF and digital technology—one that simplifies measurement of transmission, return loss, and absolute power. And it is portable for field applications. The built-in signal source offers a hundredfold improvement in frequency accuracy over stand-alone sweepers, 10 kHz resolution, and virtually no frequency drift with time and temperature. You make precise measurement of even the narrowest of narrow-band devices. Stored setups, limit lines, alternate sweep, and eight markers speed testing while direct hard-copy output of graphical or tabular data cuts test time further. Please see page 38.

NEW

K Connectors, DC to 46 GHz

The Wiltron K Connector™ takes components, systems, and measurements up to 46 GHz in coax. Included in this line are cable connectors, sparkplug and flange launchers, semirigid cable, all required tools and fixtures, and complete documentation. An evaluation kit is available to help you apply the K Connector. Test requirements for K Connector devices are satisfied with the 360 Vector Network Analyzer or the 5600B Scalar Network Analyzer. Please see page 79.

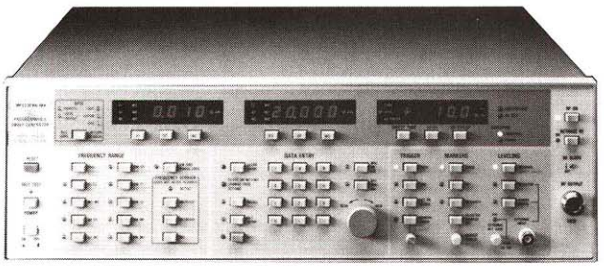
NEW



Scalar Network Analyzers, 10 MHz to 40 GHz

Here is an all-new scalar network analyzer that offers 71 dB dynamic range, 10 MHz to 40 GHz continuous coverage in coax, complete GPIB programability, direct hard-copy output to either a printer or plotter, and true ease of operation. Frequency markers and a multifunction cursor speed frequency and data identification while simple-to-operate complex limit lines indicate clearly whether the test device is within specifications. With a 6600B Sweep Generator or 6700A Swept Frequency Synthesizer, the 561 becomes a complete, automated microwave test system that reflects the latest in technology. Please see page 32.

NEW



Sweep Generators, 10 MHz to 60 GHz

The new 6600B Series expands the capabilities of the earlier 6600A to broaden its use in new applications. You choose from a selection of 39 models, one of which sweeps continuously from 10 MHz to 40 GHz. Another produces 40 mW leveled power from 10 MHz to 20 GHz. All models include a power sweep, eight markers, sub-harmonic-free signals, excellent source match, secure test parameters, and the alternate stored-setup mode. Please see page 53.

NEW

Fixed Attenuators, DC to 40 GHz

These new products truly reflect the latest advances made in microwave thin-film technology. Twenty-four fixed attenuator models are divided into two series: 1) the Gold Line (Series 41) for precision measurement applications, and 2) the Silver Line (Series 43) for use in systems and OEM equipment. Both are compatible with SMA and APC*–3.5. Please see page 76.

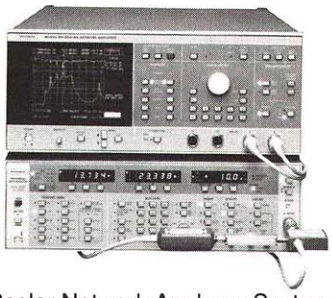
* Trademark of Bunker Ramo Corp.

Alphabetical Index

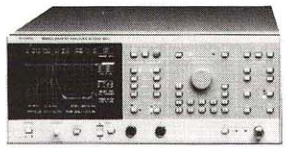
Model Number Index

Network Analyzers

General Information



Scalar Network Analyzer System
Model 5600B



RF Analyzer
Model 6400

Scalar Network Analyzer
Model 561

Vector Network Analyzer
Model 360

Network Analysis

Network analysis includes the characterization of microwave devices through the measurement of their transmission and impedance characteristics as a function of frequency. It includes the measurement of input match, output match, forward transmission, and reverse transmission. Each of these parameters is a complex quantity consisting of magnitude and phase.

Scalar Versus Vector Network Analyzers. A network analyzer system consists of three main elements: the signal source, the measurement components, and the network analyzer or signal processing element. There are two basic types of network analyzers: scalar and vector. Scalar network analyzers measure only the magnitude of the transmission or reflection signal. Vector network analyzers measure the magnitude and the phase of the transmission or reflection parameter.

Vector Network Analysis

The thrust of Wiltron's VNA product line is to satisfy *all* VNA applications. Accordingly, the Wiltron 360 display instrument was designed for general purpose applications. It is operated by software loaded from a front-panel disk drive via an MS-DOS compatible file structure. Therefore, it has been easy to adapt Wiltron software to new applications including waveguide, active device de-embedding, antennas, and radar cross sections.

Error Signal Calibration. The phase information provided by the 360 Vector Network Analyzer includes compensation for many of the error signals within the system. Six error signals can be characterized during calibration: transmission frequency response, reflection frequency response, source match, load match, directivity, and isolation. Each of these six error signals can be measured in the forward and reverse direction.

Calibration kits are offered for SMA/APC-3.5, APC*-7, Type N, and K Connector™ so that devices with almost any type of microwave connector can be tested.

Test Sets. The measurement components for Wiltron vector network analyzers are located in test sets. These test sets contain all the measuring and switching components required to make forward and reverse measurements of transmission and impedance. Wiltron's active device test sets include bias tees for active device biasing and step attenuators for setting the test port power level. An exclusive third step attenuator allows the direct measurement of active devices with up to 1 watt output power.

A summary of the microwave test sets is shown in Table II. Several connector types can be accommodated including for the first time the popular SMA and K Connectors.

Direct Phase-Locked Signal Source. The 360SS Series Signal Sources are recommended for use with the 360 Vector Network Analyzer. The 360SS sources are phase locked by the 360, ensuring accurate, fully specified measurements. The 360 system does not require the use of an expensive synthesizer because the source used is always phase locked by the 360. Frequency accuracy is one part in 10^8 with nearly zero frequency drift.

* Trademark of Bunker Ramo Corp.

Table I. Vector Network Analyzer Calibration for Diverse Applications

Method	Components Provided	Measurement Application
Traditional	Open, Short, Thruline, Broadband Load or Sliding Load	Traditional method used for general purpose measurements capability. Model of open fringing capacitance is held in network analyzer memory. Measured fringing capacitance coefficients for a specific open can be loaded via the front-panel disk drive.
Traditional With Offset Short	Short, Offset Short, Thruline, Broadband Load or Sliding Load	Offset short is substituted for open. Used for measurements, such as waveguide, where an open cannot be defined. Calibration bandwidth is limited.
LRL	Two Line Lengths Plus Known Reflection	Used for measurements, such as microstrip, where opens and loads are difficult to define. Two line lengths and a short are common calibration enhancements. TRL (through-reflection-line) and TSD (through-short-delay) are subsets of LRL. Calibration bandwidth is limited.

Table II. 360 Vector Network Analyzer Test Sets

Model	Frequency Range	Supplied Connector[1]	Test Set Type	Application
3610 3611	500 MHz to 18 GHz 500 MHz to 40 GHz	APC–7	Reversing	General purpose test sets. Internal reversing switch allows measurement of any network parameter: forward/reverse transmission and reflection so test devices can be fully characterized. Also the reversing swich allows 12-term error corrections to always be applied.
3620 3621	500 MHz to 18 GHz 500 MHz to 40 GHz	K Male	Active Device	All the features of reversing test sets plus internal bias tees for biasing of active test devices. Also step attenuators for control of test port power levels. A third step attenuator enables testing of all four parameters of active devices with up to 1 watt output power. Increases dynamic range to greater than 140 dB.

[1] All test sets can be converted to APC–7, APC–3.5, Type N, and K Connector using the 34UX50 Series Test Port Adapters. Therefore, the sets can be customized for the measurement application.

No External Computers Required. The 360 contains internal microprocessing capability that exceeds that available in most external computer/controllers. Therefore, an external computer/controller is not required for automated measurements or for printing hard copies of test data. An external computer/controller is required only when a special-purpose automated test system is used or when the test data must be externally manipulated or archived.

New Time Domain Capabilities. The optional 2360-2 Time Domain Software for the 360 Vector Network Analyzer converts frequency domain data to time domain. Low pass or bandpass processing allows characterization of microwave circuit impedance discontinuities. Wiltron's proprietary phasor impulse processing allows an analysis of the type of impedance discontinuity (capacitive, inductive, etc.) using bandpass processing that is required for band-limited microwave circuits.

Scalar Network Analysis

For measuring the magnitude of attenuation and impedance characteristics, such as SWR and return loss, the scalar network analyzer performs several of the measurements made on a vector network analyzer, but at a lower cost. The scalar network analyzer offers 71 dB dynamic range compared to the greater than 105 dB range of the vector network analyzer. In some ways the scalar analyzer is easier to use. For example, the calibration of scalar network analyzers consists only of compensating for transmission and reflection frequency response.

Measurement components for scalar network analyzers include detectors for transmission measurements and microwave bridges with built-in detectors (SWR Autotesters) for impedance (return loss) measurements. Wiltron provides a broad range of detectors and SWR Autotesters covering the 1 MHz to 40 GHz range.

Because of the extensive use of microprocessors in the Wiltron 561 Scalar Network Analyzers and the 6400 RF Analyzers, they do not require the use of an external controller. However, they are IEEE–488 compatible and can be used in special purpose automated systems.

Signal Sources. The recommended signal sources for Wiltron's 560A and 561 Network Analyzers are the 6600B Sweep Generators and 6700A Swept Frequency Synthesizers. These instruments use Wiltron *fundamental* oscillators over the 2 to 26.5 GHz range. Sweepers and synthesizers offered by other leading manufacturers use multiplied-up frequencies. This multiplication process produces signals rich in harmonics and (more worrisome) in subharmonics, which cannot be readily filtered out.

A complete scalar network analyzer system package, the 5600B Series, includes the 561 Scalar Network Analyzer, 6600B Sweep Generator, and all required measurement components.

The Wiltron 6400 Series RF Analyzers are scalar network analyzers with built-in RF sources. No external source is required. Housing the network analyzer and RF source in a single package reduces cost and provides excellent portability, especially important for field use. A patented frequency correction scheme produces a hundredfold improvement in frequency accuracy compared to that of stand-alone sweep generators. The 6400 has virtually no frequency drift with time or temperature.

Frequency Domain Translated to Distance Domain. Digital signal processing algorithms are available to enhance frequency domain data from scalar network analyzers. The 5647–P2FF Fault Location System uses frequency domain reflectometry to identify the size and location of faults along coaxial or waveguide transmission lines.

Automated Test Stations. Wiltron's new scalar network analyzers are aimed at inexpensive, automated test stations. Many new features such as complex limit lines, automated location of 1 dB, 3 dB, or other dB-down points, and limit points are great, time-saving aids.

Table III. Scalar Network Analyzer Selection Guide

Model	Frequency Range[2]	Signal Source	Application
561	1 MHz to 40 GHz	6600B Sweep Generators 6700A Synthesizers	The industry's newest scalar network analyzer, ideal for general purpose production, and R & D applications. Complex limit lines, Intelligent Cursor, and up to nine markers enhance production testing. Built-in buffer eliminates long waits while hard-copy data is made. Full capability GPIB for ATE applications is standard.
560A	1 MHz to 40 GHz	6600B Sweep Generators 6700A Synthesizers	Long an industry standard, the 560A is ideal for fault location systems. Please see the Model 5647 Option P2FF on page 28.
6407 6409	1 MHz to 1 GHz 1 MHz to 2 GHz	Built in	A complete system for measurements below 2 GHz. Ideal for field testing, as the network analyzer contains its own precision signal source with a hundredfold better frequency accuracy than stand-alone sweep generators and almost zero drift with time or temperature. Direct hard copy of tabular or graphic data to a dot-matrix printer.

[2] Waveguide detectors can be used to extend the 561 and 560A frequency range to 110 GHz or higher.

Vector Network Analyzer

Model 360, 500 MHz to 40 GHz

360 System Console
Model 360C1

NEW

360 System Cabinet
Model 360C2

360 Vector Network Analyzer Highlights

- Speed *and* Accuracy, Simultaneously
- Four S-Parameter Display on Color Screen
- One-Time Calibration Convenience
- Fast, "Real Time" Tuning of Test Device
- MS–DOS Compatible Front-Panel Disk Drive
- Time Domain, Group Delay, and Frequency Domain Test Capabilities
- Coaxial and Waveguide Measurements
- Test Sets for Active and Passive Devices

Turn-Key System: Console or Cabinet

Whether you choose your 360 system for use in production, R & D, metrology, service, or QA, there is a system console or a system cabinet configuration to meet your exact needs. Both systems consist of three units:

- Model 360 Network Analyzer
- Model 3600 Series Test Set
- Model 360SS Series System Source

The 360 provides from its front panel complete system control and display of test data. However, a rear panel GPIB connector may be used to control the system from an external computer terminal.

Four Channel Display on Large Color Screen

The 360 displays four channels simultaneously in any combination of Smith chart, rectilinear, or polar coordinates—and in frequency or time domain. Adding to the convenience, all displays are in three colors. With color, markers and limit lines are easily distinguished from the test data and graticule grid. The ease with which data are viewed and interpreted is incomparable.

Reversing and Active Device Test Sets

Two basic types of test sets cover the 0.5 to 18 GHz and 0.5 to 40 GHz range. Reversing Test Sets make full S-parameter measurements on passive devices. The Active Device Test Sets contain step attenuators and bias tees, invaluable for active component testing. Both are available with GPC–7 connectors up to 18 GHz and K Connectors™ up to 40 GHz.

Precision Components — Precision Measurements

Accurate operation of your 360 system is ensured by Wiltron precision components in the Calibration and Verification Kits. The kits include components for direct calibration and performance verification of measurements on GPC–7, K, Type N, and SMA/3.5 mm test devices.

Computer-Aided Test Software

For improved data archiving and enhanced calibration flexibility, Wiltron offers as an accessory the ANACAT* computer-aided test software.

Speed *and* Accuracy, Simultaneously

Compared to other systems, the 360 improves by twentyfold, from 40 ms to 2 ms, the time required to phase lock the system source at each test frequency. Only the Wiltron system maintains synthesizer accuracy at "real time," fast-measurement speeds.

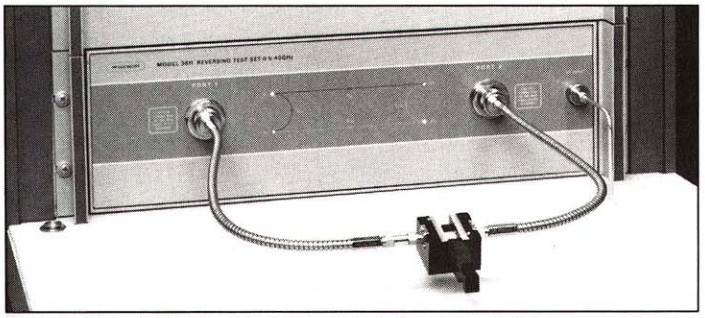
Automatic Reference Delay

Auto-Reference Delay automatically sets the correct electrical delay compensation. Furthermore, the reference delay can be entered and displayed in distance, as well as in time, by entering the test device's dielectric constant.

Unique Direct SMA Calibration and Measurements

The 360 is the first vector network analyzer to offer an SMA Calibration Kit with which accurate, 12-term error-corrected test data can be taken on SMA test devices.

* Registered trademark of EEsof, Inc.



With the SMA Calibration Kit, 12-term error-corrected test data can be taken on SMA test devices.

IBM AT compatible software permits calibration of test fixtures for real-time de-embedding.

Faster Front-Panel Disk Drive

The built-in 3.5-inch disk with 720K bytes of memory is standard on the 360. Data files are MS–DOS formatted for easy interfacing with IBM and IBM-compatible computers and software.

Broadband, Narrow-Band Tests—No Recalibration

The 360 calibration is maintained as the number of data points is changed or a reduced frequency range is selected. Here is one more feature that improves productivity.

A Choice for Greater Value

Now that engineers have a choice, the Wiltron 360 is being selected as the preferred vector network analyzer. Wherever a comparison is made, the results show that the 360 is the system that has kept pace with technology and reflects the current needs of customers. At last, the 360 gives engineers the freedom to compare and choose the network analyzer that offers the better value.

The need for a new network analyzer has been critical. Customers' demands for simultaneous high accuracy and productivity can now be satisfied. To obtain specified accuracy, other units use an expensive synthesizer as a signal source. However, because of their slow sweep speed, these units are impractical when minimizing test time is important. With these units, the only way that test devices can be adjusted while the operator views a "real time" display is to use a ramp sweep. But the ramp sweep test frequencies are not precisely repeatable. Unfortunately, even the slightest change in frequency can have a substantial effect on phase measurement accuracy. When the synthesizer digital sweep is used instead of the ramp sweep, the operator gets accuracy but at exasperatingly slow test speeds. The Wiltron 360, on the contrary, has speed and accuracy simultaneously.

Complete Characterization of Test Devices

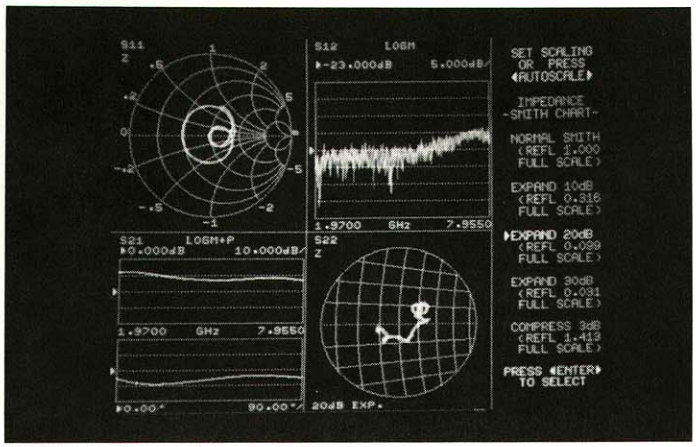
Other units cannot display more than two traces simultaneously. Therefore, there is no direct way to observe the effect of adjusting one S parameter on the other three. In gain and phase matching applications, there is no provision for viewing simultaneously the effect that matching has on input and output impedance.

The 360 solves this problem beautifully. Four S parameters can be displayed simultaneously. In gain and phase matching applications, you not only observe the effect of matching on the input and output impedances, but on the gain and phase as well.

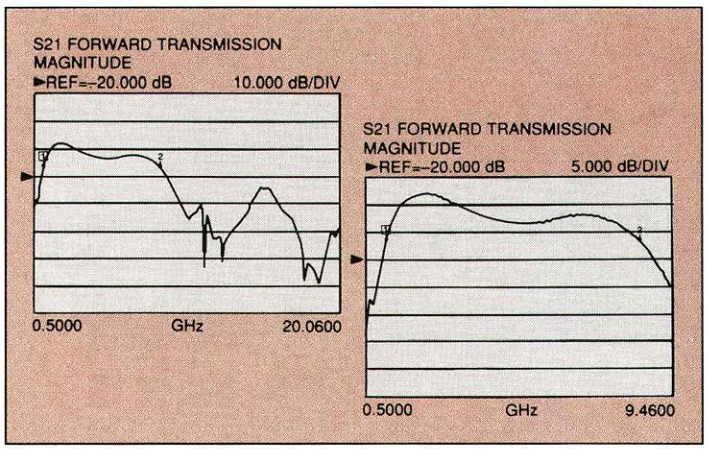
Unequaled Coaxial Frequency Coverage

One very important Wiltron contribution was to extend coaxial measurement capability up to 40 GHz. With the introduction of the Wiltron K Connector, EW and ECM engineers can now use coax up to 40 GHz, reducing system size and weight. But without a vector network analyzer, engineers would still work with a handicap, relying on waveguide measurement devices to test coaxial components. The 360 makes ancient history of 40 GHz coaxial measurement problems.

Even with these improvements in performance, Wiltron offers the 360 with significant cost savings. The system has synthesizer accuracy without synthesizer expense. Savings in most applications is as much as 20% of the system price.



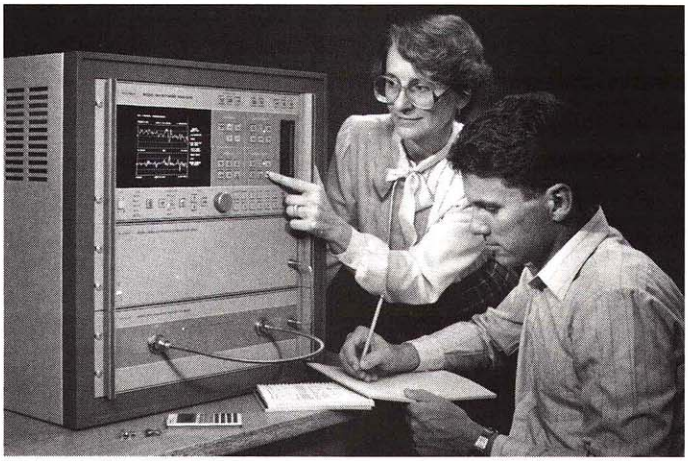
The 360 simultaneously displays four S parameters on a large, color screen.



The frequency range of the 360 can be changed from broadband to narrow-band without recalibration.

Vector Network Analyzer (Cont.)

Model 360



Solution to SMA Measurement Problems

Wiltron is keenly aware of the handicap under which engineers using SMA connectors have had to work. Since previous systems offered no SMA calibration or verification kits, error-correction could not be applied accurately to correct for the 3.5 mm-to-SMA interface mismatch. Measurement uncertainty was high. This problem persisted in spite of the widespread use of SMA devices.

The Wiltron 360 has SMA Calibration and Verification Kits with which accurate, 12-term error-corrected test data can be taken on SMA test devices. Because the K Connector is directly compatible with SMA, there is no need for adapters. Furthermore, the K/SMA interface performance is actually better than that of an SMA/SMA connection.

Convenient and Versatile Calibration

In addition to solving the SMA measurement problem, Wiltron engineers achieved four other important design objectives:

- On the 360, once the calibration has been completed, error-correction automatically takes place. Since all Wiltron test sets are auto-reversing, 12-term error correction is now always practical. Maximum accuracy is readily attained. Furthermore, the original calibration still applies, even when the number of data points is changed or a reduced frequency range is selected. This is measurement convenience at its best.
- The 360 offers three types of calibration:
  1) A standard calibration using an open circuit, short circuit, termination, and thru line.
  2) A waveguide calibration using two different offset short circuits, a termination, and a thru line.
  3) An LRL calibration for microstrip and mixed connector devices using two lengths of thru line and a reflective device.
- The 360 displays are in color on a 25% larger screen. The color is employed to simplify interpretation of simultaneously displayed data.
- The 360 uses a 3.5-inch disk drive with faster than tape cassette loading speed and greater memory. Furthermore, the files are MS–DOS compatible.

Wiltron introduced the 360 Network Analyzer because engineers from around the world wanted improved performance, significant cost savings, and above all, a choice.

0.5 to 40 GHz Measurements

Unique to the 360, higher frequency measurements are made directly from K Connector test ports over the 0.5 to 40 GHz range in coax. Because the K Connector is compatible with SMA and there is available a 360 SMA Calibration Kit, SMA devices can be measured for the first time without compromising accuracy.

A test set with GPC-7 test ports is also available. With the precision adapters provided in the calibration kit, this test set is also well suited to SMA measurements. With either test set, system performance can be certified to traceable standards with Verification Kits for GPC-7, SMA, or K Connector applications.

Hands-Off Test Procedures

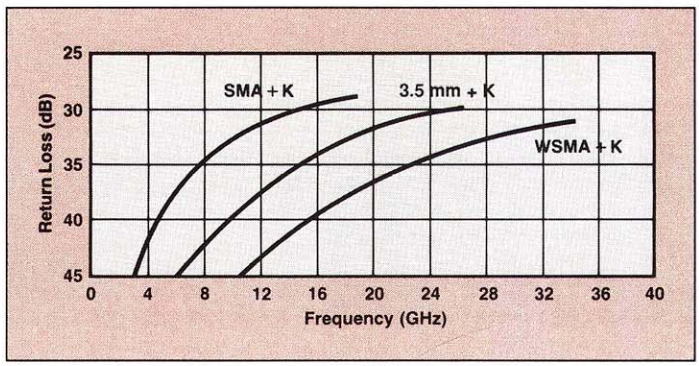
On the 360, there is no need to waste time or degrade accuracy by having to physically reverse the test device. Every test set includes automatic signal reversing so that measurement of all parameters proceeds without interruption or loss of accuracy. In addition, the Active Device Test Sets have 70 dB level-set attenuators in both port lines with which the drive signal can be adjusted to the proper test level. Furthermore, a step attenuator within the forward transmission measurement path permits measurements on devices with an output power level of up to one watt. Full S-parameter measurements on active devices are now possible, even output match, since a power-limiting pad on the output port of the test device is unnecessary.

Time and Distance Domain Measurements

When isolation of components within a test device is required or the distance to an impedance discontinuity must be measured, the 360's time/distance domain software provides the solution. This option adds a real-time display of any S parameter as a function of time or distance from the reference plane, as well as a display of frequency domain data preconditioned by a gate in the time domain.

The time domain displays are fully mixable with other display modes. Using a four-channel display, you can observe a normal frequency domain display on channel one, time domain response on channel two, time domain with gate on channel three, and frequency domain with gate on channel four.

The 360 also features an exclusive "phasor impulse" mode which displays the absolute impedance characteristics of a discontinuity without the need for data at low RF frequencies. For testing amplifiers or high-pass devices where conventional low-pass impulse response measurement would be impossible, this feature is of special value.



Return loss characteristics (uncorrected) of K Connector™ ensure excellent electrical compatibility with SMA and 3.5 mm connectors.

150 dB Dynamic Range Up to 18 GHz

Whichever your choice of display, you will appreciate the exceptional 150 dB dynamic range up to 18 GHz (Model 3620) and 140 dB up to 40 GHz (Model 3621). At very low signal levels, test data accuracy may be improved by the use of two different methods of signal enhancement: averaging and video IF bandwidth reduction. At all signal levels and at all measurement speeds, automatic 12-term vector error correction with a synthesized microwave test signal removes system residual errors to produce accurate phase and magnitude measurements. You make measurements with a new level of confidence.

Sophistication and Simplicity

The 360 is a sophisticated system that uses powerful computational capabilities to simplify operation. For example, self-explanatory menus include instructions for selecting the next function or parameter. Consequently, considering the capabilities of the system, the number of front-panel controls is small. Use of controls is simplified by their positioning in logical groups. Familiarization moves rapidly, free of irritating dependence on the instruction manual. You will enjoy the lack of lost motion and confusion as you follow the calibration and measurement procedures.

At each step, a glance at the screen tells you the complete status of your measurement. Detailed annotation includes the type of test being performed, frequency range, scale factors, reference position, marker frequency and magnitude, minimum and maximum data values, and much more. Microprocessors monitor system status and keep you informed of all test-related conditions and parameters. They take the tedium out of measurements, so you can focus on the test results.

12-Term Error Correction

There are two categories into which sources of measurement errors can be divided:

1) Repeatable
   - Transmission Frequency Response
   - Reflection Frequency Response
   - Source Match
   - Load Match
   - Directivity
   - Isolation (Crosstalk)
2) Nonrepeatable
   - Frequency Repeatability
   - Noise
   - Connector Repeatability
   - Temperature and Environment Change

Because the six sources of error in the first category are repeatable, they can be modeled mathematically and identified by calibrating with the precision components in the Calibration Kits. These six error sources can be measured in both forward and reverse direction, hence the name 12-term error correction. The extent to which 12-term error correction improves accuracy is directly dependent upon the quality of the calibration components. Having produced components that are accepted as standards throughout the world, Wiltron is able to offer its own components in Calibration Kits for GPC-7, SMA, Type N, and K Connector test devices. Furthermore, since all test sets feature internal signal reversing, 12-term error correction can always be used to obtain accurate reflection and/or transmission test data.

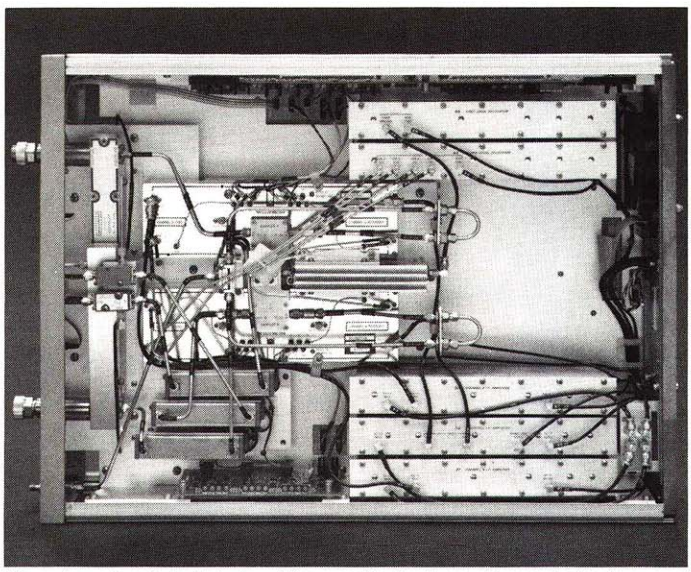
Calibration Kits are available for K, Type N, GPC–7, and SMA test devices.

Errors introduced by nonrepeatable sources are minimized by:

- Phase locking each test frequency,
- Averaging repeated measurements and reducing video IF bandwidth to effectively lower the noise floor,
- Using sturdy GPC–7 and K Connector test ports, and
- Choosing test set components that have exceptional stability.

Verification Kits

In addition to Calibration Kits, Wiltron offers Verification Kits. The Verification Kit consists of components with characteristics that are traceable to NBS. This kit is usually kept in the metrology laboratory where it provides the most dependable means of checking system accuracy.



Step attenuators in both test port lines and in the forward transmission line permit adjustment of test and output power levels in the 3620 Active Device Test Set.

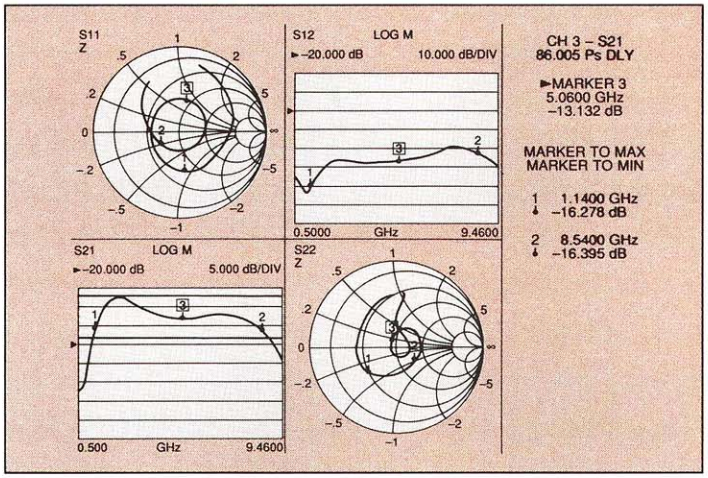
Vector Network Analyzer (Cont.)

Model 360

Applications

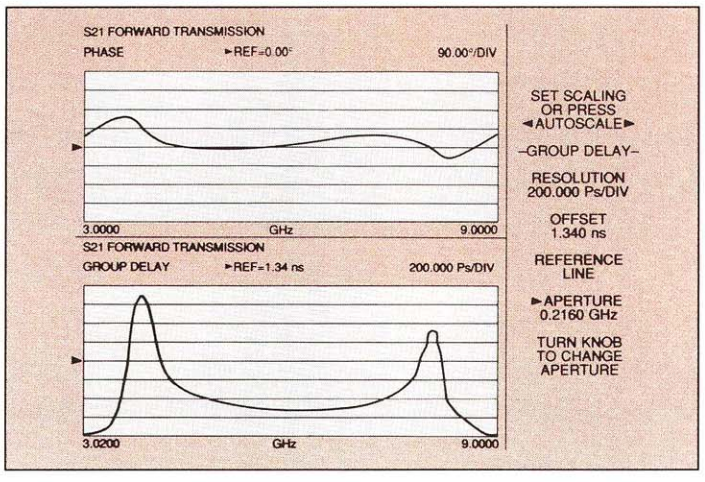
Impedance and Transmission Characteristics

The 360 tests two-port devices in both directions without disconnecting, applies 12-term vector error correction to the test data, and displays all four S parameters simultaneously in "real time" with phase-locked accuracy. On one display you see the complete characterization of amplifiers, isolators, directional couplers, cables – whatever you are testing. A color display with six markers, data limit lines, and complete annotation enhances data interpretation directly from the screen. Here you see the forward and reverse transfer characteristics as well as the input and output Smith chart impedance of a two-stage S and C band FET amplifier over the 0.5 to 9.46 GHz range.



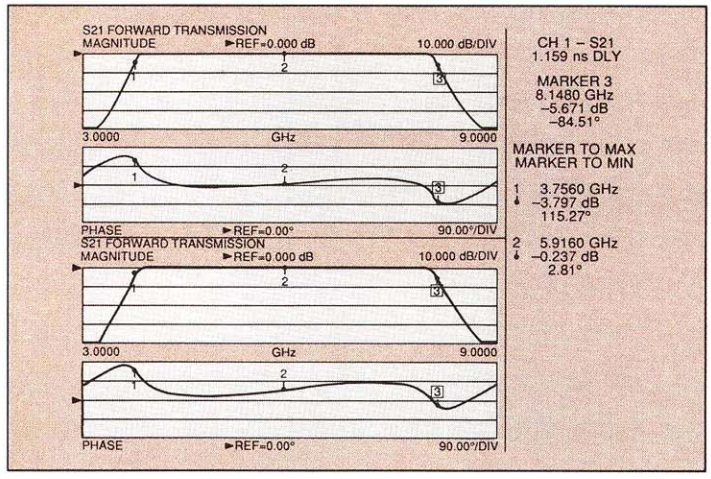
Group Delay

With a "real time" display of signal transit time, you can easily adjust your test device to optimize group delay characteristics. Variable frequency aperture settings can be made without recalibrating. Group delay and deviations from linear phase can be displayed simultaneously on separate graphs. As a result, your products will perform with improved signal fidelity. The display here shows both the deviation from linear phase and group delay for a 4 to 8 GHz bandpass filter.



Amplitude and Phase Matching

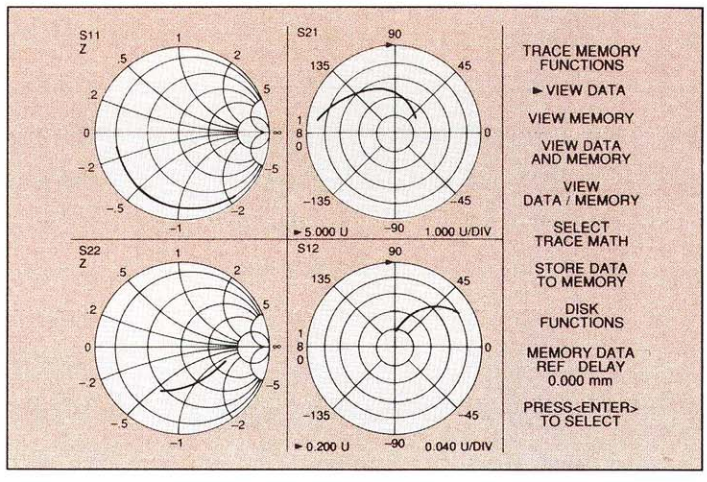
To match the amplitude and phase of a test device to a standard or to a known device, the characteristics of one can be placed in memory and compared automatically to that of the second, using the "Trace Memory" feature. Differences between the two units can be directly measured and compared. In addition, by using normalization, the differences can be indicated as deviations from a straight line. When two traces are displayed on the same graph, the use of a different color for each trace enhances analysis. In this display, the characteristics of two bandpass filters are shown. The top traces are those for the standard filter. The test filter characteristics are shown below.



Semiconductor Characteristics

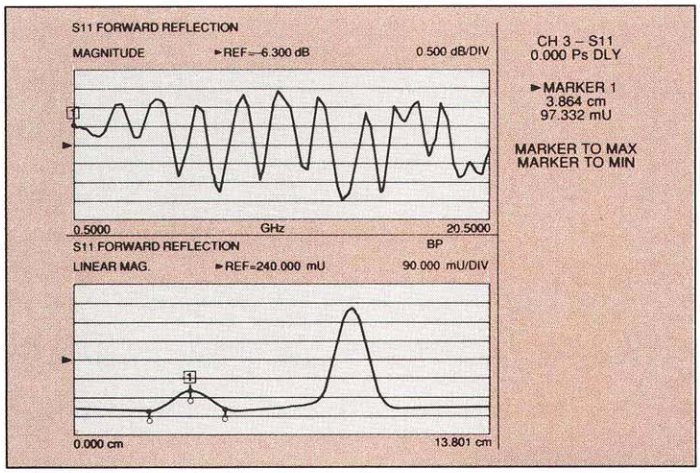
There are at least three 360 features that could change the way you test semiconductors:

- Active Device Test Sets include bias tees and step attenuators for adjusting signal levels at the measurement ports. A unique third attenuator allows direct measurement of devices up to one watt output power.
- All four S parameters can be displayed simultaneously.
- Software is available that implements de-embedding and customizes output formats. In this display, the four S parameters of an NEC700 GaAs FET over the 2 to 18 GHz range are shown.



Time Domain

With the addition of the time or distance domain (2360–2 software), your system displays discrete discontinuities as a function of time or distance. Unwanted reflections can be removed from the display by windowing and gating. For complete characterization, data can be shown in frequency and time domains simultaneously. The trace shown locates a discontinuity at 3.86 cm in an unterminated 0.141 in. semirigid cable.



Insertion Loss/Gain and Phase

Because of its low noise floor, 0.001 dB resolution, video IF bandwidth reduction, averaging, and automatic scaling, this system stands alone for transmission measurements of attenuators, high-isolation switches, and high-rejection filters.

Waveguide Components

The 360 system includes waveguide calibration and measurement capability up to 40 GHz. Direct waveguide measurements can be made using Wiltron K Connector-to-waveguide transitions and calibrating the system with two offset waveguide short circuits, a termination, and a thru connector. The reference delay includes compensation for the waveguide dispersion. You enter only the waveguide cutoff frequency.

De-embedding

Resident in the 360 is a TRL calibration to assist in de-embedding the effects of a microstrip transmission line. The TRL calibration allows you to:

- Measure the S parameters of chip-level devices in the medium in which the devices will be used, e. g., coplanar microstrip, etc.
- De-embed the S parameters of the device from the test fixture.
- Make S parameter error-corrected measurements on non-coaxial transmission lines, and move the reference planes

With the use of the generic LRL calibration scheme and an external controller, you can perform multilevel de-embedding. In this mode, any noncoaxial transmission media, including mixed media interconnects, can be accomodated. For example, a test device with a waveguide input and a coplanar microstrip output can be measured. The versatility of this mode is limited only by your ingenuity and the availability of calibration devices.

Through the use of LRL calibration and an external computer, in conjunction with ANACAT, multiple-level de-embedding is possible. This calibration allows you to make semiconductor chip measurements with a single test fixture up to 40 GHz.

Service Support

Installation

There is no charge for installation and start-up instructions for your 360 Network Analyzer. Since there are no special instructions or precautions, you can start measurements immediately. Operation is straightforward. From your first inquiry, Wiltron specialists make certain that you are pleased with your system and that it is performing to your satisfaction.

Software Support

The Wiltron optional Software Support Service keeps you up-to-date on program improvements and new program releases. By using the ever-expanding library of software programs, you will get more value with each passing year from your versatile 360 system.

Hardware Documentation Support

Your system is delivered with a complete set of operation, maintenance, and software manuals. To keep your documentation current, you receive manual updates as well as service notes. You will appreciate the clarity and thoroughness with which Wiltron support documentation is prepared.

Maintenance, Repair, and Calibration

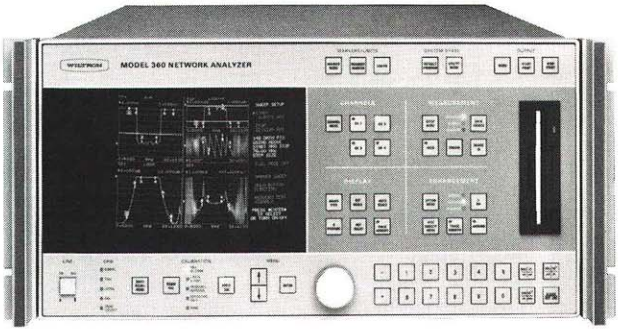
Wiltron provides worldwide support for the 360 Network Analyzer. Service centers staffed by skilled personnel welcome telephone consultation calls. On-site service and calibration performed with NBS traceable devices keep your system performing reliably and accurately. In many areas, annual service agreements are available.

Vector Network Analyzer (Cont.)

Model 360

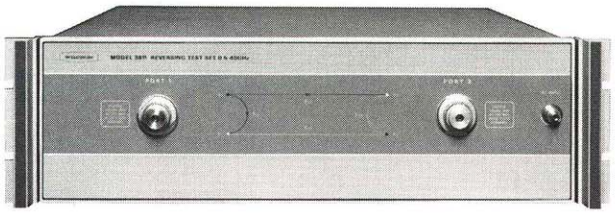
System Composition

The Network Analyzer



The 360 Network Analyzer is the control and display unit for all versions of the network analyzer system. Selected from its front panel are menu items, test functions, test parameters, measurement enhancements, and frequencies. Frequency information is provided to the system signal source over a dedicated GPIB system interface bus. Test parameters, system status, and measurement data are displayed on the large color screen and hard copied on a printer or plotter.

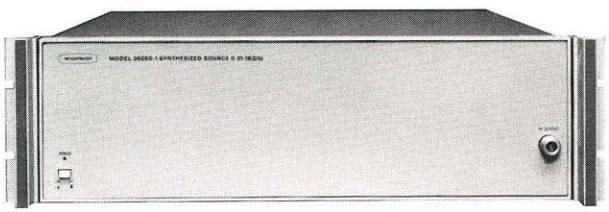
The Test Sets



There are four test sets from which to choose the unit best suited to your application. All models include automatic signal reversing with which full S-parameter tests can be made without manually reversing the test device. Models 3620 and 3621 have 70 dB variable attenuators in both port lines for adjusting the test signal level. A step attenuator in the forward transmission line attenuates the test device output power up to one watt. Calibration Kits contain adapters for test devices with connectors that differ from those of the test ports.

Model	Frequency Range	Test Port Connectors
3610 Reversing Test Set 3611 Reversing Test Set	500 MHz to 18 GHz 500 MHz to 40 GHz	GPC–7 K Connector (Male)
3620 Active Device Test Set 3621 Active Device Test Set	500 MHz to 18 GHz 500 MHz to 40 GHz	GPC–7 K Connector (Male)

The System Signal Sources



There are two signal sources designed specifically for use in the 360: the 360SS45 covering the 10 MHz to 18 GHz range and the 360SS69 with its 10 MHz to 40 GHz range. Both are under control of the 360 Network Analyzer and provide clean, phase-locked test signals for precise test data. Frequency resolution is 100 kHz. Also compatible with the 360 are the Wiltron 6600B Sweep Generators.

Specifications

MEASUREMENT CAPABILITIES

Number of Channels: Four measurement channels.
Parameters: S_{11}, S_{21}, S_{22}, S_{12}; complex input and output impedance; complex input or output admittance; and complex forward and reverse transmission. All measurements are made without the need to manually reverse the test device.
Domains: Frequency Domain and optional Time Domain (Software 2360–2). Both domains can be displayed simultaneously.
Formats: Log Magnitude, Phase, Log Magnitude and Phase, Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, Log Polar, Group Delay, Linear Magnitude, Linear Magnitude and Phase, Real, Imaginary, Real and Imaginary.
Data Points: 501. Can be switched to a nominal 168 or a nominal 85 points without recalibration.
Reference Delay: Can be entered in time or in distance (when the dielectric constant is entered). Automatic reference delay feature adds the correct electrical length compensation at the push of a button. Software compensation for the electrical length difference between reference and test is always accurate and stable since measurement frequencies are always synthesized. In addition, Wiltron offers Reference Phase Delay for dispersive transmission media, such as waveguide and microstrip.
Markers: Six independent markers can be used to read out measurement data. In delta-reference mode, any one marker can be selected to become the reference for the other five. Markers can be directed automatically to the minimum or maximum of a data trace.
Limits: Two limit lines per data trace to indicate test limits.
Limit Frequency: Identifies the ±X dB bandwidth of amplifiers, filters and other frequency sensitive devices. Interpolation algorithm determines the exact intersection frequencies of test data and limit lines.
Measurement Frequency Range: Frequency range of measurement can be narrowed within calibration range without recalibration. CW mode permits single frequency measurements, also without recalibration. In addition, the system accepts N discrete frequency points where $2 \leq N \leq 501$.

Resolution of Readout (maximum):

Log: 0.001 dB
Linear: 0.001 pU
Phase: 0.01 degrees
Group Delay: 0.001 fs
SWR: 0.001pU
Real: 0.001 pU
Imaginary: 0.001 pU
Time: 0.001 ps
Distance: 0.001 mm

Dynamic Range: The dynamic range of the signal level at port 2 is defined as the maximum signal level at 0.2 dB compression minus the noise floor.

Test Set Model	Frequency Range (GHz)	Maximum Signal Level (dBm)	Noise Floor* (dBm)	Dynamic Range (dB)
3610	0.5 to 18	0	–110	110
3611	0.5 to 18 >18 to 26.5 > 26.5 to 40	–3	–113 –108 –103	110 105 100
3620	0.5 to 18	30**	–110	140
3621	0.5 to 18 >18 to 26.5 > 26.5 to 40	30**	–113 –108 –100	143 138 130

* Using minimum video bandwidth and 1028 averages. ** Using internal series attenuator.

MEASUREMENT ENHANCEMENT

Vector Error Correction: Three methods of calibration include: standard calibrations using either open circuits or offset short circuits and RL calibration. There are four vector error corrections: Full 12-Term, One Path-Two Port, Frequency Response, and Reflection Only. Full 12-term can always be used if desired as all test sets automatically reverse the test signal. Front-panel LEDs indicate the type of calibration which is stored in memory. Front-panel button selects whether calibration is to be applied, and an LED lights when calibration data are being applied.

Calibration Standards: Can select SMA, GPC–7, Type N, and K Connector from calibration menu. Use of fixed or sliding load can be selected for each connector type. Open circuit capacitance coefficients can be modified manually or through the GPIB interface.

Data Averaging: Averaging of 1 to 4095 points can be selected. Averaging can be toggled on/off with front-panel button. Front-panel LED indicates when averaging is active.

Video IF Bandwidth: Front-panel switch selects three levels of video IF bandwidth. NORMAL, REDUCED, and MIN selections correspond to approximately 10 kHz, 1 kHz, and 100 Hz, respectively.

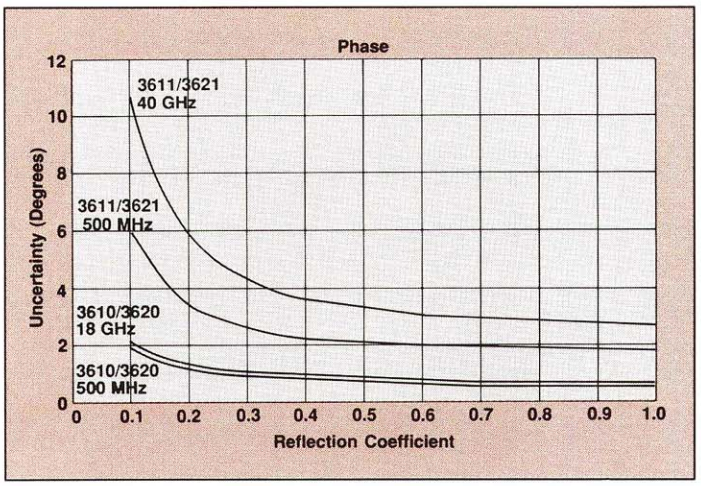
Trace Smoothing: Functions similarly to Frequency Averaging. Trace width to be smoothed can be selected from 0 to 20% of trace. Front-panel button turns smoothing on/off and front-panel LED indicates when smoothing is active.

SOURCE CONTROL

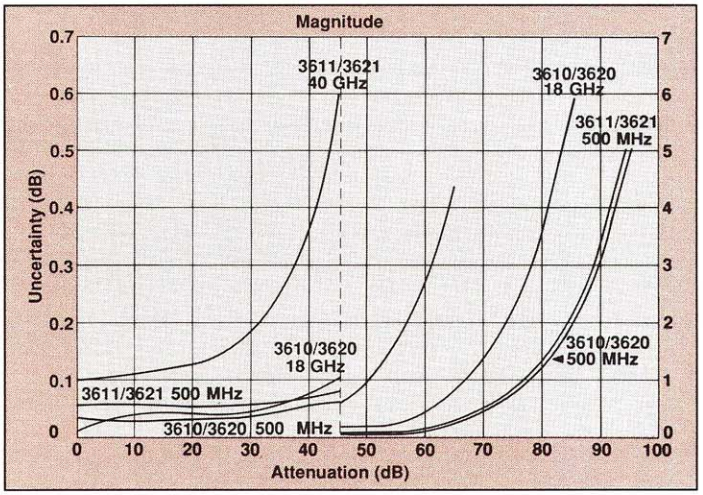
Compatibility: The 360 is compatible with the Wiltron 360SS System Sources and the 6600B Sweep Generators. The phase-locked output frequency of both is controlled by the 360 which sends frequency information through a dedicated GPIB system interface bus. The output frequency is then phase locked with the frequency accuracy of the internal 10 MHz crystal standard. Phase-lock time is typically 2 ms. Frequency resolution is 100 kHz.

MEASUREMENT ACCURACY

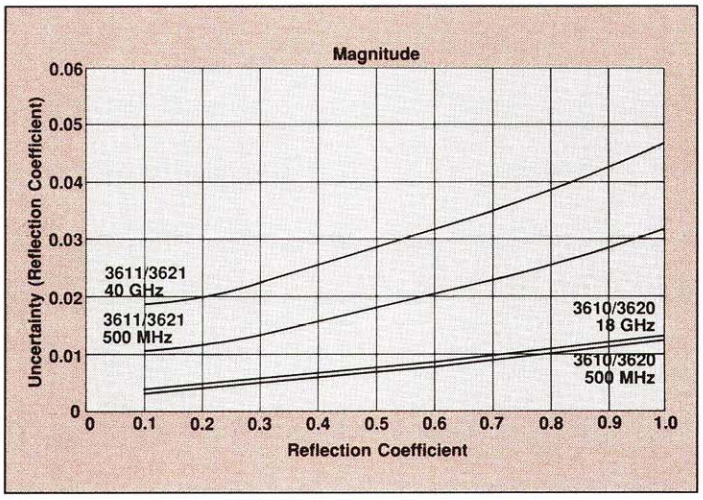
The following graphs give typical measurement accuracy after 12-term vector error correction. The errors are root-sum-of-the-squares (RSS) calculations of the contributions of residual directivity, load and source match, frequency response, isolation, network analyzer dynamic accuracy, and connector repeatability. In preparing the following graphs, a reduced video IF bandwidth and averaging of 128 points were used. Changes in the video IF bandwidth or averaging can result in variations at low levels.

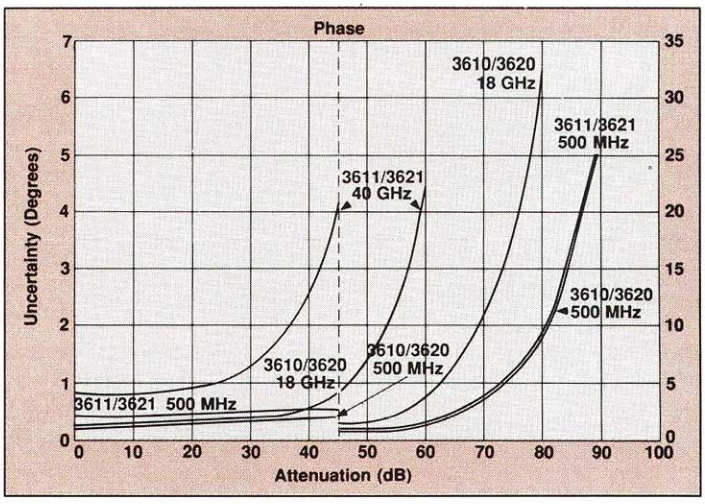


Transmission Measurements



Reflection Measurements





Vector Network Analyzer (Cont.)

Model 360

GROUP DELAY ACCURACY

Group Delay is measured by computing the phase change in degrees across a frequency step by applying the formula:

$$\tau_g = -1/360\ d\phi/df$$

Aperture: Determined by the number of steps within a frequency range. The number of steps can be changed without recalibration. The minimum aperture is 0.002 x frequency range (501 steps) and can be increased to 20% of the frequency range without recalibration. The frequency width of the aperture is displayed automatically.
Range: The maximum delay range is limited to measuring no more than ±180 degrees of phase change within the aperture set by the number of frequency points. With a frequency step size of 100 kHz, this corresponds to 10 µs.
Measurement Repeatability (sweep to sweep): For continuous measurement of a through connection, RSS fluctuations due to phase and FM noise are:

$$\pm \frac{1.41\ \{(\text{Phase Noise in deg})^2 + (\tau_g \times \text{Residual FM Noise in Hz})^2\}^{1/2}}{360\ (\text{Aperture in Hz})}$$

Accuracy:

$$\text{Error in } \tau_g = \frac{\frac{\text{Error in Phase (deg)}}{360} + \tau_g \times \text{Aperture Frequency Error (Hz)}}{\text{Aperture (Hz)}}$$

TEST PORT CHARACTERISTICS

The following specifications apply to all test sets up to 18 GHz. Specifications above 18 GHz apply only to Models 3611 and 3621 Test Sets. Specifications under GPC–7 apply to Models 3610 and 3620. Specifications under K and 3.5 mm apply to Models 3611 and 3621 and to 3610 and 3620 when 34AK50 or 34AKF50 GPC–7 to K Connector adapters are used. All specifications apply after 12-term error correction. The environment temperature is 23°C ±3°C.

	Test Ports		
	GPC–7 (dB)	3.5 mm (dB)	K (dB)
Directivity			
0.5 to 18 GHz	>50	>40	>40
>18 to 26.5 GHz	–	>40	>40
>26.5 to 40 GHz	–	–	>35
Source Match			
0.5 to 18 GHz	>40	>30	>30
>18 to 26.5 GHz	–	>30	>30
>26.5 to 40 GHz	–	–	>27
Load Match			
0.5 to 18 GHz	>40	>35	>35
>18 to 26.5 GHz	–	>30	>30
>26.5 to 40 GHz	–	–	>27
Reflection Frequency Response			
0.5 to 18 GHz	±0.1	±0.25	±0.25
>18 to 26.5 GHz	–	±0.25	±0.25
>26.5 to 40 GHz	–	–	±0.35
Transmission Frequency Response			
0.5 to 18 GHz	±0.02	±0.05	±0.05
>18 to 26.5 GHz	–	±0.06	±0.06
>26.5 to 40 GHz	–	–	±0.1
Isolation*			
0.5 to 18 GHz	>90	>90	>90
>18 to 26.5 GHz	–	>85	>85
>26.5 to 40 GHz	–	–	>75

* Measured with terminations on port 1 and 2 and using a minimum of 128 point averaging and 20% smoothing.

DISPLAY CAPABILITIES

Number of Channels: Four, each of which can display any S parameter in any format with up to two traces per channel for a maximum of eight traces simultaneously. A single channel, two channels (1 and 3 or 2 and 4) or all four channels may be displayed simultaneously.
CRT: Color display. Graticules are displayed in green, measurement data in red, and markers and limits in blue. Trace data stored in memory are displayed in green.
Trace Memory: A separate memory for each channel can be used to store measurement data for later display or for subtraction, addition, multiplication or division with current measurement data.
Scale Resolution (minimum):
Log Magnitude: 0.001 dB/div
Linear Magnitude: 1 pU
Phase: 0.01 degrees/div
Group Delay: 0.001 ps
Time: 0.001 µs
Distance: 0.001 µm
SWR: 1 pU
Autoscale: Automatically sets Resolution and Offset to fully display measurement data.
Reference Position: Can be set at any graticule line.
Annotation: Type of measurement, vertical and horizontal scale resolution, start and stop frequencies, and reference position.

HARD COPY

Dot Matrix Printer: Menu selects full screen, graphical, or tabular data. The number of data points of tabular data can be selected as well as data at markers only. Compatible with the 2225C Ink Jet Printer. Parallel (Centronics) interface.
GPIB Plotter: The 360 is compatible with HP Models 7440A, 7470A or 7475A. Menu selects plotting of full graphical data or only the measurement trace. Plotter is connected to the dedicated system bus which also controls the microwave source.
Buffer: Hard copy data are loaded into buffer memory in approximately 12 seconds. Full front-panel operation and measurement capability is then restored to the user during the remainder of the hard copy generation.

DISK DRIVE

A 3.5-inch microdiskette drive with 720K bytes formatted capacity is used to load measurement programs and to store measurement and calibration data and front-panel setups. All files are MS-DOS compatible. File names can be 1 to 8 characters long.
Measurement Data: 25.6K bytes per 501 point S-parameter data file.
Calibration Data: 57K bytes per 501 point, 12-term calibration plus front-panel setup.
Trace Memory File: 4K bytes per 501 point channel.

REMOTE PROGRAMMING

Interface: GPIB, IEEE–488
Addressing: Address can be set from the front panel and can range from 0 to 30. Defaults to address 6.
Transfer Formats: ASCII, 32 bit floating point, 64 bit floating point.
Speed: 40K bytes/s
Interface Function Codes: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DT1, DC0, C0.

TIME DOMAIN

Time Domain Software 2360–2 adds signal processing and Fourier transform technology to the 360. Data collected as an array of complex frequency points are processed enabling the user to:

1. Obtain a time (or distance) presentation for location of discontinuities.
2. Obtain a presentation that indicates the nature (inductive or capacitive) of a discontinuity—a new capability for processing bandpass data.
3. Isolate a discontinuity and return to the frequency domain to observe its characteristics, independent of others.

Modes of Operation:
1. Bandpass processing resulting in time domain display with arbitrary start and stop times.
2. Phasor Impulse Processing of bandpass data to provide a low-pass equivalent impulse response for a real and/or imaginary presentation.
3. Frequency Response with a time gate applied.
4. True Low-Pass Processing resulting in a time domain display with arbitrary start and stop times. The traditional TDR step response is available in this mode. A harmonically related series of frequency points is required.

Specifications

Type of Window (Number of Terms)	First Side Lobe Relative to Peak (dB)	Impulse Width*
Rectangular (1)	–13	1.2 W
Nominal-Hamming (2)	–43	1.8 W
Low Side Lobe Blackman-Harris (3)	–67	2.1 W
Minimum Side Lobe Blackman-Harris (4)	–92	2.7 W

* W (Bin Width) = 1/2Δf For example, when Δf = 10 GHz, W = 50 ps

GENERAL

Rear Panel Connectors and Controls:
RGB VIDEO: TTL compatible, 15 pin D subminiature.
COMP VIDEO: Connects to external video display, phono jack.
CRT INTEN: Continuous control of CRT intensity.
CRT DEGAUSS: Pushbutton control degausses CRT.
PRINTER: Connects to external printer with Centronics interface, 25 pin D Subminiature..
10 MHz REF IN: Connects to external reference frequency standard, 10 MHz, +5 dBm to –5 dBm, 50 ohms, BNC female.
10 MHz REF OUT: Connects to internal reference frequency standard, 10 MHz, ±1 ppm 0°–55°C, 0 dBm, 50 ohms, BNC female.

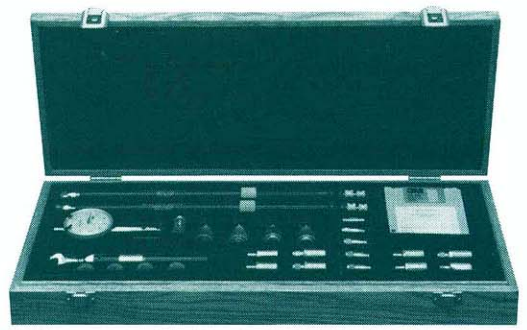
Temperature Range:
Operating: 0°C to 55°C (45°C maximum for disk drive)
Storage: –40°C to 75°C

Power Requirements:
Network Analyzer: 100V/120V/220V/240V +5%, –10%, 48–63 Hz, 350 VA maximum.
System Sources: 100V/120V/220V/240V +5%, –10%, 50–60 Hz, 250 VA maximum
Test Sets: None. Power is supplied by the 360.

Dimensions:
Network Analyzer: 222 H x 432 W x 603 D mm (8.75 H x 17 W x 23.75 D in.)
System Sources: 133 H x 432 W x 476 D mm (5.25 H x 17 W x 18.75 D in.)
Test Sets: 133 H x 432 W x 603 D mm (5.25 H x 17 W x 23.75 D in.)
Printer: 89 H x 292 W x 203 D mm (3.5 H x 11.5 W x 8 D in.)
System Cabinet: 572 H x 559 W x 699 D mm (22.5 H x 22 W x 27.5 D in.)
System Console: 1245 H x 559 W x 699 D mm (49 H x 22 W x 27.5 D in.)

Weight:
Network Analyzer: 25 kg (55 lb)
System Sources: 16 kg (35.4 lb) .
Test Sets: 14.3 kg (31.5 lb)
Printer: 3.2 kg (7 lb)
System Cabinet (empty): 40.8 kg (90 lb)
System Console (empty): 88.4 kg (195 lb)

Calibration Kits



3650 SMA/3.5 mm Calibration Kit
The 3650 Calibration Kit contains all the precision components and tools required to calibrate for 12-term error-corrected measurements of devices with SMA or 3.5 mm connectors. Components are included for calibrating male and female test ports. The kit supports calibration with broadband loads. Option 1 adds sliding loads.

Consisting of:
23S50 Short, SMA Male
23SF50 Short, SMA Female
24S50 Open, SMA Male
24SF50 Open, SMA Female
28S50–2 Termination, SMA Male (DC–26.5 GHz) (2 each)
28SF50–2 Termination, SMA Female (DC–26.5 GHz) (2 each)
33SFSF50 Insertable, SMA Female/Female (2 each)
33SS50 Insertable, SMA Male/Male
33SSF50 Insertable, SMA Male/Female (2 each)
34AS50–2 Adapter, GPC-7/SMA Male (2 each)
34ASF50–2 Adapter, GPC-7/SMA Female (2 each)
01–201 Torque Wrench
01–210 Reference Flat
01–222 Connector Gauge
01–223 Gauge Kit Adapter

Option: 1: Adds 17S50 Sliding Load, SMA Male; 17SF50 Sliding Load, SMA Female; 01–211 Female Flush Short; and 01–212 Male Flush Short.

3651 GPC-7 Calibration Kit
The 3651 Calibration Kit contains all the precision components and tools required to calibrate for 12-term error-corrected measurements of test devices with GPC–7 connectors. The kit supports calibration with broadband loads. Option 1 adds a sliding load.

Consisting of:
23A50 Short, GPC–7
24A50 Open, GPC–7
28A50–1 Termination, GPC-7 (DC–18 GHz) (2 each)
01–200 Torque Wrench
01–210 Reference Flat
01-221 Collet Extractor Tool and Vial of 4 Collets

Option 1: Adds 17A50 Sliding Load, GPC–7; and 01–220 GPC–7 Connector Gauge.

Vector Network Analyzer (Cont.)

Model 360

CALIBRATION KITS (Cont.)

3652 K Connector Calibration Kit:
The 3652 Calibration Kit contains all the precision components and tools required to calibrate for 12-term error-corrected measurements of test devices with K Connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads. Option 1 adds sliding loads.

Consisting of:
23K50 Short, K Male
23KF50 Short, K Female
24K50 Open, K Male
24KF50 Open, K Female
28K50 Termination, K Male (DC–40 GHz) (2 each)
28KF50 Termination, K Female (DC–40 GHz) (2 each)
33KK50 Insertable, K Male/Male
33KFKF50 Insertable, K Female/Female (2 each)
33KKF50 Insertable, K Male/Female (2 each)
34AK50 Adapter, GPC–7/K Male (2 each)
34AKF50 Adapter, GPC–7/K Female (2 each)
01–201 Torque Wrench
01–210 Reference Flat
01–222 Connector Gauge
01–223 Gauge Kit Adapter

Option 1: Adds 17K50 Sliding Load, K Male; 17KF50 Sliding Load, K Female; 01–211 Female Flush Short; and 01–212 Male Flush Short.

3653 Type N Calibration Kit
The 3653 Calibration Kit contains all the precision components and tools required to calibrate for 12-term error-corrected measurements of test devices with Type N connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads.

Consisting of:
23N50 Short, N Male
23NF50 Short, N Female
24N50 Open, N Male
24NF50 Open, N Female
28N50–1 Termination, N Male (DC–18 GHz) (2 each)
28NF50–1 Termination, N Female (DC–18 GHz) (2 each)
34AN50–2 Adapter, GPC–7/N Male (2 each)
34ANF50–2 Adapter, GPC–7/N Female (2 each)
01–213 Type N Reference Gauge
01–224 Type N Connector Gauge

Verification Kits

3666 3.5 mm Verification Kit
The 3666 Verification Kit contains precision 3.5 mm components with characteristics that are traceable to the National Bureau of Standards. Used primarily by the metrology laboratory, these components provide the most dependable means of determining system accuracy. A disk containing factory-measured test data for all components is supplied for comparison with customer-measured data.

Consisting of:
19S50–7 7.5 cm Air Line
19S50–7B 7.5 cm Stepped Impedance Air Line (Beatty Standard)
41SB–20 20 dB Attenuator
41SB–50 50 dB Attenuator

3667 GPC–7 Verification Kit
The 3667 Verification Kit contains precision GPC–7 components with characteristics that are traceable to the National Bureau of Standards. Used primarily by the metrology laboratory, these components provide the most dependable means of determining system accuracy. A disk containing factory-measured test data for each component is supplied for comparison with customer-measured data.

Consisting of:
18A50–10B 10 cm Stepped Impedance Air Line (Beatty Standard)
18A50–10 10 cm Air Line
41AA–20 20 dB Attenuator
41AA–50 50 dB Attenuator

3668 K Connector Verification Kit
The 3668 Verification Kit contains precision components with characteristics that are traceable to the National Bureau of Standards. Used primarily by the metrology laboratory, these components provide the most dependable means of determining system accuracy. A disk containing factory-measured test data for each component is supplied for comparison with customer-measured data.

Consisting of:
19K50–7 7.5 cm Air Line
19K50–7B 7.5 cm Stepped Impedance Air Line (Beatty Standard)
41KC–20 20 dB Attenuator
41KC–50 50 dB Attenuator

Ordering Information

NETWORK ANALYZER

360 Vector Network Analyzer supplied in 360C2 System Cabinet, including support rails and power distribution $30,750
Option 1: Deletes 360C2 System Cabinet and supplies the 360 instrument with rack mount slides and ears . . Subtract $600
Option 16: Monochrome Display . . . . . Subtract $200
360C1 System Console including 360 Network Analyzer, work shelf, support rails, component storage drawer, and power distribution. Deletes 360C2 System Cabinet . . . . . Add $1,200

TEST SETS (One Required)

3610 Reversing Test Set, 500 MHz to 18 GHz, GPC–7 Connectors $18,500
3611 Reversing Test Set, 500 MHz to 40 GHz, Male K Connectors . . . . . $28,000.
3620 Active Device Test Set, 500 MHz to 18 GHz, GPC–7 Connectors . . . . . $26,000.
3621 Active Device Test Set, 500 MHz to 40 GHz, Male K Connectors . . . . . $36,000.
Note: Test sets are supplied mounted in the 360C2 System Cabinet.
Options:
Option 1: Deletes 360C2 System Cabinet and supplies the test set instrument with rack mount slides and ears . . . . Add $250
Option 1S: Configures test set for mounting in 360C1 System Console. Includes rack mounting and power distribution. . No charge

SYSTEM SOURCES (One Required)

360SS45 Signal Source, 10 MHz to 18 GHz, 100 kHz frequency resolution, 10 dBm output power . . . . . $21,500.
360SS69 Signal Source, 10 MHz to 40 GHz, 100 kHz frequency resolution, 0 dBm output power . . . . . $36,500.
Note: Signal sources are supplied mounted in the 360C2 System Cabinet.

Options:
Option 1: Deletes 360C2 Cabinet and supplies the signal source instrument with rack mount slides and ears. . . . . Add $250
Option 1S: Configures signal source for mounting in 360C1 System Console. Includes rack mounting and power distribution. . No charge

The Wiltron 6600B Series Sweep Generators and the 6700A Swept Frequency Synthesizers (1 kHz resolution) are also compatible with the 360.

CALIBRATION KITS (As Required)

3650 SMA/3.5 mm Calibration Kit $4,250
Option 1. Male and Female Sliding Terminations . . . . .Add $3,700
3651 GPC–7 Calibration Kit $2,300
Option 1. Sliding Termination . . . . . .Add $1,200
3652 K Connector Calibration Kit $5,000
Option 1. Male and Female Sliding Terminations . . . . .Add $4,500
3653 Type N Calibration Kit $3,500

VERIFICATION KITS (As Required)

3666 3.5 mm Verification Kit $2,600
3667 GPC–7 Verification Kit $2,400
3668 K Connector Verification Kit $2,900

TEST PORT CABLES

Semirigid:
3670A50–1 Test Port Cable, dc to 18 GHz, GPC–7 connectors, one-foot long, two required. . . . . $650 each
3670A50–2 Test Port Cable, dc to 18 GHz, GPC–7 connectors, two-feet long $675
3670K50–1 Test Port Cable, dc to 40 GHz, K Connectors, one-foot long, female/female, two required. . . . . $750 each
3670K50–2 Test Port Cable, dc to 40 GHz, K Connectors, two-feet long, female/female $775
Flexible:
3671A50–1 Test Port Cable, dc to 18 GHz, GPC–7 Connectors, one-foot long, two required . . . . . $650 each
3671A50–2 Test Port Cable, dc to 18 GHz, GPC–7 connectors, two-feet long. $675
3671K50–1 Test Port Cable, dc to 40 GHz, K Connectors, one-foot long, female/female, two required. . . . . $750 each
3671K50–2 Test Port Cable, dc to 40 GHz, K Connectors, two-feet long, female/female. $775

REPLACEMENT GPIB CABLES

2100–1 GPIB Cable, 1 m (3.3 ft) long $60
2100–2 GPIB Cable, 2 m (6.6 ft) long $75
2100–4 GPIB Cable, 4 m (13.2 ft) $95
2100–5 GPIB Cable, 0.5 m (1.65 ft) $55

TEST PORT ADAPTERS

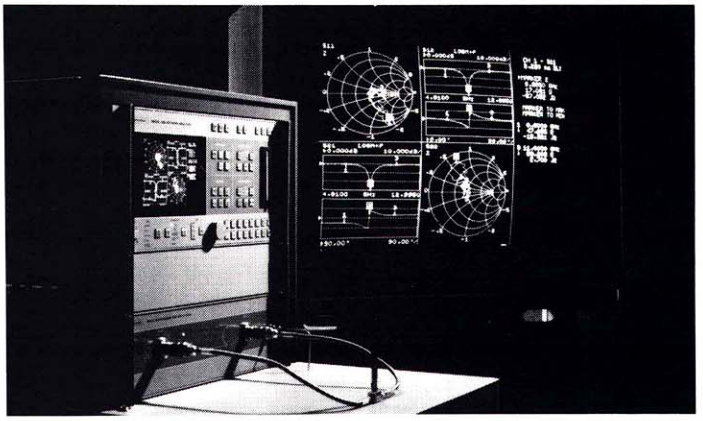
Test port adapters are for use with 3611 and 3621 Test Sets.
34UA50 Test Port Adapter, Universal/GPC–7 . . . . . $350
34UK50 Test Port Adapter, Universal/K Connector, male. . . . $250
34UN50 Test Port Adapter, Universal/N, male. $300
34UNF50 Test Port Adapter, Universal/N, female $300

SOFTWARE

2360–2 Time Domain Software, including Standard Network Analyzer Measurement Software 2360–1 . . . . . $9,000
2300–10 ANACAT Software $7,500

ACCESSORIES

2225C Ink Jet Dot-Matrix Printer, including 2225–1 Interface Cable, 1 ink cartridge, and 50 sheets of Ink Jet paper $795
2225–2 Replacement Ink Jet Cartridges (2 each) $50
2225–3 Fan-Fold Ink Jet Printer Paper (2500 sheets) $120
2000–209 3.5-inch Blank Diskettes (Box of 10) $50



TRAINING

360MS Option 10 Two-Day Training Course . . . $350 per student
With each 360 purchase, training for two operators is provided at no charge at designated training sites.

SERVICE SUPPORT

360MS Option 11 On-Site Calibration $600/Event
Complete system performance characterization using NBS traceable devices.

360MS Option 12 On-Site Service $350/Month
First year on-site service for 360, test set, and system signal source, including two calibrations. The service is available throughout the USA and in most international areas. Please check availability with your local representative.

COMPLETE NETWORK ANALYZER SYSTEMS

360MS18 Vector Network Analyzer System supplied in the 360C1 System Console for automated testing over the 500 MHz to 18 GHz range. $99,495

Consisting of:
360 Vector Network Analyzer
3610 Reversing Test Set (0.5 to 18 GHz)
360SS45 System Source (10 MHz to 18 GHz)
3650 SMA/3.5 mm Calibration Kit
3651 GPC–7 Calibration Kit
3666 3.5 mm Verification Kit
3667 GPC–7 Verification Kit
3670A50–1 Semirigid GPC–7 Test Port Cables, 1 foot long (2 each)
2225C Ink Jet Printer
2360–2 Time Domain Software
360C1 System Console

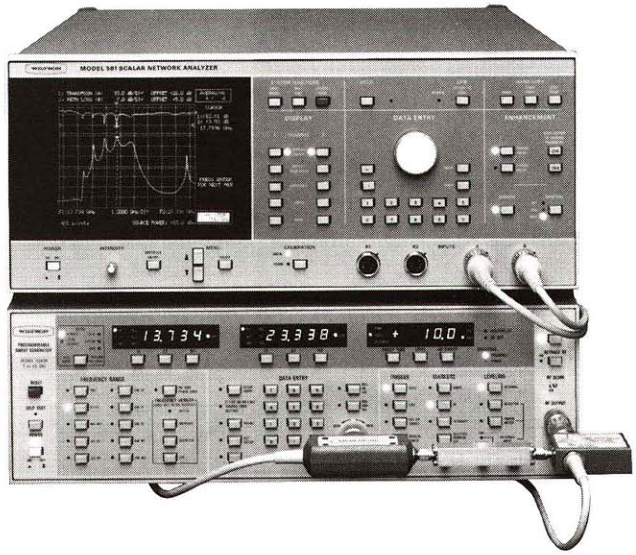
360MS40 Vector Network Analyzer System supplied in the 360C1 System Console for automated testing over the 500 MHz to 40 GHz range $137,295

Consisting of:
360 Vector Network Analyzer
3611 Reversing Test Set (10 MHz to 40 GHz)
360SS69 System Source (0.5 to 40 GHz)
3650 SMA/3.5 mm Calibration Kit with Option 1 Sliding Termination
3651 GPC–7 Calibration Kit
3652 K Connector Calibration Kit
3666 3.5 mm Verification Kit
3667 GPC–7 Verification Kit
3668 K Connector Verification Kit
3670K50–1 Semirigid K Connector Test Port Cables, 1 foot long (2 each)
34UA50 Adapter Universal/GPC–7 (2 each)
2225C Ink Jet Printer
2360–2 Time Domain Software
360C1 System Console

Scalar Network Analyzer Systems

5600B Series, 10 MHz to 40 GHz

NEW



5600B Network Analyzer System Highlights

- 10 MHz to 40 GHz Measurements from a Single Coaxial Test Port
- No Controller Required for Measurement or Hard Copy Output
- Simultaneous Measurement and Printout from Buffer Memory
- Guided Step-By-Step Normalization and Measurement Procedures
- Nine Stored Setups
- Most Extensive Cursors, Markers, and Limit Lines
- Lowest Price

Coaxial Measurements Up to 40 GHz

The 5600B Series Automated Scalar Network Analyzer Systems make simultaneous measurements of transmission loss or gain, return loss (SWR), and power. The series consists of nine models, one of which has a coaxial range of 10 MHz to 40 GHz. Each system includes a 561 Scalar Network Analyzer, 6600B Sweep Generator, and all required measurement components. Although the network analyzer and the sweep generator are GPIB (IEEE–488) programmable, the 5600B does not require an external controller for automatic operation. All selections are made on the network analyzer and sweep generator front panels. After automatic normalization, the system displays any two inputs on channels A, B, R1, or R2. The same inputs can be displayed as ratios of A/R1, A/R2, B/R1, or B/R2. Compatible with several plotters and dot-matrix printers, the system features a buffer memory that allows tests to proceed while previously taken data are being printed out.

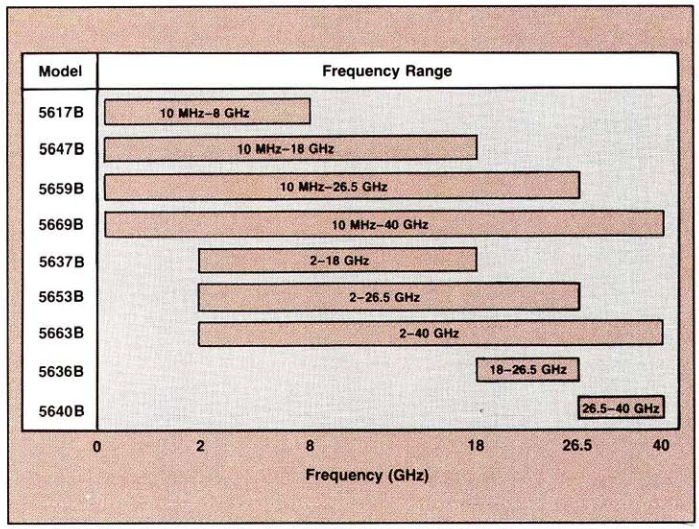
Regardless of the model you choose, you will be impressed with its performance. The dynamic range for each of the four channels is 71 dB (–55 dBm to +16 dBm). Typically the noise floor is less than –62 dBm, providing a greater than 76 dB dynamic range in almost all test setups.

Self-Explanatory Operation

The inviting front panel reflects the extensive use of microprocessors to simplify operation. Menu selections guide you through step-by-step normalization and measurement procedures. At each step the instrument provides a comprehensive display of all pertinent system status and measurement parameters. Clear control identifiers and complete, unambiguous display data make operation self-evident, an unusual feature for an instrument of this sophistication.

Microprocessor-Guided Operation

During normalization, procedural guidance is automatically provided for transmission and return loss measurements. For return loss tests, a 0 dB reference is established by connecting an open and then a short to the SWR Autotester test port. The



The 5600B family consists of nine models, one of which makes coaxial measurements from a single test port over the 10 MHz to 40 GHz range.

normalization data are taken independent of sensitivity settings at 2001 points with 0.002 dB resolution and stored in memory for correction of test data or for recall. Furthermore, an algorithm interpolates between data points to hold interpolated test data accuracy to within ±0.1 dB. Therefore, once the 561 has been normalized across a user-selected frequency range, measurements can be made over any portion of the range without renormalization. Set-up time is virtually eliminated by storing parameters for up to nine test setups.

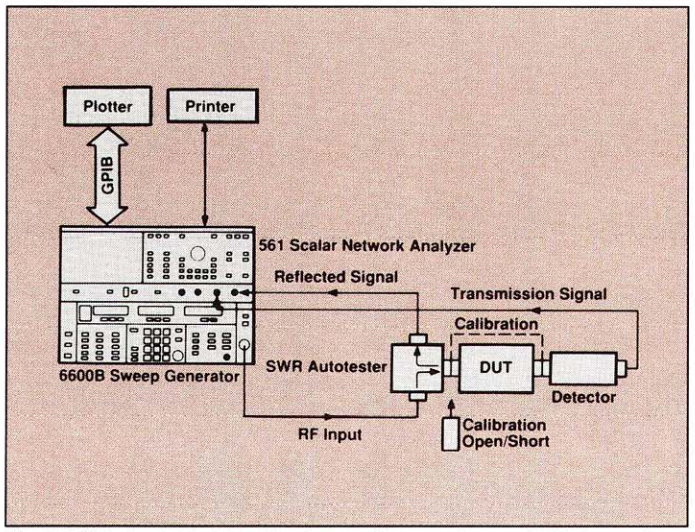
Measurements can be made at 101, 201, or 401 points (user selected) with 0.005 dB vertical resolution on both channels. Since the typical data-update time is 100 ms, the test device can be adjusted while viewing a "real time" display. A hard copy of test data can then be plotted—with or without the test, marker, or stored setup parameters—on an HP 7440A, 7470A, or 7475A Plotter or printed on an Epson FX or 2225C Ink Jet Printer. Producing hard copy is done quickly since the 5600B requires only about 10 seconds for print formatting. The next measurement can proceed while data from the last are being printed out.

Measurements in waveguide are made following the same general normalization and test procedures. Wiltron 560–10BX Adapter Cables provide the interface between the instruments and the waveguide detectors.

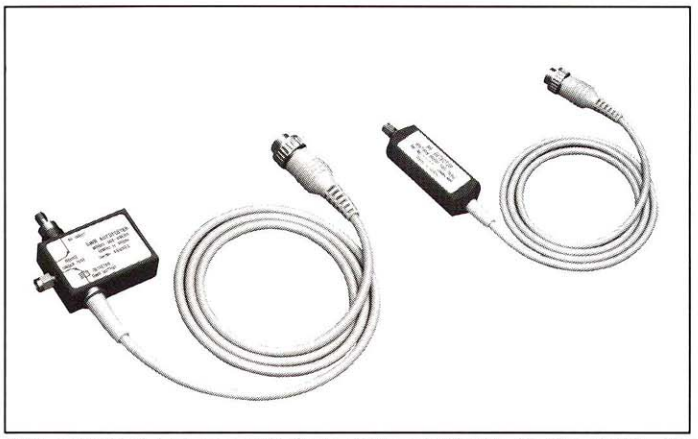
Confidence-Building Accuracy

There are several features that contribute to the accuracy of the 5600B.

- Filtered, broadband, fundamental oscillators up to 26.5 GHz which avoid the serious measurement errors inherent in multiplier-type oscillators.
- High-directivity, low-reflection measurement components.
- A powerful microprocessor to normalize errors introduced by the system itself.
- Read-only-memory (ROM) to correct nonlinearities in the oscillator frequency characteristics.
- Automatic internal calibration of all channels.
- Excellent source match of the 6600B Sweep Generators.



The 5600B test setup includes direct connection to a printer or GPIB plotter. An external controller can be added, but is not required for automated measurements.

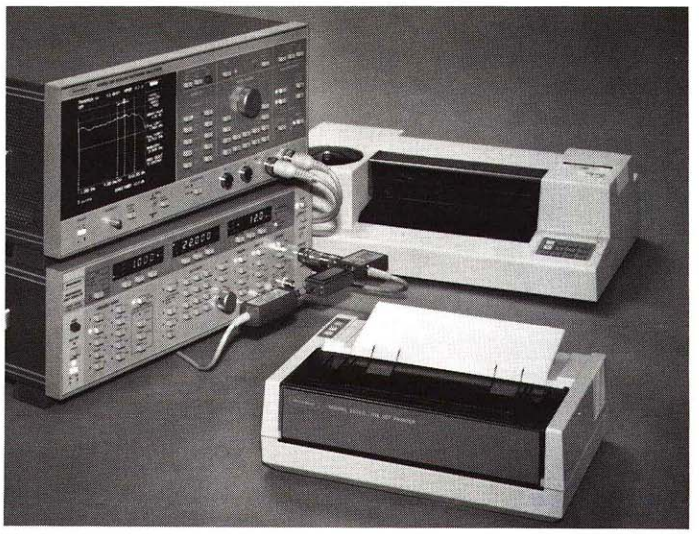


Wiltron SWR Autotesters have 40 dB directivity up to 18 GHz, 30 dB to 40 GHz. The 560–7 Series Detectors also contribute to accuracy with their excellent source match and compensated frequency response.

The exceptional return-loss accuracy of the 5600B Series is attributable to the high directivity of the Wiltron SWR Autotesters. For example, the 5647B with its GPC-7 test port has a directivity of greater than 40 dB from 10 MHz to 18 GHz. For the 560–98K50, the directivity exceeds 35 dB up to 18 GHz, 32 dB up to 26.5 GHz, and 30 dB up to 40 GHz. The same unit has a test port match of better than 23 dB up to 26.5 GHz and 15 dB up to 40 GHz. To avoid the use of error-producing adapters, SWR Autotesters are available with GPC–7, Type N, WSMA, or K Connector test ports, all with high directivity.

The accuracy of a transmission loss or gain measurement is affected by reflections from the test port, the device under test, the detector, and the signal source. These errors are minimized by the very low reflections from the Wiltron SWR Autotesters, Detectors, and 6600B Sweep Generator.

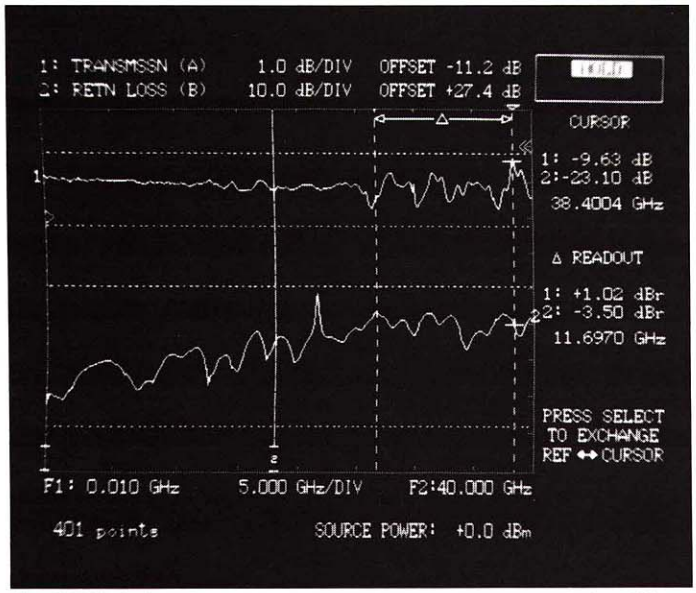
Accuracy is also improved because modulation of the input signal is not required. The need for modulation is avoided by using self-balancing amplifiers, which are stable at low signal levels. As a result, errors from modulation asymmetry and modulation-sensitive test devices are nonexistent. Without the insertion loss of a modulator, measurements can be made at higher input levels, increasing the measurement dynamic range.



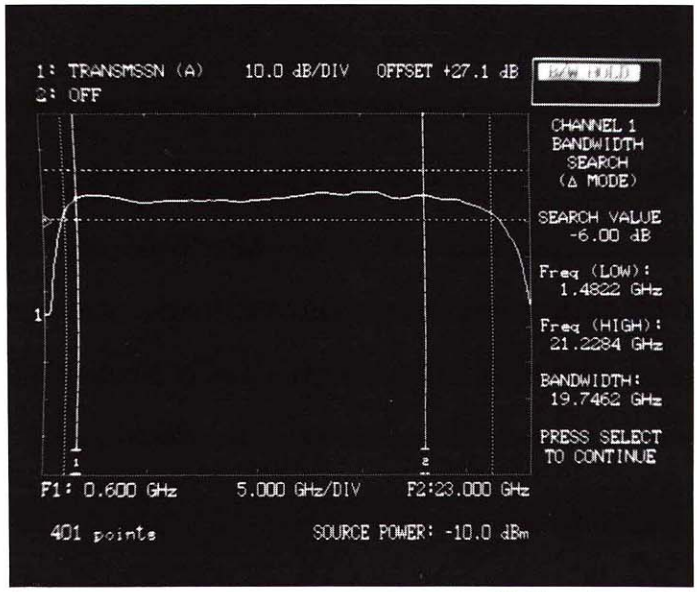
Hard copies of all displayed test data and parameters can be made on a dot-matrix printer or GPIB plotter while measurements proceed.

Scalar Network Analyzer Systems (Cont.)

5600B Series



The 5600B displays frequencies, differences in frequencies, amplitudes, differences in amplitudes, and pass/fail performance on the large, easy-to-read screen.



Cursor "X" Bandwidth automatically displays frequencies of 6 dB or other selected bandwidth amplitudes. Limit lines identify acceptable and not-acceptable performance.

Versatile Limit Lines, Cursors, Markers

The 5600B has the most extensive set of cursor functions available on a scalar network analyzer:

- **Main Cursor:** Position of the cursor is continuously variable with the tuning knob. The frequency and amplitude of the test data at the cursor on both traces are digitally displayed.
- **Cursor Delta:** The differences in amplitude and frequency between the reference cursor and the Main Cursor positions on the test data are displayed for both traces. To establish a new reference, the position of the two cursors can be reversed by making a menu selection.
- **Cursor Min/Max:** The 5600B automatically moves the cursor to the minimum or maximum value of test data on either trace and displays the value in dB or dBm.
- **Cursor "X" dB:** The cursor automatically moves on either trace to an amplitude that is equal to the entered value of "X" dB or dBm.
- **Cursor "X" Bandwidth:** Cursors are automatically displayed above and below the Main Cursor at the frequencies where the test data are equal to the entered value "X" dB. The frequencies of the low and high cursors and the bandwidth between them are displayed.
- **Cursor Next Marker:** The cursor automatically moves to the next highest frequency marker.
- **Cursor Active Marker:** The cursor automatically moves to the frequency of the active marker.

These cursor functions are in addition to the eight markers available on the 6600B Sweep Generator.

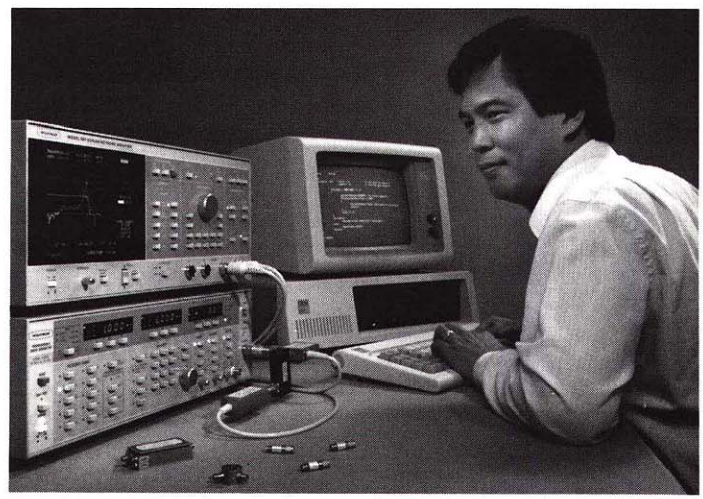
To speed the interpretation of data, complex limit lines can be entered through the front panel or the GPIB interface. Limit lines can have up to nine segments which slope or step with frequency.

Stored Test Setups

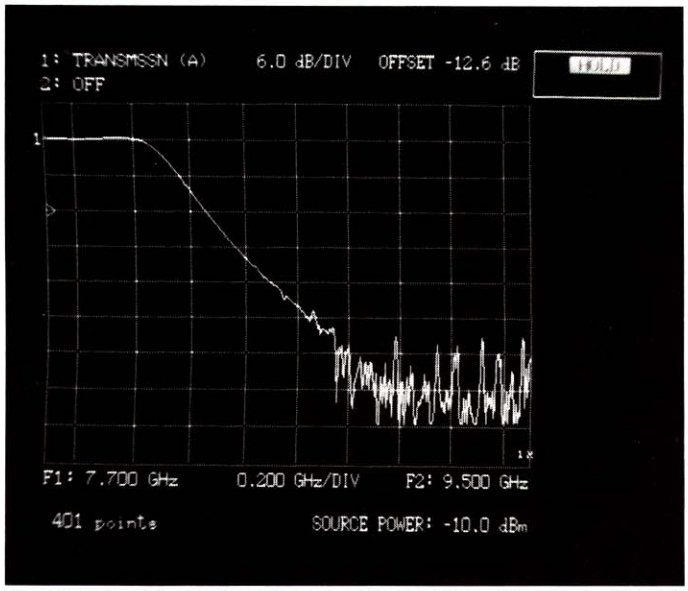
Set-up time is reduced substantially by storing up to nine front-panel setups, four of which include their own calibration data. A unique preview feature allows stored setup parameters to be reviewed before recalling or storing a new setup in the memory location. The stored data are backed by a battery with an estimated 10-year life.

GPIB Compatibility

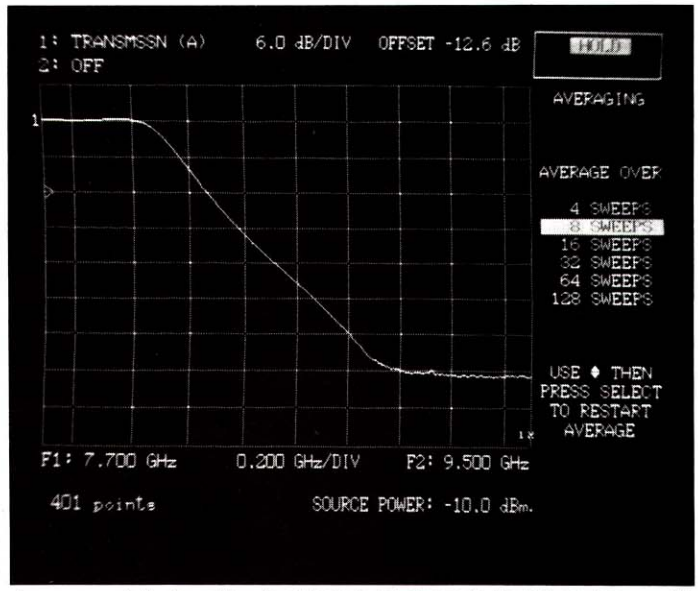
An IEEE–488 (GPIB) interface is standard, providing remote control of all front-panel functions except power on/off and CRT intensity. A high speed data transfer can be used to transfer measurement data to the host computer. This capability is especially useful in manufacturing environments where archiving of data is required.



Though the 5600B does not require a controller for automated operation, it includes GPIB (IEEE–488) interface as standard.



Characteristics of low-level signals can be difficult to measure accurately without the improvement shown in the display to the right.



Accuracy and display of low-level test signal shown to the left are improved by averaging and smoothing.

Smoothing and Averaging

When characteristics of the test device vary rapidly with frequency at very low signal levels, the trace can be smoothed by averaging and/or smoothing. The Smoothing control has three selections: Off, Min, and Max. To maintain the accuracy of the measurement data, smoothing is performed by reducing bandwidth, rather than by averaging adjacent data points in order to preserve measurement detail.

When averaging is selected, 2 to 256 successive traces can be averaged to smooth the trace display. As various combinations of smoothing and averaging are selected, the trace update time is automatically adjusted.

System Signal Source

The 6600B Sweep Generators use fundamental oscillators over the 2 to 26.5 GHz range because they deliver the purest, most accurate signals. Four aspects of their performance contribute to accurate measurements:

1) Harmonic Content. The troublesome subharmonics of multiplier-type sweep generators don't exist.
2) Residual FM. Without a multiplier, residual FM is not degraded by the multiplication factor. Residual FM in CW or narrow-band mode is less than 10 kHz peak up to 20 GHz.
3) Frequency Accuracy. By using ROM to correct for residual nonlinearities of YIG-tuned oscillators, CW accuracy is ±10 MHz over the 10 MHz to 20 GHz range.
4) Output Flatness. Since there is no tracking filter required to take out unwanted multiplier responses, the output level does not vary with sweep speed.

Five Sweep Modes

The 6600B has five sweep modes as well as five CW frequencies and eight markers. With a single keystroke, you switch from Full Range, F1 to F2, or M1 to M2 to the symmetrical sweep about CF or marker M1. The CW frequencies are also selected directly without having to use the shift key or to remember frequencies stored in memory. Sweep frequencies and the test power level are shown on the 561 display.

In addition to the versatile frequency sweep modes, the 6600B has a power sweep with which the output is swept over a 15 dB range. Furthermore, with the addition of the Option 2 Attenuator, the 15 dB power sweep can be offset in 10 dB steps over a 70 dB range. Amplifier and semiconductor characteristics, such as gain compression and saturation, can be measured rapidly over a continuously variable input power range. In the Alternate Stored Setup mode, a set of power sweep and a set of frequency sweep parameters stored in memory can be recalled to provide a "simultaneous" two-trace display of test device power *and* frequency characterisitics.

Frequency Vernier

The Frequency Vernier controls can be used to increase frequency accuracy and achieve 100 kHz resolution in the CW and ΔF modes. While monitoring the output with a counter, you simply tune with the continuous control knob until the desired frequency is obtained. Subsequent requests for this frequency will produce the same frequency, including the correction.

Phase Lock

When greater than 100 kHz resolution is required, the 6600B can be phase locked to an external source to achieve accuracies of ±10 Hz or better. Here is one more way the 6600B improves measurement accuracy and meets the needs of applications which formerly required a signal generator or synthesizer.

Scalar Network Analyzer Systems (Cont.)

5600B Series

Specifications

MEASUREMENTS

Measurement Modes: Measures and displays in dB swept transmission and return loss characteristics. Power is displayed in dBm. Complete measurement parameters for all modes are displayed.
Frequency Range: 10 MHz to 40 GHz in coax using Wiltron 560 Series Detectors and SWR Autotesters. Measurements can be made at higher frequencies with user-supplied waveguide detectors and Wiltron 560–10BX or 560–10BX–1 Adapter Cables.
Frequency Accuracy:

Model	Accuracy (MHz)
5617B	± 5
5637B, 56 47B	±10
5636B	±15
5640B, 5653B, 5659B, 5663B, 5669B	± 20

Frequency Resolution: 1 MHz
Inputs: Four inputs, A, B, R1, and R2 accept detected outputs from Wiltron 560 Series Detectors and SWR Autotesters.
Dynamic Range: 71 dB (–55 dBm to +16 dBM) on all channels, usable to –60 dBm. Noise floor is typically less than –62 dBm.
Data Correction: System residuals, including the average of open and short reflections, are stored during normalization for automatic subtraction from test data.
Normalization: During the normalization sequence, 2001 points for each trace are stored with 0.002 dB resolution over any user-selected frequency range. Normalization data are automatically interpolated for ranges less than the original normalized range.
Save/Recall: Nine sets of front-panel settings can be stored for later recall. All stored data can be previewed on the CRT or printer output prior to selection. Four of the setups include their own calibration data.
Power Sweep: Sweeps power over up to 15 dB range. Option 2 Attenuator offsets sweep range in 10 dB steps over a 70 dB range.

DISPLAY

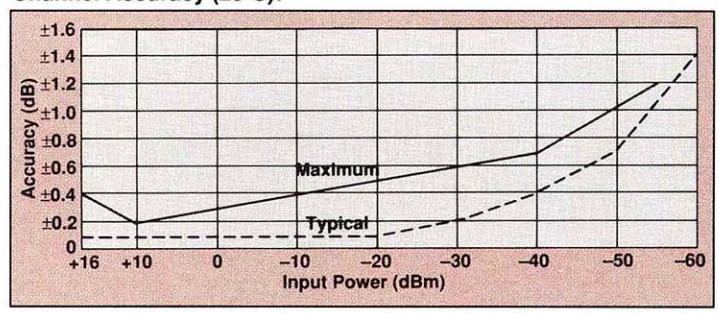
Channels: Two channels are used to select and simultaneously display any two inputs from A, B, R1, or R2. The same inputs can be displayed as ratios of A/R1, A/R2, B/R1, or B/R2.
Sweep Parameters: Displays test power level in dBm and start/stop frequencies or center frequency and symmetrical sweep width.
Alternate Sweep: Displays alternate sweeps between the current front-panel setup and any of nine stored setups.
Graticule: Ten vertical divisions. Horizontal divisions are set automatically in frequency increments of a 1, 2, 5, sequence. Graticule On/Off control turns all graticule lines off. Tick marks remain on axis to indicate graticule position.
Display Resolution:
Horizontal: 101, 201, or 401 points over selected frequency range.
Vertical: 0.005 dB
Limit Lines: Two horizontal lines or complex limit lines with up to nine segments can be set for each trace. By switching off the standard graticule, a custom graticule can be constructed with the limit lines and frequency markers. Complex limit lines can be entered through the front panel or GPIB interface.
Scaling:
Resolution: 0.1 dB to 10 dB per division in 0.1 dB steps with independent control for each channel.
Offset Range: –99 dB to +99 dB in 0.1 dB steps.
Autoscale: Automatically selects offset and resolution to provide optimum display of test data.
Trace Update Time: Typically less than 100 ms, varying with frequency range and the averaging and smoothing settings.
Smoothing: Off, Minimum, and Maximum selections use analog techniques to reduce noise on low-level traces. Trace update time is automatically adjusted for any combination of averaging and smoothing.
Averaging: 2, 4, 8, 16, 32, 64, 128, or 256 successive traces can be averaged to smooth the trace display.
CRT Intensity: Continuously adjustable from off to bright.

MARKERS AND CURSOR

Markers: Displays up to eight numerically identified markers generated by the 6600B Sweep Generator. When a marker is selected as "Active," the cursor can be moved directly to the marker. The cursor can also be moved sequentially through markers until the desired marker is reached.
Main Cursor: Continuously variable with the tuning knob. The frequency and amplitude of test data at the cursor on both traces are digitally displayed.
Cursor Delta: Displays differences in dB and frequency between the reference cursor and the Main Cursor on both traces. A menu selection reverses the position of the reference cursor and the Main Cursor.
Cursor Min/Max: Automatically moves the cursor to the minimum or maximum value of test data on either trace.
Cursor "X" dB: Automatically moves cursor on either trace to an amplitude that is equal to the entered value of "X" dB or dBm.
Cursor "X" Bandwidth: Automatically displays cursors to the right and left of the cursor at the frequencies where the test data are equal to the entered value of "X" dB. The frequencies of the low and high cursors and the bandwidth between them are displayed.
Cursor Next Marker: Moves cursor to next highest frequency marker.
Cursor Active Marker: Moves cursor to the frequency of the active marker.

ACCURACY

Channel Accuracy (25°C):

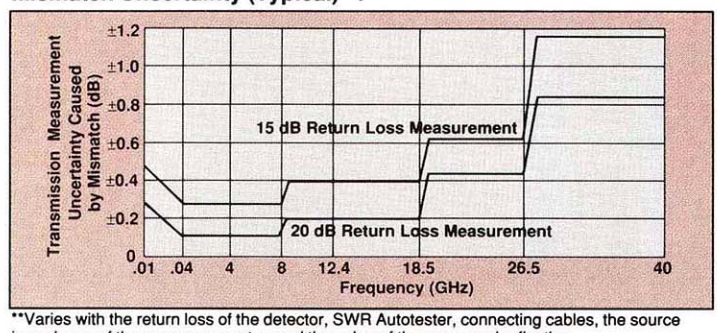


Transmssion Loss or Gain Accuracy: Uncertainties from frequency response of components are automatically subtracted from test data during the normalization procedure. Overall accuracy is then:

Transmission Loss or Gain = **Channel Accuracy** + **Mismatch Uncertainty***

* Effects of sweep generator, test device, SWR Autotester and detector mismatch can be significant. This mismatch uncertainty is minimized by Wiltron's exceptionally low reflection characterisitics of the detector, sweep generator and SWR Autotester.

Mismatch Uncertainty (Typical):**



**Varies with the return loss of the detector, SWR Autotester, connecting cables, the source impedance of the sweep generator, and the value of the measured reflection.

Overall Coaxial Return Loss Measurement Accuracy:
Uncertainties resulting from SWR Autotester and sweep generator frequency response and from system open and short characteristics are subtracted automatically from test data. Overall accuracy is then:

Return Loss Accuracy = **Channel Accuracy** + **SWR Autotester Accuracy**

ACCURACY (Cont.)

SWR Autotester Accuracy:

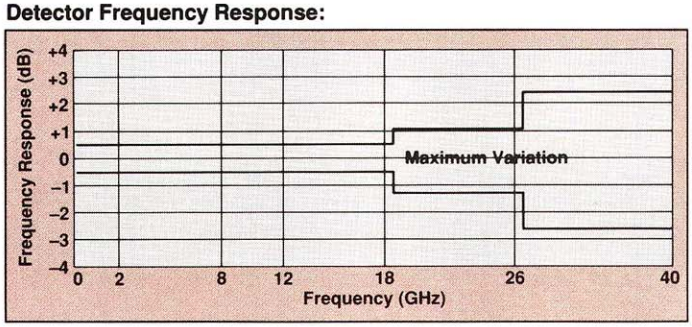
System Model	Accuracy of Measured Reflection Coefficient (ρ)*			
	10 MHz–8 GHz	>8–18 GHz	>18–26.5 GHz	>26.5–40 GHz
5617B 5637B 5647B	$0.010\pm0.06\rho^2$	$0.010\pm0.1\rho^2$	N/A	N/A
Option 6	$0.013\pm0.08\rho^2$	$0.013\pm0.12\rho^2$	N/A	N/A
5636B 5653B 5659B Option 5	$0.013\pm0.1\rho^2$	$0.013\pm0.1\rho^2$	$0.018\pm0.12\rho^2$	N/A
5663B 5669B	$0.018\pm0.15\rho^2$	$0.018\pm0.15\rho^2$	$0.025\pm0.15\rho^2$	$0.032\pm0.18\rho^2$

*Accuracy includes the effects of directivity (first term) and test port reflection (second term).

Power Measurement Accuracy:

Absolute Power Accuracy = **Channel Accuracy** + **Detector Frequency Response**

Detector Frequency Response:



Overall Waveguide Return Loss Measurement Accuracy:**

Return Loss Accuracy = **Channel Accuracy** + **User-Selected Coupler Accuracy**

**In addition, mismatch uncertainties introduced by the detectors used in a waveguide reflectometer setup can be significant.

GPIB

Interface: IEEE–488 interface is standard on all instruments. All front-panel controls are GPIB controllable except power on/off and CRT intensity. Pass-through commands allow control of the microwave signal source through the 561 GPIB port.

Data Transfer: The 5600B does not require an external controller; nevertheless, it is capable of providing high speed data transfer of test data and normalization data to an external GPIB controller.

PRINTER/PLOTTER

Plotter: Dedicated GPIB interface is compatible with HP 7440A, 7447A, and HP7475A Plotters. Display traces, markers, cursor, and graticule information are copied. When overlay traces are desired, data traces only can be plotted.

Printer: Parallel printer interface is compatible with most dot-matrix printers, including Epson FX and the optional 2225C Ink Jet Printer. Hard copy output in graphical or tabular format can be selected. Selections include, graphics with measurement parameters, test data tabulated for 26, 51, 101, 201, or 401 points, marker parameters only, or stored setup parameters.

Internal Print Buffer: After approximately 10 seconds of print formatting, a new test can be conducted while previously taken test data are being printed out from an internal printer buffer.

INPUT/OUTPUT CONNECTIONS

System GPIB: Connects system to GPIB. Rear panel.

Dedicated GPIB: Connects system to plotter. Rear panel

Parallel Printer (Centronics): Connects system to printer.

Composite Video Output: Provides composite display signal for connection to a large external CRT. BNC, rear panel.

GENERAL

Temperature Range:
Operating: 0°C to +50°C
Storage: –40°C to +70°C

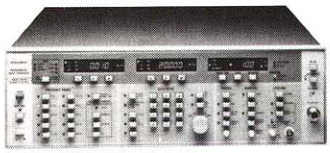
Power: 100V/110V/220V/240V ±10%, 50–60 Hz, 350 watts maximum

Dimensions: 311 H x 432 W x 476 D mm + 10 mm for feet.
(12-1/4 H x 17 W x 18-3/4 D in. +3/8 in. for feet)

Weight: 32 kg (70 lb)

SYSTEM ELEMENTS

Network Analyzer: The 561 Scalar Network Analyzer provides a simultaneous display of transmission loss/gain and return loss or power. Its test signal is supplied by the 6600B Sweep Generator. Because of its extensive use of internal microprocessors, the 561 does not require an external controller for automated measurements. Interface with waveguide detectors is provided by the 560–10BX or 560–10BX–1 Adapter Cables. The 561 makes direct connection to a printer or plotter.



Sweep Generator: The 6600B Sweep Generator is the system signal source. It uses fundamental oscillators from 2 to 26.5 GHz to provide a clean test signal, free of subharmonics.. Detailed specifications are given on page 56.

SWR Autotester: The 560 Series SWR Autotesters integrate in one small package a broadband, high directivity bridge, a detector, a low reflection test port, a reference termination, and a connecting cable. The output of the SWR Autotester is a detected signal, varying in proportion to reflections from the test device connected to the test port. Optional extender cables can be used without degradation in performance.

System Model	SWR Autotester Model	Frequency Range (GHz)	Directivity (dB)	Frequency Sensitivity (dB)	Test Port Connector
5617B 5637B 5647B	560–97A50–1	0.01–18	40	±1.2	GPC–7
Option 6	560–97N50–1	0.01–18	38	±1.5	N Male
5636B 5653B 5659B Option 5	560–98S50–1	0.01–26.5	38	±2	WSMA Male
5663B 5669B	560–98K50	0.01–40	30	±3	K Male

Input Connector:
5617B, 5637B, 5647B, Option 6: N Female
5636B, 5653B, 5659B, Option 5: Ruggedized WSMA Female
5663B, 5669B: Ruggedized K Female

Accuracy: Please see above left.

Maximum Input Power: 0.5 W

Cable Length: 122 cm (4 ft)

Insertion Loss: 6.5 dB nominal from input port to test port.

Scalar Network Analyzer Systems (Cont.)

5600B Series

SYSTEM ELEMENTS (Cont.)

SWR Autotester Dimensions and Weight:

Model	Dimensions*	Weight
560–97A50–1 560–97N50–1,	7.6 x 5 x 2.8 cm (3 x 2 x 1-1/8 in.)	340 g (12 oz)
560–98K50, 560–98S50–1,	1.9 x 3.8 x 2.9 cm (3/4 x 1-1/2 x 2-1/8 in.)	198 g (7 oz)

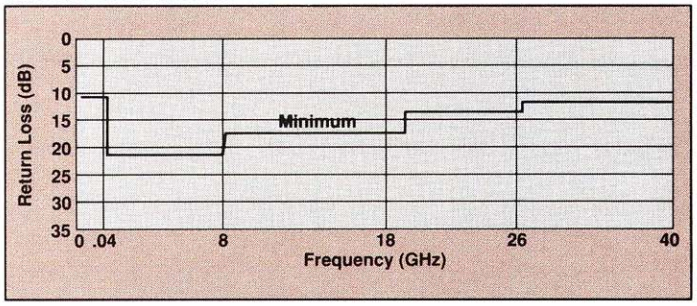
* Plus connectors and cable

Detectors: The 560 Series Detectors are used for coaxial transmission loss or gain and power measurements and with coaxial adapters for waveguide reflectometer measurements. Zero-biased, field-replaceable Schottky diodes provide –60 dBm sensitivity. Optional extender cables can be used without degradation in performance.

System Model	Detector Model	Frequency Range	Input Connector
5617B, 5637B, 5647B Option 5 Option 6	560–7A50 560–7S50 560–7N50	10 MHz to 18.5 GHz	GPC–7 WSMA Male N Male
5636B 5653B 5659B	560–7S50–2	10 MHz to 26.5 GHz	WSMA Male
5663B 5669B	560–7K50	10 MHz to 40 GHz	K Male

Maximum Input Power: 100 mW
Cable Length: 122 cm (4 ft)
Dimensions: 7.6 x 2.9 x 2.2 cm (3 x 1-1/8 x 7/8 in.)
Weight: 170 g (6 oz)

Detector Return Loss:



Field Replaceable Diode Modules:

Detector Model	Diode Module Model	Price
560–7A50	560–A–7219–A	$150
560–7K50	Factory Repair Only	$275
560–7N50	560–A–7219–A	$150
560–7S50	560–A–7219–A	$150
560–7S50–2	560–A–7219–B	$150

Open/Shorts: An Open/Short is used to establish a 0 dB return loss reference during the normalization procedure.

System Model	Open/Short Model	Connectors
5617B 5637B 5647B	22A50	GPC–7
Option 6	22NF50	N Female
5636B 5653B 5659B Option 5	22SF50	WSMA Female
5663B 5669B	22KF50	K Female

Ordering Information

Options

Description	Option			Price
Rack mounting for 561 Network Analyzer and 6600B Sweep Generator (tilt slide included).	1			$700
Adds to sweep generator a 10 dB step attenuator with a 70 dB range. Not available on 5640B.	2A 2B 2C	For 5617B, 5637B or 5647B For 5636B, 5653B, or 5659B For 5663B or 5669B		$1,500 $2,200 $2,200
		Adds	**Deletes**	
Adapts GPC–7 test ports to Type N or WSMA on 5617B, 5637B, or 5647B.	4	34AN50 Adapter, GPC–7/N Male 34ANF50 Adapter, GPC–7/N Female 34AS50 Adapter, GPC–7/WSMA Male 34ASF50 Adapter, GPC–7/WSMA Female	Nothing	$1,350
WSMA test ports on 5617B, 5637B, or 5647B	5	560–98S50–1 SWR Autotester with WSMA Male Test Port Connector with Option 1, 38 dB directivity 560–7S50 Detector, WSMA Male Connector 34SFSF50 Adapter, WSMA Female/Female 22SF Open/Short 34RSN50 Adapter, Ruggedized WSMA Male/N Male	560–97A50–1 GPC–7 SWR Autotester 560–7A50 GPC–7 Detector 22A Open/Short 34NN50 Adapter, N Male/Male	$975
Type N test port on 5617B, 5637B, or 5647B	6	560–97N50–1 SWR Autotester Type N Male Test Port Connector with Option 1, 38 dB directivity 560–7N50 Detector, N Male Connector 34NFNF50 Adapter, N Female/Female 22NF Open/Short	560–97A50–1 GPC–7 SWR Autotester 560–7A50 GPC–7 Detector 22A Open/Short	$275

Ordering Information (Cont.)

Complete Systems:

	Frequency Range								
	10 MHz to 8 GHz	18 to 26.5 GHz	2 to 18 GHz	26.5 to 40 GHz	10 MHz to 18 GHz	2 to 26.5 GHz	10 MHz to 26.5 GHz	2 to 40 GHz	10 MHz to 40 GHz
Order Model Number:	**5617B**	**5636B**	**5637B**	**5640B**	**5647B**	**5653B**	**5659B**	**5663B**	**5669B**
Your System Includes:									
Network Analyzer 561 Scalar Network Analyzer	•	•	•	•	•	•	•	•	•
Sweep Generator 6617B Sweep Generator w/Option 3, GPIB 6636B Sweep Generator w/Option 3, GPIB 6637B Sweep Generator w/Option 3, GPIB 6640B Sweep Generator w/Option 3, GPIB 6647B Sweep Generator w/Option 3, GPIB 6653B Sweep Generator w/Option 3, GPIB 6659B Sweep Generator w/Option 3, GPIB 6663B Sweep Generator w/Option 3, GPIB 6669B Sweep Generator w/Option 3, GPIB	•	•	•	•	•	•	•	•	•
SWR Autotester 560–97A50–1 SWR Autotester, GPC–7 560–98S50–1 SWR Autotester, WSMA Male 560–98K50 SWR Autotester, K Male	•	•	•		•	•	•	•	•
Detector 560–7A50 Detector, GPC–7 560–7S50–2 Detector, WSMA Male 560–7K50 Detector, K Male	•	•	•		•	•	•	•	•
Open/Short 22A50 Open/Short, GPC–7 22KF50 Open/Short, K Female 22SF50 Open/Short, WSMA Female	•	•	•		•	•	•	•	•
Accessories 34SFSF50 Adapter, WSMA Female/Female 34KFKF50 Adapter, K Female/Female 34NN50A Adapter, N Male/Male 34RKRK50 Adapter, Ruggedized K Male/Male 806–7 Interconnect Cable 2100–1 GPIB Cable, 1 m	• • • •	• • • •	• • • •	• • •	• • • •	• • • •	• • • •	• • • •	• • • •
Price	$27,300	$27,425	$33,300	$25,400	$35,300	$39,425	$41,425	$48,325	$52,825

Accessories:

2225C Ink Jet Dot-Matrix Printer, including 2225–1 Interface Cable, 1 Cartridge and 50 sheets of Ink Jet Paper $795
2225–1 Replacement Interface Cables $70
2225–2 Ink Jet Cartridges (2 each) $50
2225–3 Fan-Fold Ink Jet Paper (2500 sheets) $120
760–56 Transit Case for RF Components $305

Extender Cables: Extender Cables can be installed between the SWR Autotester or detectors and the 561, permitting measurements from up to 200-feet distance.

Model	Cable Length	Price
800–109	7.6 m (25 ft)	$50
800–110	15.2 m (50 ft)	$75
800–111	30.5 m (100 ft)	$100
800–112	61 m (200 ft)	$180

Adapter Cables: Adapter cables allow the 561 to be used with waveguide or other detectors having a BNC or SMA female output connector. Cable length is 122 cm (4 ft).

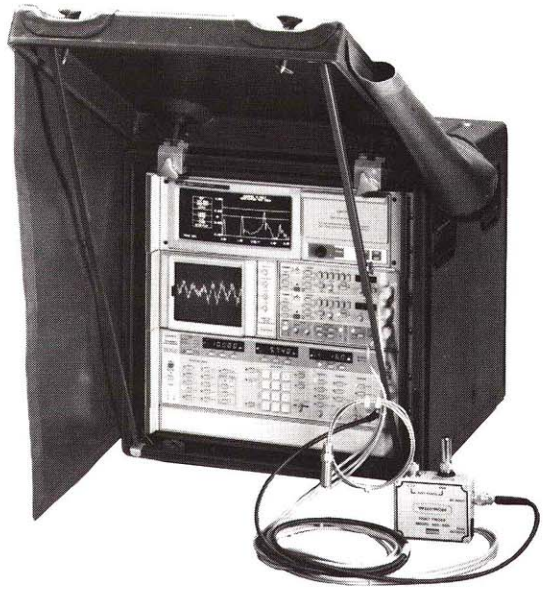
Model	Connector	Price
560–10BX	BNC Female	$100
560–10BX–1	SMA Female	$150

Replacement GPIB Cables: GPIB Cables interconnect instruments on GPIB.

Model	Cable Length	Price
2100–1	1 m (3.3 ft)	$60
2100–2	2 m (6.6 ft)	$75
2100–4	4 m (13.2 ft)	$95
2100–5	0.5 m (1.65 ft)	$55

Transmission Line Fault-Location System

Model 5647 Option P2FF, 10 MHz to 18 GHz



5647–P2FF Fault-Location System Highlights

- Single Setup Test Procedures, 10 MHz to 18 GHz
- Accurate, Reliable Operation In Hostile Environments
- One-Person Transportability
- Fault Location On Aircraft, Surface Ships, Submarines, Antenna Range, or Production Line
- Highest Accuracy, Fastest Measurements

A Wiltron Solution to a Serious Problem

The consequences of faulty transmission lines aboard airplanes, helicopters, surface ships, submarines, and ground-based antenna towers are serious. If gone undetected, a faulty line can jeopardize the success of a mission or program.

The best insurance against faulty transmission lines is the 5647 Option P2FF Transmission Line Test and Fault-Location System. In one compact module—suitable for use on the flight line, in the shipyard, at an antenna site, or on the production line—this system automatically measures transmission lines (coaxial or waveguide) over the 10 MHz to 18 GHz range. (Other models operate up to 60 GHz.) When performance falls outside specifications, the system pinpoints the location of the fault on up to 500-feet-long lines.

Easy to Use

The 5647 Option P2FF is delivered ready for immediate operation. The system includes a sweep generator, a scalar network analyzer, a controller, a detector, and a Faultfinder™ measurement component. Almost instantly after turn-on, second generation software guides the operator through return loss, transmission loss, or distance-to-fault test procedures. On-screen block diagrams show how to connect the test setup. These are followed by unambiguous, step-by-step procedures for the chosen measurement. Responses to prompts are made directly on the touch-sensitive screen so measurements progress smoothly, rapidly, without lost motion. By guiding the operator through selections and the use of accessory components (adapters, terminations) during calibration and the data-taking process, the software automatically ensures the highest possible accuracy for the measurement.

Straightforward Test Procedures

In a typical test sequence, the operator first measures return loss (or SWR) and/or transmission loss. When the results reveal a potential fault, a distance-to-fault measurement is made. After repair, the line can be retested to confirm that the fault has been corrected.

Because frequency domain reflectometry is used to locate faults, the 5647 Option P2FF can test waveguide as well as coaxial lines. In either application, test signals are transmitted down the defective line and reflected from one or several faults. Digital data processing and computation using a Fast Fourier Transform provide the operator with a visual display of the location and magnitude of the fault(s). Results are easy to interpret, and they are repeatable from one operator to another. When there is a fault close to the near-end of the line, the system "sees" beyond it to characterize all discontinuities, large and small.

Operators usually learn these test procedures in less than an hour of equipment familiarization. Once measurements begin, test results are available within 10 seconds.

One-Pass Calibration

One reason tests go so rapidly is that once calibration is made for the entire 10 MHz to 18 GHz range, transmission-loss measurements can be made anywhere within that range without recalibration. In addition to reducing test times, this zoom feature is useful for observing fine grain variation over a limited frequency range.

During the distance-to-fault calibration, the operator selects from the screen the type of cable or waveguide to be tested. As an alternative, the test line parameters can be entered. The system then automatically displays accurate distance-to-fault data, corrected for the line's propagation velocity and attenuation.

Touch Sensitive Screen

Under normal operation, the 5647 Option P2FF does not require a keyboard. In addition to simplifying operation and reducing the size of the system, this arrangement avoids contamination of an open keyboard, unauthorized modification of software, and accidental keyboard commands, which might lock up a less sophisticated system.

Unique Display Features

The clarity and convenience with which test data are displayed makes analysis a pleasure. At the touch of the screen, frames showing data from earlier measurements of return loss, transmission loss, and distance-to-fault can be recalled instantly. Also under touch control are vertical scaling, five frequency markers, and five data limit markers. Unless special vertical scaling is selected, the system automatically displays the optimum scale for the data taken.

Another powerful aid in analyzing data is the variable cursor. It can be continuously moved right and left under touch-the-screen control to display frequency and magnitude of individual test points. Other menu selections move the cursor to the minimum and maximum data points or to a selected frequency. In all modes, the frequency and value of test data at the cursor are digitally displayed.

When testing another device with the same setup, no time is lost resetting the markers and scaling factors. These can be stored with the test setup information, ready for immediate use.

Data Handling Alternatives

At the completion of each measurement, the test data can be used in several different ways:

- Viewed directly on the screen.
- Stored in bubble memory for later analysis or printout.
- Recorded on a diskette for permanent record or preservation of security.
- Plotted on an optional plotter or printer in graphical or tabular format.

In applications where test results are classified or are to be taken and evaluated later, the access-protected memory is really helpful. Test data can be stored in bubble memory and later transferred in a secure area to a diskette or printed out as hard copy. The bubble memory can then be erased to secure the system.

Bubble Memory Data Storage

RAM and nonvolatile bubble memory not only enable the system to complete individual measurements in less than 10 seconds, they can store 30 frames of data and 30 different test setups. Should additional storage be needed, 75 more data and setup frames can be stored by using the system diskette. Seventy more data and setup frames can be stored by adding an optional 256K of bubble memory, for a total of 100.

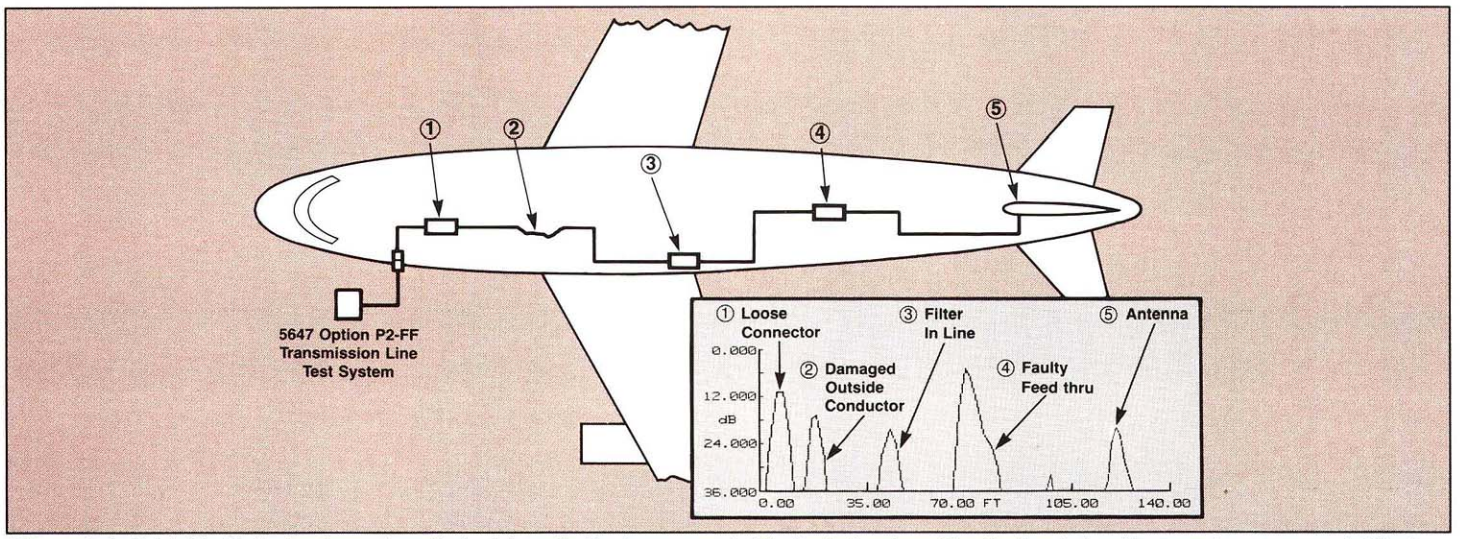
Faultfinder Measurement Component

The Wiltron Faultfinder includes all the circuitry required to interface the test transmission line to the test system. The small 57 x 95 x 117 mm (2.25 x 3.75 x 4.625 in.) device takes the frustration out of making connection to those hard-to-reach lines. Furthermore, the line is connected to only one terminal for the transmission and return loss measurements. Should the line be faulty, it can then be connected to an adjacent test port for the distance-to-fault measurement. No other components are needed. All are self-contained within the Faultfinder. For those remote test lines, extender cables are provided.

Small, Light, Rugged Enclosure

Protection against frequent climatic changes and dusty, corrosive atmospheres is provided by the aluminum alloy environmental enclosure. Composed of a tough, weather-proof outer casing, an internal support frame fitted with eight anti-vibration mounts, two coverplates that enclose and seal the front and rear of the outer casing, and manual pressure relief valves—this enclosure meets the most demanding specifications.

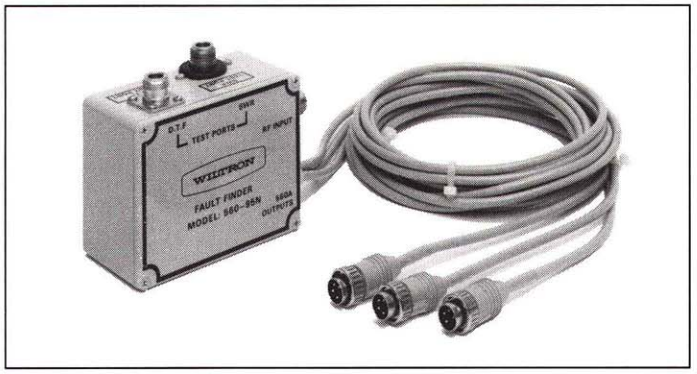
As an added benefit, when the system is in operation, the coverplates can be mounted at a 120° angle (adjustable) to protect the instruments from sun and rain. Heavy rubber side-screens shield the equipment from light and dust, enhancing legibility as well as security. A drawer with a telescopic slide is fitted in the bottom of the support frame to hold components and to provide a writing surface.



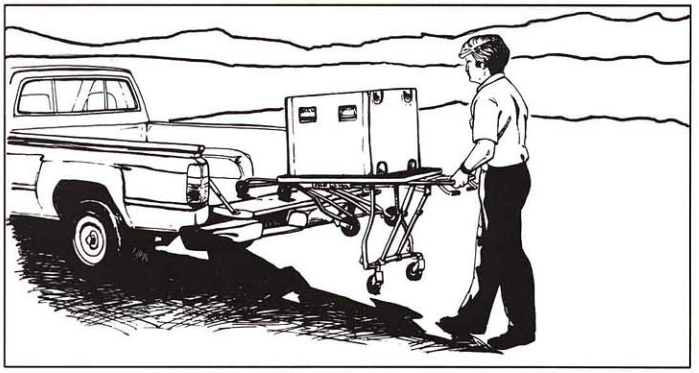
Distance-to-fault data identify the location and amplitude of discontinuities from one end of the line to the other without tedious test-and-try procedures or removal of the line.

Transmission Line Test System (Cont.)

Model 5647 Option P2FF



Faultfinder contains all required circuitry for interfacing test line measurement instruments.



Optional gurney allows one person to load and unload complete microwave test and fault-location system.

Transportability

With the optional gurney, one person can maneuver and operate the complete system. The gurney offers may features that increase transportability:

- The legs operate independently so that the user does not have to support the full weight of the unit during loading or unloading.
- A telescoping loading wheel section gives a long entry distance into vehicles.
- The legs lock automatically when the gurney is unloaded from a vehicle.
- The gurney is 58 x 102 cm (23 x 40 in.), providing adequate but not wasted working space.

Optional Printers

Fast, near-silent, automatic printing of displayed data and test parameters in graphical or tabular format is performed on an optional HP 2225D Printer or HP 7470A Plotter.

Cost-Saving Reliability

Following a growing trend toward the use of reliable commercial instruments in demanding environments, Wiltron offers the 5647 Option P2FF at a price well below that of a fully militarized unit. Remarkably, the savings are realized with no sacrifice in reliability, measurement accuracy, or ease of operation. These are factors that were considered by the US Navy when Wiltron was selected to provide instruments for the Navy AN/USM–402 Swept Frequency Measurement System.

Specifications

SYSTEM PERFORMANCE

Frequency Range: 10 MHz to 18 GHz (Other configurations are available up to 60 GHz.)
CW Frequency Accuracy: ±10 MHz
Frequeny Resolution: 1 MHz
Amplitude Resolution: 0.01 dB
Test Signal Purity:
Harmonics: <–20 dBc at ≤2 GHz
<–25 dBc at >2 GHz
Nonharmonics: <–40 dBc at ≤2 GHz
<–60 dBc at >2 GHz
Sample Times:
Return Loss, SWR, and Transmission Loss Measurements: 4 s
Distance-To-Fault Measurement: 2.5 s
Fast Fourier Transform and Display Time: 7 s
Total First-Test Time: 20 s
Subsequent-Test Time: 10 s for 100 points
Leveled Output Power: 40 mW
One-Pass Calibration: Once calibration for the entire frequency range has been completed, transmission tests can be run over any part of range without recalibration.
Limit Lines and Markers: Five limit lines are selected on the touch sensitive screen to establish data limits. Five markers are used to select frequencies. The values of all frequencies and amplitudes are digitally displayed.
Variable Cursor: Continuously variable cursor is used to identify the frequency and amplitude of points in test data. It also can be used to automatically identify the test data maximum and minimum points. The values of all frequencies and amplitudes are displayed digitally.

MEASUREMENTS

Return Loss or SWR and Transmission Data Correction: System residuals including the average of open and short circuit reflections are stored with 0.01 dB resolution for automatic subtraction from test data.
Distance-To-Fault Data Correction: System is calibrated by connecting a 50 ohm termination to the test port and storing swept response. Test data are corrected to reflect values of propagation velocity and attenuation stored for the type of waveguide or coaxial line selected.

Return Loss and SWR Accuracy:

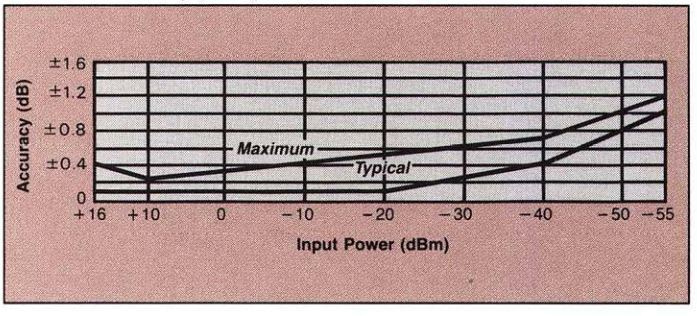
Return Loss Accuracy = **Faultfinder Accuracy** + **Channel Accuracy**

Faultfinder Accuracy:

Accuracy of Measured Reflection Coefficient (ρ)*	
0.01 to 8 GHz	>8 to 18 GHz
$0.013 \pm 0.08\rho^2$	$0.013 \pm 0.12\rho^2$

* Accuracy includes effects of directivity (first term) and test port reflection (second term) over the system frequency range.

Channel Accuracy (25°C):

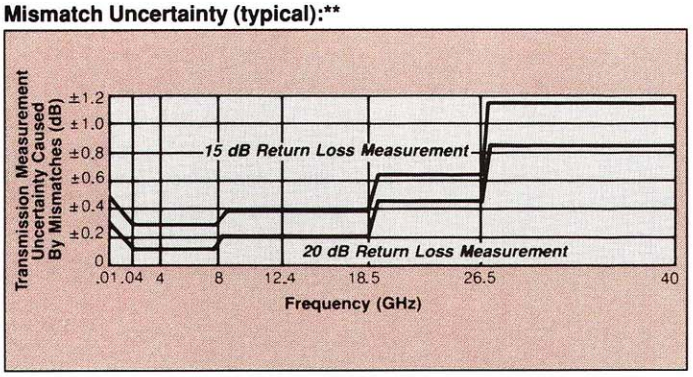


Transmission Loss Accuracy:

Transmission Loss = Channel Accuracy + Mismatch Uncertainty*

*Effects of sweep generator, test device, SWR Autotester, and detector mismatch can be significant. This mismatch uncertainty is minimized by Wiltron's exceptionally low reflection characteristics of the detector, sweep generator and SWR Autotester.

Mismatch Uncertainty (typical):**



** Varies with the return loss of the detector, SWR Autotester, connecting cables, the source impedance of the sweep generator, and the value of the measured reflection.

Distance-To-Fault:
Discontinuity Amplitude Accuracy: <2 dB typical
Distance Resolution: 1% of selected range.
Range: User selectable up to 500 ft.

MEMORY AND DISPLAY

Processor: 16 bit, 12 MHz
Main Memory: 136K bytes
Bubble Memory: 512K bytes; optional 768K bytes
Graphics Memory: 64K bytes
Transfer Rate: 22K bytes/s
Programming: Program is stored in bubble memory at factory, ready for immediate use. User can reload bubble memory from built-in disk drive.
Character Display: 16 lines of 80 characters.
Graphics Display: 640 x 224 dots, hardware vector generation.
Touch Sense Overlay: 6 x 10 matrix, programmable.

GENERAL

Printer Interface: HS–RS–232 standard.
Plotter Interface: GPIB (IEEE–488), two- or six-pen.
Software Language: Assembly, FORTRAN, and compiled BASIC.
Keyboard: Standard (66 key), detachable.
Disk Drive: Resident floppy, 5-1/2 in., 400K bytes.
MTTR: 30 min with Automatic Self Test and Diagnostic Check.

ENVIRONMENTAL

Temperature:
Operating: 0˚to 50˚C
Storage: –55˚C to +71˚C
Humidity:
Operating: 20% to 80% noncondensing.
Storage: 0 to 95% relative per MIL–STD–810C, Method 507.1, Procedure 1
Case Seal: Jet water and certified to DIN–STD 40050. Manual pressure release valve.
Shock: MIL–STD–810C, 516.2 all six flat faces, 20 g
Vibration: 3 g to 15 g, 7–500 Hz, with vibration isolators, 514.2
Sand and Dust (non-operating): MIL–STD–810C
Fungus (non-operating): MIL–STD–810C
Salt Spray (non-operating): MIL–STD–810C
Altitude (non-operating): 22,966 m (70,000 ft) per MIL–E–5400, Class 2
Safety: MIL–T–28800C, Type II
Drop Test: MIL–STD–810C, 516.2, Procedure 1

DIMENSIONS, WEIGHT, POWER

System in Environmental Case:
Dimensions: 616 W x 686 H x 787 D mm (21.1 W x 21 H x 30 D in.)
Weight: 72 kg (159 lb)
Power: 100V/120V/220V/240V +5%, –10%, 510 VA maximum

Benchtop System Without Environmental Case:
Dimensions: 432 W x 438 H x 571 D mm (17 W x 17.25 H x 22.5 D in.)
Weight: 45 kg (99 lb)
Power: 100V/120V/220V/240V +5%, –10-%, 510 VA maximum

Keyboard:
Dimensions: 400 W x 37 H x 114 D mm (15.75 W x 2.375 H x 7.25 D in.)
Weight: 1.4 kg (3 lb)

Faultfinder:
Dimensions: 95 W x 57 H x 117 L mm (3.75 W x 2.25 H x 4.625 L in.)
Weight (without cable): 0.9 kg (2 lb)
560A Connection Cable Length: 2.44 m (8 ft)
RF Cable Length: 2.44 m (8 ft)

Ordering Information

Order: Model 5647 Option P2FF Automated Transmission Line Test and Fault-Location System . . . . . Factory

Consisting of:
6647B–40 Sweep Generator
560A Scalar Network Analyzer
Fluke1722A/DN Instrument Controller
Fluke Y1720 Programmer's Keyboard
560–95NF50 Faultfinder
560–7N50 Detector
800–195 RF Cable, 2.44 m (8 ft) N Male/N Male
800–109 Detector Extender Cable, 7.6 m (25 ft), (3)
800–110 Detector Extender Cable, 15.2 m (50 ft)
2100 GPIB Cables (2)
34NFNF50 N Female/N Female Adapter
34NN50A N Male/N Male Adapter
22N50 N Male Open/Short
26N50 N Male Terminations (2)
2300–87WB P2FF Software
Environmental Enclosure and Storage Drawer

Options:
HP 7470A Plotter, Option 8: Includes Wiltron 2100–2 GPIB Cable, 2 m (6.6 ft) . . . . . Factory
Delete Environmental Enclosure, Option 15: . . . . . Factory
HP 2225D Printer, Option 17D: . . . . . Factory
Delete 560–95NF50 Faultfinder, Option 20: Adds standard Option P2 components. . . . . Factory
Fluke 1722A/WB (512 K Bubble), Option 47WB: Replaces 1722A/DN and software . . . . . Factory
Fluke 1722A/WE (512K RAM), Option 47WE: Replaces 1722A/DN and software . . . . . Factory
Collapsible Gurney . . . . . Factory

Available Accessories:
800–111 Detector Extender Cable, 30.5 m (100 ft) . . . . . Factory
N Male/TNC Female Adapter . . . . . Factory
N Male/TNC Male Adapter . . . . . Factory
N Male/SMA Female Adapter . . . . . Factory
22S50 WSMA Male Open/Short . . . . . Factory
22SF50 WSMA Female Open/Short . . . . . Factory
TNC Male Open/Short . . . . . Factory
TNC Female Open/Short . . . . . Factory

Scalar Network Analyzer

Model 561, 10 MHz to 40 GHz

NEW

561 Scalar Network Analyzer Highlights

- Automatic Measurements and Hard Copy Output Without a Controller
- Accurate Coaxial Measurements from 10 MHz to 40 GHz
- Nine Stored Setups to Eliminate Set-Up Time
- Cursors, Markers, and Limit Lines to Improve Productivity
- Complete, Annotated, Step-By-Step Normalization and Measurement Procedures
- Four Measurement Channels
- Lowest Cost Network Analyzer

Automated Measurement System

With the addition of a sweep generator, the 561 becomes an automated transmission, return loss (SWR), and power measurement system. Operating over the 10 MHz to 40 GHz range from a single coaxial test port, the system provides fully annotated displays of test data and measurement parameters.

Under internal microprocessor control (no external controller required), the 561 normalizes and simultaneously displays any two inputs on channels A, B, R1, and R2. The same inputs can be displayed as ratios A/R1, A/R2, B/R1, or B/R2. The dynamic range for each channel is 71 dB (–55 dBm to +16 dBm). Typically, the noise floor is less than –62 dBm, providing a greater than 76 dB dynamic range in almost all applications.

Normalization and Measurement

In a typical 561 test setup, the test device is inserted between the SWR Autotester and the detector. Detected signals from the SWR Autotester vary in proportion to the reflections, while the detector output varies in proportion to transmission loss or gain. The detector can be used to measure power in dBm.

During normalization, procedural guidance is automatically provided for transmission and return loss measurements. For return loss tests, a 0 dB reference is established by connecting an open and then a short to the SWR Autotester test port. The normalization data are taken independent of sensitivity settings at 2001 points with 0.002 dB resolution and stored in memory for correction of test data or for recall. Furthermore, an algorithm interpolates between data points to hold interpolated test data accuracy to within ±0.1 dB. Therefore, once the 561 has been normalized across a user-selected frequency range, measurements can be made over any portion of the range without renormalization. Set-up time is virtually eliminated by storing parameters for up to nine test setups.

During measurements, data are taken at 101, 201, or 401 points (user selected) with 0.005 dB vertical resolution on both channels. Typically, test data are updated every 100 ms, allowing "real time" adjustment of the test device. A permanent record of the test data—with or without the test, marker, or stored setup parameters—is made automatically on an HP 7440A, 7470A, or 7475A plotter or on most dot-matrix printers, including the Epson FX and the optional 2225C Ink Jet Printer. Since the 561 requires only about 10 seconds for print formatting, a new test can be conducted while the previously taken data are being printed out.

The 561 is equally effective in waveguide reflectometer setups where ratio measurements may be preferred. The 560–10BX, –1 Adapter Cables provide the interface between the instrument and waveguide detectors.

Cursors, Markers, and Limit Lines

The 561 has the most extensive set of cursor functions available on a scalar network analyzer:

Main Cursor: Position of the cursor is continuously variable with the tuning knob. The frequency and amplitude of the test data at the cursor on both traces are digitally displayed.

Cursor Delta: The difference in amplitude and frequency between the reference cursor and the Main Cursor positions on the test data are displayed for both traces. To establish a new reference, the position of the two cursors can be reversed by making a menu selection.

Cursor Min/Max: The 561 automatically moves the cursor to the minimum or maximum value of test data on either trace and displays the value in dB or dBm.

Cursor "X" dB: The cursor automatically moves to the amplitude on either trace where the test data is equal to the entered value of "X" dB or dBm.

Cursor "X" Bandwidth: Cursors are automatically displayed above and below the cursor at the frequencies where the test data are equal to the entered value "X" dB. The frequencies of the low and high cursors and the bandwidth between them are displayed.

Cursor Next Marker: The cursor automatically moves to the next highest frequency marker.

Cursor Active Marker: The cursor automatically moves to the frequency of the active marker.

These cursor functions are in addition to the eight markers available when the Wiltron 6600B Sweep Generator is used as the system signal source. Through a dedicated GPIB link, the 561 communicates with the signal source and displays an identifier for each marker, as well as the frequency and amplitude of the active marker.

To speed the interpretation of data, complex limit lines can be entered through the front panel or the GPIB interface. Limit lines can have up to nine segments which slope or step with frequency.

Averaging and Smoothing

When characteristics of the test device vary rapidly with frequency at very low signal levels, the trace can be smoothed by averaging and/or smoothing. The Smoothing control has three selections: Off, Min, and Max. To maintain the accuracy of the measurement data, smoothing is performed by reducing bandwidth, rather than by averaging adjacent data points in order to preserve measurement detail.

When averaging is selected, 2 to 256 successive traces can be averaged to smooth the trace display. As various combinations of smoothing and averaging are selected, the trace update time is automatically adjusted.

Measurement Accuracy

The return-loss accuracy of the 561 is largely attributable to the high directivity of the Wiltron SWR Autotesters. For example, the 560–97A50–1 with its GPC–7 test port connector has a directivity of better than 40 dB from 10 MHz to 18 GHz. On the 560–98K50, the directivity exceeds 35 dB up to 18 GHz, 32 dB up to 26.5 GHz, and 30 dB up to 40 GHz. The same unit has a test port match of better than 23 dB up to 26.5 GHz and 15 dB up to 40 GHz. To avoid the use of error-producing adapters, SWR Autotesters are available with either male or female test ports in Type N, WSMA, or K Connectors, all with high directivity. When the GPC–7 test port is selected, the lowest reflection adapters obtainable are offered in Type N and WSMA, which is optimized for testing SMA devices.

The accuracy of a transmission loss, gain, or power measurement is affected by reflections from the test port, the device under test, and the detector. These errors are minimized by the very low reflections from the Wiltron SWR Autotesters and detectors.

Zero-biased Schottky diodes are used in all detectors to minimize drift and circuit complexity. Except for the 560–7K50, diode modules are field-replaceable, eliminating the expense and inconvenience of returning the detectors to a service center for repair.

The accuracy of the 561 is high also because modulation of the input signal is not required. The need for modulation is avoided by using self-balancing amplifiers, which are stable at low signal levels. As a result, errors from modulation asymmetry and modulation-sensitive test devices are nonexistent. Without the insertion loss of a modulator, measurements can be made at higher input levels, increasing the measurement dynamic range.

Recommended Signal Sources

There are many advantages in selecting the Wiltron 6600B Sweep Generator as the 561 signal source. One advantage is the power sweep. In this mode, the output power is swept over a 15 dB range, enhancing gain compression measurements. In the alternate sweep mode, the 561 can display frequency response over different frequency ranges and/or power levels.

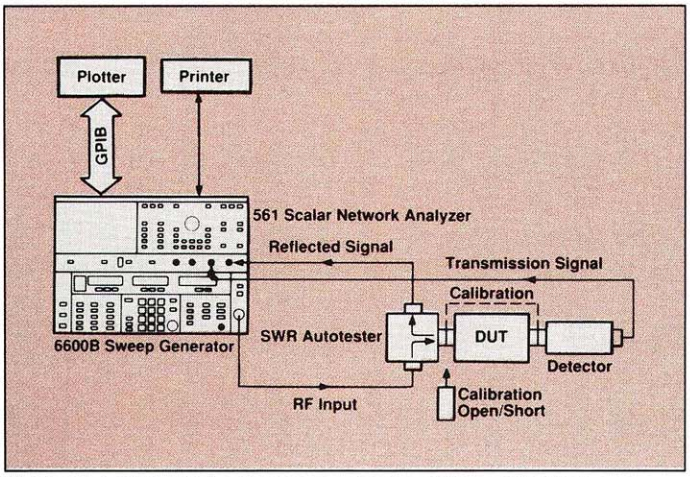
Another advantage of using a Wiltron signal source is that the 6600B uses fundamental oscillators from 2 to 26.5 GHz, avoiding the serious errors introduced by the subharmonics of frequency multipliers.

Stored Test Setups

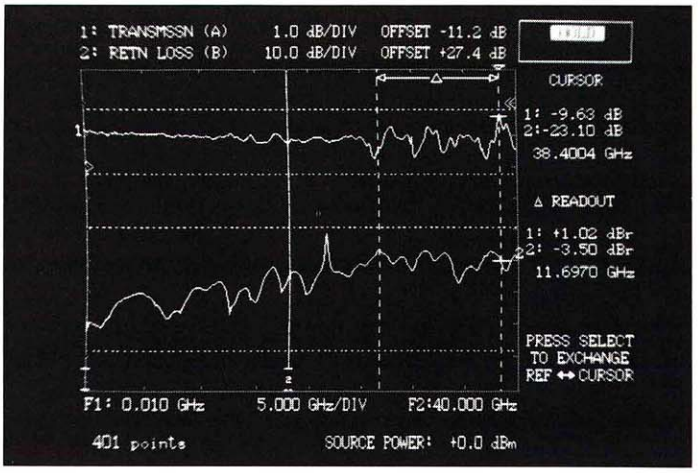
Set-up time is reduced substantially by storing up to nine front-panel setups, four of which include their own calibration data. A unique preview feature allows stored setup parameters to be reviewed before recalling or storing a new setup in the memory location. The stored data are backed by a battery with an estimated 10-year life.

GPIB Compatibility

An IEEE–488 (GPIB) interface is standard, providing remote control of all front-panel functions except power on/off and CRT intensity. A high speed data transfer can be used to transfer measurement data to the host computer. This capability is especially useful in manufacturing environments where archiving of data is required.



The 561 test setup includes direct connection to a printer or GPIB plotter. An external controller can be added, but is not required for automated measurements.



The 561 displays frequencies, differences in frequencies, amplitudes, differences in amplitudes, and pass/fail performance on the large, easy-to-read screen.

Scalar Network Analyzer (Cont.)

Model 561

Specifications

MEASUREMENTS

Measurement Modes: Measures and displays in dB swept transmission and return loss characteristics. Power is displayed in dBm. Complete measurement parameters for all modes are displayed.
Frequency Range: 10 MHz to 40 GHz in coax using Wiltron 560 Series Detectors and SWR Autotesters. Measurements can be made at higher frequencies with user-supplied waveguide detectors and Wiltron 560–10BX or 560–10BX–1 Adapter Cables.
Inputs: Four inputs, A, B, R1, and R2 accept detected outputs from Wiltron 560 Series Detectors and SWR Autotesters.
Dynamic Range: 71 dB (–55 dBm to +16 dBM) on all channels, usable to –60 dBm. Noise floor is typically less than –62 dBm.
Data Correction: System residuals, including the average of open and short reflections, are stored during normalization for automatic subtraction from test data.
Normalization: During the normalization sequence, 2001 points for each trace are stored with 0.002 dB resolution over any user-selected frequency range. Normalization data are automatically interpolated for ranges less than the original normalized range.
Save/Recall: Nine sets of front-panel settings can be stored for later recall. All stored data can be previewed on the CRT or printer output prior to selection. Four of the setups include their own calibration data.

DISPLAY

Channels: Two channels are used to select and simultaneously display any two inputs from A, B, R1, or R2. The same inputs can be displayed as ratios of A/R1, A/R2, B/R1, or B/R2.
Alternate Sweep: Displays alternate sweeps between the current front-panel setup and any of nine stored setups.
Graticule: Ten vertical divisions. Horizontal divisions are set automatically in frequency increments of a 1, 2, 5, sequence. Graticule On/Off control turns all graticule lines off. Tick marks remain on axis to indicate graticule position.
Display Resolution:
Horizontal: 101, 201, or 401 points over selected frequency range.
Vertical: 0.005 dB
Limit Lines: Two horizontal lines or complex limit lines with up to nine segments can be set for each trace. By switching off the standard graticule, a custom graticule can be constructed with the limit lines and frequency markers. Complex limit lines can be entered through the front panel or GPIB interface.
Scaling:
Resolution: 0.1 dB to 10 dB per division in 0.1 dB steps with independent control for each channel.
Offset Range: –99 dB to +99 dB in 0.1 dB steps.
Autoscale: Automatically selects offset and resolution to provide optimum display of test data.
Trace Update Time: Typically less than 100 ms, varying with frequency range and the averaging and smoothing settings.
Smoothing: Off, Minimum, and Maximum selections use analog techniques to reduce noise on low-level traces. Trace update time is automatically adjusted for any combination of averaging and smoothing.
Averaging: 2, 4, 8, 16, 32, 64, 128, or 256 successive traces can be averaged to smooth the trace display.
CRT Intensity: Continuously adjustable from off to bright.

MARKERS AND CURSOR

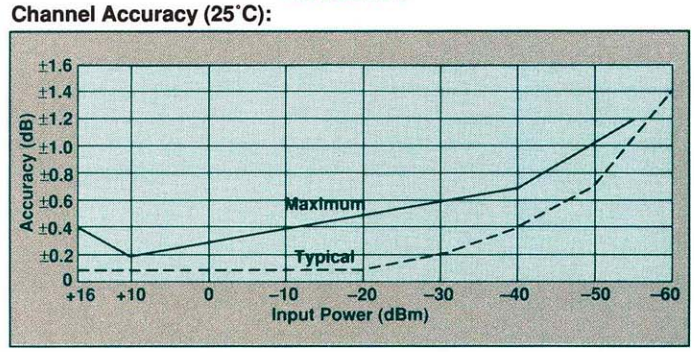
Markers: Displays up to eight numerically identified markers generated by the 6600B Sweep Generator. When a marker is selected as "Active," the cursor can be moved directly to the marker. The cursor can also be moved sequentially through markers until the desired marker is reached.
Main Cursor: Continuously variable with the tuning knob. The frequency and amplitude of test data at the cursor on both traces are digitally displayed.
Cursor Delta: Displays differences in dB and frequency between the reference cursor and the Main Cursor on both traces. A menu selection reverses the position of the reference cursor and the Main Cursor.
Cursor Min/Max: Automatically moves the cursor to the minimum or maximum value of test data on either trace.
Cursor "X" dB: Automatically moves cursor on either trace to an amplitude that is equal to the entered value of "X" dB or dBm.
Cursor "X" Bandwidth: Automatically displays cursors to the right and left of the cursor at the frequencies where the test data are equal to the entered value of "X" dB. The frequencies of the low and high cursors and the bandwidth between them are displayed.
Cursor Next Marker: Moves cursor to next highest frequency marker.
Cursor Active Marker: Moves cursor to the frequency of the active marker.

SIGNAL SOURCE

Recommended Signal Source: The Wiltron 6600B Sweep Generators are directly compatible with the 561. A dedicated GPIB system interface supplies frequency annotation on the 561 display.
Compatibility: The 561 is compatible with any signal source that meets the following requirements:
Horizontal Ramp: Provides a 0V to +10V nominal ramp signal, +12V maximum.
Blanking Signal: Provides +5V during retrace and bandswitching.
Dwell Signal: Accept TTL-low signal to dwell sweep ramp.

ACCURACY

Channel Accuracy (25˚C):

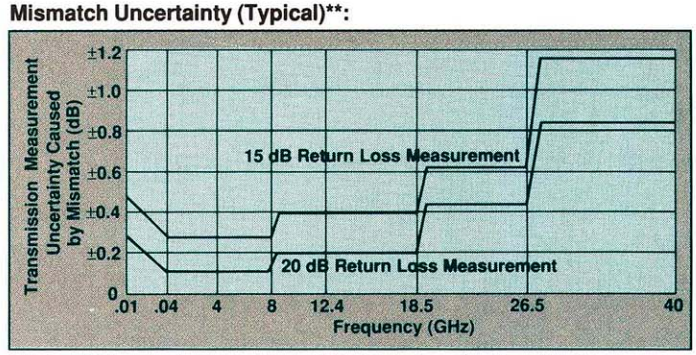


Transmssion Loss or Gain Accuracy: Uncertainties from frequency response of components are automatically subtracted from test data during the normalization procedure. Overall accuracy is then:

Transmission Loss or Gain = **Channel Accuracy** + **Mismatch Uncertainty***

* Effects of sweep generator, test device, SWR Autotester and detector mismatch can be significant. This mismatch uncertainty is minimized by Wiltron's exceptionally low reflection characterisitics of the detector, sweep generator and SWR Autotester.

Mismatch Uncertainty (Typical):**



**Varies with the return loss of the detector, SWR Autotester, connecting cables, the source impedance of the sweep generator, and the value of the measured reflection.

Overall Coaxial Return Loss Measurement Accuracy:
Uncertainties resulting from SWR Autotester and sweep generator frequency response and from system open and short characteristics are subtracted automatically from test data. Overall accuracy is then:

Return Loss Accuracy = **Channel Accuracy** + **SWR Autotester Accuracy**

SWR Autotester Accuracy:

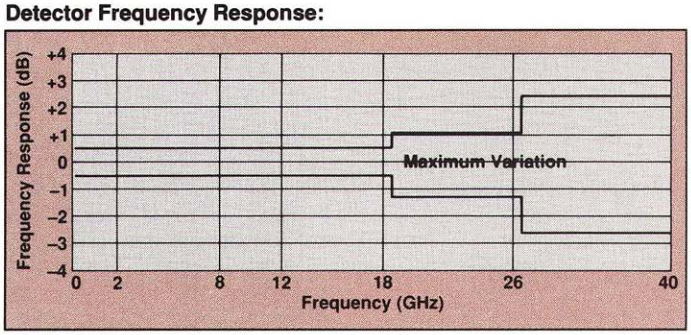
Model	Accuracy of Measured Reflection Coefficient (ρ)*			
	10 MHz–8 GHz	> 8–18 GHz	>18–26.5 GHz	> 26.5–40 GHz
560–97A50 560–97A50–1	$0.016\pm0.06\rho^2$ $0.010\pm0.06\rho^2$	$0.016\pm0.1\rho^2$ $0.010\pm0.1\rho^2$	N/A	N/A
560–97N50 560–97N50–1	$0.018\pm0.08\rho^2$ $0.013\pm0.08\rho^2$	$0.018\pm0.12\rho^2$ $0.013\pm0.12\rho^2$	N/A	N/A
560–97NF50 560–97NF50–1	$0.018\pm0.08\rho^2$ $0.013\pm0.08\rho^2$	$0.018\pm0.12\rho^2$ $0.013\pm0.12\rho^2$	N/A	N/A
560–98K50 560–98KF50	$0.018\pm0.15\rho^2$	$0.018\pm0.15\rho^2$	$0.025\pm0.15\rho^2$	$0.032\pm0.18\rho^2$
560–98S50 560–98S50–1	$0.025\pm0.1\rho^2$ $0.013\pm0.1\rho^2$	$0.025\pm0.1\rho^2$ $0.013\pm0.1\rho^2$	$0.025\pm0.1\rho^2$ $0.018\pm0.12\rho^2$	N/A
560–98SF50 560–98SF50–1	$0.025\pm0.1\rho^2$ $0.013\pm0.1\rho^2$	$0.025\pm0.1\rho^2$ $0.013\pm0.1\rho^2$	$0.025\pm0.1\rho^2$ $0.018\pm0.12\rho^2$	N/A

* Accuracy includes the effects of directivity (first term) and test port reflection (second term) over the frequency range.

Power Measurement Accuracy:

Absolute Power Accuracy = **Channel Accuracy** + **Detector Frequency Response**

Detector Frequency Response:



Overall Waveguide Return Loss Measurement Accuracy:

Return Loss Accuracy = **Channel Accuracy** + **User-Selected Coupler Accuracy**

In addition, mismatch uncertainties introduced by the detectors used in a waveguide reflectometer setup can be significant.

GPIB

Interface: IEEE–488 interface is standard on all instruments. All front-panel controls are GPIB controllable except power on/off and CRT intensity. Pass-through commands allow control of the microwave signal source through the 561 GPIB port.
Data Transfer: The 561 does not require an external controller; nevertheless, it is capable of providing high speed data transfer of test data and normalization data to an external GPIB controller.

PRINTER/PLOTTER

Plotter: Dedicated GPIB interface is compatible with HP 7440A, HP 7447A, and HP 7475A Plotters. Display traces, markers, cursor, and graticule information are copied. When overlay traces are desired, data traces only can be plotted.
Printer: Parallel printer interface is compatible with most dot-matrix printers, including Epson FX and the optional 2225C Ink Jet Printer. Hard copy output in graphical or tabular format can be selected. Selections include graphics with measurement parameters, test data tabulated for 26, 51, 101, 201, or 401 points, marker parameters only, or stored setup parameters.
Internal Print Buffer: After approximately 10 seconds of print formatting, a new test can be conducted while previously taken test data are being printed out from an internal printer buffer.

INPUT/OUTPUT CONNECTIONS

Horizontal Sweep Ramp Input: 0 to +10V nominal, +12V maximum.
Sequential Sync Input: +3.5V to +10V blanks trace during retrace or bandswitching. –3.5V to –10V defines a marker which when in the range of –8V to –10V is an active marker. Rear panel BNC connector, 10K ohm impedance.
Sweep Dwell Input: TTL-low signal stops sweep. Sweep continues when signal is removed. Rear panel BNC connector.
Bandswitching Blanking Input: Accepts ±5V signal coincident with bandswitching points. Rear panel BNC connector.
Retrace Blanking Input: +5V blanks traces during retrace. Rear panel BNC connector.
Video Marker Input: ±1V to ±10V peak input. Rear Panel BNC connector.
System GPIB: Connects 561 to GPIB. Rear panel GPIB connector.
Dedicated GPIB: Connects 561 to signal source and plotter. Rear panel GPIB connector.
Parallel Printer (Centronics): Connects 561 to printer. Rear panel.
AUX I/O: Connects 561 to Wiltron 6600B Sweep Generator. Rear panel.
External Display: Composite video signal from rear panel, BNC connector.

GENERAL

Temperature Range:
Operating: 0°C to +50°C
Storage: –40°C to +70°C
Power: 100V/110V/220V/240V ±10%, 50–60 Hz, 350 watts maximum
Dimensions: 311 H x 432 W x 476 D mm + 10 mm for feet.
(12-1/4 H x 17 W x 18-3/4 D in. +3/8 in. for feet)
Weight: 16 kg (35 lb)

MEASUREMENT COMPONENTS

SWR Autotester: The 560 Series SWR Autotesters integrate in one small package a broadband, high directivity bridge, a detector, a low reflection test port, a reference termination, and a connecting cable. The output of the SWR Autotester is a detected signal, varying in proportion to reflections from the test device connected to the test port. Optional extender cables can be used without degradation in performance.

Model	Frequency Range (GHz)	Directivity (dB)	Frequency Sensitivity (dB)	Test Port Connector	Input Connector
560–97A50 560–97A50–1	0.01–18	36 40	±1.2	GPC–7	N Female
560–97N50 560–97N50–1	0.01–18	35 38	±1.5	N Male	N Female
560–97NF50 560–97NF50–1	0.01–18	35 38	±1.5	N Female	N Female
560–98K50 560–98KF50	0.01–40	30	±3	K Male K Female	Ruggedized K Female
560–98S50 560–98S50–1	0.01–26.5	32 35	±2	WSMA Male	Ruggedized WSMA Female
560–98SF50 560–98SF50–1	0.01–26.5	32 35	±2	WSMA Female	Ruggedized WSMA Female

Scalar Network Analyzer (Cont.)

Model 561

MEASUREMENT COMPONENTS (Cont.)

SWR Autotester Accuracy: Please see page 35.
Maximum Input Power: 0.5 W
Cable Length: 122 cm (4 ft)
Insertion Loss: 6.5 dB nominal from input port to test port.

Dimensions and Weight:

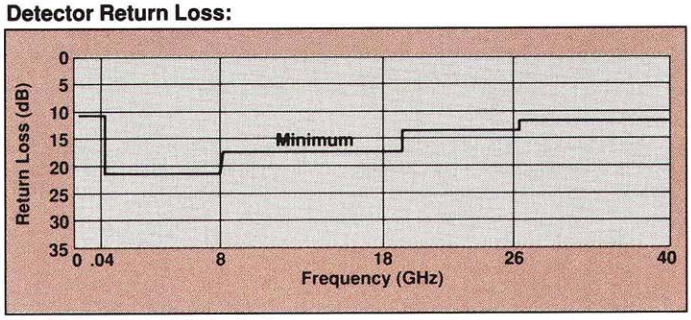
Model	Dimensions*	Weight
560–97A50, –1 560–97N50, –97NF50, –1	7.6 x 5 x 2.8 cm (3 x 2 x 1-1/8 in.)	340 g (12 oz)
560–98K50, –98KF50 560–98S50, –98SF50, –1	1.9 x 3.8 x 2.9 cm (3/4 x 1-1/2 x 2-1/8 in.)	198 g (7 oz)

* Plus connectors and cable

Detectors: The 560 Series Detectors are used for coaxial transmission loss or gain and power measurements and with coaxial adapters for waveguide reflectometer measurements. Zero-biased, field-replaceable Schottky diodes provide –60 dBm sensitivity. Optional extender cables can be used without degradation in performance.

Model	Frequency Range	Input Connector
560–7A50	10 MHz to 18 GHz	GPC–7
560–7K50	10 MHz to 40 GHz	K Male
560–7N50	10 MHz to 18.5 GHz	N Male
560–7S50	10 MHz to 18.5 GHz	WSMA Male
560–7S50–2	10 MHz to 26.5 GHz	WSMA Male
560–7S50–3	10 MHz to 34 GHz	WSMA Male

Detector Return Loss:



Maximum Input Power: 100 mW
Cable Length: 122 cm (4 ft)
Dimensions: 7.6 x 2.9 x 2.2 cm (3 x 1-1/8 x 7/8 in.)
Weight: 170 g (6 0z)

Replaceable Diode Modules:

Detector Model	Diode Module Model	Price
560–7A50	560–A–7219–A	$150
560–7K50	Factory Repair Only	$275
560–7N50	560–A–7219–A	$150
560–7S50	560–A–7219–A	$150
560–7S50–2	560–A–7219–B	$150
560–7S50–3	560–A–7219–C	$150

ACCESSORIES

Extender Cables: Extender Cables can be installed between the SWR Autotester or detectors and the 561, permitting measurements from up to 200-feet distance.

Model	Cable Length	Price
800–109	7.6 m (25 ft)	$50
800–110	15.2 m (50 ft)	$75
800–111	30.5 m (100 ft)	$100
800–112	61 m (200 ft)	$180

GPIB Cables: GPIB cables interconnect instruments on GPIB.

Model	Cable Length	Price
2100–1	1 m (3.3 ft)	$60
2100–2	2 m (6.6 ft)	$75
2100–4	4 m (13.2 ft)	$95
2100–5	0.5 m (1.65 ft)	$55

Adapter Cables: Adapter cables allow the 561 to be used with waveguide or other detectors having a BNC or SMA female output connector. Cable length is 122 cm (4 ft).

Model	Connectors	Price
560–10BX	BNC Female	$100
560–10BX–1	SMA Female	$150

Open/Shorts: An Open/Short is used to establish a 0 dB return loss reference during the normalization procedure.

Model	Connectors	Price
21A–1*	GPC–7 Short Only	
22A50	GPC–7	Included
22K50	K Male	with
22KF50	K Female	instrument
22N50	N Male	at
22NF50	N Female	no charge
22S50	WSMA Male	
22SF50	WSMA Female	

* Supplied with collet for mating with beadless end of air line.

760–56 Transit Case for RF components $305
760–75 Transit Case for the 561 . . . . . $390
2000–216 External Monitor, 260 mm (10.25 in.) diagonal . . . $300
2225C Ink Jet Printer, including 2225–1 Interface Cable, 1 ink cartridge, and 50 sheets of Ink Jet paper. $795

Ordering Information

561 Scalar Network Analyzer $7,900

SWR Autotesters:
560–97A50, 10 MHz to 18 GHz, 36 dB directivity $1,900
560–97A50–1, 10 MHz to 18 GHz, 40 dB directivity $2,200
560–97N50, 10 MHz to 18 GHz, 35 dB directivity $2,000
560–97N50–1, 10 MHz to 18 GHz, 38 dB directivity $2,300
560–97NF50, 10 MHz to 18 GHz, 35 dB directivity $2,050
560–97NF50–1, 10 MHz to 18 GHz, 38 dB directivity $2,350
560–98K50, 10 MHz to 40 GHz, 30 dB directivity $3,150
560–98KF50, 10 MHz to 40 GHz, 30 dB directivity $3,200
560–98S50, 10 MHz to 26.5 GHz, 32 dB directivity $2,400
560–98S50–1, 10 MHz to 26.5 GHz, 35 dB directivity $2,900
560–98SF50, 10 MHz to 26.5 GHz, 32 dB directivity $2,500
560–98SF50–1, 10 MHz to 26.5 GHz, 35 dB directivity . . . $3,000

Detectors:
560–7A50, 10 MHz to 18 GHz, GPC–7 . . . . . $550
560–7K50, 10 MHz to 40 GHz, K Male $675
560–7N50, 10 MHz to 18.5 GHz, N Male $525
560–7S50, 10 MHz to 18.5 GHz, WSMA Male $525
560–7S50–2, 10 MHz to 26.5 GHz, WSMA Male $600
560–7S50–3, 10 MHz to 34 GHz, WSMA Male $675

Rack Mounting, Option 1: Unit supplied with mounting ears and chassis track slide (90° tilt) installed $350
Connecting Cables: A 2100–1 GPIB Cable, 1 m (3.3 ft) long, and an 806–7 Interconnect Cable for the 6600B Sweep Generator are included with each 561.
Replacement Interconnect Cables 806–7 . . . . . $250

Scalar Network Analyzer

Model 560A, 10 MHz to 40 GHz

560A Scalar Network Analyzer Highlights

- Simultaneous Transmission and Return Loss or Power Measurements
- 10 MHz to 40 GHz Range from Single Coaxial Test Port
- 40 dB Directivity to 18 GHz, 30 dB to 40 GHz
- GPIB Programmability
- Memory-Enhanced Accuracy
- 71 dB Dynamic Range (+16 dBm to –55 dBm)

GPIB Compatible Network Analyzer

The 560A Scalar Network Analyzer makes automated, simultaneous measurement of transmission loss/gain and return loss or power over the 10 MHz to 40 GHz range. In its simplest configuration, an automated system consists of a 560A, a 560 Series SWR Autotester and Detector, a 6600B Sweep Generator, and a GPIB desktop controller. Available software includes programs for the HP 85, 9816S, 9826S, 9836S, and the Fluke 1722WB, 1722DN, 1722WE, and 1722WA. All software includes step-by-step normalization and measurement procedures.

Highest Return Loss Accuracy

The accuracy with which return loss measurements are made result largely from the high directivity of the Wiltron SWR Autotesters. With directivities of 40 dB up to 18 GHz, 32 dB up to 26.5 GHz, and 30 dB up to 40 GHz, these SWR Autotesters are available with GPC–7, WSMA, Type N, and K Connector test ports. To eliminate the errors that would be introduced by adapters, the detectors are also available with the same selection of test ports. Detector return loss specifications of 22 dB from 0.04 to 8 GHz, 17 dB up to 20 GHz, 13 dB up to 26.5 GHz and 12 dB up to 40 GHz contribute significantly to the 560A's exceptional accuracy. The substantial errors introduced by multiplier-type oscillators are eliminated when a 6600B Sweep Generaor is used as the signal source.

Memory-Enhanced Performance

High accuracy is also ensured by the use of memory which stores and automatically subtracts system residual errors from the test data. The normalization procedure applies to power measurement as well, allowing direct measurements over the +16 dBm to –55 dBm range.

Specifications

Frequency Range: 10 MHz to 40 GHz, determined by selection of SWR Autotester and detector. The 560–10BX and 560–10BX–1 Adapter Cables provide interface to waveguide detectors.
Channels: Three, with selection of A, B, R, A–R, and B–R. Two channels are displayed simultaneously.
Dynamic Range: 71 dB (+16 dBm to –55 dBm) on channels A and B. 46 dB (+16 dBm to –30 dBm) on channel R.
Amplitude Resolution: 0.01 dB
Measurement Accuracy: Please see ACCURACY on page 34.
Temperature Range:
Operating: 0°C to +50°C
Storage: –40°C to +70°C
Power: 100V/120V/220V/240V +5%, –10%, 50–60 Hz, 85 VA max.
Dimensions:
560A Horizontal Model: 133 H x 429 W x 500 D mm (5.25 H x 16.9 W x 19.7 D in. + 3/8 in. for feet)
560A–2 Vertical Model: 267 H x 213 W x 500 D mm (10.5 H x 8.4 W x 19.7 D in. + 3/8 in. for feet)
560A Option 1 Rack Mount: 133 H x 483 W x 500 D mm (5.25 H x 19 W x 19.7 D in.)
Weight:
560A and 560A–2: 11 kg (24.5 lb)
560A Option 1: 13.5 kg (30 lb)

Ordering Information

560A Scalar Network Analyzer, Horizontal Configuration	$8,500
560A–2 Scalar Network Analyzer, Vertical Configuration	$8,500

SWR Autotesters:

560–97A50, 10 MHz to 18 GHz, 36 dB directivity	$1,900
560–97A50–1, 10 MHz to 18 GHz, 40 dB directivity	$2,200
560–97N50, 10 MHz to 18 GHz, 35 dB directivity	$2,000
560–97N50–1, 10 MHz to 18 GHz, 38 dB directivity	$2,300
560–97NF50, 10 MHz to 18 GHz, 35 dB directivity	$2,050
560–97NF50–1, 10 MHz to 18 GHz, 38 dB directivity	$2,350
560–98K50, 10 MHz to 40 GHz, 30 dB directivity	$3,150
560–98KF50, 10 MHz to 40 GHz, 30 dB directivity	$3,200
560–98S50, 10 MHz to 26.5 GHz, 32 dB directivity	$2,400
560–98S50–1, 10 MHz to 26.5 GHz, 35 dB directivity	$2,900
560–98SF50, 10 MHz to 26.5 GHz, 32 dB directivity	$2,500
560–98SF50–1, 10 MHz to 26.5 GHz, 35 dB directivity	$3,000

Detectors:

560–7A50, 10 MHz to 18 GHz, GPC–7	$550
560–7K50, 10 MHz to 40 GHz, K Male	$675
560–7N50, 10 MHz to 18.5 GHz, N Male	$525
560–7S50, 10 MHz to 18.5 GHz, WSMA Male	$525
560–7S50–2, 10 MHz to 26.5 GHz, WSMA Male	$600
560–7S50–3, 10 MHz to 34 GHz, WSMA Male	$675

Sweep Generators Please see page 58 for selection.
Accessories: Please see page 36 for 560A accessories.

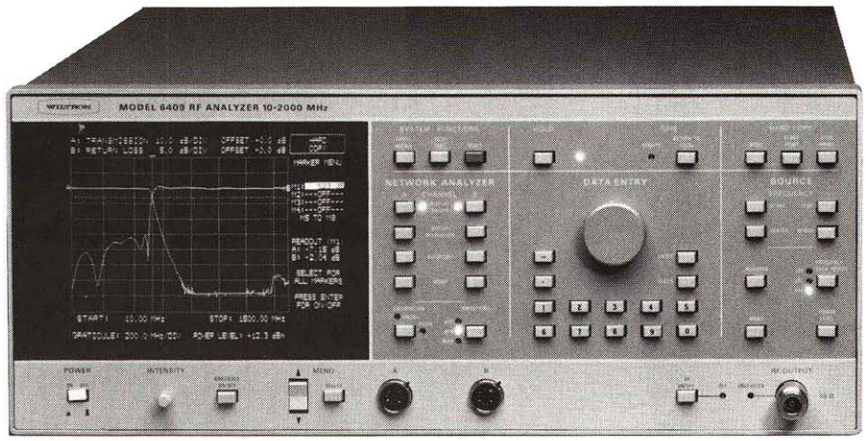
Options:

Rack Mounting for 560A, Option 1	$350
GPIB Programmability, Option 3	$750
Operation from 50–400 Hz Power Source, Option 4	$350

GPIB Field Installation Kit, P/N 560–A–7094	$875
Adapter to Connect 560A to HP 8620, P/N 560–B–8208	$60
Transit Case 760–84 for 560A	$355
Transit Case 760–56 for RF Components	$305

RF Analyzers

Models 6407 and 6409, 1 to 2000 MHz



6400 RF Analyzer Highlights

- Fast , Accurate Measurement of Transmission, Return Loss, and Absolute Power
- Unmatched, Drift-Free Stability
- Single, Easy-to-Use Unit with an Affordable Price
- 76 dB Dynamic Range (Typical)
- Full GPIB Programmability

Complete, Self-Contained System

The 6400 combines in one instrument a broadband, high-resolution signal source and a precision, two-channel scalar network analyzer. Models 6407 (1 to 1000 MHz) and 6409 (10 to 2000 MHz) make use of thin-film microelectronics technology and microprocessor enhancements to simplify and improve the accuracy of transmission, return loss, and absolute power measurements. A resident microprocessor adds operating convenience, error correction, and the drive for hard copy output of test data.

Signal Source

The microprocessor is also used to monitor internal 25 MHz comb markers with which precise identification of frequency is made automatically. With crystal-derived stability that is virtually free of temperature drift and nonlinearities, ±100 kHz frequency accuracy, and 10 kHz resolution, the instruments make accurate characterization of narrow-band devices with rapidly changing fine-grain structure. The exceptional stability and accuracy are achieved by "locking" the frequency to a crystal marker at the beginning of each sweep. The displays are drift-free, even when tests are made days apart. Up to eight markers and an "intelligent" CRT graticule make identification of frequencies as simple as can be. The frequency and amplitude on both traces are displayed at the position of the last activated marker. Performance that previously required a costly synthesizer is now available at a surprisingly low price.

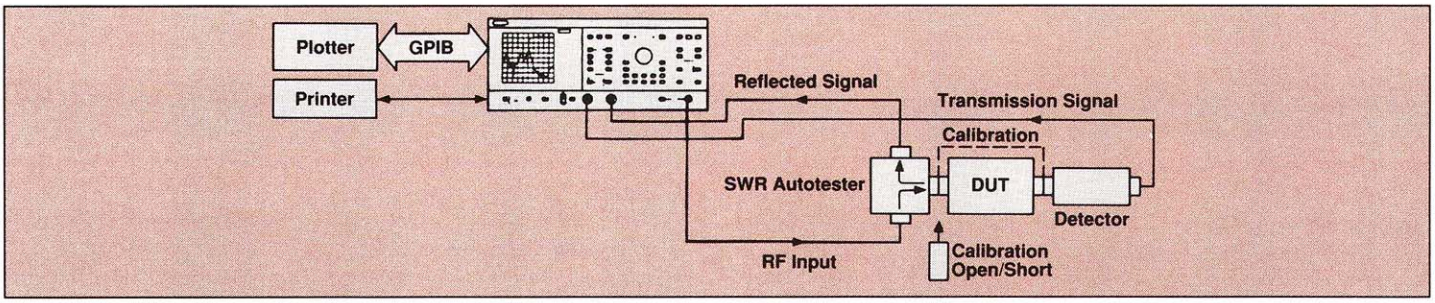
There are two sweep modes: Start/Stop and Symmetrical. In either mode, frequencies can be changed without renormalization, making it easy to zoom in on expanded frequency segments for close scrutiny. In the Alternate Sweep mode, the system displays two frequency ranges "simultaneously."

In standard units, the output power is variable from +12 dBm to +0.1 dBm in 0.1 dB steps, flat within ±0.3 dB. With the addition of the optional 70 dB step attenuator, the output power range becomes +10 dBm to –69.9 dBm, also in 0.1 dB steps. Harmonics are <–30 dBc, spurious signals <–40 dBc.

Network Analyzer

The built-in network analyzer typically has a 76 dB dynamic range and a low level sensitivity of –60 dBm. This range is achieved using accurate, low-drift, dc amplifiers that are automatically corrected for drift during retrace. No error-producing signal modulation is needed.

An unambiguous display of test conditions and data are shown on the large 178 mm (7 in.) diagonal screen. Information provided for each test includes offset, resolution, type of test being performed, reference line position, and trace identification. An "intelligent" graticule automatically spaces the vertical grid to provide an optimum display. Identification of frequencies is clearly evident, even without markers. A composite video output is available for connection to a larger, external screen, reducing, in some applications, the fatigue of monitoring and ad-



In a typical 6400 transmission and return loss measurement setup, the device under test is inserted between the SWR Autotester and the RF Detector.

justing the test device. The data display can be further enhanced by the use of go/no-go data limit lines. With the variable knob control, these lines can be used as cursors to measure peak-to-peak variations in the test device response.

Fast, near-silent, automatic printing of displayed data and test parameters in graphical or tabular format (up to 401 data points) is performed on an optional 2225C Ink Jet Printer—a real convenience in the laboratory or production area

Store and Recall

Up to nine complete front-panel setups can be stored and recalled, reducing substantially test set-up time. Included in the stored data are marker frequencies, data limits, frequency range, and vertical scaling. Also stored is normalization data which provides a 0 dB reference for transmission and return loss measurements. After one-time normalization, tests can be made at any frequency. Normalization data can be retained in memory, even when power is removed.

In addition, Autoscaling speeds testing by automatically selecting scale values and positioning the trace for the best display of the test device's full characteristics.

Quality Measurement Components

Contributing greatly to the overall measurement accuracy are the Wiltron high-performance measurement components. These include the SWR Autotester with 40 dB directivity and the RF Detector with ±0.5 dB flatness and 22 dB return loss.

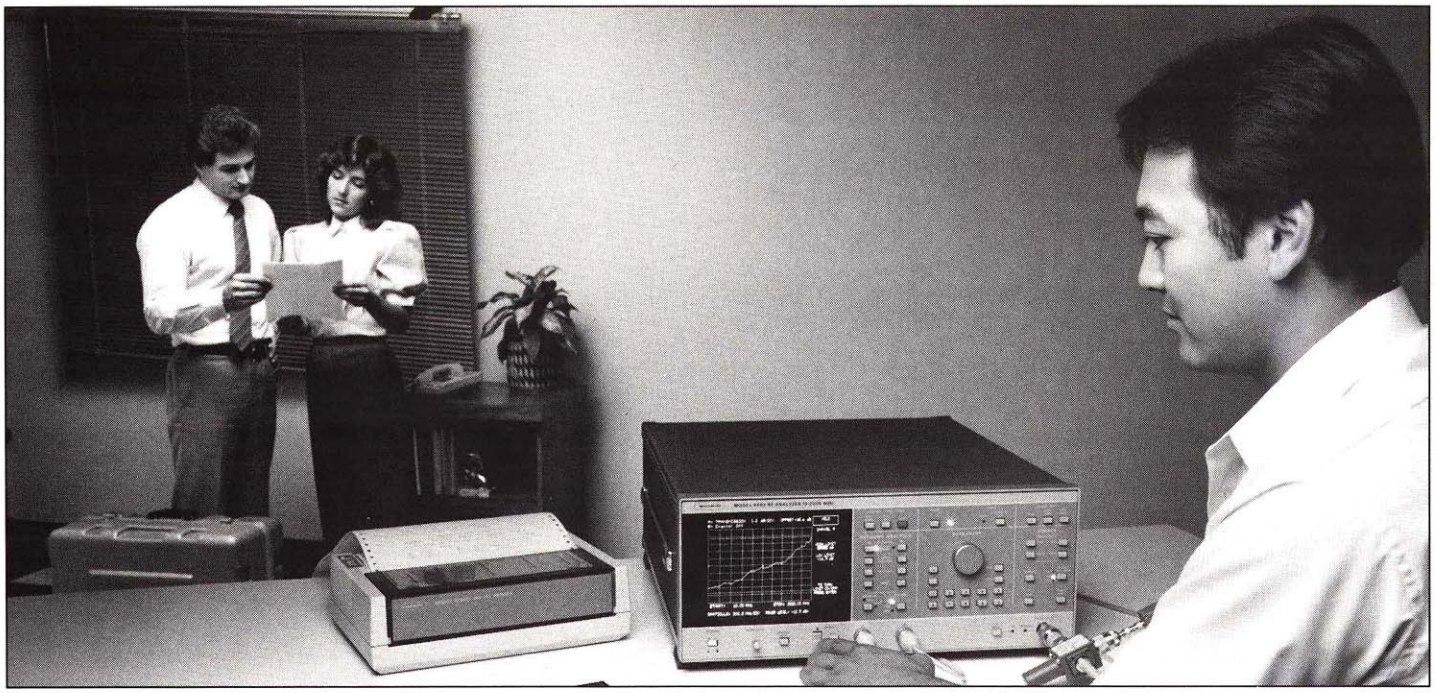
GPIB Programmability

An optional, easy-to-program GPIB interface is available for automated testing. With the addition of a computer, all front panel functions can be controlled via the interface bus.

Applications

TV Systems and Repeaters

The 6400 is the ideal instrument for measuring TV related equipment. VCRs, TV tuners, repeaters, and components can be characterized quickly and accurately. For applications where the 6400 must be located across the bench to make room for a sizable system under test, the composite video output can be used to drive a large external CRT.



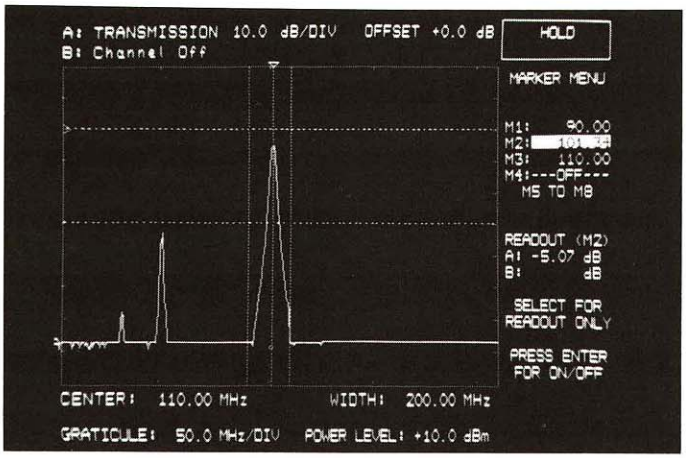
Printing of the 6400's displayed data and test parameters in graphical or tabular format can be performed on an optional 2225C Ink Jet Printer.

RF Analyzers (Cont.)

Models 6407 and 6409

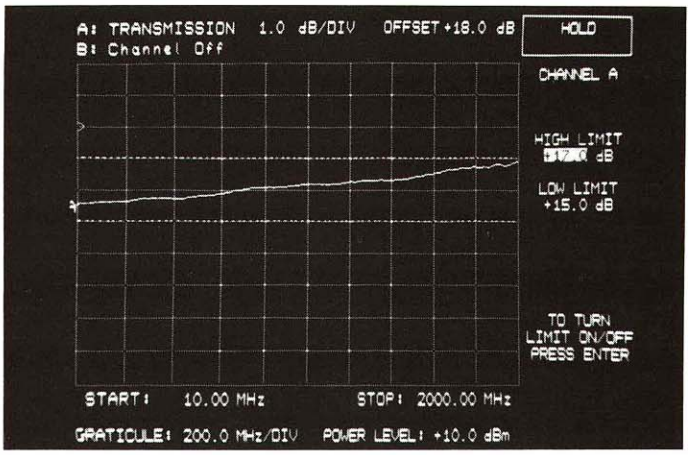
DBS Satellite Equipment

The versatility offered by a symmetrical sweep centered on a frequency and the capability to change frequencies without renormalization make testing of DBS equipment an easy task for the 6400. Frequency ranges, marker frequencies, and data limits can be stored for up to nine test setups. Changing from one channel to another is as simple as changing the center frequency of the sweep.



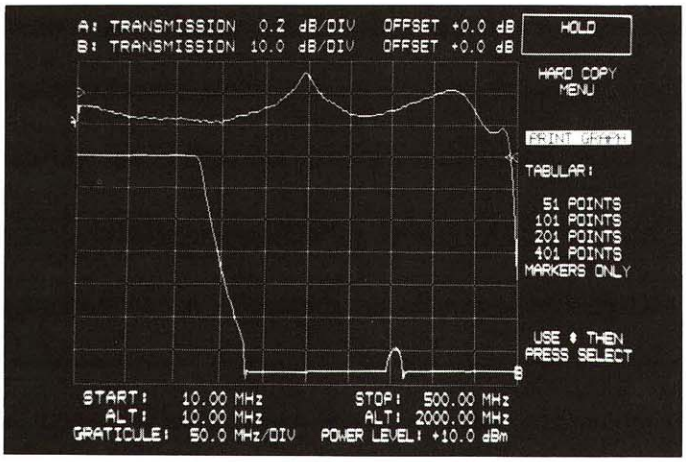
Amplifiers

The 6400's broad frequency range, flat output power, 16 dBm detector capability, and optional 70 dB attenuator make it the best instrument for testing broadband or narrow-band amplifiers. The procedure is simple: 1) normalize the system over the amplifier's full frequency range, 2) connect the amplifier, and 3) read gain directly in dB on the display. One measurement characterizes the amplifier.



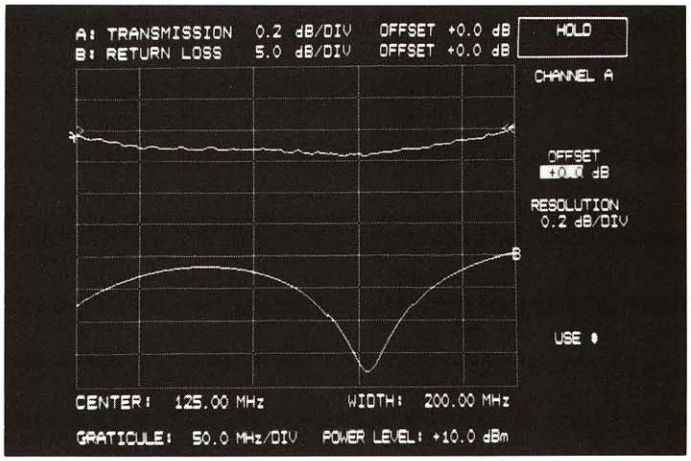
Filters

The accuracy with which filters are characterized is enhanced by the 10 kHz resolution and extremely stable output frequency of the 6400. In some setups, productivity can be improved substantially by using the Alternate Sweep mode. In this mode, a display of broadband and narrow-band characteristics can be viewed simultaneously. For example, tuning a filter whose skirt characteristics are affected by adjustment in the passband response can now be done easily and accurately while observing results on a single display. And the capability to zoom in on frequency segments, such as the passband or 3 dB points, without renormalization reduces test time.



Isolators

Measuring the forward transmission loss of an isolator requires a detector with low reflections and linear response — characterisitics that distinguish Wiltron detectors. With a 76 dB dynamic range, reverse transmission loss can be measured with the confidence that there is ample safety margin above the noise floor. Furthermore, a smoothing circuit that averages the noise at low signal levels takes the ambiguity out of determining the actual low level characterisitics. The accuracy of return loss measurement in either direction is ensured by the 40 dB directivity of the SWR Autotester.



Cellular Radio

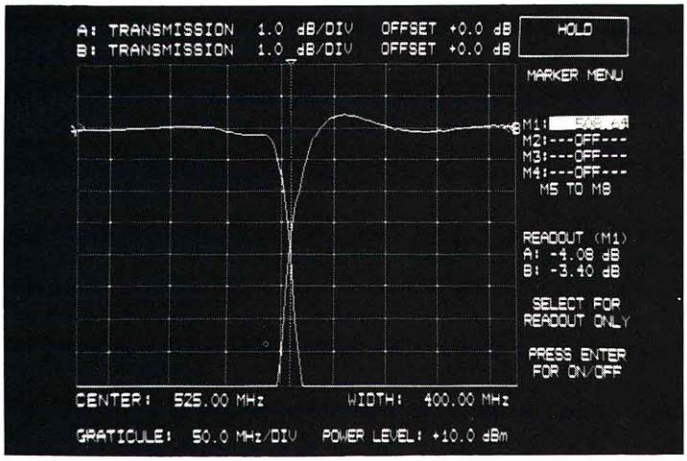
The 6400 is the most cost effective system for testing cellular radio components. From individual devices such as tuners and amplifiers, to full systems including antennas, the 6400 is perfectly suited for measuring sensitivity, conversion loss, gain, power, and other characteristics. There is no longer a need for an expensive, custom-designd test system.

Antennas

The high output power and portability of the 6400 make it particularly well suited to testing antennas in the laboratory or on the range. With ample power and a wide dynamic range, measurements can be made on systems that include high-loss cables. For field applications, a lightweight carrying case is available.

Diplexers and Multiplexers

With the 6400's dual channel display, you can normalize A and B channels for transmission loss measurements and observe both outputs of a diplexer simultaneously. You can use the zoom feature to concentrate on cross-over points or on response variations within the passband. The frequencies of important data points can be identified with up to eight markers.



Specifications

SIGNAL SOURCE

Frequency Range:
6407: 1 to 1000 MHz
6409: 10 to 2000 MHz
Frequency Resolution: 10 kHz
Frequency Accuracy: ±100 kHz
Frequency Drift (<40 MHz sweep width):
With Temperature: <10 kHz/°C
With 10% Change in Line Voltage: <10 kHz
With 3:1 Load SWR: <20 kHz
Leveled Output Power Range:
Without Attenuator: +12 dBm to +0.1 dBm in 0.1 dB steps.
With Optional Attenuator: +10 dBm to –69.9 dBm in 0.1 dB steps.
RF Output Impedance: 50 ohms (Optional 75 ohms is available on 6407, reducing output power by 2 dB).
RF Output Connector: Type N Female.
Source Match: <1.5 SWR
Output Power Flatness: ±0.3 dB
With 75 ohm Output: ±0.5 dB
With Attenuator: ±1 dB plus 0.1 dB/10 dB of attenuation.
Signal Purity:
Harmonics: <–30 dBc (except –25 dBc on 6407 from 1 to 2 MHz)
Nonharmonics: <–40 dBc
Residual AM: <–50 dBc in 100 kHz bandwidth.
Residual FM: <5 kHz peak, 30 Hz to 15 kHz post detection BW.

Sweep Time: Determined by number of data points and smoothing.

Number of Data Points	Smoothing	Typical Sweep Time
101	Off	< 100 ms
201	Off	< 250 ms
401	Off	< 400 ms
101	Min	< 350 ms
201	Min	< 550 ms
401	Min	< 1 s
101	Max	< 3 s
201	Max	< 6 s
401	Max	< 10 s

NETWORK ANALYZER

Display: 178 mm (7 in.) diagonal.
Scale Resolution: 0.1 dB to 10 dB per division in 0.1 dB steps, independent control for each channel.
Offset Range: +99.9 dB to –99.9 dB in 0.1 dB increments.
Display Resolution:
Vertical: 0.003 dB maximum.
Hosizontal: 101, 201, or 401 points, front panel selectable.
Dynamic Range: 76 dB (+16 dBm to –55 dBm), both channels. Usable to –60 dBm
Smoothing: Off, Minimum, or Maximum, front panel selectable. Minimum and Maximum smoothing use digital and analog techniques to reduce noise on low level traces.
Normalization: During normalization sequence, 800 points for each trace are stored with 0.002 dB resolution for the full band of the unit. Normalization data are automatically interprolated for ranges less than the full range.
Graticule: Ten vertical divisions. Horizontal divisions are set automatically in frequency increments of a 1, 2, 5 sequence from 1 to 500 MHz. Graticule ON/OFF control turns all graticule lines off. Tick marks remain on axis to indicate graticule position.
Markers: Up to eight individually controlled markers can be placed with 10 kHz resolution on the display. Amplitude of both traces at active marker is displayed in dB or dBm.

SYSTEM ACCURACY

Transmission Loss Accuracy:
Uncertainties resulting from frequency response of components are automatically subtracted from test data during normalization procedure. Overall accuracy is then:

Transmission Accuracy = **Channel Accuracy** + **Mismatch Uncertainty**

Typical mismatch uncertainty using a 6400 Series Detector is ±0.1 dB for a test device with 20 dB return loss and ±0.3 dB for one with 15 dB return loss.

Return Loss Accuracy:
Uncertainties resulting from frequency response of components are automatically subtracted from test data during normalization procedure. Overall accuracy is then:

Return Loss Accuracy = **Channel Accuracy** + **SWR Autotester Accuracy**

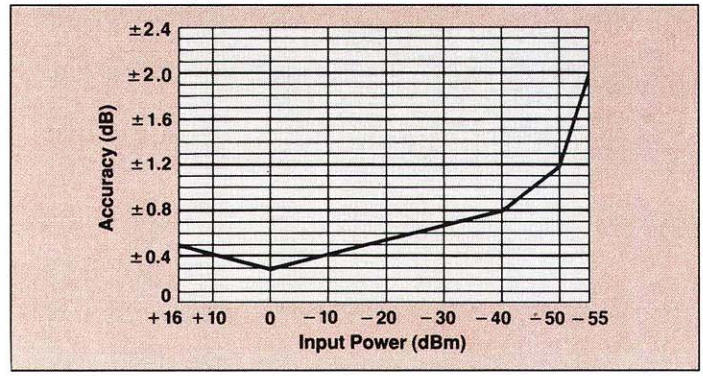
6400 Series SWR Autotester accuracy is $\pm(0.01 + 0.06\rho^2)$, where ρ is the reflection coefficient of the device under test.

Absolute Power Accuracy:

Absolute Power Accuracy = **Channel Accuracy** + **Detector Frequency Response**

The 6400 series detector frequency response is ±0.5 dB (±0.2 dB from 1 to 1,000 MHz).

Channel Accuracy (25°C):



RF Analyzers (Cont.)

Models 6407 and 6409

GENERAL

Dimensions: 177 H x 430 W x 495 D mm
(7 H x 17 W x 18-3/4 D in.)
Weight: 16 kg (35 lb)
Power: 100V/110V/220V/240V ±10%, 48–66 Hz, 130 VA maximum.
Operating Temperature: 0°C to 50°C

MEASUREMENT COMPONENTS

SWR Autotesters:
The 6400 Series SWR Autotesters are used to make precision return loss measurements. Fully compatible with the 6400, they are available in a variety of connector types and frequency ranges.

SWR Autotester Model	Frequency Range (MHz)	Test Port Connector	Impedance (Ohms)	Directivity (dB)	Price
6400–6B50 6400–6B75	1 to 1000	BNC Male	50 75	40	$600 $600
6400–6N75 6400–6NF75	1 to 1000	N Male N Female	75	40	$700 $725
6400–6N50 6400–6NF50	1 to 2000	N Male N Female	50	40	$700 $725
6400–6N75–1 6400–6NF75–1	1 to 2000	N Male N Female	75	40, ≤1.8 GHz 38, >1.8 GHz	$800 $825

Maximum Input Power: 27 dBm (500 mW)
Test Port Impedance Match: 1.13 SWR (50Ω); 1.22 SWR (75Ω)
Insertion Loss (input to test port): 6.5 dB nominal.
Open/Short: An Open/Short that mates directly on the test port is supplied with each SWR Autotester.

Detectors:
The 6400 Series Detectors are used to make precision transmission loss or gain and absolute power measurements.

Detector Model	Frequency Range (MHz)	Input Connector	Impedance (Ohms)	Price
6400–71B50 6400–71B75	1 to 1000	BNC Male	50 75	$375 $400
6400–71N75	1 to 1000	N Male	75	$400
6400–71N50 6400–71N75–1	1 to 2000	N Male	50 75	$375 $475

Impedance Match: 1.17 SWR
Maximum Input Power: 20 dBm (100 mW)

Replacement Diode P/N 10–21 for 6400–71 Series Detectors . .$30

Terminations:
Precision Terminations are used to terminate the output of a two-port device for the most accurate return loss measurements.

SWR: 1.002 + 0.003F
(F in GHz)

Termination Model	Frequency Range (MHz)	Connector	Impedance (Ohms)	Price
26N50 26NF50	DC to 18,000	N Male N Female	50	$450 $450
26N75 26NF75	DC to 4,000	N Male N Female	75	$350 $350

Adapters:
These 50 ohm precision adapters are used for calibration or measurement of non-insertable devices. The 12 Series Matching Pads convert from 50 to 75 ohm impedance.

SWR: 1.1

Adapter Model	Frequency Range (MHz)	Connectors	Price
34NN50A 34NFNF50	DC to 18,000	N Male/N Male N Female/N Female	$150 $200
34NFNF75	DC to 18,000	N Female/N Female	$200
34NN75A	DC to 2,000	N Male/N Male	$175

50/75 Ohm MatchingPads:
The 12B50/75 and 12N50/75 pads are used to match 50 to 75 ohm or 75 to 50 ohm circuits.
Frequency Range: DC to 2,000 MHz
SWR: 1.25
Insertion Loss: 6 dB nominal

Minimum Loss Adapter: The 12N75 converts a 50 ohm output to 75 ohms with less than 3 dB loss.

Matching Pad Model	Connectors	Price
12B50/75	BNC Male (50 ohm) BNC Female (75 ohm)	$250
12N50/75	N Male (50 ohm) N Female (75 ohm)	$250
12N75	N Male/N Male (50 to 75 ohm only)	$300

ACCESSORIES

Extender Cables:
Extender Cables are used to make remote measurements and are placed between the SWR Autotester or detector and the 6400. Cables cause no degradation in performance.

Model	Length	Price
800–109	7.6 m (25 ft)	$50
800–110	15.2 m (50 ft)	$75
800–111	30.4 m (100 ft)	$100
800–112	61 m (200 ft)	$180

RF Extender Cable:
Model 800–195, N Male/N Male connectors, 2.4 m (8 ft) long . $1,030

GPIB Cables:
GPIB cables are used to interconnect instruments on IEEE–488 bus.

Model	Length	Price
2100–5	0.5 m (1.6 ft)	$55
2100–1	1 m (3.3 ft)	$60
2100–2	2 m (6.6 ft)	$75
2100–4	4 m (13.2 ft)	$95

RF Limiters:
RF Limiters are used to protect the 6400 detectors against damage from:
1) DC Voltage—blocks voltage up to 50 Vdc.
2) AC Voltage—filters 60 Hz up to 100 Vac and impulse currents of 500 mA.
3) RF Power—provides protection up to 4W over the 1 to 1500 MHz range.

Model	Connectors	Impedance (Ohms)	Price
1B50	BNC Male/BNC Female	50	$250
1B75		75	$300
1N50	N Male/N Female	50	$250
1N75		75	$300

Open/Shorts:
An Open/Short is used to establish a 0 dB return loss reference during the normalization procedure.

Model	Connectors	Impedance (Ohms)	Price
22BF50	BNC Female	50	$100
22BF75		75	$100
22N50	N Male	50	$150
22N75		75	$175
22NF50	N Female	50	$150
22NF75		75	$175

RF Cables:
Frequency Range: DC to 2000 MHz

Model*	Connectors	Impedance (Ohms)	Price
10B50–1, –2, –3	BNC Male to BNC Male	50	$200
10B75–1, –2, –3			
10BN75–1, –2, –3	N Male to BNC Male	75	$200
10N50–1, –2, –3	N Male to N Male	50	$200
10N75–1, –2, –3		75	$200

* Dash numbers equal length in feet.

Signal Dividers:
Frequency Range: 1 to 2000 MHz

Model	Connectors	Impedance (Ohms)	Price
11B50	BNC Female	50	$250
11B75		75	$250
11N50	N Female	50	$250
11N75		75	$250

External Monitor:
An external monitor is used when a remotely located, 260 mm (10.25 in.) diagonal screen (green phosphor) is required. Outside dimensions are 327 W x 284 H x 310 D mm (12.9 x 11.2 x 12.2 in.)
Part Number 2000–216 . . . . . $300

Ordering Information

6407 RF Analyzer (1 to 1000 MHz) $10,925
6409 RF Analyzer (10 to 2000 MHz) $12,365

Options
Rack Mounting, Option 1: Unit supplied with mounting ears and chassis track slide (90° tilt) installed $405
70 dB Step Attenuator, Option 2 . . . . . $635
GPIB Programmability (IEEE–488), Option 3 . . . . . $520
75 Ohm Output Impedance on 6407, Option 4 . . . . . $85
Front Panel Protective Cover, Option 6 . . . . . $90

Transit Cases
6400 Transit Case, Model 760–75 . . . . . $390
6400 Components and Printer Transit Case, Model 760–74 . $450

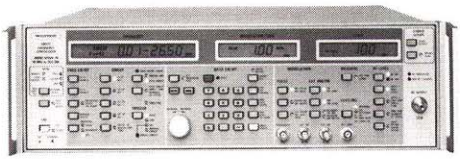
Printer and Printer Accessories
Model 2225C Ink Jet Printer, Option 5: Supplied with Interface Cable, 50 sheets of paper, and one Ink Jet Cartridge. . $795
Interface Cable, Part Number 2225–1 . . . . . $70
Replacement Ink Jet Cartridges (2 each), Part Number 2225–2 . . . . . $50
Fan Fold Ink Jet Paper (2500 sheets), Part Number 2225–3 . $120

Signal Sources

General Information

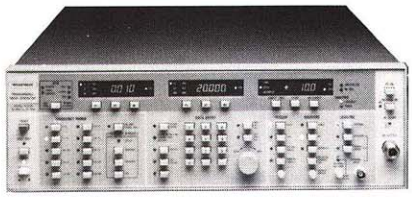
Plug-In Sweep Generator
Model 610D

NEW



Swept Frequency Synthesizer
Model 6700A

NEW



Programmable Sweep Generator
Model 6600B

Signal Source Introduction

Microwave signal sources have traditionally been divided into three categories: sweep generators, signal generators, and synthesizers. Originally synthesizers were intended for producing precisely accurate frequencies, while signal generators specialized in modulation capability, high signal purity, low leakage, and precise output levels. And originally, sweep generators supplied a swept frequency output for frequency response testing.

Advances in microwave source technology over the last several years have reduced the cost of frequency synthesis. At the same time, synthesizers have taken on some of the features of both signal generators and sweep generators. Wiltron's 6700A Series Swept Frequency Synthesizers are the first to include every feature commonly associated with sweepers *and* signal generators. In addition, they are available in both narrowband and broadband models, so that you only pay for the frequency coverage you need. This is all at a price not significantly above that of a microwave sweeper.

Fundamental Oscillators

There are two approaches to microwave frequency generation: 1) the use of fundamental oscillators and 2) the use of circuits that multiply signals. Wiltron uses in all of its products fundamental oscillators over the 2 to 26.5 GHz range. This approach provides better signal purity, free of all subharmonics that produce significant measurement errors. The other leading manufacturer of synthesizers employs the multiplier approach with subharmonic levels as high as –25 dBc. With fundamental oscillators, Wiltron can offer narrow-band and broadband sources. You select the precise frequency range you desire, thereby reducing your test equipment costs.

All Wiltron fundamental oscillators are YIG (yttrium-iron-garnet) tuned and use bipolar or GaAs FET as their active devices. YIG-tuned oscillators have superior linearity, broader bandwidth, and better spectral purity than other types of sources.

Wiltron manufactures most of its own YIG oscillators. The inherent high reliability of the Wiltron processes allows the company to warrant all YIG-tuned oscillators for two years. This is assurance that your Wiltron signal source is a quality product—one that will give you years of trouble-free service.

A Carefully Planned Approach

Wiltron offers three microwave sources: the 6600B Programmable Sweep Generators, 6700A Swept Frequency Synthesizers, and 610D Plug-In Sweep Generators with the 6100D Series Single-Band and the 6200D Series Multiband Plug-Ins. The last two digits in the model number identify the frequency range and are similar for all product lines. The tables on the next page summarize the frequency range offerings within the three families.

Sources for Wiltron Network Analyzers

Wiltron signal sources are ideal companions to the many Wiltron scalar and vector network analyzers. The 561 Scalar Network Analyzer, when combined with either the 6600B Sweep Generator or 6700A Swept Frequency Synthesizer, makes a particularly attractive automated measurement system. A dedicated digital bus between the two units gives the network analyzer full frequency and power information to annotate both the CRT display and the hard-copy data.

A dedicated family of sources, the 360SS Series, was designed specifically for the Wiltron 360 Vector Network Analyzer. These sources are less expensive than the corresponding 6600B Series and are optimized for use with the 360. Since the 360SS Series is used only with the 360, from which all parameters are selected, the 360SS units have blank front panels. Because the 360 itself phase locks the signal source to the correct crystal-controlled frequency, a synthesizer is not required. If desired, the 360 will operate as described above with the 6600B or 6700A Series.

The 6600B Programmable Sweep Generators

Thirty-nine models cover the 10 MHz to 60 GHz range. The industry's broadest continuous frequency coverage—10 MHz to 40 GHz at 5 mW output power—is unique with the Model 6669B. This broadband coverage is made possible through Wiltron's development of the widely accepted K Connector with its SMA and APC-3.5 compatibility and up to 46 GHz range. Extremely broadband coaxial systems can now be designed and production tested using these connectors.

The 6600B family meets the most stringent narrow-band test requirements as well. Single-band units are available from 10 MHz to 60 GHz and are especially well suited to design and production testing of narrow-band devices, such as those in telecommunications systems. With output power levels as high as 50 mW, the 6600B units can be directly substituted for local oscillators in mixer and receiver test setups or used as drivers for high power TWT amplifiers.

All 6600B models, whether broadband or narrow-band, have excellent spectral purity with harmonics typically less than –40 dBc and spurious less than –60 dBc. The 6600B family is light weight, typically 16 kg (35.4 lbs); therefore it is ideally suited to field, antenna, and shipboard use. Features include eight frequency markers, an alternate sweep for simultaneous narrow-band and broadband testing, and an alternate power sweep for amplifier compression and mixer saturation measurements. Nine stored setups reduce production set-up time, and an optional full-capability GPIB interface makes the 6600B ideal for automated test (ATE) systems.

The 610D Plug-In Sweep Generators

The 610D and its broad range of single and multiband plug-ins is ideal as an economical sweeper for benchtop testing. Narrow-band plug-ins are available from 100 kHz to 40 GHz. One broadband plug-in spans 10 MHz to 18.5 GHz. A unique front option panel eases the installation of standard options, such as harmonics markers for precise frequency identification, multiple variable frequency markers, preset sweep ranges, or a built-in crystal detector.

The 6700A Swept Frequency Synthesizer

The 6700A family combines all the features of synthesizers, sweep generators, and signal generators in a truly universal microwave signal source. Full capability AM, FM, and pulse modulation makes testing of communications and radar systems straightforward. The 6700A even contains a standard internal pulse generator, eliminating the need for an external pulse generator. Pulse rise and fall time of the modulated signal is less than 10 ns, thus ensuring excellent pulse fidelity.

You can also eliminate an external power meter. The 6700A has its own built-in power meter that uses the 560-7 Series Detectors with bandwidths as wide as 10 MHz to 40 GHz.

Measurements made using the 6700A will be accurate since unwanted spurious and harmonic signals are virtually eliminated. Through the 2 to 26.5 GHz range, both harmonics and spurious signals are less than –60 dBc, and there are *no* subharmonics. Single sideband noise is minimized through careful phase-lock-loop design which produces 1 kHz frequency resolution (2 kHz above 26.5 GHz) and fast frequency switching, typically 15 ms.

The superb mechanical packaging design of the 6700A ensures EMI performance meeting Mil-Std-461B. In fact, during EMI qualification tests, technicians were surprised to find that they could detect no radiated emissions. Leakage from the 6700A was below the sensitivity of their measuring receivers. You can be sure that the 6700A won't interfere with sensitive receivers in your ATE system. Furthermore, the RF deck tilts out for easy servicing, and the weight of the unit is only 25 kg (55 lbs), compared to 42.4 kg (94 lbs) for competitive units.

6700A Swept Frequency Synthesizers
Page 46

Model	Range (GHz)	Output Power mW[1] (Minimum)
6709A	0.01–2	10
6709A-40	0.01–2	40
6717A	0.01–8.4	10
6717A-20	0.01–2	20
6722A	0.01–12.4	10
6722A-20	0.01–12.4	20
6747A	0.01–20	10
6747A-20	0.01–20	20
6759A	0.01–26.5	10
6769A[2]	0.01–40	5
6719A	2–8.4	20
6721A	2–12.4	10
6721A-20	2–12.4	20
6737A	2–20	10
6737A-20	2–20	20
6753A	2–26.5	3
6753A-10	2–26.5	10
6763A[2]	2–40	5
6728A	8–12.4	20
6728A-40	8–12.4	40
6729A	8–20	10
6729A-20	8–20	20
6730A	12.4–20	20
6730A-40	12.4–20	40
6736A	18–26.5	5
6742A[3]	18–40	5
6740A	26.5–40	10

[1] Without optional attenuator.
[2] Scheduled for later introduction.
[3] Dual outputs: 18 to 26.5 GHz and 26.5 to 40 GHz.

6600B Programmable Sweep Generators
Page 53

Model	Range (GHz)	Output Power mW (Minimum)
6609B	0.01–2	20
6609B-50	0.01–2	50
6617B	0.01–8	10
6617B-40	0.01–8	40
6645B	0.01–18	10
6645B-40	0.01–18	40
6647B	0.01–20	10
6647B-40	0.01–20	40
6659B	0.01–26.5	5
6668B	0.01–40	4
6669B	0.01–40	4
6619B	2–8	10
6619-40B	2–8	40
6621B	2–12.4	10
6621B-40	2–12.4	40
6635B	2–18	10
6635B-40	2–18	40
6637B	2–20	10
6637B-40	2–20	40
6653B	2–26.5	5
6662B	2–40	4
6663B	2–40	4
6610B	1–2	20
6616B	1.7–4.3	10
6620B	3.6–6.5	20
6624B	4–8	10
6627B	5.9–9	10
6628B	8–12.4	10
6628B-50	8–12.4	50
6629B	8–20	10
6629B-40	8–20	40
6631B	10–15.5	10
6630B	12.4–20	10
6630B-50	12.4–20	50
6660B	12.4–40	4
6632B	17–22	5
6636B	18–26.5	3
6640B	26.5–40	5
6672B	40–60	1

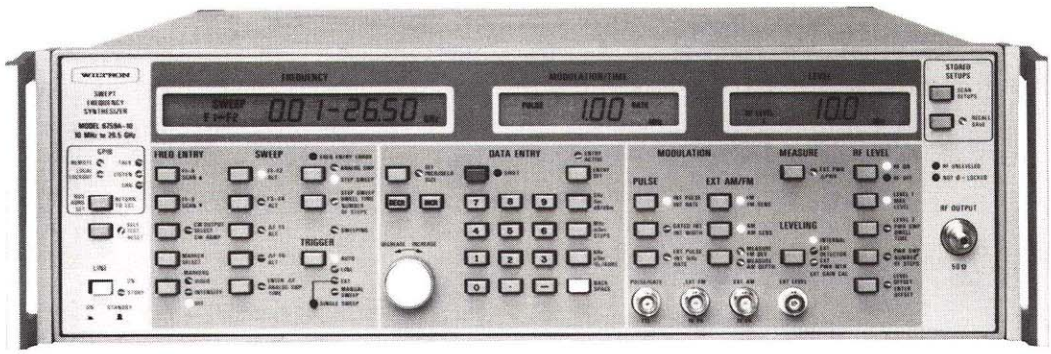
610D Sweep Generators Plug-Ins
Page 60

Model	Range	Output Power mW (Minimum)
Multiband		
6221D	2–12.4 GHz	5
6221D-10	2–12.4 GHz	10
6225D	4–18.5 GHz	5
6225D-10	4–18.5 GHz	10
6237D	2–18.5 GHz	5
6237D-10	2–18.5 GHz	10
6237D-15	2–18.5 GHz	15
6247D	0.01–18.5 GHz	5
6247D-10	0.01–18.5 GHz	10
Dual Band		
6213D	0.01–4.2 GHz	10
6215D	1–4 GHz	20
6219D	2–8 GHz	10
6223D	4–12.4 GHz	10
6229D	7.9–18.5 GHz	10
Single Band		
6104C	0.1–110 MHz	20
61084D	1–1500 MHz	10
6109D	0.01–2 GHz	20
6110D	1–2 GHz	20
6112D	1.4–2.5 GHz	20
6114D	2–4 GHz	20
6116D	1–2 GHz	20
6112D	1.7–4.3 GHz	10
6120D	3.6–6.5 GHz	20
6124D	4–8 GHz	10
6126D	3.7–8.3 GHz	10
6127D	5.9–9 GHz	10
6128D	7.9–12.4 GHz	10
6130D	10–15.5 GHz	10
6131D	0.01–2 GHz	20
6132D	17–22 GHz	5
6136D-1	18–26.5 GHz	3
6140D-1	26.5–40 GHz	1

Swept Frequency Synthesizers

6700A Series, 10 MHz to 40 GHz

NEW



6700A Swept Frequency Synthesizer Highlights

- 25 ms Switching Speed Over Any Frequency Step Size
- 20 mW Output Power Up to 20 GHz
- 1 kHz Resolution up to 26.5 GHz
- Built-In Power Measuring Capability
- Simultaneous FM, AM, and Pulse Modulation, Including a Built-In Pulse Generator
- Continuous Analog Sweep *and* Phase-Locked Step Sweep Capability

Performance and Versatility

The Wiltron 6700A Series covers the 10 MHz to 40 GHz range with 28 models, one of which spans the full range. The series offers many features: 25 ms frequency switching speeds over any step size, up to 20 mW output to 20 GHz (10 mW to 40 GHz), 1 kHz resolution up to 26.5 GHz, wideband FM, ac- and dc-coupled AM, and pulse modulation with an internal high-performance pulse generator. In every aspect of synthesizer performance—accuracy, stability, signal purity, close-in phase noise, EMI, modulation—this series is exceptional. To add further to its value, the 6700A includes a continuous analog sweep capability, as well as a phase-locked step sweep.

Clean Signals

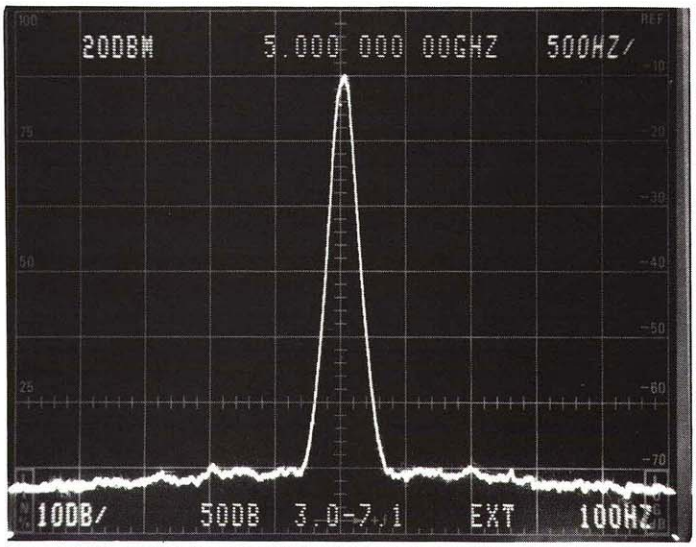
The 6700A uses fundamental YIG-tuned oscillators from 2 to 26.5 GHz because they produce the cleanest signals. Completely free of the error-producing subharmonics of frequency multipliers, these signals can be applied to your test device with confidence that the test data will be accurate. Harmonic and spurious are less than –60 dBc from 2 to 26.5 GHz.

The phase-locked stability and low phase noise of the 6700A make it an ideal signal source for simulation and test of narrow-band devices and communications systems. Noise characteristics compare very favorably with those of much more expensive, less versatile instruments.

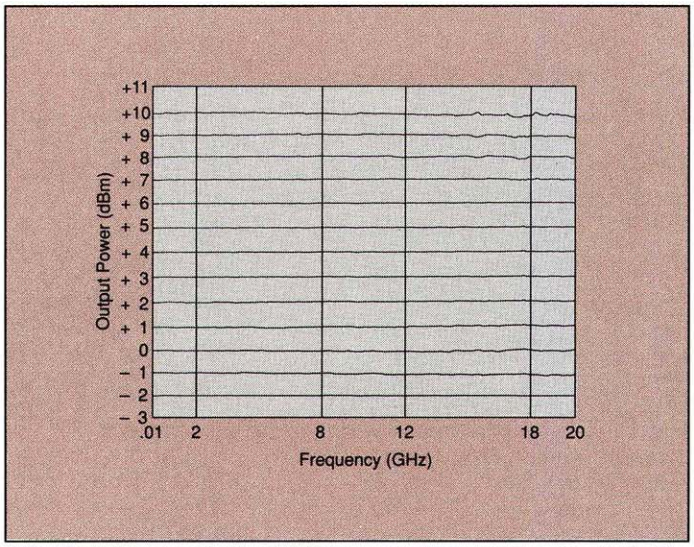
Broadest Selection

Model	Range	Output Power[1] (Minimum)
6709A	10 MHz to 2 GHz	10 mW
6709A–40	10 MHz to 2 GHz	40 mW
6717A	10 MHz to 8.4 GHz	10 mW
6717A–20	10 MHz to 8.4 GHz	20 mW
6722A	10 MHz to 12.4 GHz	10 mW
6722A–20	10 MHz to 12.4 GHz	20 mW
6747A	10 MHz to 20 GHz	10 mW
6747A–20	10 MHz to 20 GHz	20 mW
6759A	10 MHz to 26.5 GHz	3 mW
6759A–10	10 MHz to 26.5 GHz	10 mW
6769A[2]	10 MHz to 40 GHz	5 mW
6719A	2 to 8.4 GHz	20 mW
6721A	2 to 12.4 GHz	10 mW
6721A–20	2 to 12.4 GHz	20 mW
6737A	2 to 20 GHz	10 mW
6737A–20	2 to 20 GHz	20 mW
6753A	2 to 26.5 GHz	3 mW
6753A–10	2 to 26.5 GHz	10 mW
6763A[2]	2 to 40 GHz	5 mW
6728A	8 to 12.4 GHz	20 mW
6728A–40	8 to 12.4 GHz	40 mW
6729A	8 to 20 GHz	10 mW
6729A–20	8 to 20 GHz	20 mW
6730A	12.4 to 20 GHz	20 mW
6730A–40	12.4 to 20 GHz	40 mW
6736A	18 to 26.5 GHz	5 mW
6742A[3]	18 to 40 GHz	5 mW
6740A	26.5 to 40 GHz	10 mW

[1] Without optional attenuator.
[2] Scheduled for later introduction.
[3] Dual outputs: 18 to 26.5 GHz and 26.5 to 40 GHz



Typical 5 GHz signal shows low SSB noise and absence of spurious signals.



In the Power Sweep mode, the 6700A can sweep frequency at each power level, simplifying gain compression measurements.

Built-In Pulse Generator

Because pulse performance is often critical in synthesizer applications, every model includes as standard equipment an internal pulse generator and modulator. Specifications include an on/off ratio of 80 dB below 20 GHz, 70 dB above, and a rise time of less than 10 ns. The internal pulse generator provides repetition rates from 10 Hz to 1 MHz and pulse widths of 25 ns to 99 ms, both parameters being crystal derived.

For additional pulse modulation capability, you can apply externally generated pulses to the 6700A. The pulse width range then becomes 10 ns to CW at repetition rates from 10 Hz to 10 MHz. Furthermore, an applied TTL signal can be used to gate the internal generator to produce pulse bursts. This pulse burst capability, combined with the 6700A's programmable frequency hopping, saves time and simplifies tests in complex radar simulation applications.

Wide Dynamic Range

With a greater than 100 dB dynamic range, the 6700A eliminates the need for external attenuators when testing filters, attenuators, tuners, isolators, mixers, and receivers. For your convenience, power levels can be selected on the keypad, control knob, Increase/Decrease key, or GPIB—all with 0.01 dB resolution.

AM, FM, and Pulse Modulation.

The 6700A produces simultaneous AM, FM, and pulse modulation. Sensitivity levels for FM and AM input signals are adjustable and calibrated so that modulation values may be read directly from an LCD display. For AM, the modulation range is 0 to 90% at rates of dc to 50 kHz. For FM, the deviation range is up to 20 times the modulation rate from 100 Hz to 250 kHz. In addition, an "unlocked FM" mode can be enabled from the front panel for deviation up to ±25 MHz and modulation rates down to dc. The modulation versatility of the 6700A allows you to use this single instrument in almost all applications.

Step Sweep and Analog Sweep

The 6700A has two sweep modes. The first is the step sweep which consists of up to 1000 synthesized steps, spaced by as little as 1 kHz. The dwell time per step can be adjusted to allow an adequate settling time for the test device or other instruments.

The second sweep mode is a true analog sweep with frequency accuracy that is at least tenfold better than that of a conventional sweep generator. Because the start/stop and bandswitching frequencies are phase-lock-corrected during each sweep, the analog sweep is drift-free and repeatable.

Frequency parameters for four sweep ranges (F1–F2, F3–F4, ΔF F5, ΔF F6) in the step or analog sweep can be stored and recalled as needed to save set-up time and simplify measurements.

Alternate Sweep

In the Alternate Sweep mode, you sweep alternately between any two of the F1–F2, F3–F4, ΔF F5, and ΔF F6 ranges. You improve productivity by measuring filter rejection outside the passband while simultaneously viewing response within the passband.

Power Sweep

The Power Sweep might be considered a third sweep mode. In this mode, the output power can be automatically stepped over your selected range. In addition a frequency sweep can be made at each power level, thereby generating a family of curves which greatly simplify gain compression measurements.

Nine Markers

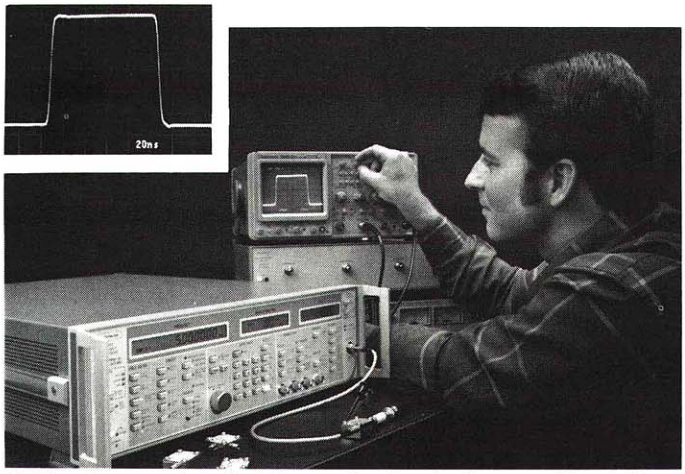
In both the step and analog sweep modes, you have nine markers for precise frequency identification. These can be saved with other sweep parameters for recall, reducing set-up time when changing from one test device to another.

Integral Power Meter

The built-in power meter eliminates the expense and inconvenience of an external power meter. By connecting one of the Wiltron detectors listed on page 52, you measure over the +16 dBm to –35 dBm range from 10 MHz to 40 GHz. For remote power measurements, extension cables up to 61 m (200 ft) long can be used with negligible effect on accuracy.

Swept Frequency Synthesizers (Cont.)

6700A Series



Built-in pulse generator typically has less than 5 ns rise time over a 25 ns to 99 ms pulse width range.

High Fidelity Radar Simulation

The 6700A generates pulsed signals in three ways:

- 1) By controlling the built-in pulse modulator with the internal pulse generator, you avoid the inconvenience and expense of an external pulse generator.
- 2) By externally "gating" the internal pulse generator, you can easily create complex pulse bursts.
- 3) By externally controlling the internal pulse generator/modulator, you obtain high pulse fidelity with no droop, minimal overshoot, video feedthrough of less than ±5 mVpk, and constant peak power with changing pulse widths.

Accurate rotating antenna simulation is achieved with 0 to 90% modulation depths, ac- or dc-coupled AM, fast frequency agility, and amplitude-modulated pulse envelopes.

Doppler simulation is enhanced with phase-locked and unlocked, dc-coupled FM.

Receiver Measurement Capability

The growing demand for greater sensitivity and selectivity in EW/ECM, navigation, and communication receivers can be fulfilled only with performance like that of the 6700A. Exceptional EMI and RFI shielding takes the guesswork out of low signal level tests. The broad frequency range of this one instrument permits measurements at all receiver frequencies—from baseband to microwave. Virtually every receiver characteristic can be measured with ease: sensitivity, selectivity, discriminator alignment, audio noise and distortion, AM reflection, intermodulation, distortion, SINAD, audio hum, and AGC response.

Wiltron Quality Components

When you consider overall measurement accuracy, the 6700A is superb. Wiltron fundamental oscillators avoid the errors introduced by the subharmonics of multiplier-type oscillators. Wiltron-designed PIN switches hold harmonic levels to better than –60 dBc above 2 GHz, while spurious are typically less than –70 dBc.

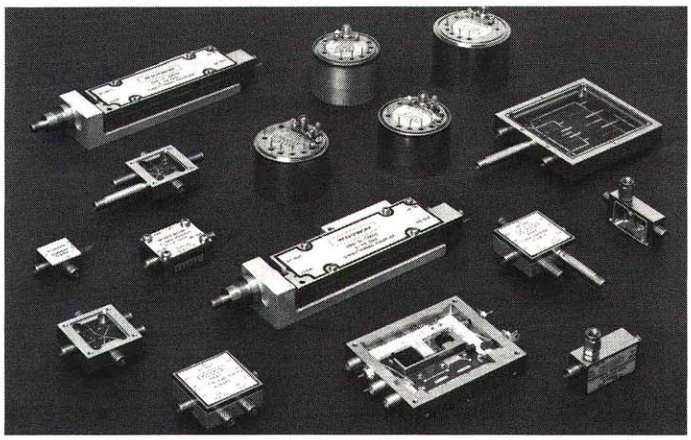
Source match is better than 13 dB return loss (1.6 SWR), a result of the excellent directivity of the Wiltron-designed leveling loop coupler. The addition of external components to improve match is unnecessary.

Also contributing to accuracy is the diode detector in the leveling loop. This component, also Wiltron designed, is digitally calibrated to compensate for variations in the temperature response and linearity. The result is a more accurate RF level.

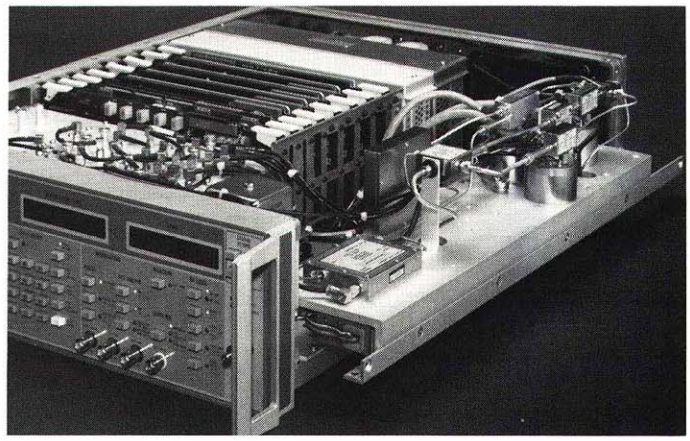
Serviceability

An inside view of the 6700A provides convincing evidence of the care given to making it serviceable. For instance, a major competitor has 109 potentiometer adjustments in its 26.5 GHz synthesizer. The 6700A has 10! Precision voltage regulators and microprocessor-controlled, digital-to-analog converters are used throughout to eliminate manual adjustments, to improve stability and reliability, and to reduce calibration time. Major functions can be tested and recalibrated from the front panel without an external controller. Internal firmware makes it easy.

To enhance serviceability further, circuitry is divided into readily accessible modules, including one each for the entire front and rear panels. A tilt-out RF deck exposes all microwave components for easy inspection or replacement. Access to the components while the instrument is in operation contributes to efficient troubleshooting.



Precision components manufactured in the Wiltron microelectronics facility contribute greatly to the exceptional performance of the 6700A.



Tilt-out microwave deck exposes all high-frequency components and cabling.

Specifications

FREQUENCY

Range	Model	Output Power[1]
10 MHz to 40 GHz	6769A[2]	+10 dBm, ≤20 GHz +5 dBm, >20 GHz
2 to 40 GHz	6763A[2]	+10 dBm, ≤20 GHz +5 dBm, >20 GHz
18 to 40 GHz	6742A[3]	+7 dBm
26.5 to 40 GHz	6740A	+10 dBm
10 MHz to 26.5 GHz	6759A	+10 dBm, ≤20 GHz +5 dBm, >20 GHz
10 MHz to 26.5 GHz	6759A–10	+10 dBm
2 to 26.5 GHz	6753A	+10 dBm, ≤20 GHz +5 dBm, >20 GHz
2 to 26.5 GHz	6753A–10	+10 dBm
18 to 26.5 GHz	6736A	+7 dBm
10 MHz to 20 GHz	6747A	+10 dBm
10 MHz to 20 GHz	6747A–20	+13 dBm
2 to 20 GHz	6737A	+10 dBm
2 to 20 GHz	6737A–20	+13 dBm
8 to 20 GHz	6729A	+10 dBm
8 to 20 GHz	6729A–20	+13 dBm
12.4 to 20 GHz	6730A	+13 dBm
12.4 to 20 GHz	6730A–40	+16 dBm
10 MHz to 12.4 GHz	6722A	+10 dBm
10 MHz to 12.4 GHz	6722A–20	+13 dBm
2 to 12.4 GHz	6721A	+10 dBm
2 to 12.4 GHz	6721A–20	+13 dBm
8 to 12.4 GHz	6728A	+13 dBm
8 to 12.4 GHz	6728A–40	+16 dBm
10 MHz to 8.4 GHz	6717A	+10 dBm
10 MHz to 8.4 GHz	6717A–20	+13 dBm
2 to 8.4 GHz	6719A	+13 dBm
10 MHz to 2 GHz	6709A	+10 dBm
10 MHz to 2 GHz	6709A–40	+16 dBm

[1] Optional attenuator reduces rated power by 3 dB.
[2] Scheduled for later introduction
[3] Dual outputs: 18 to 26.5 GHz and 26.5 to 40 GHz

CW MODE

Output: Nine independent, presettable CW frequencies.
Accuracy: Same as internal or external time base.
Internal 10 MHz Time Base Stability:
With Aging: $<1 \times 10^{-9}$/day
With Temperature: $<\pm 5 \times 10^{-9}$ over 0° to +55°C range.
Resolution: 1 kHz at ≤26.5 GHz
2 kHz at >26.5 to 40 GHz
10 MHz Reference Output: 2 Vp–p typical into 50Ω. AC coupled. BNC, rear panel, 50Ω impedance.
External 10 MHz Reference Input: Accepts external 10 MHz ±100 Hz, 0 to +10 dBm time base signal. Automatically disconnects internal time base. BNC, rear panel, 50Ω impedance.
High Resolution Input: Accepts 20–32.1 MHz external synthesizer signal to improve resolution to equal that of external instrument. BNC, rear panel, 50Ω impedance, 0 dBm.
Switching Time (for any step size): <15 ms typical, 25 ms max. to within 1 kHz.
Lock Output: Provides TTL-high signal when frequency is phase locked.

SWEEP MODES

Analog Sweep
F1–F2, F3–F4, ΔF F5, and ΔF F6 Sweep Width: Independently selected, 1 MHz to full range continuous sweep. For >50 MHz sweep width, start/stop and bandswitching frequencies are phase-lock-corrected during every sweep. For ≤50 MHz width, the center frequency is phase-lock-corrected.
Accuracy: The lesser of ±30 MHz or ±(2 MHz + 0.25% of sweep width) for sweep speeds of ≤50 GHz/s
Resolution: 1 MHz
Sweep Time Range: 30 ms to 99 s

Phase-Locked Step Sweep
F1–F2, F3–F4, ΔF F5, and ΔF F6 Sweep Width: Independently selected, 1 kHz to full range. Every frequency step in sweep range is phase locked.
Accuracy: Same as internal or external time base.
Resolution: Minimum step size is 1 kHz at ≤26.5 GHz
2 kHz at >26.5 to 40 GHz
Number of Steps: Variable from 1 to 1000
Dwell Time Per Step: Variable from 1 ms to 99 s
Switching Time (for any step size): <15 ms typical, 25 ms max. to within 1 kHz.

Alternate Sweep
Sweeps alternately in analog or step sweep between any two of the sweep ranges: F1–F2, F3–F4, ΔF F5, and ΔF F6.

Manual Sweep: Provides stepped, phase-locked adjustment of frequencies between sweep limits.

Programmable Frequency Agility
Under GPIB control, up to 512 nonsequential frequencies can be stored and then addressed as a phase-locked step sweep.
Switching Time (for any step size): <15 ms typical, 25 ms max. to within 1 kHz.

Markers: Up to nine independent, presettable markers.
Video: TTL high during marker. BNC, rear panel.
Intensity (analog sweep only): Intensified dot on trace. Obtained by momentary dwell in sweep.
Accuracy: Same as sweep frequency accuracy.
Resolution (Step Sweep): 1 kHz at ≤26.5 GHz
2 kHz at >26.5 to 40 GHz
Resolution (Analog Sweep): 1 MHz or sweep width divided by 4096, whichever is greater.

Sweep Triggering:
Auto: Triggers sweep automatically.
Line: Triggers sweep from power line frequency.
External: Accepts TTL-high signal of >1 µs width to trigger, abort, or reset analog sweep. BNC, rear panel.
Single: Triggers, aborts, and resets a single sweep. Front-panel pushbutton.

Sweep Dwell Input: Accepts TTL-low signal to stop sweep. Sweep continues when signal is removed. BNC, rear panel.
Horizontal Sweep Output: Provides 0V at beginning to 10V at end of sweep for all sweep modes, regardless of sweep width. In CW mode, voltage is proportional to frequency between 0V at low end and 10V at high end of range. In CW mode, CW RAMP provides a repetitive, 30 ms, 0V to 10V ramp. BNC, rear panel.
V/GHz Output: Rear panel switch selects 0.5 V/GHz or 1 V/GHz up to 20V maximum. BNC, rear panel.
Bandswitch Blanking Output: Rear panel switch selects +5V or –5V signal coincident with bandswitching points. BNC, rear panel.
Retrace Blanking Output: Rear panel switch selects +5V or –5V output signal coincident with sweep retrace. AUX I/O Cannon 25 pin D style, rear panel.
Pen Lift Output: Rear panel switch selects normally open or normally closed internal relay contacts during sweep retrace. BNC, rear panel.
Sequential Sync Output: Provides TTL-high signal during retrace and at bandswitching points for interface to network analyzers, –5V during marker, and –10V during selected marker. BNC, rear panel.

Swept Frequency Synthesizers (Cont.)

6700A Series

SPECTRAL PURITY

All specifications apply to the phase-locked CW and Step Sweep Modes.

Spurious Signals:

Subharmonics: ≤26.5 GHz: None
>26.5 to 40 GHz: −20 dBc

Harmonics: ≤2 GHz: −30 dBc (−20 dBc for 6709A–40, 6717A–40, and 6747A–20)
>2 to ≤26.5 GHz: −60 dBc
>26.5 to 40 GHz: −20 dBc

Nonharmonics: ≤2 GHz: −40 dBc
>2 GHz: −60 dBc, typically −70 dBc

Single-Sideband Phase Noise (dBc, CW mode, typical):

Range (GHz)	Offset From Carrier				
	30 Hz	100 Hz	1 kHz	10 kHz	100 kHz
0.01 to 2	−69	−78	−80	−84	−107
>2 to 8	−66	−71	−73	−76	−100
>8 to 12.4	−64	−68	−70	−73	−107
>12.4 to 20	−60	−63	−67	−74	−105
>20 to 26.5	−55	−61	−64	−69	−102
>26.5 to 40	−54	−57	−61	−68	−99

Power Line and Fan Rotation Spurious (dBc, CW mode, typical):

Range (GHz)	Offset From Carrier		
	<300 Hz	300 Hz to 1 kHz	>1 kHz
0.01 to 8	−50	−60	−65
>8 to 12.4	−46	−53	−58
>12.4 to 20	−41	−48	−53
>20 to 26.5	−40	−47	−52
>26.5 to 40	−35	−42	−47

Residual FM (CW mode, 50 Hz–15 kHz BW, typical):

Frequency Range (GHz)	Residual FM (Hz RMS)
0.01 to 2	80
>2 to 8	90
>8 to 12.4	190
>12.4 to 20	240
>20 to 26.5	280
>26.5 to 40	480

Residual FM (analog sweep, 50 Hz–15 kHz BW):

Frequency Range (GHz)	Residual FM (kHz RMS)
0.01 to 8	5
>8 to 12.4	7
>12.4 to 20	10
>20 to 26.5	15
>26.5 to 40	30

RF OUTPUT

Power level specifications apply at 25°C ±10°. Please see page 49 for power ratings.

Leveled Output Power Range:

Without Attenuator: 12 dB

With Option 2A, 110 dB Attenuator for Models with Maximum Frequency of ≤12.4 GHz: 122 dB

With Option 2B, 90 dB Attenuator for Models with Maximum Frequency of >12.4 GHz and ≤ 26.5GHz: 102 dB

Attenuator Insertion Loss: Reduces rated power by 3 dB max.

Output Power Entry Resolution: 0.01 dB

Output Power Display Resolution: 0.1 dB

Output Power Accuracy and Flatness:

Step Sweep and CW Modes:

Attenuation Below Maximum Power	Frequency		
	0.01 to 20 GHz	>20 to 26.5 GHz	>26.5 to 40 GHz
Accuracy*			
0 to 12 dB	±0.6 dB	±0.6 dB	±0.8 dB
0 to 30 dB**	±1.4 dB	±1.6 dB	N/A
30 to 60 dB**	±2.6 dB	±2.6 dB	N/A
>60 dB**	±3.1 dB	±5.0 dB	N/A
Flatness			
0 to 12 dB	±0.4 dB	±0.4 dB	±0.6 dB
0 to 30 dB**	±0.8 dB	±1.0 dB	N/A
30 to 60 dB**	±2.0 dB	±2.0 dB	N/A
>60 dB**	±2.5 dB	±3.0 dB	N/A

* Includes flatness variations ** For models with attenuator.

Analog Sweep Modes (typical):

Attenuation Below Maximum Power	Frequency		
	0.01 to 20 GHz	>20 to 26.5 GHz	>26.5 to 40 GHz
Accuracy*			
0 to 12 dB	±1.0 dB	±1.5 dB	±2.0 dB
0 to 30 dB**	±3.5 dB	±3.6 dB	N/A
>30 to 60 dB**	±4.0 dB	±4.2 dB	N/A
>60 dB**	±5.0 dB	±5.2 dB	N/A
Flatness			
0 to 12 dB	±1.0 dB	±1.5 dB	±2.0 dB
0 to 30 dB**	±3.0 dB	±3.1 dB	N/A
>30 to 60 dB**	±3.5 dB	±3.6 dB	N/A
>60 dB**	±4.0 dB	±4.2 dB	N/A

* Includes flatness variations. ** For models without attenuator.

Power Level Stability with Temperature: Typically 0.02 dB/°C

Power Level Switching Time (to within specified accuracy):

Without Change in Step Attenuator (pulse off): <50 µs

With Change in Step Attenuator (pulse off): <20 ms

Source Impedance: 50Ω

Source SWR (internal leveling):

Without Attenuator: <1.7 at <2 GHz
<1.6 at 2 to 20 GHz
<2.0 at >20 GHz

With Attenuator: <2 typical

Level Offset: Offsets displayed power level to establish a new reference level.

RF On/Off Between Frequency Steps: Rear panel switch selects RF On or Off during frequency switching in CW or step sweep mode.

Retrace RF On/Off: Rear panel switch selects RF On or Off during retrace.

RF Off: With RF control in Off position, oscillators are turned fully off.

Internal Leveling: Power is leveled at output connector in all modes.

External Leveling:

External Detector: Levels power at remote detector location. Front-panel BNC connector, positive or negative 0.5 mV to 500 mV. EXT GAIN CAL adjusts input gain to optimum value.

External Power Meter: Levels output power at remote power sensor location. Front panel BNC connector, ±1V full scale EXT GAIN CAL adjusts input gain to optimum value.

External Leveling Bandwidth (pulse off): >30 kHz typical in Detector mode, >0.7 Hz typical in Power Meter mode.

Unleveled Indicator: Lights when output power is unleveled.

POWER SWEEP

Range: Sweeps between any two power levels.

Resolution: 0.01 dB/step

Accuracy: Same as output accuracy.

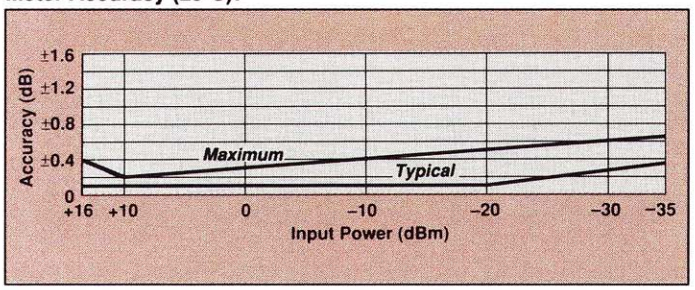
Number of Steps: Variable from 1 to 1000
Dwell Time per Step: Variable from 50 ms to 10 s

POWER METER

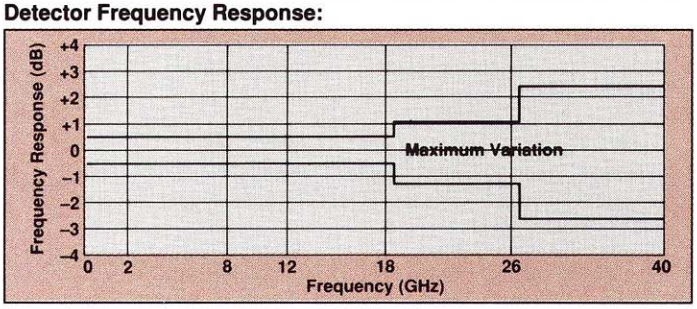
Built-In Power Meter Range: +16 dBm to –35 dBm. Compatible with Wiltron 560–7 or 6400–71 Series Detectors. Rear panel input.
Built-In Power Meter Accuracy:

Power Measurement Accuracy = **Meter Accuracy** + **Detector Frequency**

Meter Accuracy (25°C):



Detector Frequency Response:



MODULATION

AM, FM, and pulse modulation can be applied simultaneously.

PULSE MODULATION

On/Off Ratio: >80 dB at ≤20 GHz
>70 dB at >20 to 40 GHz
Pulse Rise and Fall Time: <5 ns typical, 10 ns max.
Pulse Overshoot and Ringing: <10% typical
Pulse Width Compression: ±5 ns max.
Video Feedthrough: <±2 mVpk typical, ±5 mVpk max.

Accuracy of Peak Pulse Power (relative to CW level, 100 Hz ≤PRF ≤1 MHz):

Pulse Width	<2 GHz	≥2 GHz
< 100 ns	*	*
100 ns to < 200 ns	*	± 1.5 dB
200 ns to < 500 ns	*	± 1.5 dB
500 ns to < 1 µs	± 1.2 dB	± 0.8 dB
1 µs to <2 µs	± 0.9 dB	± 0.5 dB
2 µs to < 5 µs	± 0.6 dB	± 0.3 dB
≥ 5 µs	± 0.3 dB	± 0.3 dB

* RF power is controllable, but not automatically leveled for very narrow pulses.

Internal Pulse Generator:
Pulse Width Range: 25 ns to 99.9 ms
Pulse Width Control Resolution: 25 ns at up to 100 µs width
1 µs at >100 µs to 1 ms width
10 µs at >1 to 10 ms width
100 µs at >10 to 99.9 ms width
Note: Specified resolution may exceed the 3-digit display resolution.

Pulse Width Accuracy: ±10 ns typical
Pulse Repetition Rate: 10 Hz to 1 MHz
Gate Width Range: 100 ns to infinity.
Pulse Input: Rear panel switch selects TTL-high or -low signal for triggering or gating internal pulse generator. BNC, rear panel.
Pulse Sync Output: TTL-high signal, 100 ns minimum pulse width, preceding RF pulse by 100 ns. BNC, rear panel.

External Pulse Input:
Pulse Width Range: 10 ns to CW
Repetition Rate: 10 Hz to 10 MHz
Delay Time: 50 ns typical

AMPLITUDE MODULATION

Specifications are measured at 1 kHz rate, 30% AM depth, with internally leveled RF at 4 dB below maximum rated output, unless otherwise noted.
AM Input: Rear panel switch selects ac or dc coupling. BNC, front and rear panel, 600Ω impedance.
Sensitivity: 1%/V to 100%/V, selectable.
Sensitivity Accuracy: ±10% of displayed value ±1% AM plus AM flatness.
Depth: 0–90% typical with RF level at 6 dB below maximum rated output.
AM Depth Metering Accuracy: Same as Sensitivity Accuracy.
AM Bandwidth (3 dB, pulse off): DC to 50 kHz or 50 Hz to 50 kHz, selectable.
AM Bandwidth with Pulse Modulation (typical):
>10 kHz for pulse widths of ≥16 µs
>10 kHz times the duty factor for pulse widths of <16 µs
Flatness (relative to 1 kHz rate, pulse off): ±0.3 dB from dc to 10 kHz
Distortion: <5% typical.
Incidental Phase Modulation (100 Hz–10 kHz modulation rates): <0.4 radians, typical.
Incidental FM: Incidental phase modulation times modulation frequency.

FREQUENCY MODULATION

FM Input: ±1 Vpk provides full range frequency deviation. BNC, front and rear panel, 600Ω impedance.
Sensitivity:
Phase-Locked Mode: 10 kHz/V to 5 MHz/V, selectable to 3 digits.
Unlocked Mode: 10 kHz/V to 25 MHz/V, selectable to 3 digits.
Accuracy: ±5% at 40 kHz modulation rate.
Maximum Deviation:
Phase-Locked Mode: ±20 times the modulation rate.
Unlocked Mode: ±25 MHz
Deviation Meter Accuracy: ±5% of full range plus FM flatness.
Modulation Rates (3 dB BW):
Phase-Locked Mode: 100 Hz–250 kHz at ≤300 kHz/V sensitivity.
1–250 kHz at >300 kHz/V sensitivity.
Unlocked Mode: DC to 250 kHz rate.
Flatness (relative to 40 kHz rate):
Phase-Locked Mode:
±1 dB from 200 Hz to 200 kHz at ≤300 kHz/V sensitivity.
±1 dB from 3 kHz to 200 kHz at 300 kHz/V sensitivity.
Unlocked Mode: ±1 dB from dc to 200 kHz
Distortion at 1 kHz: <10%
Incidental AM: ±0.2% per MHz deviation.

INSTRUMENT STATUS (IEEE-488)

GPIB Indicators: LED lights indicate the following conditions:
Remote: Operating on GPIB.
Talk: Talking on GPIB.
Listen: Listening on GPIB.
SRG: Sending a service request.
Local Lockout: Disables the RETURN TO LOCAL pushbutton. Instrument can be placed in local mode only via GPIB.
Remote Operation: All front-panel functions except line power and GPIB address are programmable via GPIB (IEEE–488). Additional programmable commands include: front-panel settings, stored setups, error/malfunction messages, operational status and self-test diagnostics.

Swept Frequency Synthesizers (Cont.)

6700A Series

INSTRUMENT STATUS (Cont.)

GPIB Speed: 15K bytes/s
GPIB Address: Selectable from front panel.
IEEE–488 Interface Functions: SH1
Acceptor Handshake: AH1
Talker: T6
Listener: L4
Service Request: SR1
Remote Local: RL1
Parallel Poll: PP1
Device Clear: DC1
Device Trigger: DT1

GENERAL

Stored Setups: Saves front-panel settings and nine additional stored setups for approximately ten years. Setups can be recovered directly by using the RECALL function or sequentially by using the SCAN function. Whenever the instrument is turned on, control settings come on at the same functions and values existing when power was removed.
Memory Sequencing Input: Accepts TTL-low signal to sequence through nine stored setups. BNC, rear panel.
Self-Test: Self-test is performed when power is applied or SELF TEST key is pressed. If an error is detected, a diagnostic code appears, identifying the cause and location of the error.
Secure Mode: Front-panel readouts are blanked to protect confidential test parameters.
Parameter Entry: Instrument-controlled parameters may be entered in 3 ways: keypad, control knob, or step DECR/INCR keys. Controlled parameters are frequency, power level, sweep speed, dwell time, pulse width, pulse repetition rate, AM % depth, AM sensitivity, and FM sensitivity. Entry is terminated by pressing appropriate unit key, i.e., GHz, MHz, dBm, ms, %, etc. Values of each are displayed on LCD readout.
Reset Control: Returns test parameters to preset default values
Warm-Up Time From Standby: 30 minutes.
Warm-Up Time From Power Application: 72 hours to achieve 1×10^{-9} per day frequency stability

Output Connectors:. Type N female ≤20 GHz, K female >20 GHz

Weight: 25 kg (55 lb) maximum.
Dimensions: 133 H x 429 W x 584 D mm
(5-1/4 H x 16-7/8 W x 23 D in.)
Power: 90–130V or 120–240V, 50–400 Hz, 220 VA (30 VA in Standby)
Standby: With ac line power connected, unit is placed in standby when power switch is released from On position.

ENVIRONMENTAL

Operating Temperature Range: 0°C to 55°C
Relative Humidity: 95%
EMI: Meets the conducted and radiated emission requirements of MIL–STD–461B, CE03, RE02, Part 4, Class A3 and VDE 0871/1978, Level B. Tested for conducted and radiated susceptibility per MIL–STD–462, CS02, CS06, and RS03 with no functional failures.

ACCESSORIES

Power Meter Extender Cables:
800–109 Extender Cable, 7.6 m (25 ft) $50
800–110 Extender Cable, 15.2 m (50 ft) $75
800–111 Extender Cable, 30.5 m (100 ft) $100
800–112 Extender Cable, 61.0 m (200 ft) $180

GPIB Cables:
2100–1 GPIB Cable, 1 m (3.3 ft) long $60
2100–2 GPIB Cable, 2 m (6.6 ft) long $75
2100–4 GPIB Cable, 4 m (13.2 ft) $95
2100–5 GPIB Cable, 0.5 m (1.65 ft) $55

Transit Case 760–81 for 6700A $655

Ordering Information

Model	Frequency Range	Output Power[1] (Minimum)	Price
6709A	10 MHz to 2 GHz	+10 dBm	$24,750
6709A–40	10 MHz to 2 GHz	+16 dBm	$25,500
6717A	10 MHz to 8.4 GHz	+10 dBm	$29,500
6717A–20	10 MHz to 8.4 GHz	+13 dBm	$30,500
6719A	2 to 8.4 GHz	+13 dBm	$26,000
6721A	2 to 12.4 GHz	+10 dBm	$31,000
6721A–20	2 to 12.4 GHz	+13 dBm	$32,500
6722A	10 MHz to 12.4 GHz	+10 dBm	$34,500
6722A–20	10 MHz to 12.4 GHz	+13 dBm	$35,500
6728A	8 to 12.4 GHz	+13 dBm	$24,500
6728A–40	8 to 12.4 GHz	+16 dBm	$26,000
6729A	8 to 20 GHz	+10 dBm	$30,500
6729A–20	8 to 20 GHz	+13 dBm	$32,000
6730A	12.4 to 20 GHz	+13 dBm	$25,000
6730A–40	12.4 to 20 GHz	+16 dBm	$26,500
6736A	18 to 26.5 GHz	+7 dBm	$26,500
6737A	2 to 20 GHz	+10 dBm	$34,000
6737A–20	2 to 20 GHz	+13 dBm	$35,500
6740A	26.5 to 40 GHz	+10 dBm	$31,000
6742A[2]	18 to 40 GHz	+7 dBm,	N/A
6747A	10 MHz to 20 GHz	+10 dBm	$36,000
6747A–20	10 MHz to 20 GHz	+13 dBm	$37000
6753A	2 to 26.5 GHz	+10 dBm, ≤20 GHz +5 dBm, ≤26.5 GHz	$39,000
6753A–10	2 to 26.5 GHz	+10 dBm	$41,000
6759A	10 MHz to 26.5 GHz	+10 dBm, ≤20 GHz +5 dBm, ≤26.5 GHz	$42,000
6759A–10	10 MHz to 26.5 GHz	+10 dBm	$44,000
6763A[3]	2 to 40 GHz	+10 dBm, ≤20 GHz +5 dBm, >20 GHz	N/A
6769A[3]	10 MHz–40 GHz	+10 dBm, ≤20 GHHz +5 dBm, >20 GHz	N/A

[1] Without optional attenuator [2] Dual outputs [3] Scheduled for later introduction

Options:
Rack Mounting , Option 1: Rack mount kit with chassis track slides and mounting ears. Weight is 2.3 kg (5 lb). $350
Attenuator, Option 2: Adds 10 dB step attenuator to increase the RF output range. Reduces rated power by 3 dB (4 dB for Option 2C).

For Models With Upper Frequency Limit (GHz)	Maximum Attenuation (dB)	Order	Price
≤18	110	Option 2A	$2,000
20 and 26.5	90	Option 2B	$2,700
>18	110	Option 2C	$3,500

Rear Panel RF Output, Option 9K: Adds rear panel K Connector RF output. Deletes front panel connector. Degrades output power, flatness, and SWR. $500

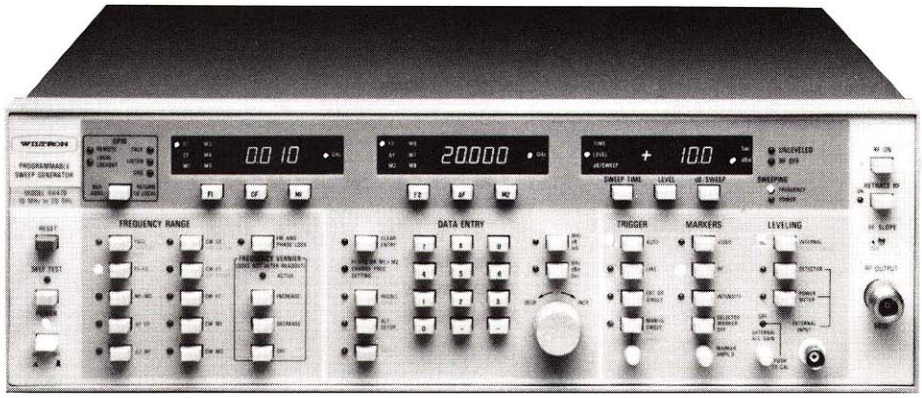
Power Meter Detectors:

Detector Model	Frequency Range	Input Connector	Price
6400–71N50	10 MHz to 2 GHz	N Male	$375
6400–71N75–1	10 MHz to 2 GHz	N Male, 75Ω	$475
560–7A50	10 MHz to 18 GHz	GPC–7	$550
560–7S50	10 MHz to 18.5 GHz	WSMA Male	$525
560–7N50	10 MHz to 18.5 GHz	N Male	$525
560–7S50–2	10 MHz to 26.5 GHz	WSMA Male	$600
560–7K50	10 MHz to 40 GHz	K Male	$675

Sweep Generators

6600B Series, 10 MHz to 60 GHz

NEW



6600B Sweep Generator Highlights

- 40 mW Leveled Power from 10 MHz to 20 GHz
- 10 MHz to 40 GHz Sweep from a Single Connector
- Subharmonic-Free Signals from Fundamental Oscillators
- 15 dB Power Sweep Range Plus Optional 70 dB Attenuator
- Eight RF, Video, or Intensity Modulated Markers

Measurement Accuracy and Convenience

The 6600B Sweep Generators combine the latest microwave and microprocessor technology to produce a general-purpose swept signal source that makes the most accurate microwave measurements—in automated or manual systems. From a selection of 39 models, you choose the exact combination of capabilities you need: wideband sweep, narrowband sweep, and high power. All models feature exceptional source match, signal purity, frequency accuracy, resolution, and output flatness to improve the accuracy of your microwave measurements.

Innovative Design Philosophy

In designing the 6600B Series, Wiltron recognized that the great majority of a sweeper's cost is in the microwave components. Rather than mount these components in a plug-in, Wiltron engineers made each model a stand-alone, self-contained instrument. Every model is optimized to avoid the pick-up, interference, and over-heating that can plague plug-in sweeper designs. Each microwave module achieves the highest possible performance level, giving the 6600B distinct advantages over other sweepers.

Wide Selection

Model	Frequency Range	Output Power (mW)
6609B	10 MHz to 2 GHz	20
6609B–50		50
6617B	10 MHz to 8 GHz	10
6617B–40		40
6645B	10 MHz to 18 GHz	10
6645B–40		40
6647B	10 MHz to 20 GHz	10
6647B–40		40
6659B	10 MHz to 26.5 GHz	5
6668B	10 MHz to 40 GHz	4
6669B	10 MHz to 40 GHz	3
6619B	2 to 8 GHz	10
6619B–40		40
6621B	2 to 12.4 GHz	10
6621B–40		40
6635B	2 to 18 GHz	10
6635B–40		40
6637B	2 to 20 GHz	10
6637B–40		40
6653B	2 to 26.5 GHz	5
6662B	2 to 40 GHz	4
6663B	2 to 40 GHz	3
6610B	1 to 2 GHz	20
6616B	1.7 to 4.3 GHz	10
6620B	3.6 to 6.5 GHz	20
6624B	4 to 8 GHz	10
6627B	5.9 to 9 GHz	10
6628B	8 to 12.4 GHz	10
6628B–50		50
6629B	8 to 20 GHz	10
6629B–40		40
6631B	10 to 15.5 GHz	10
6630B	12.4 to 20 GHz	10
6630B–50		50
6660B	12.4 to 40 GHz	4
6632B	17 to 22 GHz	5
6636B	18 to 26.5 GHz	3
6640B	26.5 to 40 GHz	5
6672B	40 to 60 GHz	1

Sweep Generators (Cont.)

6600B Series

Versatile Sweep Modes and Eight Markers

The 6600B Series has five sweep modes, as well as five CW frequencies and eight markers, to enhance your network analyzer display of test data. With a single keystroke, you switch from broadband sweep (Full Range, F1 to F2, or M1 to M2) to narrow-band symmetrical sweep about center frequency CF or marker M1. The CW frequencies are also selected directly without use of a shift key or having to remember frequencies stored in memory, both required by a major competitor. The exceptional attention given to all aspects of front-panel layout make the 6600B a pleasure to use.

Power Sweep

In addition to the versatile frequency sweep modes, the 6600B has a power sweep with which the output is swept over a 15 dB range. Furthermore, with the addition of the Option 2 Attenuator, the 15 dB power sweep can be offset in 10 dB steps over a 70 dB range. Amplifier and semiconductor characteristics, such as gain compression and saturation, can be measured rapidly over a continuously variable input power range. In the Alternate Stored Setup mode, a set of power sweep and a set of frequency sweep parameters stored in memory can be recalled to provide a "simultaneous" two-trace display of test device power *and* frequency characteristics.

ROM Frequency Accuracy

The accuracy with which frequencies can be selected is especially important when measuring devices with rapidly changing frequency characteristics. By using ROM to correct for residual nonlinearities of YIG-tuned oscillators, Wiltron holds accuracy to ±10 MHz from 10 MHz to 20 GHz. In addition, there is no degradation of accuracy when tuning from one band to the next, as is the case with multiplier techniques.

Nine Stored Setups

Because the 6600B has memory for nine independent test setups, operation of the Alternate Stored Setup mode is as simple as recalling the test parameters from memory. Set-up time is virtually eliminated.

Front Panel Security

When test parameters must be kept secret, an instruction to blank the digital displays is stored with the other test setup information by simply pressing the security key. Also, the secure information can be easily cleared to reduce protection problems.

Fundamental Oscillators

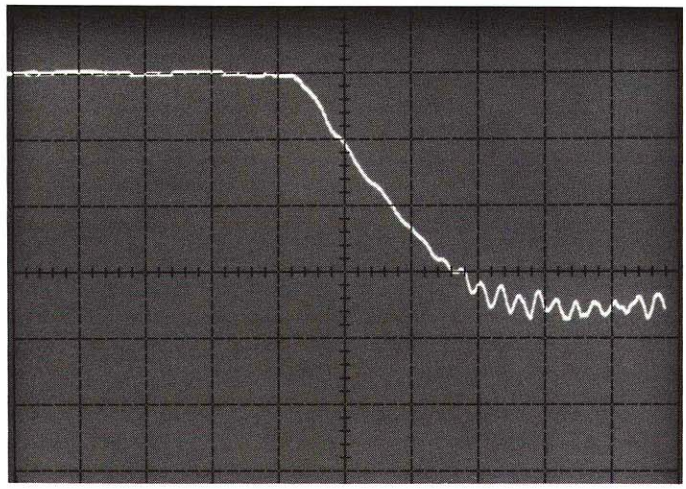
The 6600B Series uses fundamental oscillators over the 2 to 26.5 GHz range because they deliver the purest, most accurate signals. Four aspects of their performance contribute to accurate measurements:

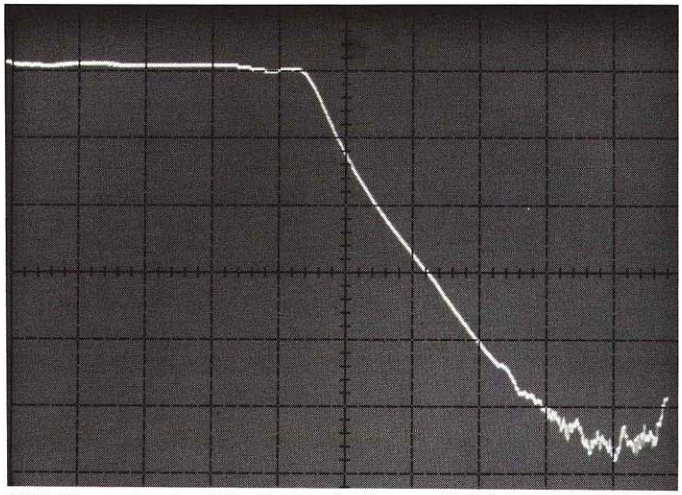
1) Harmonic Content. The troublesome subharmonics of multiplier-type sweep generators don't exist.
2) Residual FM. Without a multiplier, residual FM is not degraded by the multiplication factor. Residual FM in CW or narrow-band mode is less than 10 kHz peak up to 20 GHz.
3) Frequency Accuracy. CW accuracy is ±10 MHz over the full 10 MHz to 20 GHz range.
4) Output Flatness. Since there is no tracking filter required to take out unwanted multiplier responses, the output level does not vary with sweep speed.

Low Harmonics

Harmonic content can cause large errors in the measurement of reflection and transmission. The photographs below show test results when a competitor's multiplier-type sweeper (A) and a Wiltron fundamental oscillator sweeper (B) are used to make the same measurement. Photograph (A) shows the effect of multiplier subharmonics from a 2–7 GHz oscillator on test results above 7 GHz. With a clean signal from its fundamental oscillator, the Wiltron 6659B shows in (B) a 20 dB improvement in dynamic range. This is a result of the 40 dB (typically 55 dB above 4 GHz) harmonic suppression of the 6659B, a vast improvement over the 25 dB specification of the sweeper shown in (A). Spurious signals are better than –60 dBc for all models between 2 and 60 GHz—one more reason why the 6600B is the preferred signal source for precise microwave measurements.

Harmonics can also introduce significant uncertainty when measuring power levels. For example, with the Wiltron specified harmonic level of <–40 dBc, the measurement uncertainty due to detection of harmonics is less than ±0.2 dB. In contrast, multplier-type sweepers with a specification of <–25 dBc can have as much as ±0.7 dB uncertainty.





(A) Subharmonics of multiplied frequencies in competitor's instrument give erroneous indication of response outside filter passband. (B) Clean signals from fundamental oscillators of 6600B Sweep Generator show that actual response of the filter is 20 dB better than that measured in (A).

Alternate Stored-Setup Sweep

In some applications, test times can be cut in half by simultaneously displaying two traces of characteristics over different frequency and/or power ranges. For example, with a simultaneous display of amplifier reflection and output power, you can adjust the amplifier for optimum balance of the two without changing the test setup. Similarly, the broadband rejection characteristics and the narrow passband response of a filter can be observed simultaneously. The time saved in avoiding sequential tests with two sets of test parameters is substantial.

Phase Lock

When resolution greater than 100 kHz is required, the 6600B can be phase locked to an external source. When phase locked to a frequency counter, accuracies of ±10 Hz or better can be achieved. Here is one more way the 6600B Series improves measurement accuracy and meets the needs of applications which formerly required a signal generator or synthesizer.

Exceptional Source Match

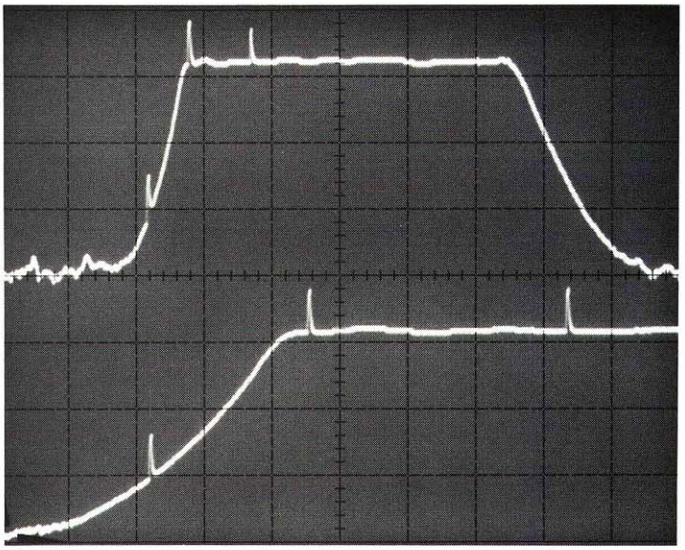
A poor source impedance match can introduce significant errors in test results. Energy reflected from the mismatch causes uncertainty in return loss and transmission measurements. This error is minimized by the exceptionally good source match of the 6600B. In the 6637B, for example, source SWR is 1.5 from 2 to 20 GHz. These values compare very favorably to the 1.9 SWR above 2 GHz specified for a competitor's unit. When a 10 dB return loss measurement is made on the competitor's unit, the uncertainty is 1.7 dB. In contrast, the 6600B sweeper with a source match of 1.5 SWR holds uncertainty to 1 dB, an improvement of 0.7 dB.

Frequency Vernier

The FREQUENCY VERNIER controls can be used to increase frequency accuracy in the CW and ΔF mode. While monitoring the output with a counter, you simply press the INCREASE and DECREASE buttons until the desired frequency is obtained. Subsequent requests for frequency will produce the same frequency, including the correction.

Complete Programmability

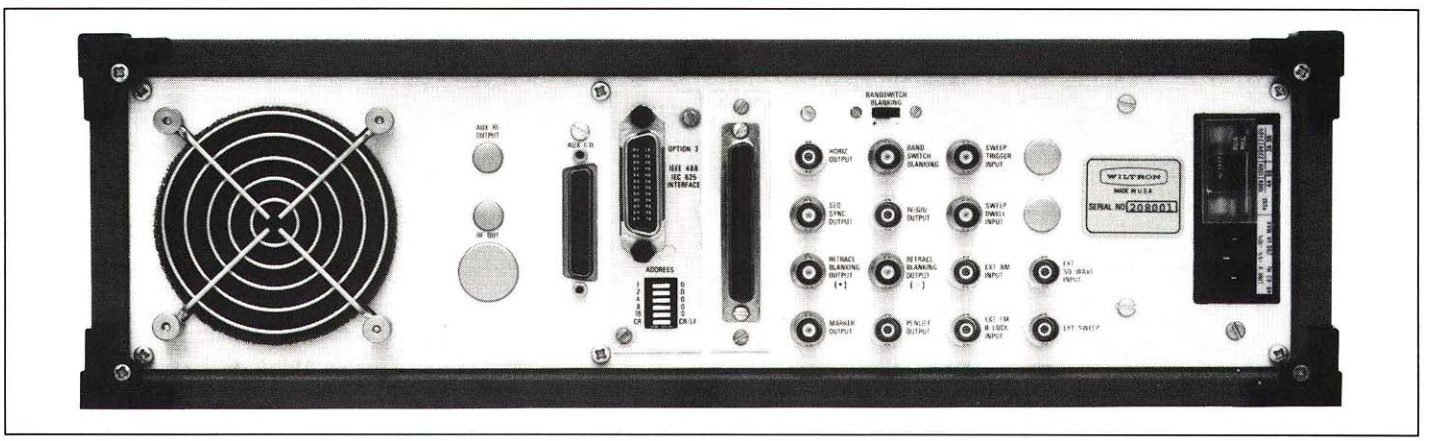
Every measurement parameter can be controlled over GPIB (IEEE–488) by descriptive commands that make the 6600B compatible with every computer or controller. In addition, special interfaces are included to ensure compatibility with every available network analyzer. With complete programmability, the 6600B works smoothly in interactive, real-time systems. Parallel poll, serial poll, service request (SRQ), and group execute trigger provide programming flexibility to achieve optimum test sequencing, timing, and control. A local lock-out command protects the system against errors that might be inadvertently introduced by operating the front-panel controls.



Alternate Sweep mode sweeps alternately between two independently selected frequency ranges: 2–12.4 GHz for the top trace, 3–5 GHz for the bottom trace.

Self-Test

The 6600B Series features a self-test that allows you to diagnose problems and return the unit to service with a minimum of down-time. When the self-test is initiated, remotely or from the front panel, up to 25 error codes are available on the front panel LED readouts. The error codes direct the repair technician to the module(s) that needs service. These error codes are completely documented in the 6600B Service Manual so that the repair technician can proceed from an error code to at least a board level solution, often to component level. When self-test is initiated remotely, the 6600B supplies a pass or fail indication over the bus. The self-test is an independent function and does not disrupt previous front-panel settings.



Sweep Generators (Cont.)

6600B Series

Specifications

FREQUENCY

Frequency Range: 10 MHz to 60 GHz in 39 models. Please see pages 58 and 59.

Frequency Control:

Full: Sweeps upward across the complete frequency range.

F1–F2: Sweeps from F1 to F2, entered independently on keypad or control knob. F2 must be greater than F1.

M1–M2: Sweeps from M1 to M2 markers, entered independently on keypad or control knob. M2 must be greater than M1.

ΔF: Sweeps upward symmetrically about CF or M1. Sweep width is adjustable on keypad or control knob in MHz or GHz.

CW: Single frequency at CF, F1, F2, M1, and M2, entered independently on keypad or control knob.

Frequency Vernier: Fine adjustment of frequency in CW and ΔF modes up to ±12.7 MHz for models with specified frequency accuracies of <±10 MHz. A new correction in frequency can be made with the control knob. Correction applies until released with Off button or the frequency is changed. ACTIVE light is on whenever a vernier adjustment is in use.

Manual: Continuous manual adjustment of frequency between sweep limits in every sweep mode. Can be used to set recorder.

CW Filter Enable/Disable:

Enabled: Filter inserted for CW mode and sweep widths ≤50 MHz. Shift key function.

Disabled: Filter removed for all modes of operation.

Frequency Stability:

For Models With Upper Frequency Limit (GHz)	With Time (10 Minutes, Typical*) (kHz)	With 10 % Line Voltage Change (kHz)
≤26.5	±200	±100
>26.5 to 40	±400	±200
> 40 to 60	±600	±300

* After 30 minutes warmup at selected CW frequency.

Frequency Resolution:

Normal: 1 MHz

Frequency Vernier: 100 kHz on ±12.7 MHz range, 200 kHz on ±25 MHz range, 300 kHz on ±37.5 MHz range.

Step Sweep: 4096 programmable points.

Frequency Accuracy: Please see pages 58 and 59.

MARKERS

Marker Selection: Eight markers at M1 through M8, entered independently on keypad or control knob in MHz or GHz.

Accuracy: Same as frequency accuracy. Please see page 58.

Resolution: 0.4% of sweep width.

Display: Front-panel pushbuttons select one of three marker modes:

Video: Positive video pulse, 0 to +5 volts, TTL-compatible, adjustable with MARKER CONTROL. 1K ohm impedance, rear panel BNC connector.

RF: Up to 5 dB attenuated RF level at marker frequency, adjustable with MARKER CONTROL.

Intensity: Intensified dot on trace, obtained by momentary dwell in sweep.

Amplitude of video and RF marker increases twofold when single marker is selected.

SWEEP AND TRIGGERING

Alternate Stored Setup: Sweeps alternately between the current front-panel setup and one of nine stored setups.

Sweep Triggering:

Auto: Triggers sweep automatically.

Line: Triggers sweep from power line frequency.

External: Triggers sweep from externally applied 4 to 25 Vpk or TTL-compatible pulse with >1 µs width and >5 µs fall time. Rear panel BNC connector.

Single: EXT OR SINGLE SWEEP selects mode, triggers, aborts, and resets single sweep.

Sweep Time: Adjustable from approximately 0.01 to 99 s. Entered on keypad or control knob in ms or s.

Retrace RF: Front panel pushbutton activates RF power during retrace.

Horizontal Output: 0 to 10 volt ramp coincident with sweep in all sweep modes. In CW mode, output voltage varies in proportion to frequency, 0 volts at 0 GHz and 10 volts at upper frequency limit. In shift key CW RAMP mode voltage varies from 0 to 10 volts between sweep limits. Rear panel BNC connector.

Sequential Sync Output: +5 volt TTL-compatible pulse occurring at oscillator bandswitching points and during sweep retrace. –5 volt occurring at markers, –10 volt at selected marker. Rear panel BNC connector.

Retrace Blanking (–) Output: –5 volt pulse occurring during sweep retrace. Rear panel BNC connector. <100 ohm impedance.

Retrace Blanking (+) Output: +5 volt TTL-compatible pulse occurring during sweep retrace. Rear panel BNC connector.

Bandswitching Blanking Output: ±5 volt pulse occurring during oscillator bandswitching points. Polarity selected on rear panel switch. Rear panel BNC connector. <100 ohm impedance.

V/GHz: Reference voltage varying in proportion to output frequency as follows:

For Models With Upper Frequency Limit (GHz)	V/GHz Output (V/GHz)
≤20	1
>20 to 40	0.5
>40 to 60	0.33

Rear panel BNC connector. 100 ohm impedance

Penlift Output: Normally open relay contacts for lifting recorder pen during sweep retrace. Internal jumper can be installed to provide normally closed contacts. Rear panel BNC connector.

Sweep Dwell Input: Low true TTL-compatible pulse causes frequency sweep to stop. Can be used to count marker frequencies with an external counter and Frequency Counter Interface output, Option 13.

External Sweep Input: Externally applied 0 to 10 volt ramp sweeps frequency between selected sweep limits. Rear panel BNC connector. 10K ohm impedance. Front-panel control.

POWER SWEEP AND LEVELING

Leveling:

Internal: Levels output power at front-panel connector. Please see pages 58 and 59 for power variation specifications. Not available on 6640B and 6672B.

External Detector: Levels output power at remote test position where directional detector samples RF power and provides a positive or negative polarity detected signal of 5 mV to 500 mV to front-panel BNC connector. Front-panel ALC control adjusts input signal level to optimum value.

Power Meter: Levels output power at remote test position where a power meter samples RF power and provides a ±1V full scale video signal to front-panel BNC connector. Front-panel ALC gain control adjusts input signal level to optimum value.

Unleveled Indicator: Lights when ouput is insufficient to maintain leveling across the selected sweep range.

Power Sweep: Sweeps over up to 15 dB range, entered on keypad or control knob. Option 2 Attenuator offsets sweep range in 10 dB steps over 70 dB range.

Attenuator: Option 2 adds a 10 dB attenuator with a 70 dB range. Please see pages 58 and 59 for accuracy specifications.

RF Slope Control: Adjusts slope of leveled output power by increasing power at the higher frequencies to compensate for frequency dependent cable losses in test setup.

MODULATION

External AM Input: Rear panel BNC connector. 10K ohm impedance.
Sensitivity: 1 dB/V
Frequency Response (typical): DC–50 kHz
Input Impedance: 10K ohms
Amplitude Control Range: >13 dB
Maximum Input: 20V
External FM and Phase-Lock Input: Rear panel BNC connector. 10K ohm impedance.
Sensitivity: –6 MHz/V
Maximum Deviation for Modulation Frequency of:
DC–100 kHz: ±25 MHz
100–250 kHz: ±5 MHz
External Square Wave Input: Externally applied TTL-compatible square wave modulates output at dc to 50 kHz rate. Will accommodate ±6V square wave. On/Off ratio, typically 40 dB. Maximum input, ±20 volts. Rear panel BNC connector. Order Option 11 for 6610B, 6616B, 6619B 6619B–40, 6620B, 6624B, 6627B, 6628B, 6628B–50, 6630B, 6630B–50, 6631B, 6632B, 6636B, 6640B, and 6672B. Standard on all others.

INSTRUMENT STATUS

GPIB Indicators: When GPIB Option 3 is added to the instrument, LED lights indicate the following conditions:
Remote: Operating on GPIB
Talk: Talking on GPIB
Listen: Listening on GPIB
SRQ: Sending a service request
Local Lockout: Disabling the RETURN TO LOCAL pushbutton. The instrument can be placed in local mode only via GPIB.
Nonvolatile Memory: Retains front-panel control settings in memory for up to 10 years. Whenever instrument is turned on, control settings come on at the same functions and values existing when power was removed.
Self-Test: Performs self-test every time power is applied or when SELF TEST pushbutton is pressed. If an error is detected, a diagnostic code appears, identifying the cause and location of the error.

GENERAL

Test Setup Storage: Stores nine test setups for recall during normal or Alternate Stored Setup modes.
Continuous Control: Knob provides smooth, continuous control of frequency, sweep time, and power.
Front Panel Security: Blanks LEDs to secure test parameters.
Power Variation With Temperature: ±0.08 dB/°C. Not applicable to units with external leveling only.
Residual AM (30 kHz bandwidth): >50 dBc. Not applicable to units with external leveling only.
Output Connector: Type N female all models except:
Model 6632B and 6636B: Ruggedized WSMA female
Model 6640B: WR28 Waveguide (UG–599/U Flange)
Models 6662B and 6668B: Ruggedized WSMA female to 26.5 GHz; WR28 Waveguide, 26.5 to 40 GHz (UG–599/U Flange)
Models 6653B, 6669B, 6660B, 6663B, and 6669B: Ruggedized K Connector™ female.
Model 6672B: WR19 Waveguide (UG–383/U Flange)
Test Parameter Data Entry: Frequency sweep time and power level are entered on keypad with up to 5 digit resolution or on continuous control knob. Entry is terminated by pressing appropriate unit (MHz, dB, mS, or GHz) pushbutton. Entry errors are cleared by pressing CLEAR ENTRY
Reset Control: Returns controls to following conditions:
Frequency Range: Full
Trigger: Auto
Markers: M1 and M2 only on.
RF: On
Level: Specified power level.
Leveling: Internal
Sweep Time: 50 ms
CW, Marker, ΔF Frequencies: Varies with model number.
Shift Key: Activates dual function controls—CW RAMP (horizontal output ramp), CW FILTER (CW filter enable/disable), DISPLAY OFF (blanks front-panel LEDs), POWER SWEEP (sweeps output power), EXTERNAL SWEEP (external sweep input), RETURN TO LOCAL (address selection), and SELECTED MARKER OFF (removal of all markers).
Warranties: Two years on YIG oscillators, one year on instruments.
Dimensions: 133 H x 432 W x 476 D mm
(5.25 H x 17 W x 18.75 in.)
Weight: 16 kg (35.4 lb) maximum.
Input Power: 100V/120V/220V/240V ±5%, –10%, selectable on rear panel, 50–60 Hz, 250 VA maximum.
Operating Temperature Range: 0 to 55°C

Ordering Information

Frequency Ranges: Please see pages 58 and 59.
Options:
Rack Mounting, Option 1: Unit supplied with mounting ears and chassis track slide (90° tilt) installed $350
Attenuator, Option 2: Adds 10 dB step attenuator with 70 dB range. Output power is selected on keypad or control knob directly in dBm over an 82 dB range.

For Models With Upper Frequency Limit (GHz)	Order	Price
≤18	Option 2A	$1,500
20	Option 2B	$2,200
26.5	Option 2C	$2,200
40	Option 2D	$2,700

GPIB Interface, Option 3: Adds GPIB (IEEE–488). All pushbutton controls except line power On/Off are bus controlled. Field installable $500
Rear Panel RF Output, Option 9: Option 9S adds SMA female and Option 9N adds Type N female rear-panel RF output connector and deletes front-panel RF connector, degrading output power (typically 1 dB at 20 GHz), source SWR (typically 2 at >8 GHz), and power variation. Not available on units with upper frequency above 26.5 GHz. $350
Auxiliary Rear Panel RF Connector, Option 10: Adds SMA female connector to rear panel, providing an attenuated (approximately –15 to –25 dBm) sample of the reduced RF output signal (typically 1.5 dB ≤18 GHz; 2 dB, >18 GHz). Not available on models with upper frequency limit above 26.5 GHz. $450
External Square Wave Input, Option 11: Adds rear-panel BNC connector for externally applied TTL-compatible signal which modulates RF at rates from dc to 50 kHz. On/Off ratio, typically 40 dB. Maximum input, ±20 volts. Accommodates ±6 volt square wave. Order for 6610B, 6616B, 6619B, 6619B–40, 6620B, 6624B, 6627B, 6628B, 6628B–50, 6630B, 6630B–50, 6631B, 6632B, 6636B, 6640B, and 6672B. Standard on all others. $350
Auxiliary Rear Panel RF Connector, Option 12: Adds SMA female connector to rear panel, providing an RF sample that is approximately 10 dB below output power.

Frequency Range (GHz)	Order	Price
2 to 18	Option 12A	$1,450
2 to 26.5	Option 12B	$1,885

Frequency Counter Interface, Option 13: Adds rear panel BNC connector to provide interface with HP 56343A counter for counting marker frequencies $100

Extender Board 660–D–8062–3 . . . . . $50
Transit Case 760–84 . . . . . $355

6600B Series Sweep Generator Specifications (Cont.)

Model	Frequency Range (GHz)	Output Power (25°C ±5°)		Power Level Accuracy			Leveled Power Variation		Source SWR (Leveled Power)
		Internally Leveled Maximum (mW)	With Opt.2, 70 dB Attenuator (mW)	Leveled (dB)	With Opt. 2, 70 dB Attenuator Add (dB)	Attenuator Accuracy Per Step (dB)	With Frequency (dB)	With Frequency Opt. 2, 70 dB Attenuator (dB)	
6669B	0.01 to 40	>3	>1.5	±2	±2.5	±1	±1.5	±2	1.5 (≤18 GHz) 1.7 (>18 GHz) 2 (>26.5 GHz)
6668B[6]		>10 (≤18 GHz) >4 (>18 GHz)	N/A	±1.5 N/A (>26.5 GHz)	N/A	N/A	±1 N/A (>26.5 GHz)[1]	N/A	1.5 (≤18 GHz) 1.7 (>18–26.5 GHz) (>26.5)[1]
6659B	0.01 to 26.5	>10 (≤18 GHz) >5 (>18 GHz)	>5 (≤18 GHz) >2 (>18 GHz)	±1.5	±2	±0.7	±1	±1.5	1.5 (≤18 GHz) 1.7(>18 GHz)
6647B	0.01 to 20	>10	>6.6	±1	±1.5	±0.4	±0.6	±1.5	1.5
6647B–40		>40	>26.3						
6645B	0.01 to 18	>10	>6.6	±1	±1.5	±0.4	±0.6	±1.5	1.5
6645B–40		>40	>26.3						
6663B	2 to 40	>3 (≤26.5 GHz) >1 (>26.5 GHz)	>1.5 >0.5	±2	±2.5	±1	±1.5	±2	1.5 (≤18 GHz) 1.7 (>18 GHz) 2 (>26.5 GHz)
6662B[7]		>10 (≤18 GHz) >4 (>18 GHz)	N/A	±1.5 N/A (>26.5 GHz)	N/A	N/A	±1 (<26.6 GHz)	N/A	1.5 (≤18 GHz) 1.7 (>18-26.5 GHz) (26.5-40 GHz)[1]
6653B	2 to 26.5	>10 (≤18 GHz) >5 (>18 GHz)	>5 (≤18 GHz) >2 (>18 GHz)	±1.5	±2	±0.7	±1	±1.5	1.5 (≤18 GHz) 1.7 (>18 GHz)
6637B	2 to 20	>10	>6.6	±1	±1.5	±0.4	±0.5	±1.5	1.5
6637B–40		>40	>26.3						
6635B	2 to 18	>10	>6.6	±1	±1.5	±0.4	±0.5	±1.5	1.5
6635B–40		>40	>26.3						
6621B	2 to 12.4	>10	>7.4	±1	±1.5	±0.4	±0.5	±1.4	1.5
6621B–40		>40	>29.5						
6617B	0.01 to 8	>10	>7.9	±0.9	±1	±0.4	±0.5	±1	1.5
6617B–40		>40	>31.6						
6619B	2 to 8	>10	>7.9	±1	±1.5	±0.4	±0.4	±0.9	1.5
6619B–40		>40	>31.6						
6629B	8 to 20	>10	>6.6	±1	±1.5	±0.4	±0.5	±1.5	1.5
6629B–40		>40	>26.3						
6660B	12.4 to 40	>4	>2	±2	±2.5	±1	±1.5	±2	1.5 (≤18 GHz) 1.7 (>18 GHz) 2 (>26.5 GHz)
6609B	0.01 to 2	>20	>17.8	±0.6	±0.8	±0.3	±0.3	±0.8	1.3
6609B–50		>50	>44.5						
6610B	1 to 2	>20	>17.8	±1	±1.5	±0.4	±0.3	±0.5	1.3
6616B	1.7 to 4.3	>10	>7.8	±1	±1.5	±0.4	±0.4	±0.7	1.2
6620B	3.6 to 6.5	>20	>15.6	±1	±1.5	±0.4	±0.3 (±0.03 dB/30 MHz)	±0.8	1.5
6624B	4 to 8	>10	>7.8	±1	±1.5	±0.4	±0.4	±0.9	1.5
6627B	5.9 to 9.0	>10	>7.8	±1	±1.5	±0.4	±0.3	±0.8	1.5
6628B	8 to 12.4	>10	>7.4	±1	±1.5	±0.4	±0.4	±0.9	1.5
6628B–50		>50	>37.2						
6630B	12.4 to 20	>10	>6.6	±1	±1.5	±0.4	±0.5	±1	1.5
6630B–50		>50	>33.9						
6631B	10 to 15.5	>10	>7	±1	±1.5	±0.4	±0.4	±0.9	1.5
6632B	17 to 22	>5	>3.2	±1	±3	±0.7	±0.8	±2.3	1.7
6636B	18 to 26.5	>3.1	>1.2	±1	±3	±0.7	±1	±2.5	1.7
6640B	26.5 to 40	>5[1]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6672B	40 to 60	>1[1]	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[1] External leveling only [2] Excluding 5% band edges where specification is >20 dBc [3] Measured in 30 Hz–15 kHz bandwidth [4] Subharmonics [5] At 25°C

Source SWR With Opt. 2, 70 dB Attenuator	Signal Purity			Frequency Accuracy[5]		Frequency Stability			Price	Model
	Harmonics (dBc)	Non-Harmonics (dBc)	Residual FM[3] (kHz peak)	CW Mode (MHz)	Sweep Mode ≤50 MHz (MHz)	With Temperature (MHz/°C)	With 10 dB Power Level Change (kHz)	With 3:1 Load SWR (kHz)		
N/A	<–30 (<2 GHz) <–40 (2–26.5 GHz) <–20 (>26.5 GHz	<–40 (≤2 GHz) <–60 (>2 GHz)	<7 (<8 GHz) <10 (8–18 GHz) <15 (18–26.5 GHz) <20 (>26.5 GHz)	±20	±30	±1 (≤26.5 GHz) ±2 (>26.5 GHz)	±500	±300	$40,000 $39,000	6669B 6668B
1.7 (≤12.4 GHz) 2 (>12.4 GHz)	<–30 (≤2 GHz) <–40 (>2 GHz)	<–40 (≤2 GHz) <–60 (>2 GHz)	<7 (<8 GHz) <10 (8–18 GHz) <15 (>18 GHz)	±20	±30	±1 (≤2 GHz) ±0.5 (>2 GHz)	±500	±300	$29,000	6659B
1.7 (≤12.4 GHz) 2 (>12.4 GHz)	<–30 (≤2 GHz) <–40 (>2 GHz) <–20 (≤2 GHz) <–25 (>2 GHz)	<–40 (≤2 GHz) <–60 (>2 GHz)	<7 (≤8 GHz) <10 (>8 GHz)	±10	±15	±1 (≤2 GHz) ±0.5 (>2 GHz)	±500	±300	$24,000 $28,000	6647B 6647B–40
1.5 (<8 GHz) 1.6 (8-12.4 GHz) 1.8 (>12.4 GHz)	<–30 (≤2 GHz) <–40 (>2 GHz) <–20 (≤2 GHz) <–25 (>2 GHz)	<–40 (≤2 GHz) <–60 (>2 GHz)	<7 (≤8 GHz) <10 (>8 GHz)	±10	±15	±1 (≤2 GHz) ±0.5 (>2 GHz)	±500	±300	$23,500 $27,500	6645B 6645B–40
N/A	<–40 (2–26.5 GHz) <–20 (>26.5 GHz)	<–60	<7 (<8 GHz) <10 (8–18 GHz) <15 (18–26.5 GHz) <20 (>26.5 GHz)	±20	±30	±1 (≤26.5 GHz) ±2 (>26.5 GHz)	±500	±300	$35,500 $34,000	6663B 6662B
1.7 (≤12.4 GHz) 2 (>12.4 GHz)	<–40	<–60	<7 (<8 GHz) <10 (8–18 GHz) <15 (>18 GHz)	±20	±30	±1	±500	±300	$27,000	6653B
1.7 (≤12.4 GHz) 2 (>12.4 GHz)	<–40 <–25	<–60	<7 (<8 GHz) <10 (8–18 GHz)	±10	±15	±0.5	±500	±300	$22,000 $26,000	6637B 6637B–40
1.5 (<8 GHz) 1.6 (8–12.4 GHz) 1.8 (>12.4 GHz)	<–40 <–25	<–60	<7 (<8 GHz) <10 (8–18 GHz)	±10	±15	±0.5	±500	±300	$20,000 $24,500	6635B 6635B–40
1.5 (<8 GHz) 1.6 (8-12.4 GHz)	<–40 <–25	<–60	<10	±10	±15	±0.5	±500	±300	$18,900 $22,750	6621B 6621B–40
1.5	<–30 (≤2 GHz) <–40 (>2 GHz) <–20 (≤2 GHz) <–25 (>2 GHz)	<–40 (≤2 GHz) <–60 (>2 GHz)	<7	±5	±10	±1 (≤2 GHz) ±0.5 (>2 GHz)	±100	±100	$16,000 $17,000	6617B 6617B–40
1.5	<–40 <–25	<–60	<7	±10	±15	±0.5	±100	±100	$13,000 $14,500	6619B 6619B–40
1.6 (≤12.4 GHz) 1.8 (>12.4 GHz)	<–40 <–25	<–60	<10	±10	±15	±0.5	±500	±300	$15,000 $19,750	6629B 6629B–40
N/A	<–40 (2–26.5 GHz) <–20 (>26.5 GHz)	<–60	<10 (8-18 GHz) <15 (18–26.5 GHz) <20 (>26.5 GHz)	±20	±30	±1 (≤26.5 GHz) ±2 (>26.5 GHz)	±300	±300	$27,850	6660B
1.5	<–30 <–20	<–40	<7	±5	±10	±1	±100	±10	$10,900 $12,250	6609B 6609B–50
1.5	<–30[2]	<–60	<7	±10	±15	±0.5	±500	±300	$9,200	6610B
1.5	<–20 (1.7–2.26 GHz) <–30 (2.26–4.3 GHz)	<–60	<7	±10	±15	±0.5	±500	±300	$9,200	6616B
1.5	–40	<–60	<7	±10	±15	±0.5	±500	±300	$9,600	6620B
1.5	<–30[2]	<–60	<7	±10	±15	±0.5	±500	±300	$11,000	6624B
1.8	<–40	<60	<10	±10	±15	±0.5	±500	±300	$10,600	6627B
1.8	<–40 <–25	<–60	<10	±10	±15	±0.5	±500	±300	$10,800 $12,500	6628B 6628B–50
1.8	<–32 <–25	<–60	<10	±10	±15	±0.5	±500	±300	$10,800 $13,500	6630B 6630B–50
1.8	<–40	<–60	<10	±10	±15	±0.5	±500	±300	$11,700	6631B
2	<–40	<–60	<10	±15	±25	±1	±500	±300	$13,500	6632B
2	<–40	<–60	<30	±15	±25	±2	±500	±300	$15,000	6636B
N/A	<–20	<–60	<40	±20	±30	±2	N/A	±300	$17,000	6640B
N/A	<–20[4]	<–60	<50	±30	±45	±3	N/A	±300	$24,250	6672B

[6] Dual outputs: 0.01–26.5 GHz and 26.5 to 40 GHz [7] Dual outputs: 2 to 26.5 GHz and 26.5 to 40 GHz

Plug-In Sweep Generator

610D Series, 100 kHz to 40 GHz

610D Sweep Generator Highlights

- Thirty-One Model Selection
- Broadband Phase Lock and FM Capability
- Substantial Initial Cost Savings
- Field-Proven Reliability and Value

Plug-In Economy and Versatility

From a selection of 31 single-band, dual-band, and multiband plug-ins covering the 100 kHz to 40 GHz range, there is a low-cost solution to almost every swept measurement application. Many options are offered so that the 610D can be readily adapted to widely varying requirements. With years of proven performance in the field, the 610D is the favorite of those who demand top performance at a low initial investment.

Marker Systems

A selectable Intensity, Video, or RF marker is standard. Option 1 adds a crystal-controlled frequency marker comb providing marker intervals of 1, 10, 50, and 100 MHz with 0.01% accuracy. Option 14 is an External RF Marker input which accepts a 1 MHz to 1 GHz signal. Option 11 provides two additional Variable Frequency Markers, which are available in both ΔF and F1–F2 sweep modes.

The 610D is the only sweeper with an Intensity Marker system that can be used with any oscilloscope and does not require Z-axis modulation. This patented intensity dot is especially useful in applications where attenuation or AGC is present. Since the dot is generated by merely stopping the sweep briefly and allowing the CRT brightness to build up, it operates independently of all external devices.

Phase Lock and FM Capability

With Option 28, the 610D can be phase locked with an external synchronizer to obtain synthesizer-like stability and noise level. For applications requiring external FM, Option 28 provides dc to 1 MHz frequency response.

Flicker-Free Display

The 610D provides both positive and negative bandswitch blanking to eliminate bright intensity dots at the bandswitch points in multiband plug-ins. In addition, all plug-ins, including the 10 MHz to 18.5 GHz and the 2 to 18.5 GHz models, sweep fast enough to produce a flicker-free display when used with normal CRT phosphors.

Remote Programming

To make the 610D suitable for ATE applications, it has been designed to be frequency programmable. Since the internal oscillators are voltage tunable, an external voltage can be applied to the remote control terminal on the rear panel to obtain a desired CW output. An ac voltage superimposed on a dc level provides a sweep output. Sensitivity is 9.75 volts for a full band frequency change. Also useful in programming applications is the full band dc signal available from the rear panel.

Network Analyzer Compatibility

A standard feature of the 610D is its complete compatibility with all HP8410 network analyzers. Sequential sync, sweep dwell, and 1 volt/GHz are available from the rear panel. The Model 6247D plug-in furnishes continuous coverage over the 10 MHz to 18 GHz range of the 8410C.

Preset Frequencies

Option 4 includes a panel switch on which three bands, such as C, X or Ku, can be preset. This option is particularly useful when tests are made over repetitive frequency ranges.

General Purpose Interface Bus

Option 16 conforms to IEEE-488 and provides digital frequency control with 10,000 point resolution over the full range of the plug-in. Other features included are a programmable remote sweep triggering capability and a programmable residual FM quieting filter.

Specifications

Frequency Range: 100 kHz to 40 GHz, determined by plug-in range. Please see pages 62 and 63.
Frequency Dial: 18.5 cm (7.3 in.) linear scale, machine divided.
Sweep Controls:
Start–Stop: Sweeps from F1 to F2. Both F1 and F2 are independently adjustable over the full range.
ΔF Sweep: Sweep is centered at Variable Frequency Marker setting. Width is adjustable from 0 to 10% of the band. Control reads directly in percent of the band, calibrated up to 10% with ±10% accuracy.
CW Operation: Single-frequency output may be switch-selected at either F1, F2, or Variable Marker settings.
Remote: Permits sweeping with external voltage or programming ΔF sweep and center frequency with external resistors or voltages. (Please see Option 4.)
Marker Outputs:
Variable Frequency Markers: Three types of variable marker outputs available with 1% of the band accuracy.
RF Pip: Reduces RF momentarily, amplitude adjustable.
Video Marker: Adds negative video pulse to vertical output.
Intensity Marker: Develops brightened dot on CRT trace by momentarily slowing sweep.
Sweep Time: Continuously adjustable in four decade ranges from 0.01 to 100 s per sweep.
Sweep Mode:
Auto: Sweep occurs automatically.
Line Sync: Sweep occurs automatically synchronized with power line.
Manual: Front-panel control provides continuous uncalibrated manual adjustment of frequency between the end frequencies set. The horizontal voltage out tracks the frequency.
Triggered: Single sweep is actuated by front-panel pushbutton or external signal (>1 μs, +1 to +25V) applied at rear.
RF Retrace: RF may be switched On or Off during retrace.
Leveling: External leveling may be achieved with a negative detector. In addition, internal leveling is standard on most plug-ins.
Modulation:
Internal AM: Square-wave modulation of 1 kHz, adjustable in frequency, with an On/Off ratio that is typically greater than 30 dB at rated output power.
External AM: 60 kHz bandwidth typical. Input impedance approximately 18K ohms, ac coupled.
External FM:
Sensitivity: ±1% of full band sweep per volt input.
Sensitivity (Option 28): 20 MHz/V or 6 MHz/V, switch selectable.
Maximum Input: ±10V peak.
Bandwidth (3 dB):
Models 6104C and 61084D: 60 kHz at 1% deviations.
40 kHz at 10% deviation.
Other Models (typical): 100 kHz at 10% deviation

Deviation:

Modulation Frequency	Frequency Range	Deviation	
		Standard	With Option 28
DC to 100 Hz	Full Band	10%	N/A
>100 Hz to 1 kHz	Full Band	1%	N/A
DC to 100 kHz	≤8 GHz >8 GHz	N/A	±50 MHz ±30 MHz
>100 kHz to 1 MHz	Full Band	N/A	±2 MHz

1V/GHz Output: Provides a reference voltage proportional to the output frequency.
Trigger Input: Permits external triggering of sweep with a pulse >1 ms, +1V to +25V.
Dwell Input: Slows the sweep when a ground potential is applied.
Horizontal Output: Direct coupled sawtooth 0 to +11.2V concurrent with the sweep.
Pen Lift Contacts: Provides contact closure during sweep.
Blanking Outputs:
Sequential Sync: Provides combined retrace blanking and bandswitch blanking signal.
Retrace Blanking: Provides selectable + or –6V during retrace
Bandswitch Blanking: Provides + or –10V during bandswitching.
Rear Panel Connectors and Switches:
115/230V line selector switch (50 or 400 Hz)
TRIGGER INPUT
BLANKING and BANDSWITCH BLANKING OUTPUTS
1V/GHz OUTPUT
EXT AM and EXT FM INPUTS
DWELL INPUT
INTERNAL AM switch and FREQUENCY ADJUST
REMOTE FREQUENCY PROGRAMMING terminals
FM/NORMAL switch
SEQUENTIAL SYNC OUTPUT
Line Power: 115/230 Vac, 50 to 400 Hz. 140 W max.
Dimensions: 17.8 H x 44.6 W x 34.6 D cm (7 H x 17-9/16 W x 13-5/8 D in.)
Weight:
Model 610D Mainframe: 8.2 kg (18 lb)
Shipping Weight: 11.8 kg (26 lb)
Plug-Ins: 4.5 kg (10 lb)
Shipping Weight (typical): 6.4 kg (14 lb)

Ordering Information

Model 610D Mainframe $3,150

Options: Up to three can be provided on the front option panel. However, Option 1, 4, and 11 are not available in the same instrument.
Option 1: Crystal-Controlled Frequency Marker Comb providing 1, 10, 50 and 100 MHz marker spacing $750
Option 2C: RF Detector, 50Ω, Type N female $300
Option 2D: RF Detector, 75Ω, Type N female $300
Option 4: Preset Frequencies enabling the setting of up to three output center frequencies and sweep widths on front option panel $175
Option 7: External Leveling Input on rear panel in parallel with front panel connector $10
Option 8: Variable Marker Out on rear panel providing pulse coincident with variable frequency marker $10
Option 11: Three additional variable markers $500
Option 14: External RF Marker Input on rear panel accepting 1 MHz to 1 GHz signal to produce a frequency marker. Option 1 must be ordered with Option 14 . . . . . $25
Option 16: IEEE–488 General Purpose Interface Bus . . . $1,100
Option 21: 75Ω Output Impedance for Model 6104C $65
Option 28: Phase Lock Capability. Not available on Models 6104C and 61084D $300
61084D/75: 75Ω Output Impedance for Model 61084D. 1.4 SWR, max $350

ACCESSORIES

P/N B383: Plug-In Extender Cable $95
P/N B533–2: Rack Mount Hardware for 610D $15
No charge when ordered with 610D.
P/N B588: Extender Card for 610D PC boards $25
P/N B7478: Adapter Cable for use with HP8410 . . . . . $60
P/N 2100–2: Interface Cable for Option 16, 2 m long $75
P/N 2100–4: Interface Cable for Option 16, 4 m long $95
2100–1 GPIB Cable, 1 m (3.3 ft) long $60
2100–2 GPIB Cable, 2 m (6.6 ft) long $75
2100–4 GPIB Cable, 4 m (13.2 ft) $95
2100–5 GPIB Cable, 0.5 m (1.65 ft) $55

Plug-In Sweep Generators (Cont.)

610D Series Plug-Ins

Plug-In Model	Frequency Range	Leveled Output Power (Maximum)	Leveled Power Variations (dB)	Leveling Slope Control	1 dB Step Attenuator Range (dB)	Frequency Accuracy (25°C)	Frequency Stability		
							With Temperature (Per °C)	With 10% Line Voltage Change	Frequency Pulling With 3:1 SWR
Multiband									
6221D 6221D–10	2 to 12.4 GHz	5 mW (+7 dBm) 10 mW (+10 dBm)	±0.6	Yes	–	±100 MHz	±0.05%	0.001%	0.02%
6225D 6225D–10	4 to 18.5 GHz	5 mW (+7 dBm) 10 mW (+10 dBm)	±0.9	Yes	–	±100 MHz	±0.05%	0.001%	0.02%
6237D 6237D–10 6237D–15	2 to 18.5 GHz	5 mW (+7 dBm) 10 mW (+10 dBm) 15 mW (+11.7 dBm)	±0.9	Yes	–	±100 MHz	±0.05%	0.001%	0.02%
6247D 6247D–10	10 MHz to 18.5 GHz	5 mW (+7 dBm) 10 mW (+10 dBm)	±1	Yes	–	±125 MHz	±0.05%	0.001%	0.02%
Dual Band									
6213D	10 MHz to 4.2 GHz	10 mW (+10 dBm)	±0.4	Yes	–	±25 MHz	±0.1%	0.001%	0.02% or 400 kHz
6215D	1 to 4 GHz	20 mW (+13 dBm)	±0.5	Yes	–	±40 MHz	±0.05%	0.001%	0.1%
6219D	2 to 8 GHz	10 mW (+10 dBm)	±0.5	Yes	–	±80 MHz	±0.05%	0.001%	0.02%
6223D	4 to 12.4 GHz	10 mW (+10 dBm)	±0.5	Yes	–	±80 MHz	±0.05%	0.001%	0.02%
6229D	7.9 to 18.5 GHz	8 mW (+9 dBm)	±0.8	Yes	–	±100 MHz	±0.05%	0.001%	0.02%
Single Band									
6104C	0.1 to 110 MHz	20 mW (+13 dBm)	±0.15	No	79	±1 MHz	±50 kHz	0.001%	1 kHz
61084D	1 to 1,500 MHz	10 mW (+10 dBm)	±0.2	Yes	79	±12 MHz	±500 kHz	0.001%	500 kHz
6109D	10 to 2,000 MHz	20 mW (+13 dBm)	±0.3	Yes	–	±20 MHz	±500 kHz	0.001%	500 kHz
6110D	1 to 2 GHz	20 mW (+13 dBm)	±0.5	Yes	–	±10 MHz	±0.01%	0.001%	0.5%
6112D	1.4 to 2.5 GHz	20 mW (+13 dBm)	±0.2	Yes	–	±10 MHz	±0.01%	0.001%	0.05%
6114D	2 to 4 GHz	20 mW (+13 dBm)	±0.5	Yes	–	±20 MHz	±0.01%	0.001%	0.01%
6116D	1.7 to 4.3 GHz	10 mW (+10 dBm)	±0.6	Yes	–	±20 MHz	±0.01%	0.001%	0.01%
6120D	3.6 to 6.5 GHz	20 mW (+13 dBm)	±0.3 (±0.03/30 MHz)	Yes	–	±15 MHz	±0.01%	0.001%	0.01%
6124D	4 to 8 GHz	10 mW (+10 dBm)	±0.4	Yes	–	±30 MHz	±0.01%	0.001%	0.01%
6126D	3.7 to 8.3 GHz	10 mW (+10 dBm)	±0.6	Yes	–	±40 MHz	±0.01%	0.001%	0.01%
6127D	5.9 to 9 GHz	10 mW (+10 dBm)	±0.3	Yes	–	±40 MHz	±0.01%	0.001%	0.01%
6128D	7.9 to 12.4 GHz	10 mW (+10 dBm)	±0.4	Yes	–	±50 MHz	±0.02%	0.001%	0.01%
6130D	12.4 to 18.5 GHz	10 mW (+10 dBm)	±0.5	Yes	–	±50 MHz	±0.03%	0.001%	0.01%
6131D	10 to 15.5 GHz	10 mW (+10 dBm)	±0.4	Yes	–	±40 MHz	±0.02%	0.001%	0.01%
6132D	17 to 22 GHz	5 mW (+7 dBm)	±0.8	Yes	–	±70 MHz	±0.05%	0.001%	0.02%
6136D–1	18 to 26.5 GHz	3 mW (+5 dBm)	–	Yes	–	±100 MHz	±0.05%	0.001%	0.05%
6140D–1	26.5 to 40 GHz	1 mW (0 dBm)	–	Yes	–	±200 MHz	±0.05%	0.001%	0.05%

[1] Measured in 30 Hz–28 kHz bandwidth at 115 Vac. Residual FM is increased approximately twofold at 50 Hz line frequency.
[2] Measured at maximum rated power.
[3] Excluding 5% band edges, where specification is –20 dBc.
[4] Output SWR is 1.3 from 2 to 8 GHz, 1.5 from 8 to 12.4 GHz, and 1.8 from 12.4 to 18.5 GHz.
[5] Harmonics are –20 dBc from 10 to 100 MHz and from 2 to 4.2 GHz (–17 dBc on 6247D) and –30 dBc from 100 MHz to 2 GHz and above 4.2 GHz.
[6] SWR is 1.4 from 10 MHz to 2 GHz, 1.3 from 2 to 8 GHz, 1.5 from 8 to 12.4 GHz, and 1.8 from 12.4 to 18.5 GHz.
[7] Nonharmonics are –30 dBc from 10 MHz to 2 GHz and –60 dBC from 2 to 4.2 GHz.

Amplitude Modulation Depth (dB)	Type Oscillator	Signal Purity			Output		Prices		Plug-In Model
		Residual FM[1] (kHz Peak)	Non-Harmonics[2] (dBc)	Harmonics[3] (dBc)	SWR	Connector	Internal and External Leveling	External Leveling Only (Model)–1	
									Multiband
20	Fundamental	35	–60	–30	Note 4	N	$11,700 $12,750	– –	6221D 6221D–10
20	Fundamental	35	–60	–30	Note 4	N	$12,750 $14,225	– –	6225D 6225D–10
20	Fundamental	35	–60	–30	Note 4	N	$14,500 $16,800 $19,200	– – –	6237D 6237D–10 6237D–15
20	Het. ≤2 GHz Fund. >2 GHz	50	–40, ≤2 GHz –60, >2 GHz	Note 5	Note 6	N	$19,425 $21,525	– –	6247D 6247D–10
									Dual Band
30	Het. ≤2 GHz Fund. >2 GHz	7	Note 7	Note 8	1.4	N	$8,200	–	6213D
20	Fundamental	10	–60	–30	1.35	N	$6,575	–	6215D
20	Fundamental	15	–60	–30	1.5	N	$6,575	–	6219D
20	Fundamental	15	–60	–30	1.5	N	$8,225	–	6223D
20	Fundamental	20	–60	–30	2	N	$8,575	–	6229D
									Single Band
15	Heterodyne	0.6	–40	–30	1.2	BNC	$5,200	–	6104C
20	Heterodyne.	5	–45	–30	1.4	N	$3,750	–	61084D
20	Heterodyne	7	–40	–30	1.3	N	$5,500	–	6109D
30	Fundamental	5	–60	–30	1.25	N	$4,225	$4,075	6110D
30	Fundamental	6	–60	–30	1.3	N	$4,325	$4,150	6112D
30	Fundamental	7	–60	–30	1.35	N	$4,125	$3,950	6114D
30	Fundamental	7	–60	Note 9	1.35	N	$4,500	$4,300	6116D
30	Fundamental	7	–60	–40	1.35	N	$4,600	$4,400	6120D
30	Fundamental	10	–60	–30	1.5	N	$5,025	$4,825	6124D
30	Fundamental	10	–60	Note 10	1.5	N	$5,550	$5,350	6126D
30	Fundamental	15	–60	–30	1.5	N	$5,200	$5,000	6127D
30	Fundamental	15	–60	–30	1.5	N	$4,750	$4,550	6128D
30	Fundamental	20	–60	–30	1.8	N	$5,075	$4,850	6130D
30	Fundamental	20	–60	–30	1.8	N	$5,550	$5,325	6131D
30	Fundamental	25	–60	–30	2.5	SMA	$6,975	$6,750	6132D
10	Fundamental	50	–60	–30	–	SMA	–	$7,150	6136D–1
10	Doubler	75	–60	–20	–	UG-599/U	–	$11,500	6140D–1

[8] Harmonics are –20 dBc from 10 to 100 MHz, –30 from 100 MHz to 2 GHz, –20 dBc from 2 to 2.2 GHz, and –30 dBc from 2.2 to 4.2 GHz.
[9] Harmonics are –20 dBc from 1.7 to 2.2 GHz and –30 dBc from 2.2 to 4.2 GHz.
[10] Harmonics are –20 dBc from 3.7 to 4.4 GHz and –30 dBc from 4.4 to 8.3 GHz.

Options:
Option 21: 75Ω Output Impedance for Model 6104C $100
Option 28: Phase Lock Capability. Not available on Models 6104C and 61084D $300
61084D/75: 75Ω Output Impedance for Model 61084D. 1.4 SWR Max $350

Precision Measurement Components

General Information

Precision Components – Precision Measurements

This section of the catalog describes a complete line of precision components which can be used with the Models 561 and 560A Scalar Network Analyzers (pages 32 and 37) and the Model 6400 RF Analyzer (page 38) or with other instruments to provide the most accurate measurements.

SWR Autotesters and Bridges

SWR Autotesters and SWR Bridges are directional measurement devices that separate the incident and the reflected signals of a device under test. The reflected component can then be compared to the incident signal to determine the difference between the device's impedance and its characteristic impedance.

The directivity of the SWR Autotester or bridge is the measure of how well the incident and reflected signals can be separated. For example, 40 dB directivity means that the error signal in the output is 40 dB below the reflected signal to be measured. This error signal is present regardless of the magnitude of the reflected signal; therefore, the smaller the reflected signal being measured, the greater the potential error introduced by directivity. When using a device with 40 dB directivity to make a 20 dB return loss measurement, the uncertainty, or possible error due to directivity, is +0.829 dB to –0.9151 dB. If the measured return loss is 30 dB, the uncertainty increases to +2.3866 dB to –3.3018 dB or a total of 5.6884 dB.

The RF Measurement Chart can be used to determine the uncertainty due to directivity. The "X dB Below Reference" column represents the difference between the directivity and the measured reflection (return loss). The "1 + XdB" and "1 – X dB" values are the algebraic sum of the error signal and the measured reflected signal as their phase relationship varies over 360°. Therefore, the peak-to-peak ripple (1 ± X) is the total measurement uncertainty caused by the error signal. If the error and directivity signals are equal, 1 + X dB equals 6 dB (voltage doubled causes 6 dB change) and 1 – X dB becomes infinite, since the two signals are equal in amplitude and 180° out of phase (zero voltage). Uncertainty curves (next page) show the measurement uncertainty with a 35 dB directional device.

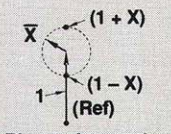
It is clear that high directivity is a very important consideration when selecting a directional device for reflection measurements. Equally important is that the device under test be connected directly to the test port of the SWR Autotester or bridge. An adapter inserted between the test device and the test port decreases the effective directivity.

To avoid the use of adapters, Wiltron offers SWR Autotesters and SWR Bridges with all common connector types, male and female interfaces.

For a detailed discussion of error analysis, please contact your Wiltron sales representative and request *Technical Review* Number 5, "Why Tolerate Unnecessary Measurement Errors?"

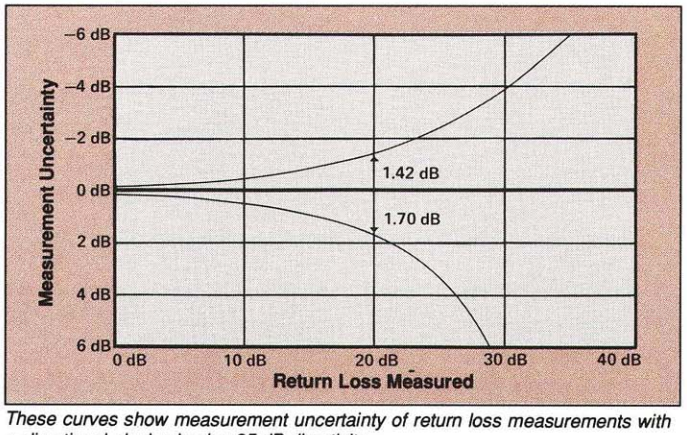
RF Measurement Chart

Conversion tables for return loss, reflection coefficient, and SWR with values for interactions of a small phasor X with a large phasor (unity reference) expressed in dB related to reference.



Phasor Interaction

			Relative to Unity Reference			
SWR	Reflection Coefficient	Return Loss (dB)	X dB Below Reference	Ref + X (dB)	Ref – X (dB)	Ref ± X Pk to Pk Ripple (dB)
17.3910	.8913	1	1	5.5350	–19.2715	24.8065
8.7242	.7943	2	2	5.0780	–13.7365	18.8145
5.8480	.7079	3	3	4.6495	–10.6907	15.3402
4.4194	.6310	4	4	4.2489	– 8.6585	12.9073
3.5698	.5623	5	5	3.8755	– 7.1773	11.0528
3.0095	.5012	6	6	3.5287	– 6.0412	9.5699
2.6146	.4467	7	7	3.2075	– 5.1405	8.3480
2.3229	.3981	8	8	2.9108	– 4.4096	7.3204
2.0999	.3548	9	9	2.6376	– 3.8063	6.4439
1.9250	.3162	10	10	2.3866	– 3.3018	5.6884
1.7849	.2818	11	11	2.1567	– 2.8756	5.0322
1.6709	.2512	12	12	1.9465	– 2.5126	4.4590
1.5769	.2239	13	13	1.7547	– 2.2013	3.9561
1.4985	.1995	14	14	1.5802	– 1.9331	3.5133
1.4326	.1778	15	15	1.4216	– 1.7007	3.1224
1.3767	.1585	16	16	1.2778	– 1.4988	2.7766
1.3290	.1413	17	17	1.1476	– 1.3227	2.4703
1.2880	.1259	18	18	1.0299	– 1.1687	2.1986
1.2528	.1122	19	19	.9237	– 1.0337	1.9574
1.2222	.1000	20	20	.8279	– .9151	1.7430
1.1957	.0891	21	21	.7416	– .8108	1.5524
1.1726	.0794	22	22	.6639	– .7189	1.3828
1.1524	.0708	23	23	.5941	– .6378	1.2319
1.1347	.0631	24	24	.5314	– .5661	1.0975
1.1192	.0562	25	25	.4752	– .5027	.9779
1.1055	.0501	26	26	.4248	– .4466	.8714
1.0935	.0447	27	27	.3796	– .3969	.7765
1.0829	.0398	28	28	.3391	– .3529	.6919
1.0736	.0355	29	29	.3028	– .3138	.6166
1.0653	.0316	30	30	.2704	– .2791	.5495
1.0580	.0282	31	31	.2414	– .2483	.4897
1.0515	.0251	32	32	.2155	– .2210	.4365
1.0458	.0224	33	33	.1923	– .1967	.3890
1.0407	.0200	34	34	.1716	– .1751	.3467
1.0362	.0178	35	35	.1531	– .1558	.3090
1.0322	.0158	36	36	.1366	– .1388	.2753
1.0287	.0141	37	37	.1218	– .1236	.2454
1.0255	.0126	38	38	.1087	– .1100	.2187
1.0227	.0112	39	39	.0969	– .0980	.1949
1.0202	.0100	40	40	.0864	– .0873	.1737
1.0180	.0089	41	41	.0771	– .0778	.1548
1.0160	.0079	42	42	.0687	– .0693	.1380
1.0143	.0071	43	43	.0613	– .0617	.1230
1.0127	.0063	44	44	.0546	– .0550	.1096
1.0113	.0056	45	45	.0487	– .0490	.0977
1.0101	.0050	46	46	.0434	– .0436	.0871
1.0090	.0045	47	47	.0387	– .0389	.0776
1.0080	.0040	48	48	.0345	– .0346	.0692
1.0071	.0035	49	49	.0308	– .0309	.0616
1.0063	.0032	50	50	.0274	– .0275	.0549
1.0057	.0028	51	51	.0244	– .0245	.0490
1.0050	.0025	52	52	.0218	– .0218	.0436
1.0045	.0022	53	53	.0194	– .0195	.0389
1.0040	.0020	54	54	.0173	– .0173	.0347
1.0036	.0018	55	55	.0154	– .0155	.0309
1.0032	.0016	56	56	.0138	– .0138	.0275
1.0028	.0014	57	57	.0123	– .0123	.0245
1.0025	.0013	58	58	.0109	– .0109	.0219
1.0022	.0011	59	59	.0097	– .0098	.0195
1.0020	.0010	60	60	.0087	– .0087	.0174



These curves show measurement uncertainty of return loss measurements with a directional device having 35 dB directivity.

RF Detectors

Just as directivity is the principle error contributor in reflection measurements, the impedance match of the signal source and RF detector is the largest error contributor in transmission measurements.

Wiltron offers a complete line of coaxial RF detectors covering from 100 kHz to 40 GHz with the lowest SWR available. The excellent impedance match of the detectors, along with that of the test port on the SWR Autotesters and bridges, minimize errors when making simultaneous transmission and reflection measurements.

The principle error signals present in a transmission measurement are shown to the right. Typically, when Wiltron measurement components are used in transmission measurements, the uncertainty of a 20 dB to 30 dB insertion loss measurement is ±0.2 dB to ±0.4 dB. If RF detectors and sources with high SWR are substituted, the uncertainty can easily exceed ±1.0 dB.

Wiltron *Technical Review* Number 13, " An Easy-To-Follow Method For Determining The Accuracy of Microwave Attenuation Gain and Insertion Loss Measurements" is available upon request.

Precision Terminations, Air Lines, and Adapters

Wiltron is recognized as the leader in the field of impedance standards. The company's complete line of components, including terminations and air lines, provide 60 dB accuracy in impedance measurements. Not only do these products increase measurement accuracy, they also provide the only method of certifying the performance of SWR Autotester, bridges, directional couplers, terminations, and other devices.

A series of precision measurement adapters are available to adapt one connector type to another. Adapters can be a major source of measurement error and, therefore, must be carefully selected. Wiltron precision adapters typically have 6 dB better return loss than competitive units.

The new 35 Series Waveguide-to-Coax Adapters use Wiltron K Connectors which are fully SMA compatible and extend the coaxial frequency range up to 46 GHz.

Model 41K Series Precision Attenuators

As discussed above, the SWR of the source and RF detector is very important in minimizing transmission measurement errors. One of the simplest ways to improve impedance match is to insert a precision attenuator between the device under test and the source or RF detector. The 41K Series attenuators are specifically designed for such applications where accuracy is a basic requirement.

In addition to being available as individual units of 3, 6, 10, or 20 dB, the 41K Fixed Attenuators are also available in sets with calibration data.

Model 43K Series Fixed Attenuators

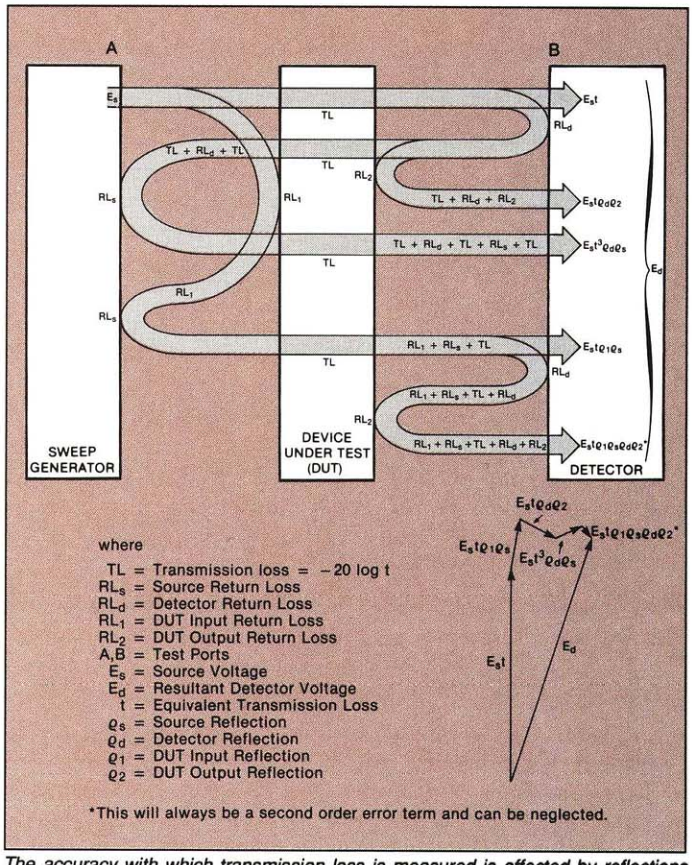
Many other attenuator applications have as their principle objective the reduction of power. Since the attenuator might not be inserted at a measurement point, the measurement precision discussed earlier is not required. In such a power-reducing system application, attenuators are often required in large quantities, making price an important consideration.

The 43K Series includes models from dc to 18 GHz, dc to 26.5 GHz, and dc to 40 GHz. All are available with 3, 6, 10, or 20 dB attenuation values. All have the Wiltron K Connectors and are compatible with SMA connectors.

Whatever your fixed attenuator needs might be, Wiltron provides the solution.

Power Dividers

The Wiltron K240C is the first power divider to operate from dc to 40 GHz. In addition, there is the Model K240B for the dc to 26.5 GHz range. Both models use the Wiltron K Connector on all ports.

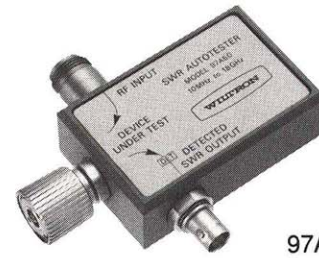


The accuracy with which transmission loss is measured is affected by reflections and re-reflections from the source, DUT input, DUT output, and detector mismatches. The value of the total measurement uncertainty is dependent on the magnitude and phase relationship of the signals shown.

SWR Autotesters

Model 59A50 and 97 Series, 10 MHz to 18 GHz

59A50



97A50

59 Comparison SWR Autotester Highlights

- Compatibility with Ripple Extraction Technique for Accurate SWR Measurements with 60 dB Effective Directivity
- 10 MHz to 18 GHz Frequency Range
- Integrated Microwave Bridge and Detector
- SWR Measurements Down to 1.006
- Precision GPC–7 Test and Reference Port Connectors

When combined with an 18A50 Air Line (page 70) and a 29A50–20 Reference Offset Termination (page 71) in the Ripple Extraction test setup described in *Wiltron Technical Review* #8, the 59A50 makes precise SWR measurements with an effective directivity of 57 dB. Contained in the small package is a broadband microwave bridge and a detector.

Specifications

Model	Test and Reference Port Connectors	Directivity (dB)	Accuracy ①②		Price
			10 MHz–8 GHz	>8–18 GHz	
59A50	GPC–7	36	$0.016\pm0.06\rho^2$	$0.016\pm0.10\rho^2$	$1,800

Frequency Range: 10 MHz to 18 GHz
Frequency Sensitivity: ±1.5 dB maximum
Accuracy:③ $0.0014\pm0.01\rho^2$
Insertion Loss: 6.5 dB nominal④
Detector Polarity: Negative
SWR Output Time Constant: 2 µs
Maximum Input Power: 0.5 W
Input Connector: Type N Female stainless steel.
Detector Output Connector: BNC Female
Dimensions: 7.6 x 5 x 2.8 cm (3 x 2 x 1-1/8 in.) plus connectors.
Weight: 340 g (12 oz)

Companion Equipment: 561 Network Analyzer, 6600B Sweep Generator, 29A50–20 Precision Termination, and an 18A50 Air Line.

① Including effects of test port reflections and directivity.
② Where ρ is the measured reflection coefficient.
③ When used with the Ripple Extraction method (*Wiltron Technical Review* #8).
④ Typically 9 dB at 18 GHz from RF input port to test port.

97 Broadband SWR Autotester Highlights

- High 40 dB Directivity
- Low Test Port Reflections
- Broadband 10 MHz to 18 GHz Frequency Range
- Small Package Including Bridge, Termination, and Detector
- Selection of GPC–7, WSMA, or Type N Test Port Connector

These precision SWR Autotesters integrate in one small package a broadband microwave bridge, a precision termination, a detector, and a GPC–7, Type N, or WSMA test port connector. With high directivity and low test port reflections, the 97 Series provides accurate return loss (SWR) measurements over the 10 MHz to 18 GHz range. An accuracy equation is provided for every model.

Specifications

Model	Test Port Connector	Directivity (dB)	Accuracy ①②		Price
			10 MHz–8 GHz	>8–18 GHz	
97A50	GPC–7	36	$0.016\pm0.06\rho^2$	$0.016\pm0.1\rho^2$	$1,900
97A50–1	GPC–7	40	$0.010\pm0.06\rho^2$	$0.010\pm0.1\rho^2$	$2,200
97N50 97NF50	Type N Male Type N Female	35	$0.018\pm0.08\rho^2$	$0.018\pm0.12\rho^2$	$1,900
97N50–1 97NF50–1	Type N Male Type N Female	38	$0.013\pm0.08\rho^2$	$0.013\pm0.12\rho^2$	$2,200
97S50 97SF50	WSMA Male WSMA Female	35	$0.018\pm0.08\rho^2$	$0.018\pm0.12\rho^2$	$1,900
97S50–1 97SF50–1	WSMA Male WSMA Female	38	$0.013\pm0.08\rho^2$	$0.013\pm0.12\rho^2$	$2,200

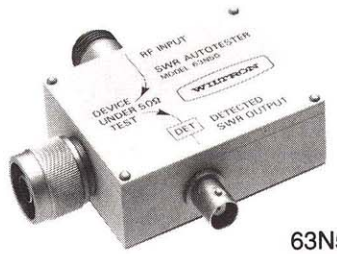
Frequency Range: 10 MHz to 18 GHz
Frequency Sensitivity: ±1.5 dB maximum
Insertion Loss: 6.5 dB nominal③
Detector Polarity: Negative
SWR Output Time Constant: 2 µs
Maximum Input Power: 0.5 W
Input Connector: Type N Female stainless steel.
Detector Output Connector: BNC Female
Dimensions: 7.6 x 5 x 2.8 cm (3 x 2 x 1-1/8 in.) plus connectors.
Weight: 340 g (12 oz)

Companion Equipment: 561 Network Analyzer, 6600B Sweep Generator, 28 Series Termination, and 18 Series Air Line.

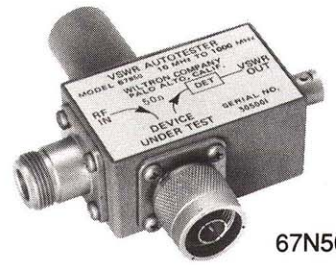
① Including effects of test port reflections and directivity.
② Where ρ is the measured reflection coefficient.
③ Typically 8.5 dB at 18 GHz from RF input port to test port.

SWR Autotesters

63 and 67 Series, 10 to 4200 MHz



63N50



67N50

63 Precision SWR Autotester Highlights

- 10 to 4200 MHz Frequency Range
- Precision Stainless Steel Test Port Connector
- Small Package Containing RF Bridge, Reference Termination, and a Detector
- Directivity Better Than 46 dB

With directivity that is better than 46 dB, these highest performing SWR Autotesters provide SWR measurement accuracy of $0.005 \pm 0.06\rho^2$, where ρ is the measured reflection coefficient. In addition to a GPC–7 test port connector, the series offers stainless-steel Type N connectors that conform to MIL–G–39012. All models include a built-in microwave bridge, reference termination, and a negative output detector.

Specifications

Model	Test Port Connector	Frequency Range (MHz)	Directivity (dB)	Accuracy①	Price
63A50	GPC–7	10 to 4000	40	$0.01 \pm 0.06\rho^2$	$875
63A50–1			46	$0.005 \pm 0.06\rho^2$	$1,000
63A50–2	GPC–7	10 to 4200	40	$0.01 \pm 0.06\rho^2$	$1,000
63A50–1,2			46②	$0.005 \pm 0.06\rho^2$	$1,200
63N50	N Male	10 to 4000	40	$0.01 \pm 0.06\rho^2$	$775
63N50–1			46	$0.005 \pm 0.06\rho^2$	$900
63N50–2	N Male	10 to 4200	40	$0.01 \pm 0.06\rho^2$	$900
63N50–1,2			46②	$0.005 \pm 0.06\rho^2$	$1,100
63NF50	N Female	10 to 4000	40	$0.01 \pm 0.06\rho^2$	$800
63NF50–1			46	$0.005 \pm 0.06\rho^2$	$925
63NF50–2	N Male	10 to 4200	40	$0.01 \pm 0.06\rho^2$	$925
63NF50–1,2			46②	$0.005 \pm 0.06\rho^2$	$1,150

Impedance: 50Ω
Insertion Loss: 6.5 dB nominal from intput to test port.
Detector Polarity: Negative
SWR Output Time Constant: 2 µs
Maximum Input Power: 0.5 W
Input Connector: Type N Female, stainless steel.
Detector Output Connector: BNC Female.
Dimensions: 6.7 x 5.1 x 2.54 cm (2-5/8 x 2 x 1 in.) plus connectors.
Weight: 340 g (12 oz)

Companion Equipment: 561 Network Analyzer and 6600B Sweep Generator.

① Where ρ is measured reflection coefficient.
② Over 10 to 4000 MHz range.

67 Low-Cost SWR Autotester Highlights

- 50 or 75Ω Impedance
- Type N, F, or BNC Test Port Connectors
- 10 to 1000 MHz Frequency Range
- Low Price Includes Built-In Bridge, Reference Termination, and Detector.

Compared to a reflectometer setup, slotted line, or a lower-directivity bridge device, the 67 Series offers the advantages of convenience, accuracy and cost saving. With an integrated RF bridge, reference termination, and detector, these units provide an output that is direct reading in SWR without the need for calibrated mismatches or terminations. Specifications give an overall accuracy equation that includes the effects of the termination, detector, and reflections from the test port connector. All models are available in 50 or 75Ω impedance. The 75Ω Models 67N75 and 67NF75 are fitted with a special Type N female input connector that will not be damaged if mated with a 50Ω connector.

Specifications

Model	Test Port Connector	Input Impedance (Ohms)	Price
67B50	BNC Male	50	$375
67BF50	BNC Female		$400
67B75	BNC Male	75	$400
67BF75	BNC Female		$425
67FF75	F Female	75	$400
67N50	N Male	50	$500
67NF50	N Female		$500
67N75	N Male	75	$525
67NF75	N Female		$525

Frequency Range: 10 to 1000 MHz
Directivity: 40 dB
Accuracy: $0.01 \pm 0.1\rho^2$, where ρ is the measured reflection coefficient.
Insertion Loss: 6.5 dB nominal from input to test port.
Detector Output Polarity: Negative
SWR Output Time Constant: 2 µs
Maximum Input Power: 0.5 W
Video Impedance: <15K ohms at –15 dBm
Input Connector: BNC Female., Type N Female on 67N50, 67NF50, 67N75, and 67NF75 .
Detector Output Connector: BNC Female
Dimensions: 5.7 x 3.5 x 2.86 cm (2-1/4 x 1-3/8 x 1-1/8 in.) plus connectors.
Weight: 170 g (6 oz)

Companion Equipment: 561 Network Analyzer and 6600B Sweep Generator.

SWR Bridges

Model 58A50 and 87 Series, 2 to 18 GHz

58A50

87A50

58A50 Comparison SWR Bridge Highlights

- Measurement Capability to 1.006 SWR
- Broad 2 to 18 GHz Frequency Range
- Compatibility with Ripple Extraction Technique for Accurate SWR Measurements with 57 dB Effective Directivity
- Precision GPC–7 Test Port Connector

When used with an 18A50 Precision Air Line (page 70) and a 29A50–20 Reference Offset Termination (page 71) in the Ripple Extraction test setup described in *Wiltron Technical Review* #8, the 58A50 makes accurate SWR measurements down to 1.006 (50 dB return loss). With an effective directivity of 57 dB, this SWR Bridge is the best choice for accurate measurement of very small reflections over the 2 to 18 GHz range.

Specifications

Frequency Range: 2 to 18 GHz
Directivity: 35 dB
Accuracy: ①② $0.0014 \pm 0.01\rho^2$, where ρ is the measured reflection coefficient.
Insertion Loss: 6.5 dB nominal③
Maximum Input Power: 0.5 W

Test Port Connector: GPC–7
Input and Output Connector: Type N Female.
Dimensions: 6.7 x 5.1 x 2.26 cm (2-5/8 x 2 x 7/8 in.) plus connectors.
Weight: 340 g (12 oz)

Model 58A50 . . . . . $1700

Companion Equipment: 18A50 Air Line, 29A50–20 Reference Offset Termination, 70 or 75 Series Detector, 561 Network Analyzer and 6600B Sweep Generator.

① Including the effects of test port reflections and directivity.
② When used with the Ripple Extraction method (*Wiltron Technical Review* #8).
③ Typically 9 dB at 18 GHz from input to test port.

87 Broadband SWR Bridge Highlights

- Broadband 2 to 18 GHz Frequency Range
- High 38 dB Directivity
- Precise GPC–7 Test Port Connector
- Built–In Reference Termination

The 87 Series SWR Autotesters are precision, high directivity measurement components—ideal for SWR and return loss measurements. Both models include a built-in termination and are provided with an overall accuracy equation. These SWR Bridges can be used for making very low-level SWR measurements by amplifying the RF output prior to detection. Since both the phase and amplitude of the reflected signal are preserved in the RF output, these components can also be used to make accurate phase comparisons in a network analyzer system.

Specifications

Model	Directivity (dB)	Accuracy① 2 to 3 GHz	Accuracy① > 3 to 4 GHz	Accuracy① > 4 to 18 GHz	Price
87A50	35	$0.018 \pm 0.31\rho^2$	$0.018 \pm 0.2\rho^2$	$0.018 \pm 0.12\rho^2$	$1,900
87A50–1	38	$0.013 \pm 0.31\rho^2$	$0.013 \pm 0.2\rho^2$	$0.013 \pm 0.12\rho^2$	$2,300

Frequency Range: 2 to 18 GHz
Insertion Loss: 6.5 dB nominal②
Maximum Input Power: 0.5 W

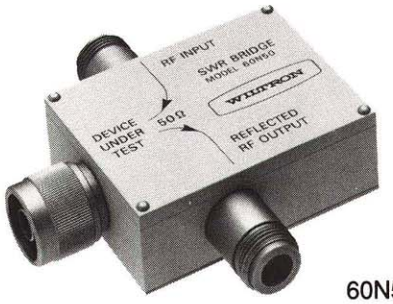
Test Port Connector: GPC–7
Input and Output Connector: Type N Female.
Dimensions: 7.3 x 5.1 x 2.86 cm (2-7/8 x 2 x 1-1/8 in.) plus connectors.
Weight: 340 g (12 oz)

Companion Equipment: 70 or 75 Series Detector, 561 Network Analyzer and 6600B Sweep Generator.

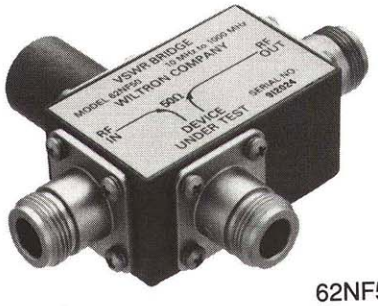
① Where ρ is the measured reflection coefficient.
② Typically 9 dB at 18 GHz from input to test port.

SWR Bridges

60 and 62 Series, 5 to 2000 MHz



60N50



62NF50

60 RF SWR Bridge Highlights

- 5 to 2000 MHz Frequency Range
- 46 dB Directivity
- GPC–7 or Type N Test Port Connector
- Built-In Reference Termination
- Attractive Hardwood Storage Case

The 60 Series RF SWR Bridges are precision devices, designed to make very accurate measurement of SWR over the 5 to 2000 MHz range. All models contain a built-in reference termination and preserve phase and amplitude of the reflected signal. For extremely low values of SWR, the RF output can be amplified before detection. Wiltron 73 or 74 Series RF Detectors (page 74) are perfect companions to the 60 Series SWR Bridges. Storage is convenient in the handsome hardwood case supplied.

Specifications

Model	Test Port Connector	Directivity (dB)	Price
60A50	GPC–7	40	$800
60A50–1		46	$950
60N50	N Male	40	$700
60N50–1		46	$850
60NF50	N Female	40	$700
60NF50–1		46	$850

Frequency Range: 5 to 2000 MHz
Accuracy:① $0.01 \pm 0.09\rho^2$, where ρ is the measured reflection coefficoefficient.
Insertion Loss: 6.5 dB nominal from input to test port.
Maximum Input Power: 0.5 W
Test Port Connector: GPC–7
Input and Output Connector: Type N Female.
Dimensions: 6.7 x 5.1 x 2.54 cm (2-5/8 x 2 x 7/8 in.) plus connectors.
Weight: 340 g (12 oz)

Companion Equipment: 73 or 74 Series Detector, 561 Network Analyzer and 6600B Sweep Generator.

① Including the effects of test port reflections and directivity.

62 RF SWR Bridge Highlights

- Exceptional Value at Low Cost
- 10 to 1000 MHz Frequency Coverage
- 40 dB Directivity
- 50 or 75 Ohm Impedance
- BNC and Type N Test Port Connector

The 62 Series SWR Bridges are low-cost SWR measurement components with 40 dB directivity and a choice of 50Ω or 75Ω impedance. Every model includes a highly accurate internal reference termination. Models 62N75 and 62NF75 are fitted with special Type N female input connectors that will not be damaged if mated with a 50Ω connector. For accurate SWR measurements over the 10 to 1000 MHz range, the 62 Series has no equal. For optimum performance, a 73 or 74 RF Detector (page 74) is recommended.

Specifications

Model	Test Port Connector	Input Impedance (Ohms)	Price
62B50	BNC Male	50	$400
62BF50	BNC Female		$400
62B75	BNC Male	75	$475
62BF75	BNC Female		$475
62FF75	F Female	75	$475
62N50	N Male	50	$400
62NF50	N Female		$400
62N75	N Male	75	$475
62NF75	N Female		$475

Frequency Range: 10 to 1000 MHz
Accuracy:① $0.01 \pm 0.12\rho^2$, where ρ is the measured reflection coefficient.
Insertion Loss: 6.5 dB nominal from input to test port.
Maximum Input Power: 0.5 W
Input and Output Connector: Type N Female on 62N and 62NF; BNC Female on 62B, 62BF, and 62FF.
Dimensions: 5.7 x 3.5 x 2.86 cm (2-1/4 x 1-3/8 x 1-1/8 in.) plus connectors.
Weight: 170 g (6 oz)

Companion Equipment: 73 or 74 Series Detector, 561 Network Analyzer and 6600B Sweep Generator.

① Including the effects of test port reflections and directivity.

Air Lines and Open/Shorts

18, 19 Series, 2 to 26.5 GHz; 22 Series, DC to 40 GHz

22A

NEW

22K

22KF

18, 19 Air Line Highlights

- Virtually Lossless Gold Over Silver Plating
- Impedance Traceable to NBS Through Mechanical Dimensions
- SWR Measurements Down to 1.006 up to 18 GHz, 1.01 up to 26.5 GHz

Precision Air Lines provide both a standard impedance and a time delay for use in the Error Averaging Measurement System and the Ripple Extraction Measurement System, both described in *Wiltron Technical Review* #8. With these systems, SWR measurements can be made down to 1.006 up to 18 GHz and 1.01 up to 26.6 GHz

A beadless connector is used at the measurement end to provide a minimum reflection connection. The other end is beaded to keep the center conductor captive, thus fixing the plane of reference at the beadless end.

Specifications

Model	Frequency Range (GHz)	Test Port Connector	Beaded Port Connector	SWR	Dia. (mm)	Length (cm)	Price
18A50	2 to 18	GPC–7	GPC–7	1.003 (Test Port) 1.02 (Beaded End)	7	30	$900
18N50 18NF50	2 to 18	N Male N Female	GPC–7	1.006	7	30	$900 $900
19K50 19KF50	2 to 40	K Male K Female	K Male	1.015	2.9	15	$1,050 $1,050
19S50 19SF50	2 to 26.5	WSMA Male WSMA Female	WSMA Male	1.006 to 18 GHz, 1.01 to 26.5 GHz	3.5	25	$900 $900

Companion Equipment: 21A–1 Short with collated GPC–7 for use with 18A50 in a 5600–P1 Accuracy Enhancement System as described in Application Note TN 5600–2, 58A50 SWR Bridge or 59A50 SWR Autotester, and 29A50–20 Offset Termination.

22 Precision Open/Short Highlights

- Single Gold-Plated Component Providing Full Open and Short Reflections for Accurate SWR Measurements
- DC to 40 GHz Frequency Coverage
- GPC–7, K Connector™, Type N, WSMA, and BNC Connectors
- 50 or 75 Ohm Impedance

The 22 Series Open/Shorts are used on the test port of an SWR Autotester or SWR Bridge to establish a full reflection reference for accurate SWR measurements. When used with the 561 or 5600B Network Analyzers, the average of the open and short reflections over a swept frequency range can be automatically averaged to enhance measurement accuracy. Except for the 21A–1, which is a short only with a collet for mating with the beadless end of the 18A50 Air Line, all models consist of an open on one end and a short on the other.

Specifications

Model	Frequency Range (GHz)	Test Port Connector	Impedance (Ohms)	Price
21A–1	DC to 18	GPC–7 with collet for mating with beadless end of 18A50 Air Line	50	$100
22A50	DC to 18	GPC–7	50	$100
22BF50 22BF75	DC to 1	BNC Female	50 75	$100 $100
22N50 22NF50	DC to 18	N Male N Female	50	$150 $150
22N75 22NF75	DC to 2	N Male N Female	75	$175 $175
22K50 22KF50	DC to 40	K Male K Female	50	$175 $175
22S50 22SF50	DC to 26.5	WSMA Male WSMA Female	50	$150 $175

Coaxial Terminations

26, 28, 29 Series and Model K210, DC to 40 GHz

NEW

28K50

26N50

28A50–1

29S50–2

29A50–20

26, 28 Precision Termination Highlights

- Accurate Reference for SWR Measurements
- Precise Termination for Test Instrument or Device Under Test
- GPC–7, K Connector™, Type N, or WSMA Connectors
- Aged Termination for Long-Term Stability

These precision, metrology-grade terminations are used in measurement systems where achieving the smallest possible reflections is critical.

Specifications

Model	Frequency Range (GHz)	Test Port Connector	Input Impedance (Ohms)	SWR (F in GHz)	Price
26N50 26NF50	DC to 18	N Male N Female	50	1.004 + 0.0026F	$450 $450
26N75 26NF75	DC to 4	N Male N Female	75	1.004 + 0.0025F	$350 $350
28A50 28A50–1	DC to 18	GPC–7	50	1.01 + 0.001F 1.02	$550 $650
28K50 28KF50	DC to 40	K Male K Female	50	1.04 to 18.5 GHz 1.07 to 26.5 GHz 1.135 to 40 GHz	$650 $650
28S50	DC to 26.5	WSMA Male	50	1.036 to 18.5 GHz 1.173 to 26.5 GHz	$450
28S50–1	DC to 26.5	WSMA Male	50	1.02 o 1.5 GHz 1.135 to 26.5 GHz	$550
28SF50	DC to 26.5	WSMA Female	50	1.036 to 18.5 GHz 1.173 to 26.5 GHz	$450
28SF50–1	DC to 26.5	WSMA Female	50	1.02 to 18.5 GHz 1.135 to 26.5 GHz	$550
K210	DC to 40	K Male	50	1.1 to 18 GHz 1.25 to 40 GHz	$240

Maximum Input Power: 0.5 W

29 Offset Termination Highlights

- 50 Ohm Offset Terminations for Precise Measurement of Low SWR or High Directivity
- SWR Measuremtns Down to 1.006 Up to 18 GHz, 1.01 to 26.5 GHz

When used in the 5600–P1 Accuracy Enhancement System described in Application Note TN 5600–2, the 29 Series Offset Terminations permit SWR measurements down to 1.006 up to 18 GHz and 1.01 up to 26.5 GHz.

Specifications

Model	Frequency Range (GHz)	Test Port Connector	Return Loss (dB)	Price
29A50–20	DC to 18	GPC–7	20 ±0.5 to 1 GHz 20 ±1 to 4 GHz 20 ±1.5 to 18 GHz	$500
29S50–20	DC to 26.5	WSMA Male	20 ±1.5 to 18.5 GHz 20 ±2.5 to 26.5 GHz	$500
29SF50–20	DC to 26.5	WSMA Female	20 ±1.5 to 18.5 GHz 20 ±2.5 to 26.5 GHz	$500

Adapters

34, K220 and K230 Series, DC to 40 GHz

NEW

34KFKF50

34ASF50

34NN50A

34ANF50

NEW

K224

K222

K232

K230

34 Precision Adapter Highlights

- Low SWR and Insertion Loss
- GPC–7, K Connector™, Type N, and WSMA Connectors
- Convenient Transition with Minimal Effect on Signal
- 50 or 75 Ohm Impedance

The 34 Series of adapters enables accurate measurements with GPC–7, K Connector, Type N, or WSMA interfaces. Every adapter is fully specified and 100% tested to ensure low reflections and optimum phase performance over a broad frequency range. Furthermore, all WSMA adapters are phase matched to provide a consistent electrical length, whether a male or female connector is used.

Specifications

Model	Frequency Range (GHz)	Connectors	SWR	Price
34AN50 34ANF50	DC to 18	GPC–7 to N Male GPC–7 to N Female	1.02	$325 $350
34AS50 34ASF50	DC to 18	GPC–7 to WSMA Male GPC–7 to WSMA Female	1.033	$325 $350
34KFKF50	DC to 40	K Female to K Female	1.106 to 18.5 GHz 1.173 to 26.5 GHz 1.253 to 40 GHz	$250
34NN50A 34NFNF50	DC to 18	N Male to N Male N Female to N Female	1.1	$150 $200
34NN75A 34NFNF75	DC to 2	N Male to N Male N Female to N Female	1.2	$175 $200
34SFSF50	DC to 40	WSMA Female to WSMA Female	1.1 to 18.5 GHz 1.17 to 26.5 GHz	$175

Impedance: 50Ω, except 34NN75 and 34NFNF75 which are 75Ω.
Weight (typical): 92 g (3.25 oz).

K220, K222, K224 Adapter Highlights

- K Connector™ DC–40 GHz Frequency Range
- K Male/K Male, K Female/K Female, and K Male/K Female Models
- SMA and 3.5 mm Compatibility
- Quantity Discounts

The K220 Series is a low-cost, yet precise set of K Connector, SMA, and 3.5 mm adapters. With their low SWR and consistent phase length, the adapters are frequently used to adapt various test device connectors to the test port without degrading calibration parameters. Productivity is improved as adapters are installed without having to recalibrate the test system.

Specifications

Model	Frequency Range (GHz)	Connectors	SWR	Price
K220 K222 K224	DC to 40	K Male to K Male K Female to K Female K Female to K Male	1.2	$80 $80 $80

K230, K232, K234 Panel Adapter Highlights

- Inexpensive, Panel-Mounted Feedthru Adapter
- Broad DC to 40 GHz Frequency Range
- Compatibility With SMA and APC–3.5

The K230 Series is the panel-mounted version of the K220 Series Adapters. The units mount in a standard 3/8 in. "D" hole.

Specifications

Model	Frequency Range (GHz)	Connectors	SWR	Price
K230 K232 K234	DC to 40	K Male to K Male K Female to K Female K Female to K Male	1.2	$90 $90 $90

Ruggedized and W/G-to-Coaxial Adapters

34R Series, DC to 40 GHz; 35 Series, 7.5 to 50 GHz

34RKRK50

34RSN50


35WRD750K

NEW


35WR19K


35WR42K

34R Ruggedized Adapter Highlights

- Enhanced Reliability of Microwave Test Setup
- Easy-to-Grasp Type N Outside Diameter
- Rigid Test Connections for Improved Test Data Repeatability
- Compatibility with WSMA and K Connectors

The 34RKRK50 and 34RSN50 Adapters provide a rugged, rigid connection between a 6600 Series Sweep Generator that has a WSMA or K Connector output and Wiltron SWR Autotesters or SWR Bridges. Both adapters have an outside diameter equal to that of a Type N connector, adding mechanical strength to the test setup and making installation convenient and fast.

Specifications

Model	Frequency Range (GHz)	Connectors	SWR	Price
34RKRK50	DC to 40	RK Male to RK Male	2	$350
34RSN50	DC to 22	RS Male to N Male	1.25	$275

Impedance: 50Ω

35 Waveguide-to-Coaxial Adapter Highlights

- 7.5 to 50 GHz Frequency Coverage
- K Connector™ Compatibility with SMA and GPC–3.5
- Standard and Double-Ridge Designs

The 35 Series precision adapters transform standard or double-ridge waveguide to coaxial K Connectors and are compatible with SMA and 3.5 mm connectors. The twelve models listed below cover the 7.5 to 50 GHz range.

Specifications

Model	Frequency Range (GHz)	Connectors	W/G Flange UG–( )U	SWR	Price
35WR19K 35WR19KF	40 to 50 Usable to 54	WR19 to K Male WR19 to K Female	383	1.25	$375 $375
35WR22K 35WR22KF	33 to 50	WR22 to K Male WR22 to K Female	383	1.25	$375 $375
35WR28K 35WR28KF	26.5 to 40	WR28 to K Male WR28 to K Female	599	1.25	$275 $275
35WR42K 35WR42KF	18 to 26.5	WR42 to K Male WR42 to K Female	595	1.25	$250 $250
35WRD180K 35WRD180KF	18 to 40	WRD180 to K Male WRD180 to K Female	N/A	1.25	$350 $350
35WRD750K 35WRD750KF	7.5 to 18	WRD750 to K Male WRD750 to K Female	1580	1.25	$300 $300

Impedance: 50Ω
Maximum Input Power: 1 W

Microwave Detectors

70, 71, 73, 74, 75 Series, 100 kHz to 40 GHz


71B50


73N75


74N50


75A50

NEW


70KC50

NEW


75KC50

Detector Highlights

- Broadband Coverage: 10 MHz to 40 GHz with a Single Detector
- K Connector™ Compatibility with SMA and APC*–3.5
- Lowest SWR: 1.33 to 20 GHz, 1.5 to 40 GHz
- Flat Response: ±0.5 dB to 20 GHz, ±1.5 dB to 40 GHz
- Best Value for Instrumentation, System, and OEM Applications
- Low Price and Availability from Stock

Best Combination of Performance and Price

By using the latest design and microelectronics production technologies, Wiltron low-barrier Schottky-diode detectors outperform others and offer significant cost savings. Within this product line, you will find a model that matches your needs for instrumentation, system, or OEM applications. Eight frequency ranges varying from 100 kHz–2 GHz to 10 MHz–40 GHz allow you to select the exact coverage you need at the lowest possible cost. Input connector types include APC–7, type N, BNC and K Connector™, the last being compatible with SMA and APC–3.5 connectors. In addition to frequency coverage and price, these detectors are distinguished by their low SWR, flat frequency response, and close output-voltage tracking over a wide dynamic range.

Superior Performance

The degree to which a detector's output voltage accurately indicates the applied power is largely determined by the detector's impedance match, frequency response, and capability to produce a true logarithmic response. These detectors achieve superior performance by using specially designed Schottky diodes and Wiltron-developed, thin-film techniques for matching the diodes to the input transmission line. As a result, the broadband 70 and 75 series hold SWR to less than 1.5 to 26.5 GHz and 1.9 to 40 GHz, compared to 2.2 up to 26.5 GHz of competitive units. By reducing the error signals that result from reflections, the excellent match improves measurement accuracy. (At this time, there are no other 40 GHz detectors available with which to compare the Wiltron designs.)

SMA and APC–3.5 Compatibility

Operation up to 40 GHz is made possible by the Wiltron-developed K Connector. Because it is compatible with SMA and APC–3.5 connectors, you can standardize on a single detector to cover the 10 MHz to 40 GHz range. As an extra bonus, K Connector performance is superior to that of SMA below 18 GHz. And it is more reliable. Having been qualified to MIL-C-39012C, the K Connector contributes to the detectors' capability to withstand rough treatment in harsh environments.

Pulse Response

The pulse response of a detector is determined by its resistance, capacitance, and load impedance. The achievable rise time is given by the following equation:

$$t_r = 2.2 \left(\frac{R_V R_L}{R_V + R_L} \right) (C_O + C_L)$$

where R_V = diode video resistance, C_O = detector bypass capacitance, and $R_L + C_L$ = load characteristics. The standard detectors loaded with 1000 ohms have typical rise times of less than 50 ns.

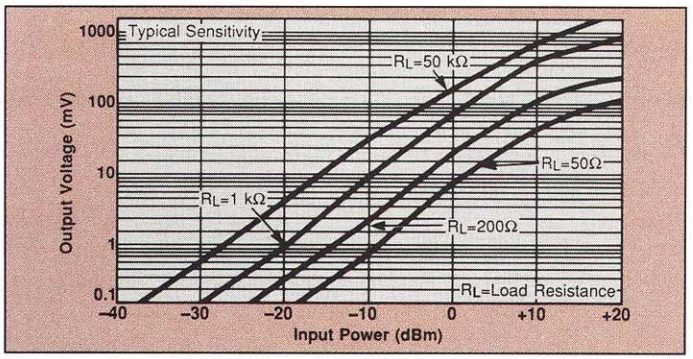
Field Replaceable Diodes

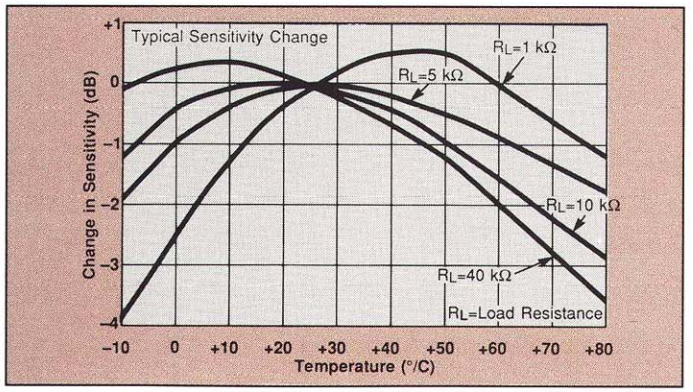
To avoid all degradation in performance when a diode is replaced in the field, Wiltron replacement modules include the thin-film matching circuit. Performance after replacement cannot be distinguished from that of a new detector.

* Trademark of Bunker Ramo Corp.

Specifications

Model	Frequency Range	Flatness (dB)	Connectors In	Connectors Out	Impedance (Ohms)	SWR Maximum	Low Level Sensitivity at –30 dBm (mV/μW)	High Level Sensitivity at +13 dBm (Volts, Min.)	Input Max. (mW)	Output Capacitance (pF)	Price
70KA50	0.01–20 GHz	± 0.5	K(m)	SMC(m)	50	1.33	0.5	1	100	30	$195
70KB50	0.01–26.5 GHz	±0.5 to 20 GHz	K(m)	SMC(m)	50	1.33 to 20 GHz 1.5 to 26.5 GHz	0.5	1	100	30	$255
70KC50	0.01–40 GHz	± 0.5 to 20 GHz ±1 to 26.5 GHz ±1.5 to 40 GHz	K(m)	SMC(m)	50	1.33 to 20 GHz 1.5 to 26.5 GHz 1.9 to 40 GHz	0.5	1	100	30	$375
71B50	100 kHz–3 GHz	±0.5	BNC(m)	BNC(f)	50	1.2	0.35	1	100	500	$100
71B75	100 kHz–2 GHz	±0.5	BNC(m)	BNC(f)	75	1.25	0.35	1	100	500	$125
73N50	100 kHz–4 GHz	±0.5	N(m)	BNC(f)	50	1.2	0.35	1	100	500	$140
73N75	100 kHz–2 GHz	±0.5	N(m)	BNC(f)	75	1.2	0.35	1	100	500	$175
74N50B	0.01–12.4 GHz	±0.3	N(m)	BNC(f)	50	1.15 to 4.5 GHz 1.3 to 12.4 GHz	0.4	1	100	20	$145
75A50	0.01–18.5 GHz	±0.5 to 12.4 GHz ±1 to 18.5 GHz	GPC–7	BNC(f)	50	1.25 to 4.5 GHz 1.35 to 7 GHz 1.5 to 12.4 GHz 1.6 to 18.5 GHz	0.4	1	100	20	$300
75N50B	0.01–18 GHz	±0.3 to 12.4 GHz ±0.6 to 18 GHz	N(m)	BNC(f)	50	1.15 to 4.5 GHz 1.30 to 15 GHz 1.39 to 18 GHz	0.4	1	100	20	$210
75KA50	0.01–20 GHz	±0.5	K(m)	BNC(f)	50	1.33	0.4	1	100	20	$190
75KB50	0.01–26.5 GHz	±0.5 to 20 GHz ±1 to 26.5 GHz	K(m)	BNC(f)	50	1.33 to 20 GHz 1.5 to 26.5 GHz	0.4	1	100	20	$245
75KC50	0.01–40 GHz	±0.5 to 20 GHz ±1 to 26.5 GHz ±1.5 to 40 GHz	K(m)	BNC(f)	50	1.33 to 20 GHz 1.5 to 26.5 GHz 1.9 to 40 GHz	0.4	1	100	20	$345





Ordering Information

Negative Output Polarity: Please make selection from above table.

Positive Output Polarity: Add suffix P to the negative polarity model number. Price for 70KA50P, 70KB50P, 70KC50P, 75KA50P, 75KB50P, 75KC50P, 71B50P, 71B75P, and 73N50P . . . . . .Add $25
Price for 73N75P, 74N50P, 74S50P, 75A50P, and 75N50P. . . . . No additional charge

Option 2: Matches frequency response of two detectors:

Upper Frequency Limit (GHz)	≤8	≤12.4	≤18	≤26.5	≤40
Frequency Response Tracking (dB)	±0.2	±0.3	±0.6	±0.8	±1.2

Price . . . . . $20 per detector

Field Replaceable Diode Modules:

Series	Negative Polarity	Positive Polarity	Price
70K Series (≤20 GHz)	A16177	A18948	$50
70K Series (>20 GHz)	A16176	A18873	$70
71 and 73 Series	10–A2X985	10–A2X985	$25
74N50B	A18735	A18736	$50
75A50	10–75	10–75	$50
75N50B	B16132	A18694	$45
75K Series (≤20 GHz)	A16177	A18948	$50

Fixed Attenuators

41 and 43 Series, DC to 40 GHz

41KC–S

Fixed Attenuator Highlights

- 3, 6, 10, or 20 dB Attenuation Up to 40 GHz
- Low SWR, 1.25 Up to 40 GHz
- SMA and APC*–3.5 Compatibility
- Rugged and Reliable K Connector™

Advanced Performance and Reliability

The Wiltron fixed attenuators consist of two series: 1) the Gold Line (Series 41) for precision measurement applications, and 2) the Silver Line (Series 43) for use in systems and OEM equipment. Both series include a single unit covering the dc to 40 GHz range with attenuation values of 3, 6, 10, and 20 dB. Other models span the dc to 18 GHz and dc to 26.5 GHz ranges.

With the introduction of this new product line, Wiltron advances the accepted standards for fixed attenuator performance and reliability. For example, Gold Line Model 41KC–10 offers absolute attenuation accuracy of 0.5 dB to 26.5 GHz and 0.8 dB to 40 GHz. The SWR is 1.15 to 18 GHz, 1.18 to 26.5 GHz, and 1.28 at 40 GHz. But performance is not the only distinquishing feature. Because the attenuators use the new K Connector™, they can be connected directly to SMA or APC–3.5 devices. And compared to SMA, the K Connectors offer a vast improvement in reliability.

For applications in metrology and calibration laboratories where precise characterization is essential, the Gold Line models are available in sets consisting of 3, 6, 10, and 20 dB units, each provided with attenuation and SWR calibration data. Calibration data are also optionally available for individual units, each of which is serialized.

Design Features

There are several design features that account for the exceptional performance of Wiltron attenuators: 1) The geometry is small (2.9 mm), minimizing internal reflections and their adverse effect on frequency response and return loss. 2) The use of sputtered resistors provides accurate control of attenuation values over a broad frequency range. 3) The use of K Connectors improves reliability compared to SMA.

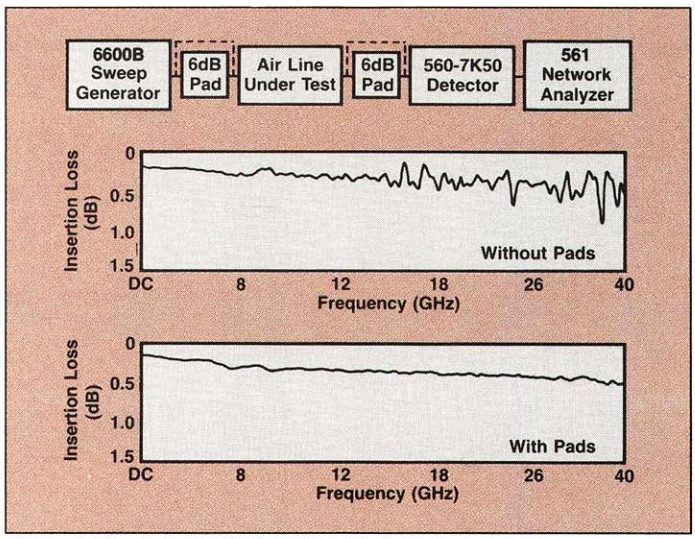
The new attenuators include the latest advances made in microwave thin-film technology. Miniaturization of the attenuator element is achieved by using sputtered tantalum nitride on both sides of a 0.127 mm (0.005 in.) Alumina circuit board. The board is mounted as an air dielectric suspended-substrate stripline. Tantalum nitride was selected as the resistive element for its exceptional stability with time and temperature.

The reliability of the attenuator connectors is affected by insertion force, outer conductor mating area, and mating alignment. The K Connector is used on Wiltron attenuators because it has excellent performance in all of these areas. For example, a typical female SMA center conductor requires 1.36 kg (3 lb) of insertion force compared to 0.23 kg (0.5 lb) for the K Connector. In addition, the K Connector's outer conductor is four times thicker than that of SMA, resulting in a conservative order of magnitude improvement in the number of reliable connections.

To avoid a major cause of connector failure, the K Connector male pin is deliberately made shorter than the SMA pin. Therefore, the outer housing is properly aligned prior to mating of the center conductors, preventing a destructive alignment.

Gold Line – Improved Measurement Accuracy

Adding Gold Line attenuators to your attenuation measurement setup will improve your measurement accuracy. In the test setup shown, the insertion loss of an air line was measured, first without and then with matching 6 dB pads. The difference in the accuracy of the two measurements is striking. By attenuating reflections and re-reflections that occur at the input and output of the air line, the pads reduce mismatch errors and allow the system to measure more accurately the actual insertion loss.



Adding 6 dB pads to an SWR test setup improves measurement accuracy.

* Trademark of Bunker Ramo Corp.

Silver Line – Improved System Reliability

Fixed attenuators used in systems or OEM equipment must be small, lightweight, economical, and reliable under severe environmental conditions. The Silver Line meets these requirements. K Connectors ensure well-seated, low-reflection connections that provide consistent operation year after year.

The small size, 8 mm dia. x 28.6 mm length (0.312 x 1.125 in.), and light weight, 8 g (0.28 oz), make the Series 43 an attractive choice for miniaturized, lightweight systems.

Discounts are available for OEM quantities.

Common Specifications

Impedance: 50 ohms
Power Rating (average): 2W at 20°C
1W at 85°C
Temperature Coefficient: 0.001 dB/dB/°C
Connectors: K Connector, male and female, compatible with SMA and APC–3.5.
Material: Passivated stainless steel housing.

Size:
Length: 28.6 mm (1.125 in.)
Diameter: 8 mm (0.312 in.)
Weight: 8 g (0.28 oz)
Temperature Range:
Operating: –55°C to +85°C
Nonoperating: –55°C to + 125°C

Ordering Information

Single Fixed Attenuators: Select from tables below.
Option C Calibration Data: Attenuation and SWR test data are provided for attenuation and SWR for input and output ports at 500 MHz frequency intervals . . . . . $30 per unit

Precision Fixed Attenuator Sets: A set of 3, 6, 10. and 20 dB Gold Line (Series 41) Attenuators are supplied in a handsome hardwood case. Calibration data are included for each unit.
Order:
Model 41KA–S (DC to 18 GHz) $590
Model 41KB–S (DC to 26.5 GHz) $870
Model 41KC–S (DC to 40 GHz) $1,150

Gold Line Specifications

Model	Absolute Attenuation* (dB)	Attenuation Accuracy			SWR				Price
		DC–18 GHz	>18–26.5 GHz	>26.5–40 GHz	DC–12 GHz	>12–18 GHz	>18–26.5 GHz	>26.5 –40 GHz	
DC to 40 GHz									
41KC–3	3	±0.4	±0.5	±0.8	1.10	1.15	1.25	1.43	$250
41KC–6	6	±0.4	±0.5	±0.8	1.10	1.15	1.18	1.28	$250
41KC–10	10	±0.4	±0.5	±0.8	1.10	1.15	1.18	1.28	$250
41KC–20	20	±0.4	±0.5	±0.8	1.10	1.15	1.18	1.28	$250
DC to 26.5 GHz									
41KB–3	3	±0.4	±0.5	–	1.10	1.15	1.25	–	$180
41KB–6	6	±0.4	±0.5	–	1.10	1.15	1.18	–	$180
41KC–10	10	±0.4	±0.5	–	1.10	1.15	1.18	–	$180
41KB–20	20	±0.4	±0.5	–	1.10	1.15	1.18		$180
DC to 18 GHz									
41KA–3	3	±0.4	–	–	1.10	1.15	–	–	$110
41KA–6	6	±0.4	–	–	1.10	1.15	–	–	$110
41KA–10	10	±0.4	–	–	1.10	1.15	–	–	$110
41KA–20	20	±0.4	–	–	1.10	1.15	–	–	$110

* For traceability, all Gold Line units are serialized.

Silver Line Specifications

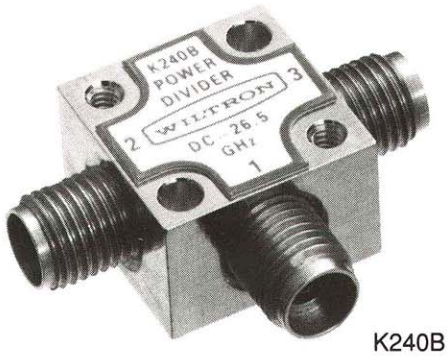
Model	Nominal Attenuation** (dB)	Attenuation Frequency Response (dB)			SWR				Price
		DC–18 GHz	>18–26.5 GHz	>26.5–40 GHz	DC–12 GHz	>12–18 GHz	>18–26.5 GHz	>26.5 –40 GHz	
DC to 40 GHz									
43KC–3	3	±0.5	±0.6	±0.9	1.15	1.20	1.30	1.50	$170
43KC–6	6	±0.5	±0.6	±0.9	1.15	1.20	1.30	1.40	$170
43KC–10	10	±0.5	±0.6	±0.9	1.15	1.20	1.30	1.40	$170
43KC–20	20	±0.5	±0.6	±0.9	1.15	1.20	1.30	1.40	$170
DC to 26.5 GHz									
43KB–3	3	±0.5	±0.6	–	1.15	1.20	1.30	–	$135
43KB–6	6	±0.5	±0.6	–	1.15	1.20	1.30	–	$135
43KB–10	10	±0.5	±0.6	–	1.15	1.20	1.30	–	$135
43KB–20	20	±0.5	±0.6	–	1.15	1.20	1.30		$135
DC to 18 GHz									
43KA–3	3	±0.5	–	–	1.15	1.20	–	–	$85
43KA–6	6	±0.5	–	–	1.15	1.20	–	–	$85
43KA–10	10	±0.5	–	–	1.15	1.20	–	–	$85
43KA–20	20	±0.5	–	–	1.15	1.20	–	–	$85

** ±1 dB from dc to 26.5 GHz; ±1.3 dB from >26.5 to 40 GHz, including frequency response.

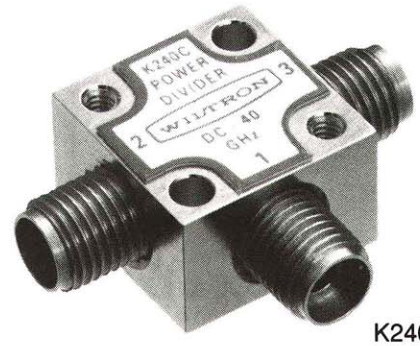
Power Dividers

K240 Series, DC to 40 GHz

NEW



K240B



K240C

K240 Power Divider Highlights

- DC to 40 GHz Frequency Range
- K Connector™ Compatibility with SMA and APC–3.5
- Excellent Amplitude and Phase Tracking
- One Watt Input Power Rating

These power dividers are symmetrical, three-resistor designs that can be used in applications where signals from dc to 40 GHz must be accurately divided or combined. K Connectors are used, ensuring compatibility with APC–3.5 and SMA. All models have exceptional amplitude and tracking characterisitics: ±0.6 dB and ±6° from dc to 40 GHz. These features, combined with small size and light weight, make this series suitable for system as well as measurement applications.

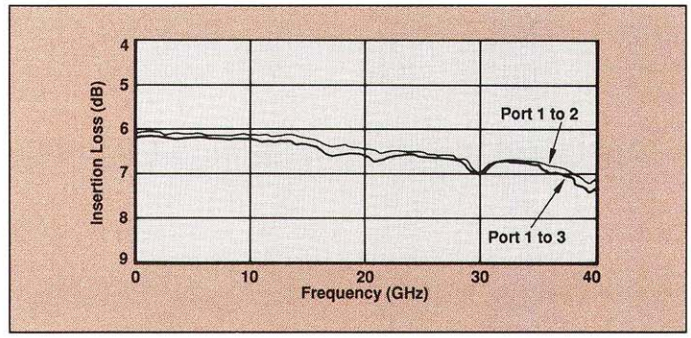
Specifications

Model	Frequency Range (GHz)	Price
K240B	DC to 26.5	$675
K240C	DC to 40	$790

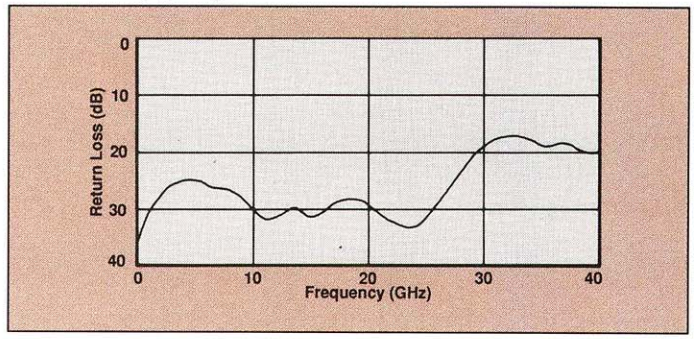
	Frequency Range (GHz)			
	DC to 6	>6 to 18	>18 to 26.5	>26.5 to 40
Tracking of Outputs Amplitude: Phase:	± 0.3 dB ± 2°	± 0.3 dB ± 3°	± 0.6 dB ± 4°	± 0.6 dB ± 6°
Insertion Loss (max.):	7 dB	7.5 dB	8 dB	8.5 dB
SWR:	1.2	1.4	1.5	1.7

Impedance: 50Ω
Maximum Input Power: 1 W
Connectors: K Female
Configuration: Tee
Dimensions: 15 x 15 x 9 mm (0.58 x 0.58 x 0.37 in.) plus connectors.
Weight: 43 gr (1.5 oz)

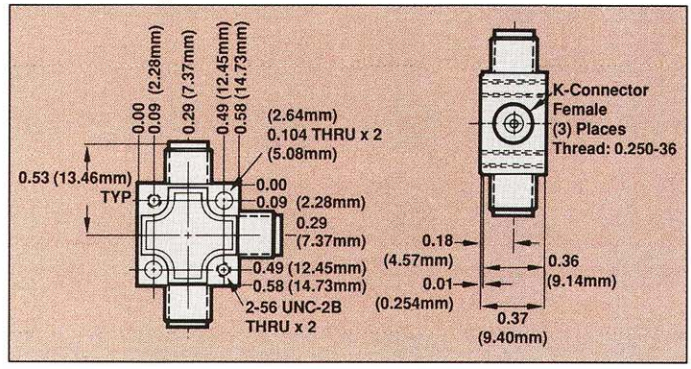
Insertion Loss (typical):



Return Loss (typical):



Outline Drawing:



K Connectors and Cable

General Information

DC to 46 GHz Coaxial Connectors

The K Connector™ family is a low-cost, SMA and 3.5 mm compatible connector system that has excellent performance from dc to 46 GHz and outperforms SMA below 18 GHz. Also in contrast to most SMA designs, the K Connector includes an integral transition and contact interface, hermetic seals, and field replaceable parts. Here is the one connector that can be accepted as the standard for devices, systems, instrumentation, and OEM applications.

On the following pages, you will find everything you need—launchers, connectors, cables, adapters, tools, fixtures, stress relief contacts, an evaluation kit—to begin designing in coax up to 46 GHz. Features you will appreciate include:

- DC to 46 GHz frequency range
- SMA and 3.5 mm compatibility
- Hermetic seals
- Currently available scalar and vector test equipment
- Field replaceable connectors
- Protected female contacts
- Complete set of tools, fixtures, and documentation
- Familiar assembly procedures
- Low-loss, stress-relieved connection to microcircuits
- Low-loss coaxial cable
- Rugged and reliable construction

Wiltron *K Commentary*

To keep you informed of new K Connector products, production techniques, and test procedures, we will be glad to send you each quarter a copy of the Wiltron *K Commentary*. Please call your local representative to have your name added to the mailing list.

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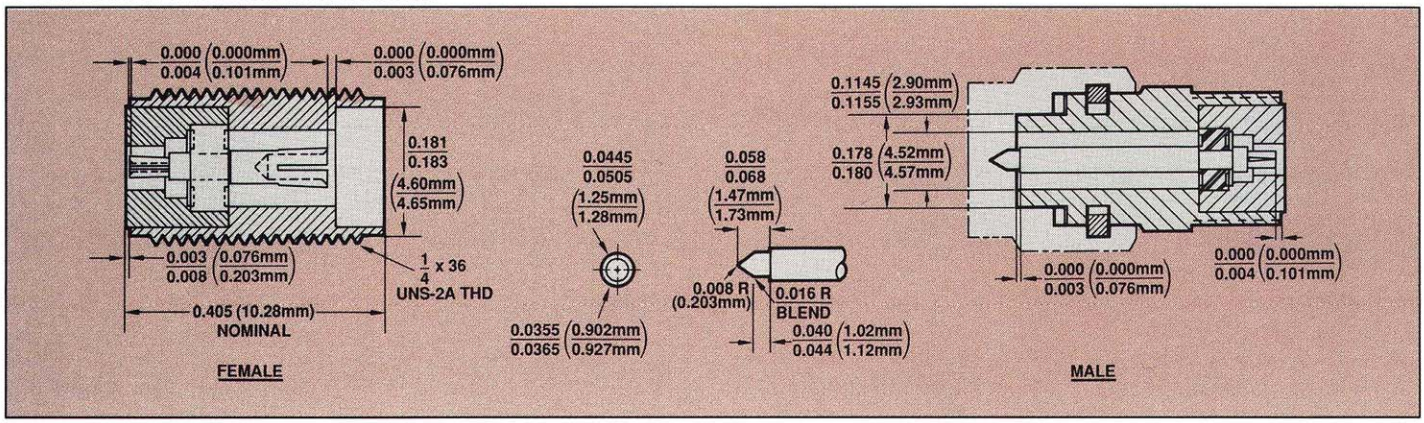
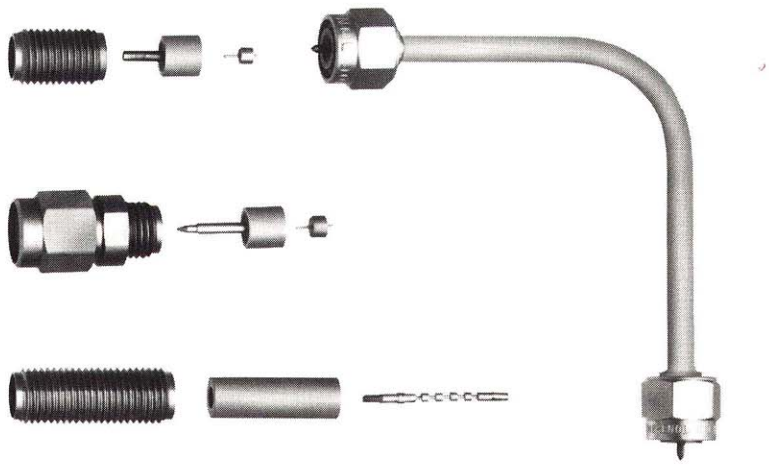
K Connector Interface Dimensions



K Connectors™ and Cable

K100, K200, and 01–100 Series; DC to 46 GHz



K Connector™ Highlights

- Excellent Performance Up to 46 GHz
- Performance Exceeding SMA Below 18 GHz
- Superior Reliability
- Compatibility With SMA and APC*–3.5
- Familiar Assembly Procedures
- Complete Testability on Existing Network Analyzers

Performance and Reliability at 46 GHz

The K Connector is a reliable, 2.92 mm device that operates up to 46 GHz and outperforms an SMA connector below 18 GHz. It is compatible with SMA, WSMA, and 3.5 mm connectors and is assembled using procedures that are similar to those used on SMA. It is well suited to applications in components, systems, or instrumentation.

Launcher Design

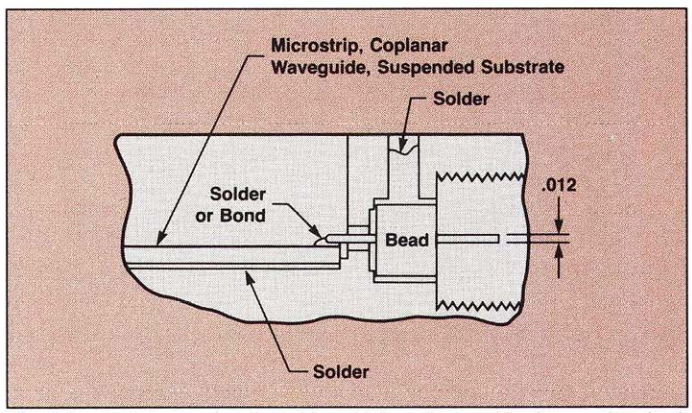
At the heart of the K Connector product line are the launchers. As their name implies, the launchers "launch" (make the transition) from a microwave circuit (microstrip, suspended substrate, stripline, or coplanar waveguide) to a coaxial connector and an outside transmission line. The key to making the transition without compromising electrical and mechanical objectives is the glass bead in the launcher assembly.

Low-Reflection Bead

The K Connector's standard glass bead has a unique 12 mil center conductor and readily connects to fragile devices. The bead is appropriate for most applications employing Duroid and ceramic (Alumina) microstrip, such as the 10 mil wide center conductor on a 10 mil thick Alumina substrate. Applications using suspended substrate geometries are equally well satisfied. The bead is constructed of Corning 7070 glass and has a gold-plated center conductor and a gold-plated Kovar collar. Other versions of the standard bead are available for the smaller geometry and stripline applications. These versions include a sliding contact for stress relief.

The outstanding design of the bead is largely accountable for the excellent performance of the K Connector launchers. Because the small 12 mil pin introduces minimal discontinuity, return loss is typically better than 20 dB at 40 GHz and better than 25 dB below 18 GHz. In addition, the design provides for soldering the bead to achieve a hermetic seal.

Both the sparkplug (screw-in) and the flange-mounted K Connector launchers offer an additional advantage over existing designs: These launchers do not use an epoxy pin to secure the center conductor, as used in some SMA designs. Without an epoxy pin, the outer conductor remains solid, and thereby eliminates the RF leakage path common to pin-captivated designs. Furthermore, the K launchers have a wall thickness which is four times that of SMA launchers (0.032 vs. 0.0088 inches). The heavier wall results in superior resistance to overtorquing. Finally, the K Connector launcher can be removed for repair without removal of the glass bead. This ensures that during removal the critical microcircuit-to-glass bead interface is not disturbed, that hermeticity is preserved, and that the microcircuit will not be subjected to the additional stress caused by heating to soldering temperature.



The K Connector's glass bead provides a high quality transition from a microcircuit to an outside transmission line.

* Trademark of Bunker Ramo Corp.

Exceptional Reliability and Repeatability

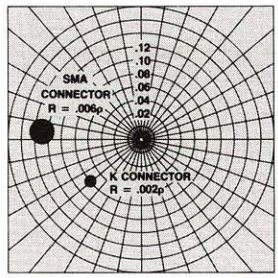
Microwave connector reliability is affected by insertion force, outer conductor strength, stress relief while mating, and mating alignment. The K Connector exhibits exceptional performance in all of these areas.

For proper seating, a standard SMA connector requires three pounds of insertion force. In contrast, the K Connector requires only 0.5 pounds. All other factors being equal, the reduced wear on the female center conductor equates to a 12-fold improvement in reliability. However, other factors are not equal. For example, the K Connector's outer conductor is four times thicker than that of SMA. Taken together, the lower insertion force and the thicker wall offer a conservative 30-fold improvement in the number of reliable connections typically available from an SMA. This estimate is confirmed by life tests which show that the K Connector makes approximately 10,000 connections with negligible change in electrical characteristics.

All K Connectors, including the cable connectors, incorporate one other feature that eliminates a major cause of connector failure. This failure is caused by misalignment of the male pin with respect to the female. To solve the problem, the K Connector male pin is deliberately made shorter than the SMA pin. With this arrangement, the outer housing is properly aligned prior to the mating of the center conductors. Thus a proper, non-destructive alignment before mating is ensured.

Threefold Improvement

There are other advantages to the mating interface design. The K Connector female center conductor has four slots. Most SMA connectors have only two. With four slots, the pressure exerted by the male pin on the female is distributed more evenly, improving reliability and repeatability. A polar plot shows that the repeatability of the K Connector offers a more than threefold improvement over that of SMA, placing the K Connector on the same level as the considerably more expensive APC–3.5 connector.



K Connector's repeatability (R) is threefold better than SMA's.

Compatibility

With previous connectors that operated above 18 GHz, compatibility with existing lower-frequency connectors was often lost. This necessitated the stocking of adapters to change from one sex or type of connector to another. With the K Connector, the cost and inconvenience of stocking adapters are avoided. The K Connector interfaces electrically and mechanically with 3.5 mm connectors, including SMA, APC–3.5 and Wiltron's WSMA, without degradation in performance. Engineers benefit from the superiority of the K Connector launchers in lower frequency applications without worrying about compatibility with other connectors within the system.

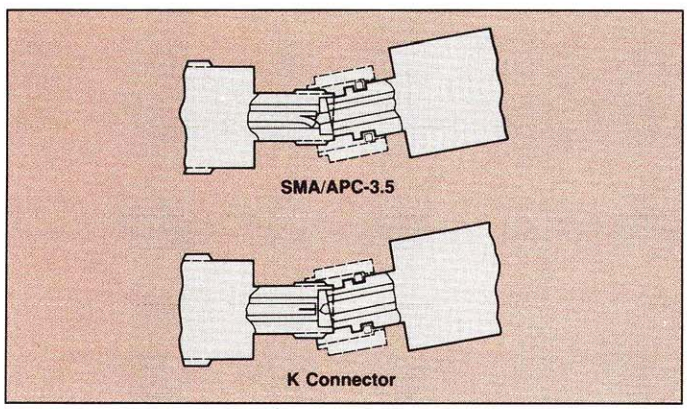
Money Saver

In addition to its technological superiority, the K Connector provides an excellent return on investment: low initial investment and considerable long-term cost savings. The initial investment is low because the K Connector was designed to achieve critical cost objectives. Furthermore, the connector is produced in large quantities, reducing production costs and allowing a selling price that is only slightly more than that of a similar SMA device and less than half that of a similar APC–3.5. Quantity discounts as high as 60% also help keep initial costs low.

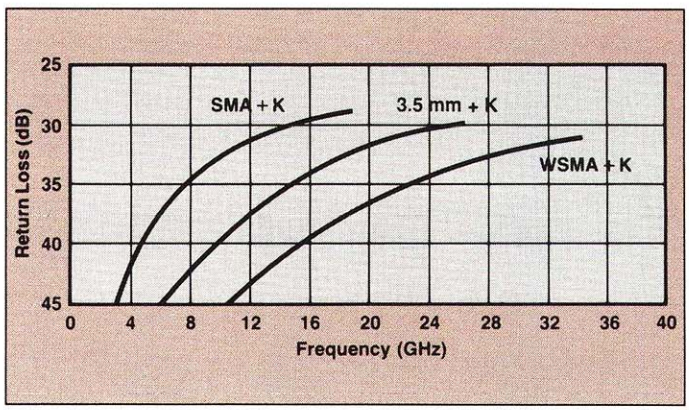
Because the K Connector is mechanically similar to SMA and APC–3.5, many of their tools and assembly techniques can be adapted to the K Connector. The initial cost of additional tooling and training required to switch to the K Connector is surprisingly low.

After a low intial investment, many long-term cost advantages begin to take effect:

- Smaller, lighter devices can be designed in coax up to 46 GHz. Furthermore, since coax has no lower frequency limit, coax devices can be designed for extremely broadband applications.
- Unmatched reliability reduces down time and repair costs.
- Below 18 GHz, the superior performance of the K Connector makes it possible to reduce tuning and adjusting time on critical circuits. Specifications can be tightened and life expectancy extended without additional production costs.
- Because the K Connector is compatible with SMA and APC–3.5, the expense of adapters is avoided.
- The complete testability offered by the 5669B Automated Scalar Network Analyzer reduces customer rejections that result when test data are difficult to correlate. And test time is reduced by making measurements over the 10 MHz to 40 GHz range with a single test setup.



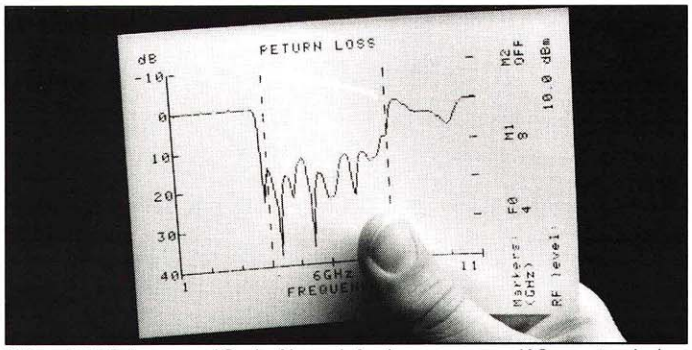
The shortened male pin in the K Connector (bottom) allows center conductors to be pre-aligned before contact, eliminating damage to the female connector.



Return loss characteristics of K Connector when mated with SMA, APC–3.5, and WSMA ensure excellent electrical compatibility.

K Connectors™ and Cable (Cont.)

K100, K200, and 01–100 Series



Wiltron 5669B Automated Scalar Network Analyzer measures K Connector devices over the 10 MHz to 40 GHz range from a single test port.

Wiltron offers a choice of six different K Connector Launchers.

Confidence-Building Testability

The old way of making microwave measurements on K Connectors above 18 GHz would require several waveguide couplers and fragile, lossy adapters. Measurements would be costly, time consuming, and full of uncertainties. All this is changed with the Wiltron 5669B Automated Scalar Network Analyzer System covering the 10 MHz to 40 GHz range. In addition, with a full selection of Wiltron waveguide-to coaxial adapters (page 73), the same system can be used to test waveguide devices.

Tools to Simplify Assembly

Wiltron supports the K Connector with a full set of tools and fixtures which make assembly an easy task. Assembly is assisted at every step with the right tool and with complete instructions for its use.

A Cable Assembly Kit (01–118) is available for installing connectors on cable. The kit provides gauging fixtures and a tool for pressing the support bead into the male or female cable connectors. The kit also includes a cable bending fixture, which supports the cable wall and reduces the possibility of outer conductor deformation.

Soldering the cable connector sleeve to the cable is accomplished with a reusable Teflon fixture which holds the male or female sleeve squarely in place while the soldering process is underway. The fixtures (Models 01–107M and 01–107F) are available in packs of ten.

To achieve the full benefit of the accuracy and excellent match designed into the launchers, it is necessary to machine the mounting holes accurately. This operation is performed with the 01–104 Machining Set. The set consists of a special stepped drill that drills in one operation the required holes for the launchers, thus ensuring concentricity. The set also includes a 1/4 x 36 tap needed to thread the sparkplug launcher mounting hole.

Accurate positioning of the launcher glass bead is vital to overall performance. Fixtures are available to hold the glass bead accurately centered during the soldering process. These fixtures are reusable and are available in packs of ten for sparkplug launchers (Model 01–103) and in packs of five for flange launchers (Model 01–106).

The 01–105 Torquing Kit offers all the wrenches and fixtures needed to apply the proper torque (16 inch-pounds) to the male and female sparkplug launchers and female cable connectors. In addition, the kit can be used to quickly replace a damaged launcher or to change the sex of an installed unit.

Complete Family

Wiltron's family of K Connector products is large and growing. Virtually every interface need can be satisfied by one or more of the items offered. As a convenience to the design engineer, each item is completely specified with both guaranteed and typical performance.

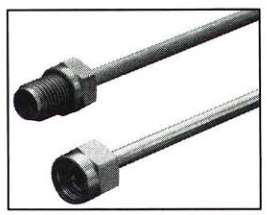
There are six different models of K Connector launchers. Two types of sparkplug (screw-in) launchers are available: the K102F female version and the K102M male version. Both screw into the housing that encloses the microwave circuit. And, like all Wiltron launchers, they can be easily removed for replacement or repair without unsoldering the glass bead and its interface to the microwave circuit.

When the housing that encloses the microwave circuit is not thick enough to support a threaded, screw-in launcher, flush-mounted (flange) launchers are required. Models with two mounting holes are available in both male and female version, K103F and K103M. Two other models have four mounting holes and are called the K104F and K104M. The mounting hole spacing is identical to that of similar SMA flange launchers. The glass bead interface, of course, is the same design used for the sparkplug launcher.

Since the loss of 0.085 inch cable is too high and the high frequency limit of 0.141 inch cable is too low, a new semirigid cable has been designed. The new cable has an outside diameter of 0.118 inch and uses a microporous Teflon dielectric. Compared to solid Teflon, microporous Teflon has better mechanical and impedance stability, since it does not expand and contract with changing temperatures. The center conductor of the cable is soft copper with a 0.032 inch diameter, allowing a minimum bend radius of 1/4 inch with no displacement of the center conductor. The cable loss is typically 1.1 dB/ft at 40 GHz, which is one-half the loss of other cables operating in this frequency range. At lower frequencies, the loss is similar to that of 0.141 semirigid cable.

Cable Connectors

To complement this high performance cable, both male and female cable connectors are available. The the cable connectors, K101M and K101F, use gold-plated, beryllium-copper center conductors for optimum performance and wear characteristics. Typical return loss at 40 GHz for finished cables exceeds 16 dB (1.35 SWR). Connectors for use with 0.085 inch cable are also available.



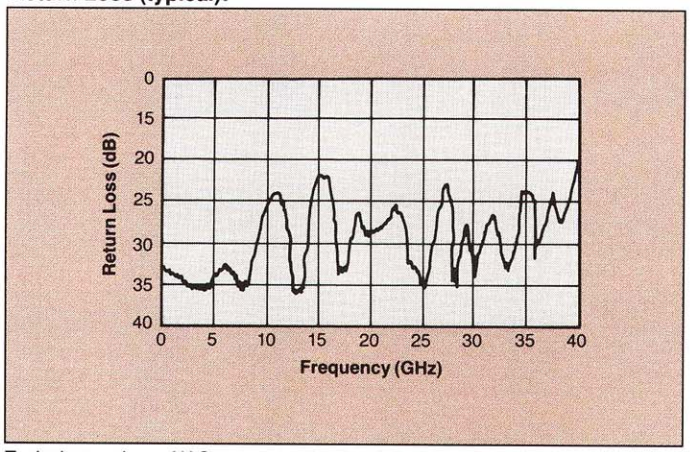
Female (K101F) and Male (K101M) cable connectors for special, low-loss 0.118 inch semirigid cable.

Specifications

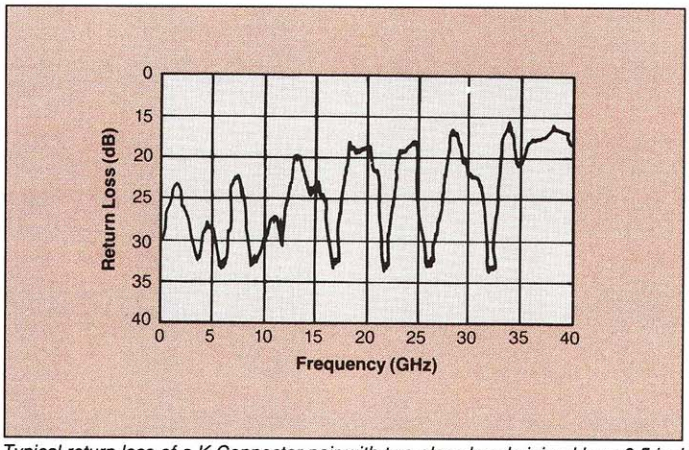
MICROSTRIP-TO-K LAUNCHERS & CABLE CONNECTORS

Return Loss (launchers only): 15 dB up to 40 GHz.
Coupling Nut Tightening Torque:: 13.8 Kg-cm (12 in.-lb) max.
Material: Passivated stainless steel with heat-treated beryllium copper center conductors.
Pin Depth: 0.000 to –0.076 mm (.000 to –0.003 in.) for male and female connectors.
Temperature Range: –55°C to +125°C

Return Loss (typical):



Typical return loss of K Connector pair without glass beads.

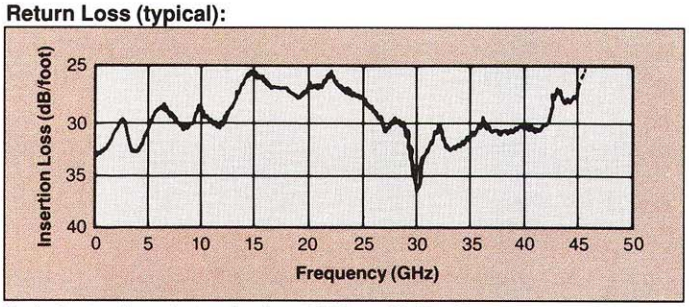


Typical return loss of a K Connector pair with two glass beads joined by a 0.5 inch microstrip.

CABLE

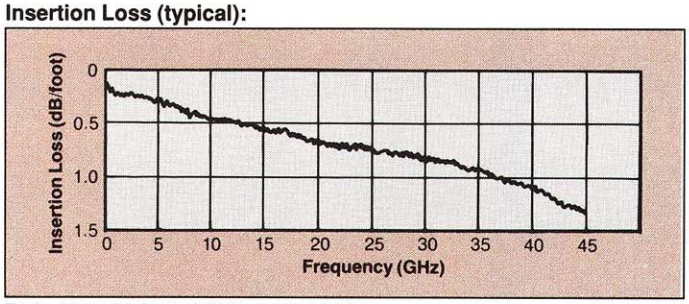
Type: Semirigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor.
Impedance: 50 ± 2 ohms
Dielectric Type: Microporous Teflon, 0.241 cm (0.095 in.) diameter.
Dielectric Constant: 1.687
Relative Velocity: 0.77
Outside Diameter: 0.299 cm (0.32 in.)
Center Conductor Diameter: 0.081 cm (0.032 in.)
Minimum Bend Radius: 0.64 cm (0.25 in.)
Attenuation: 0.5 dB/ft at 10 GHz
0.7 dB/ft at 20 GHz
1.0 dB/ft at 30 GHz
1.4 dB/ft at 40 GHz

Return Loss (typical):



Typical return loss of a two-foot long K118 semirigid cable.

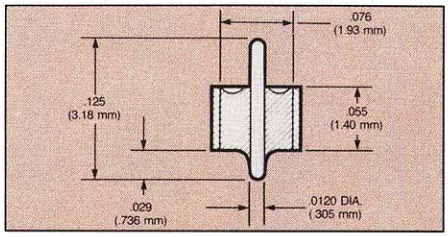
Insertion Loss (typical):



Typical insertion loss of K118 semirigid cable.

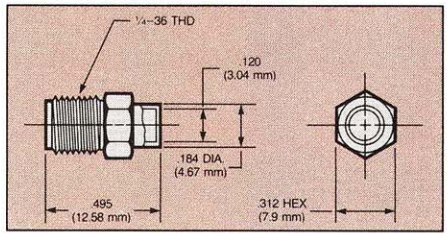
COAXIAL CONNECTORS

K100 Glass Beads for K102, K103, and K104 connectors, pack of 5.



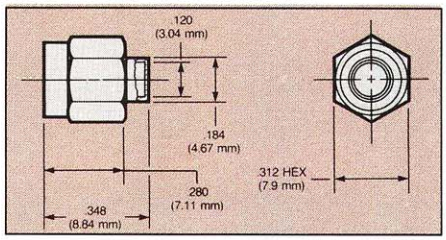
	5 to 100	105 to 500
Prices	$5.00 each in lots of 5	$4.90 each in lots of 5

K101F Female In-Line Cable Connector for 0.118 in. cable.



	1 to 24	25 to 99	100 to 499
Prices	$21.00	$18.75	$17.80

K101M Male In-Line Cable Connector for 0.118 in. cable.

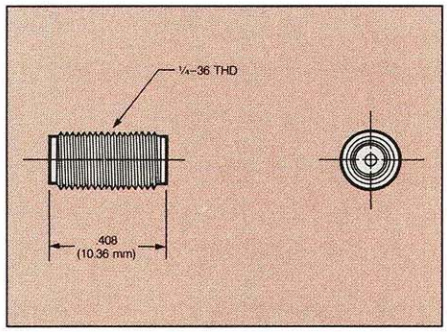


	1 to 24	25 to 99	100 to 499
Prices	$14.00	$12.50	$11.90

K Connectors™ and Cable (Cont.)

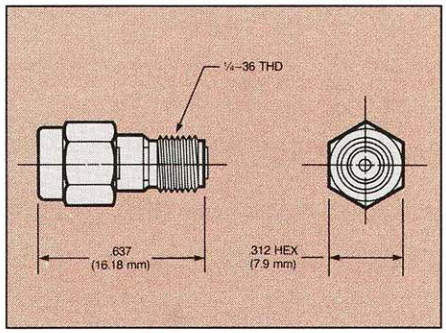
K100, K200, and 01–100 Series

K102F Female Sparkplug Launcher Connector



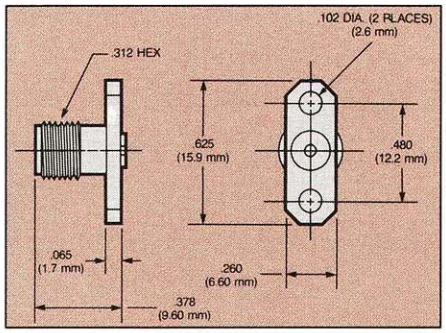
Prices	1 to 24	25 to 99	100 to 499
	$15.00	$10.15	$8.60

K102M Male Sparkplug Launcher Connector



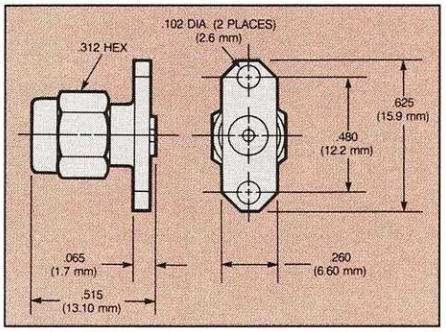
Prices	1 to 24	25 to 99	100 to 499
	$23.00	$17.55	$15.45

K103F Female Flange Launcher Connector



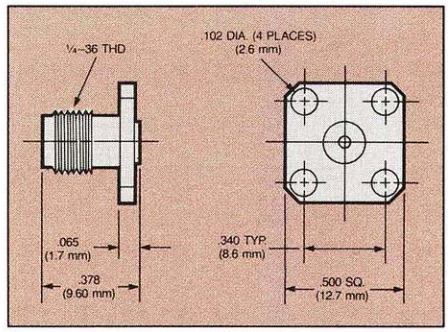
Prices	1 to 24	25 to 99	100 to 499
	$18.00	$12.55	$10.55

K103M Male Flange Launcher Connector



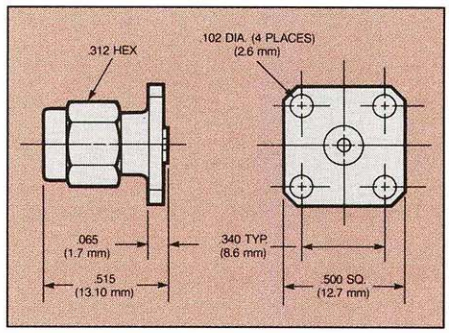
Prices	1 to 24	25 to 99	100 to 499
	$25.00	$19.25	$16.95

K104F Female Flange Launcher Connector



Prices	1 to 24	25 to 99	100 to 499
	$18.00	$12.55	$10.55

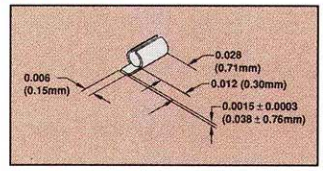
K104M Male Flange Launcher Connector



Prices	1 to 24	25 to 99	100 to 499
	$25.00	$19.25	$16.95

STRESS RELIEF CONTACTS

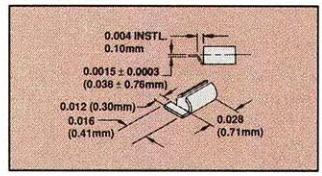
K110–1 Microstrip and Coplanar Waveguide Stress Relief Contacts.



Frequency Range: DC–46 GHz
Return Loss: 20 dB at ≤26.5 GHz
17 dB at >26.5 GHz
Packaging: In lots of 25

Prices	25 to 225	250 to 475
	$1.90 each in lots of 25	$1.87 each in lots of 25

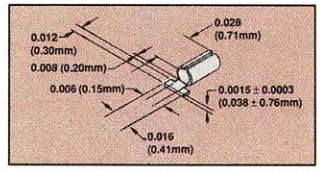
K110–2 Stripline Stress Relief Contacts.



Frequency Range: DC–46 GHz
Return Loss: 20 dB at â26.5 GHz
17 dB at >26.5 GHz
Packaging: In lots of 25

Prices	25 to 225	250 to 475
	$2.20 each in lots of 25	$2.17 each in lots of 25

K110–3 Microstrip Stress Relief Contacts.



Frequency Range: DC–46 GHz
Return Loss: 20 dB at ≤26.5 GHz
17 dB at >26.5 GHz
Packaging: In lots of 25

Prices	25 to 225	250 to 475
	$1.90 each in lots of 25	$1.87 each in lots of 25

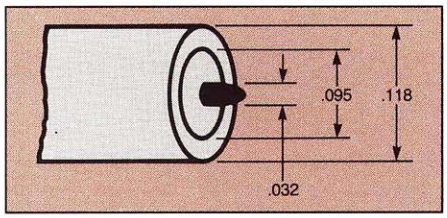
EVALUATION KIT

01–101A Evaluation Kit
Description: Kit contains one K120 10-inch Male/Male Cable Assembly, two K102F Female Sparkplug Launcher Connector Assemblies, two K104F Female Flange Launcher Connector Assemblies, five K100 Glass Beads, one 01–104 Drill and Tap Set, five K110–1 Microstrip Sliding Contacts, five K110–2 Stripline Sliding Contacts, and all other parts and fixtures required to assemble launchers with or without sliding contacts.

Price $295

SEMIRIGID COAXIAL CABLE

K118 Semirigid Coaxial Cable
Description: 1.52 m (5 ft) length of 0.118 inch semirigid cable for K101 series connector.



	1 to 9	10 to 49	50 to 99
Prices	$55.00	$51.00	$48.00

CABLE ASSEMBLIES

K120–6 Cable Assemblies
Description: Semirigid cable with K101M Male Connector on each end. Assembled length is 15.25 cm (6 in.).

	1 to 24	25 to 999	100 to 999
Prices	$90.00	$80.00	$75.00

K120–12 Cable Assemblies
Description: Semirigid cable with K101M Male Connector on each end. Assembled length is 30.5 cm (12 in.).

	1 to 24	25 to 999	100 to 999
Prices	$95.00	$85.00	$80.00

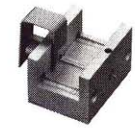
TOOLS AND FIXTURES

01–103 Soldering Fixture for sparkplug launcher glass beads, package of 10.
Package Price $35

01–104 Drill and Tap Set for precision machining of concentric holes for mounting K Connector in microwave housing. Drill Part No. B14094. Tap Part No. B783255
Price $95

01–105 Male and Female Sparkplug Torquing Kit
Price $340

01–106 K Soldering Fixture for flange launcher glass bead, package of 5.
Package Price $30



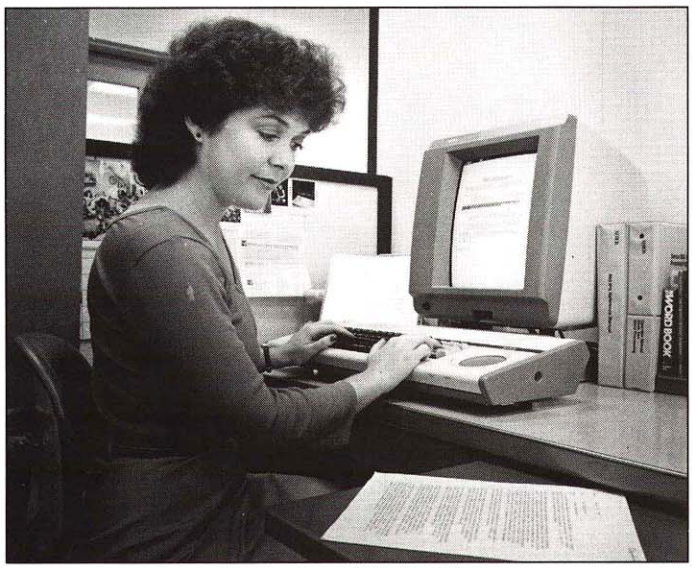
01–107F Cable Sleeve Soldering Fixture for K101F Female Cable Connectors, package of 10.
Package Price $70

01–107M Cable Sleeve Soldering Fixture for K101M Male Cable Connector, package of 10.
Package Price $70

01–108 Drill and Tap Set for precision machining of concentric holes for mounting K Connector in microwave housing in applications where sliding contacts are used. Drill Part No. B16526. Tap Part No. 783255
Price $95

01–118 K Connector Cable Assembling Fixture for 0.118 in. semirigid coaxial cable.
Price $200

Ordering Information



Placing Purchase Orders

Orders may be placed through Wiltron Regional or Representative Sales Offices listed on pages 88 and 89 or directly with the factory at Wiltron Company, 490 Jarvis Drive, Morgan Hill, California 95037-2809, Tel: (408) 778-2000, Telex: 285227 WILTRON MH, Fax: 408-778-0239.

Prices and Terms of Sale

The prices that may be included in this catalog are for USA customers only and were the prevailing net prices at the time of printing. These prices are useful for budgetary estimating purposes, but are subject to change without notice. Delivered prices can be optained from Wiltron Regional or Representative Sales Offices.

USA Customers: Prices are F.O.B. factory. Standard credit terms are 50% due within 20 days, the balance within 40 days after the date of the invoice. Shipping charges may be prepaid or C.O.D, as specified on the purchase order.

International Customers: Prices and terms of sale may be obtained from the Wiltron Regional and Representative Sales Offices or from the factory. For orders placed directly with the factory, the terms of sale is an irrevocable letter of credit. The beneficiary must be Wiltron Company, 490 Jarvis Drive, Morgan Hill, California 95037–2809, USA.

Prices are F.O.B. origin. Prices for C.I.F. point of destination are available upon request.

Export packaging for air shipments is provided at no charge.

OEM and Special Purchase Agreements

OEM and Special Purchase Agreements are available for multiple-unit requirements.

Minimum Order

There is a minimum order amount of $25 in USA currency or the equivalent in other currencies.

Rental

In the USA, Wiltron instruments and systems are available for rental at 10% of the selling price per month for a minimum rental period of 3 months. Sixty percent of the rent paid may be applied toward purchase.

USA Government Sales

Many Wiltron products may be purchased on the following GSA Federal Supply Schedule: Contract GS-OOF-78443, Section H, Instruments and Laboratory Equipment, August 1, 1985 through July 31, 1988

National Stock Numbers for Wiltron products are listed on NSN List dated 1 January 1986.

Source Inspection

Source inspection is available for an additional charge.

Certificates of Conformance

Certificates of Conformance to published specifications and traceability to NBS are available upon request.

Warranty

All Wiltron products are warranted against defects in materials and workmanship for one year from the date of shipment, except for YIG-tuned oscillators, which are warranted for two years. Wiltron's obligation covers repairing or replacing products which prove to be defective during the warranty period. Buyers shall prepay transportation charges for equipment returned to Wiltron for warranty repair. Obligation is limited to the original purchaser. Wiltron is not liable for consequential damages.

Limitations of Warranty

The foregoing warranty does not apply to Wiltron connectors that have failed due to normal wear. Also, the warranty does not apply to defects resulting from improper or inadequate maintenance by the Buyer, unauthorized modification or misuse, or operation outside of the environmental specifications for the product. No other warranty is expressed or implied, and the remedies provided herein are the Buyer's sole and exclusive remedies.

Software Warranty

Wiltron software is supplied without representation or warranty of any kind. Wiltron therefore assumes no responsibility and will not accept liability (consequential or otherwise) arising from the use of program material, disk, or tape.

Special Products

Many Wiltron products can be modified to meet special application requirements. Specifications for frequency range, output power, modulation capabilities, connectors, and spectral purity are typical of those that can be changed on special order. Some instrument front panels can be painted with standard gloss or semigloss finishes in special colors. Paint can be supplied either by the customer or by Wiltron.

Special instruments designed for specific applications are also available, though not listed in this catalog. Application Engineers in your Wiltron Regional or Representative Sales Offices can help match a Wiltron solution to your application. The following are examples of available special instruments:

- SM3517 Dynamic Range Extender for the 560A Scalar Network Analyzer
- SM3519-1,-2,-3 Gain-Compression Test Sets, 0.5 to 26.5 GHz
- SM3500 Precision Ramp Generator for Voltage-Controlled Attenuators

Service and Support

Worldwide Support System

Wiltron is committed to providing fast, professional customer support and service through a worldwide network of service centers staffed by factory-trained personnel. A variety of flexible, comprehensive service plans and support products are available to help maximize customer productivity in an efficient, cost-effective manner.

Repair and Calibration Services

Wiltron Service Centers are equipped to maintain all Wiltron products in peak operating condition. You can choose from a variety of service options, selecting the one that best fits your individual needs. All repaired products and replacement parts are covered by a 90-day warranty.

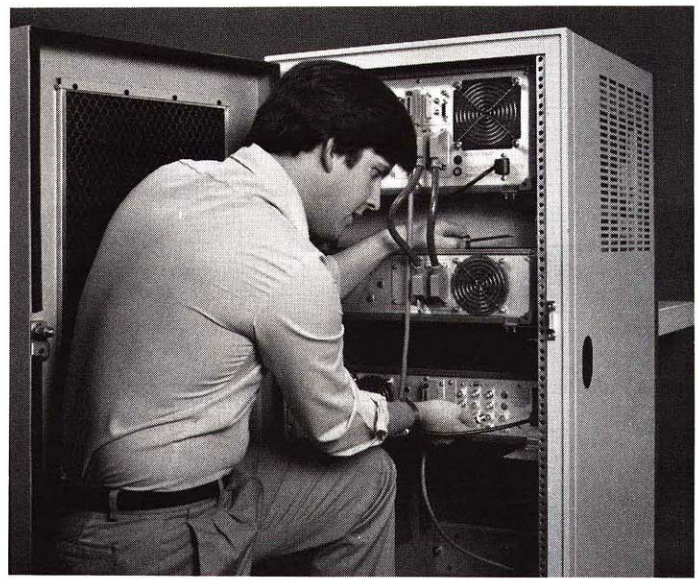
- **Fixed Price Service**
  This program provides for one-time repair and/or calibration at a pre-determined fixed price. The price includes all labor and (in most instances) all material required. These fixed prices, which are based on historical averages, allow you to determine service costs in advance, thereby avoiding the potential delay associated with the quotation and approval process. While most products are covered, some equipment must be excluded because of age or abuse. In such cases, with your approval, the repair will be performed on a labor and material basis.

- **Exchange Assembly Service**
  For fastest response and minimum down-time, most Wiltron products are supported by an exchange assembly program. When using this service, you only have to identify the defective assembly and order an exchange replacement from the closest Wiltron Service Center. Identifying the faulty assembly is facilitated by the built-in diagnostic routines in most Wiltron products. The exchange assembly is sent directy to you. Upon return of the defective assembly you receive a significant credit towards the cost of the exchange assembly. For more information on the Exchange Assembly Service and a list of products covered, please contact a Wiltron Service Center.

- **Labor and Material Service**
  For customers unable to take advantage of the Fixed Price and Exchange Assembly Programs, service is also available on a material and labor basis. In this case, an estimate of labor and material repair costs is made based upon an inspection of your specific product. Work proceeds after receipt of your approval.

- **Replacement Parts**
  Wiltron supports customers who have their own maintenance facilities by providing an extensive inventory of repair parts at each service center. When ordering, simply notify the Service Center of the Wiltron part number and description as shown in the manual, along with the model and serial number of your instrument.

- **Telephone Consultation**
  Wiltron service specialists are available to provide "over the phone" guidance to customers with service questions.



Special Services

A variety of special services are offered to meet customer needs and to promote customer convenience.

- **Blanket Service Agreement**
  Turnaround time can be reduced, and customer documentation and administration costs can be minimized through the use of a Blanket Service Agreement. Your Service Engineer can give you details on establishing a Blanket Service Agreement.
- **Extended Warranty**
  Extended warranty service on most products can be arranged for a one-time charge at the time of order. Please consult the factory for specifics.
- **Service Reports**
  Service reports detailing work performed are available on request at no additional charge.
- **Calibration Certificates**
  For every product calibrated, Wiltron provides a Certificate of Calibration. It is your assurance that the instrument meets its published specifications and is traceable to the National Bureau of Standards.
- **MIL–STD–45662 Calibration**
  Wiltron can provide service and documentation meeting MIL–STD–45662. However, there is an extra charge for the additional documentation and responsibilities associated with this service.
- **On–Site Service**
  On-site service is available as an option on certain Wiltron products and may be arranged on an "on-available" basis for others. Please contact the factory for specifics.

Customer Training

Maintenance training is available on most Wiltron products. These courses, generally lasting one to two days per product, are designed to help maintenance personnel effectively troubleshoot and maintain Wiltron products. Courses may be given either at a Wiltron Service Center or at the customer's site and are scheduled as required.

Sales Offices

USA

ALABAMA
GENTRY ASSOCIATES, INC.
4950 Research Drive
Huntsville, AL 35805
Telephone: (205) 837-0692

ALASKA
WILTRON COMPANY
490 Jarvis Drive
Morgan Hill, CA 95037
Telephone: (408) 778-2000

ARIZONA
TREMBLY ASSOCIATES
2740 S. Hardy Drive, Suite 3
P.O. Box 27468
Tempe, AZ 85282
Telephone: (602) 967-2058 (Phoenix)
(602) 790-9945 (Tuscon)

ARKANSAS
TESTECH, INC.
1909 North Glenville, Suite 103
Richardson, TX 75081
Telephone: (214) 644-5010

CALIFORNIA (Northern)
MCH ASSOCIATES
4100 Moorpark Avenue
San Jose, CA 95117
Telephone: (408) 246-7330

CALIFORNIA (Southern)
BLAIR ASSOCIATES
2568 West Woodland Drive
Anaheim, CA 92801
Telephone: (714) 220-1201

COLORADO
TREMBLY ASSOCIATES
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Wheatridge, CO 80033
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CONNECTICUT
WILTRON REGIONAL OFFICE
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Woburn, MA 01801
Telephone: (617) 933-8330

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ELECTRONIC MARKETING ASSOCIATES INC.
649 West Germantown Pike
Plymouth Meeting, PA 19462
Telephone: (215) 828-7400 (Plymouth Meeting)
(215) 248-5050 (Philadelphia)
(215) 265-1600 (King of Prussia)
(302) 652-5333 (Wilmington)

DISTRICT OF COLUMBIA
ELECTRONIC MARKETING ASSOCIATES, INC.
14100 Laurel Park Drive
Laurel, MD 20707
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FLORIDA (Fort Lauderdale)
GENTRY ASSOCIATES, INC.
6601 N. W. 14th Street, Suite 3
Ft. Lauderdale, FL 33313
Telephone: (305) 791-8405

FLORIDA (Orlando)
GENTRY ASSOCIATES, INC.
2447 Orlando Central Parkway
Orlando, FL 32809-6989
Telephone: (305) 859-7450

FLORIDA (Tampa)
GENTRY ASSOCIATES, INC.
5460 Beaumont Center Drive, Suite 542
Tampa, FL 33634
Telephone: (813) 886-0720

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GENTRY ASSOCIATES, INC.
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Roswell, GA 30075
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Morgan Hill, CA 95037
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Morgan Hill, CA 95037
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Cedar Rapids, IA 52402
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KENTUCKY (Eastern)
EQS SYSTEMS, INC.
7009 B Taylorsville Road
Huber Heights, OH 45424
Telephone: (513) 236-7676

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GENTRY ASSOCIATES, INC.
1799 Stumpf Blvd.
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MAINE
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1877 Orchard Lake Road
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ELECTRONIC INSTRUMENT ASSOCIATES, INC.
400 Natchez Avenue No.
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Kansas City, MO 64116
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San Jose, CA 95117
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2350 East Patrick Lane, Suite 17
Las Vegas, NV 89119
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CENTRAL ASSOCIATES NY/NJ, INC.
11 Neil Drive
Old Bethpage, NY 11804
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ELECTRONIC MARKETING ASSOCIATES INC.
649 West Germantown Pike
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NEW MEXICO
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119 Quincy N.E.
Albuquerque, NM 87108
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NEW YORK (Metro New York City Area)
CENTRAL ASSOCIATES NY/NJ, INC.
11 Neil Drive
Old Bethpage, NY 11804
Telephone: (516) 694-3205

NEW YORK (Upstate)
OSSMANN ASSOCIATES, INC.
6666 Old Collamer Road
East Syracuse, NY 13057
Telephone: (315) 437-7052

NORTH CAROLINA
GENTRY ASSOCIATES, INC.
1336 South Church Street
Burlington, NC 27215
Telephone: (919) 227-3639

NORTH DAKOTA
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400 Natchez Avenue No.
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EQS SYSTEMS, INC.
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EQS SYSTEMS, INC.
7009 B Taylorsville Road
Huber Heights, OH 45424
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OKLAHOMA
TESTECH, INC.
1909 North Glenville, Suite 103
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OREGON
CAIN-WHITE & COMPANY, INC.
10900 NE 8th Street, Suite 900
Bellevue, WA 98004
Telephone: (206) 462-2118

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ELECTRONIC MARKETING ASSOCIATES, INC.
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TENNESSEE (Knoxville)
GENTRY ASSOCIATES, INC.
333 L Troy Circle
Knoxville, TN 37919
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GENTRY ASSOCIATES, INC.
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Fax: (03) 5601806

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Telex: (841) 528523
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Fax: (011) 211812

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Fax: (011) 2566446

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Fax: (613) 820-9525

CHINA
CHINA NATIONAL INSTRUMENTS IMPORT & EXPORT CORPORATION
P.O. Box 2811
Xi Jiao, Er-Li Kou Beijing
Telephone: 890931
Telex: (716) 22304 CMIEC CN

CHINA ELECTRONICS IMPORT & EXPORT CORPORATION
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Telex: (303) 2645 ELEPEX

DENMARK
S C METRIC A/S
Skodsborgvej 305
DK-2850 Naerum
Telephone: (02) 804200
Telex: (855) 37163

EGYPT
ALKAN ESTABLISHMENT
2 El Mesaha Square, Dokki, A.R.E.
P.O. Box 1913, Cairo 11511
Telephone: (02) 987114
Telex: (927) 93644 ALKAN UN

FINLAND
INSTRUMENTARIUM ELEKTRONIIKKA
P.O. Box 64, Vitikka 1
SF-02631 ESPOO
Telephone: (0) 5281
Telex: (857) 124426 HAVUL
Fax: (0) 502 1073

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91370 Verrieres le Buisson
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Telex: (842) 691789 F
Fax: (1) 60-11-98-09

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WILTRON GmbH
Rudolf Diesel Str 17, 8031 Gilching
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Fax: (08105) 1700

HONG KONG
SCHMIDT & COMPANY (H.K.) LTD.
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Telephone: (5) 8330222
Telex: (780) 74766
Fax: (5) 8918754

INDIA
HINDITRON SERVICES PVT. LTD.
Eros Bldg., 5th Floor
Maharishi Karve Road, Churchgate
Bombay 400 020
Telephone: (22) 220920
Telex: (953) 01175326 HSPL IN

HINDITRON SERVICES PVT. LTD.
33/44, Rajmahal Vilas Extension
8th Main Road
Bangalore 560 080
Telephone: 363139
Telex: (953) 0845741 HSPL IN

HINDITRON SERVICES PVT. LTD.
204-206, Hemkunt Tower
98 Nehru Place
New Delhi 110 019
Telephone: (11) 6410380
Telex: (953) 03161458 HCPL IN

HINDITRON SERVICES PVT. LTD.
Emerald Complex 1-7-264
5th floor, Sarojini Devi Road
Secunderabad 500 003
Telephone: 821117
Telex: (953) 1556973 HCPL IN

INDONESIA
PT CENTRONIX
36, Jalan Matraman Raya
Jakarta Timur
Telephone: (21) 884087
Telex: (796) 48216
FAX: (21) 881186

IRELAND (Southern)
ATRON ELECTRONICS LTD. (Avelec Group)
Lynwood House, Ballinteer Road, Dublin 16
Telephone: (01) 988433
Telex: (852) 90662 ATRN EI

ISRAEL
RACOM ELECTRONICS, LTD.
P.O. Box 21120
Tel Aviv 61210
7 Kehilat Saloniki St, Tel Aviv 69513
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Fax: (03) 491576

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Telephone: (02) 4982451
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Viale Erminio Spalla 41, 00142 Rome
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Fax: (03) 7980419

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Saito Bldg. #201, 3-35-11, Tsuruya-cho
Kanagawa-ku, Yokohama, Japan 221
Telephone: (045) 316-0381
Fax: (045) 316-0380, Yokohama

KOREA
MYOUNG CORPORATION
Teo Eui Do
C.P.O. Box 14, Seoul
Telephone: (02) 784-9942
Telex: (787) 24283
Fax: (02) 7842387

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TAREQ COMPANY
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Fax: (09) 601720
Cable: NUCLEONIC Auckland

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