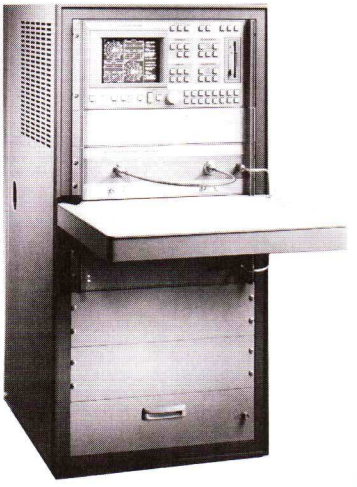
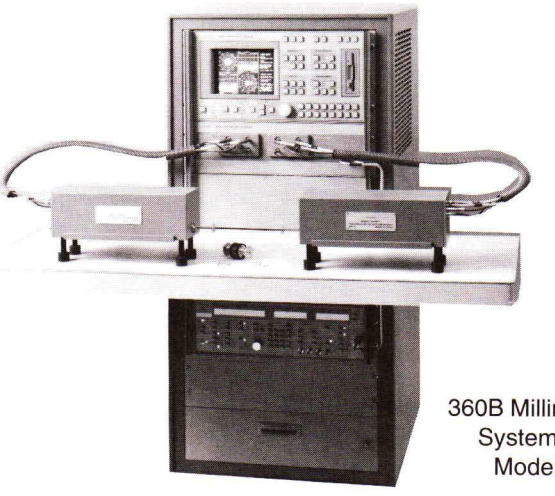
Vector Network Analyzer

Model 360B: Coaxial—10 MHz to 62.5 GHz; Waveguide—33 GHz to 110 GHz



360B
System Console
Model 360C1



360B Millimeter-Wave
System Console
Model 360C3

360B Vector Network Analyzer Highlights

- *40 MHz to 62.5 GHz Continuous Coaxial Coverage*
- *Full-Reversing Waveguide Test Solution From 33 to 110 GHz*
- *Full Color Four S-parameter Display*
- *High Denisty 1.44 Mbyte MS–DOS® Compatible Front-Panel Disk Drive*
- *Time Domain, Group Delay, and Frequency Domain Test Capabilities*

Wiltron continues its tradition of responding to customer needs with the new 360B Vector Network Analyzer (VNA). The 360B VNA builds upon a strong foundation of exceptional measurement accuracy, capability, and ease-of-use. New and improved features and capabilities provide powerful benefits in any vector measurement application.

The 360B VNA is recognized as the leader for performance, accuracy, and versatility. Wiltron's modern approach makes it easy to upgrade or convert a 360B system to new capability. Since its introduction in 1987, Wiltron has continued to expand its VNA family of products to solve new requirements. Several innovative products are available to expand the selection of 360B measurement solutions.

A Pulse/CW system offers unique 20 ns pulsed RF and CW S-parameter measurement capability in one package. Noise figure measurement accuracy takes a step ahead with the 3642A Noise Figure module and the addition of the 360B's vector error correction. The 360TSM test set multiplexer allows the 360B to control multiple test sets and sources. Now, from one interface you can measure from 10 MHz to 110 GHz using both waveguide and coaxial test sets.

Continuous Coaxial Coverage to 62.5 GHz

The coaxial frequency coverage of the 360B Series is unmatched. Continuous coverage is available from 40 MHz to 60 GHz (62.5 GHz with Test Set Option 5). Engineers in both commercial and defense sectors can benefit from designing in coax to 60 GHz - reducing systems size and weight. 60 GHz coverage also significantly increases the resolution of time domain measurements, allowing more accurate designs. Extensive OSL, offset short, and LRL/LRM calibration software with dispersion compensation let you accurately measure your coaxial, microstrip, waveguide, and on-wafer devices.

Waveguide Measurements to 110 GHz

Over the 33 to 110 GHz range, waveguide measurements can be made more easily and more accurately with Wiltron's full-reversing waveguide test solution. Wiltron also offers you a choice with economical One-Path Two-Port and Reflection-Only measurement configurations. The 360B VNA's exceptional dynamic range, over all four mm-wave bands, allows you to measure devices with greater precision and confidence. Also, the high-speed time/distance domain capability allows compensation for waveguide dispersion.

Turn-Key System: Console or Cabinet

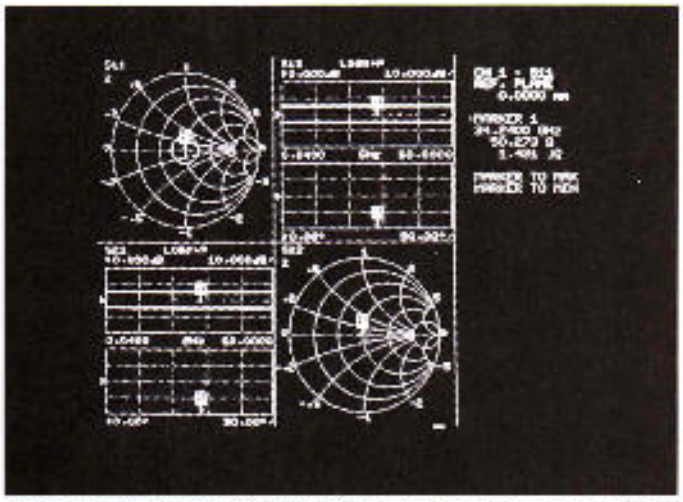
Whether you choose your 360B system for production, R&D, metrology, service, field testing, or QA, there is a system console or system cabinet configuration to meet your exact needs.

Coaxial systems consist of the following three units (an additional 6700B Series synthesizer is required for some specialized measurements):

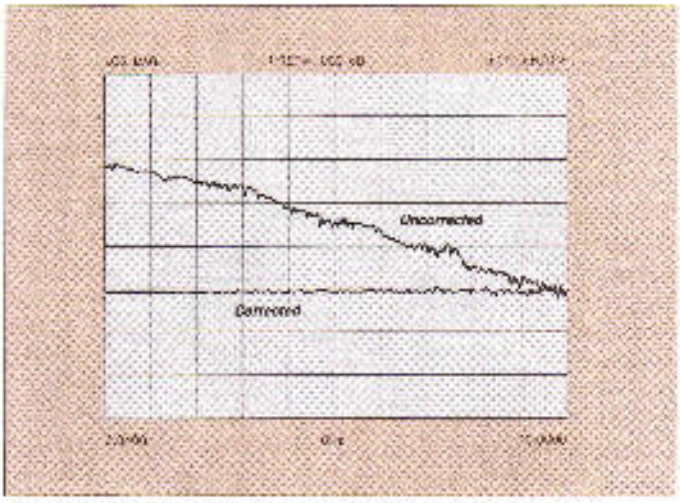
1) 360B Network Analyzer
2) 3600A Series Test Set
3) System Signal Source (Wiltron 360SS, 6600B, or 6700B Series)

Waveguide systems consist of five units:

1) 360B Network Analyzer
2) 3635B Millimeter-Wave Test Set
3) 3640B Series Transmission/Reflection Module(s)
   or
   3641B Series Transmission Module
4) 360SS47 System Source (or equivalent 6700B Series)
5) 6729B Microwave Synthesizer



Four independent display channels let you tailor the data presentation for your measurement application.



Flat test port power correction provides constant input power for some device testing.

Four-Channel Display on Large Color Screen

The 360B 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 four 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.

Data Trace Overlay

Device evaluation and comparison is now easier than ever before with the new trace overlay capability. Superimpose an amplifier's gain data trace onto its input match data trace on a single graph. Overlaid data is displayed in yellow while the primary channel's data is shown in red. Vertical graticule lines have been added to all rectilinear graphs for enhanced data interpretation.

New Front Panel

A molded bezel exposes the 360B's color VGA display for improved brightness and clarity. Test data is now easier to read and interpret. Rubberized front panel buttons improve reliability and tactile feedback. Tinted keycaps distinguish frequently used functions.

Microstrip and Coplanar Waveguide Measurements

By combining the 360B with a Wiltron 3680 Series Universal Test Fixture, you can measure microstrip and coplanar waveguide devices, on-substrate. Wiltron provides the complete measurement solution, with a wide selection of VNAs, test fixtures, on-substrate calibration kits, and accessories. Three models of test fixtures are available covering dc to 20 GHz, 40 GHz and 60 GHz, respectively. See page 102 for more information.

Measurement Stability

Accurate measurements depend on a VNA's ability to maintain its calibrated state. Over time, significant factors such as temperature change, cable flexure, and frequency drift contribute to random measurement errors. The 360B VNA counters these effects with temperature-stable components, minimized cabling, fewer interconnections, and a unique phase-locking scheme. With the 360B VNA, your measurements are repeatable several days after calibration.

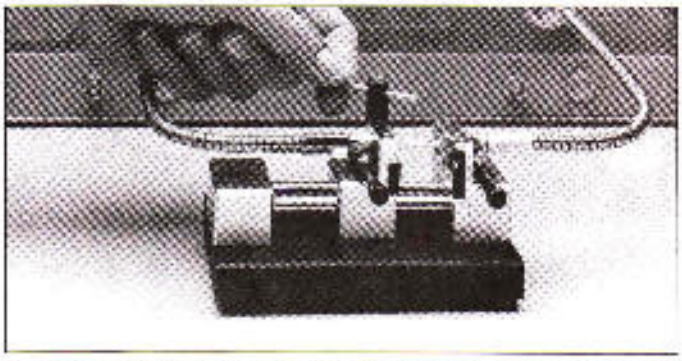
Flat Test Port Power Correction

For device measurements requiring constant input power levels, the 360B offers automated Flat Test Port Power Correction. Using an external power meter, test port power measurements are made at each frequency, or to save time, interpolated between user-defined frequencies. The correction data is then fed back to the signal source's level loop to provide a constant test port power. Flat Test Port Power Correction capability is compatible with Wiltron signal sources 360XS, 660CB, and 670CB Series.

High-Speed Time (Distance) Domain Measurements

When identification of discontinuities within a test device is required or the distance to an impedance discontinuity must be measured, the 360B's Option 2A, High Speed Time (Distance) Domain measurement capability is the solution. This option adds a near 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. Wiltron's time domain digital signal processing decreases the processing time for a 401-point FFT to less than 350 ms.



The Wiltron 3680 Series Universal Test Fixture measures microstrip and CPW devices.

Vector Network Analyzer

Model 360B

The 360B 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.

Precision Calibration Kits and Components

Accurate operation of your 360B system is ensured by Wiltron precision calibration and verification kits. The kits include components for direct calibration and performance verification of measurements on SMA/3.5 mm, GPC-7, Type N, K Connector®, and V Connector® (1.85 mm) test devices. Waveguide calibration kits are also available for four mm-wave bands: Q (WR-22), U (WR 19), V (WR 15), W (WR-10).

Verification Kits

In addition to calibration kits, Wiltron offers verification kits. The verification kit consists of components with characteristics that are traceable to NIST. This kit is usually kept in the metrology laboratory where it provides the most dependable means of checking system accuracy.

Reversing Test Sets

Reversing Test Sets make full S parameter measurements on passive devices. Models 3610A, 3611A and 3612A cover the 40 MHz to 20 GHz, 40 MHz to 40 GHz, and 40 MHz to 60 GHz ranges, respectively, with K Connector or V Connector test ports.

Active Device Test Sets

The Active Device Test Sets contain step attenuators and bias tees, required for active device testing. Models 3620A, 3621A, and 3622A cover the 40 MHz to 20 GHz, 40 MHz to 40 GHz ranges, and 40 MHz to 60 GHz respectively, with K Connector and V Connector test ports.

Frequency Converter Test Sets

For testing mixers, multipliers, dividers – any frequency translation device—the 360B has the 3630A and 3631A Frequency Converter test sets with 10 MHz to 40 GHz and 10 MHz to 60 GHz coverage, respectively. These four-channel receivers can operate with two signal sources and the receiver signal, all at different frequencies. With its internal 70 dB step attenuator, the 3630A or 3631A are also an excellent choice for antenna measurements.

Waveguide Test Sets to 110 GHz

Measurements to 110 GHz are supported by the 3635B Millimeter Test Set and 3640B and 3641B Series Modules. The 3635B controls companion 3640B/41B Series modules and supplies necessary DC, RF, and IF signals. 3640B/41B Series modules are available in four waveguide bands to cover the 33 to 110 GHz range. The 3640B Series modules include a mm-wave source. A pair of 3640B modules allows measurement of all four S-parameters on a two port device without reversal of the test device. A 3640B module combined with a 3641B module allows for simultaneous measurement of S_{11} (input reflection) and S_{21} (forward transmission) characteristics.

Test Set Multiplexer

The new 360TSM Test Set Multiplexer allows the use of two test sets and two sources with a single 360B Network Analyzer. From the front panel, an operator can select a different test set or source. Sources or test sets may be located up to 30 meters from the 360B. The 360TSM brings a new level of versatility to the 360B family. Systems can be configured with different connector-type test ports or even a combination of coaxial and waveguide test ports. One test set can be located with a probe station and another can be located in the 360B cabinet. For production use, multiple test sets can improve productivity by allowing measurements on one test set while another device is being connected to the second test set.

Speed and Accuracy, Simultaneously

The 360B VNA offers the fastest step sweep available for real time measurements of your devices. A 3605S Series Signal Source is phase locked in less than 2ms to provide synthesized frequency accuracy. Only the Wiltron system maintains synthesizer accuracy at "real time" measurement speeds for enhanced throughput.

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.

High Density MS-DOS Disk Drive

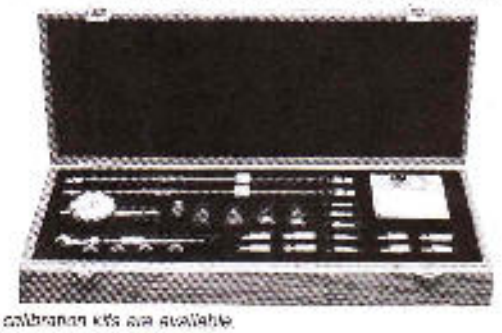
The built-in 3.5-inch disk with 1.44 Mbytes of memory is standard on the 360B. Data files are MS-DOS® formatted for easy interfacing with IBM and IBM-compatible computers and software.

Broadband, Narrow-Band Tests—No Recalibration

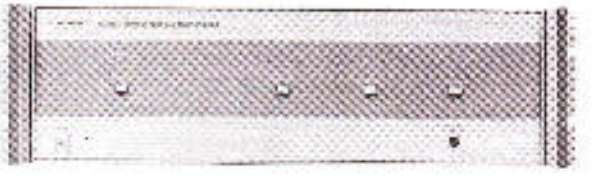
The 360B calibration is maintained as the number of data points is changed or a reduced frequency range is selected. Here is one more feature that improves productivity.

Set-On Mode

The 360B offers a "Set On" mode making it possible to use the 360B as a tuned receiver over the 10 MHz to 60 GHz frequency range. The IF bandwidth is selectable between 10 kHz, 1 kHz, and 100 Hz. This mode significantly increases the versatility of the 360B in ATE applications that check for harmonics and spurious signals and for signals whose frequency is known.



Precision calibration kits are available.



The 360TSM allows (2) test sets and (2) sources to be controlled from a single 360B.

Complete Characterization of Test Devices

It is often desired to observe the effect of adjusting one S-parameter on the other three. In gain and phase matching applications, it is necessary to simultaneously view the input and output impedances. The 360B provides simultaneous viewing of 4 characteristics, in color, on a large screen. The color is employed to simplify interpretation of simultaneously displayed data.

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

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 360B has SMA Calibration Kits with which accurate, 12-term error-corrected test data can be taken on SMA test devices.

Easy-to-Use, Flexible Calibration Procedure

The 360B incorporates a more flexible error-correction process that now better addresses on-wafer and other single-standard calibration applications. Measure one standard at a time or two standards simultaneously. The ordering of reflection standards may be modified to suit a variety of calibrations. The system reference impedance (Z0) may also be modified to other than 50 ohms.

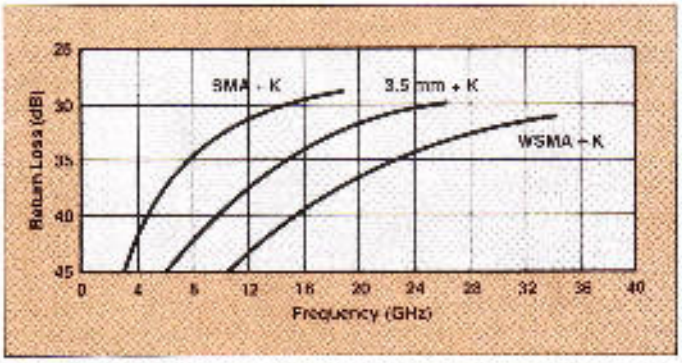
On the 360B, once the calibration has been completed, error-correction is automatically applied. Since all Wiltron test sets are auto-reversing, 12-term error correction is now always practical. Maximum accuracy is readily attained. The 360B also maintains its calibration when the number of data points is changed or a reduced frequency range is selected.

The 360B 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/LRM calibration for microstrip and mixed connector devices using three lengths of thru line (or a match device) and a reflective device.

Hands-Off Test Procedures

Wiltron's S-parameter test sets include 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—while using a power-limiting pad on the output port of the test device.



Return loss characteristics (uncorrected) of K connector shows excellent electrical compatability with SMA and 3.5 mm connectors.

Dual Source Control

Dual Source Control capability allows the 360B to independently control two sources and a receiver directly, without the need for an external computer/controller. Mixers, up/down converters, and other devices requiring two tone stimulus are easily tested with the 360B, Dual Source Control capability, and two of Wiltron's compatible sources. Antennas may be tested on a far-field range with one source remote from the 360B. Any 3600 Series test set may be used with the Dual Source Control.

N-Discrete Frequencies Mode

To take the tedium out of collecting data at many specific frequencies, the 360B includes the "N Discrete Frequencies" mode. You select from 2 to 501 discrete frequencies, arranged in any sequence.

Unique Marker Sweep

Unique to the 360B is its capability to sweep between any two markers. You simply select the number of the markers positioned at the desired start and stop frequencies. Once the system is calibrated, you can select marker sweep limits anywhere within the calibrated range without recalibration. Some measurements are as simple as viewing a broadband sweep, setting the markers to bracket the characteristics of interest, then initiating the data-taking process.

Intuitive front panel operation eases complex measurements.

Model 360B

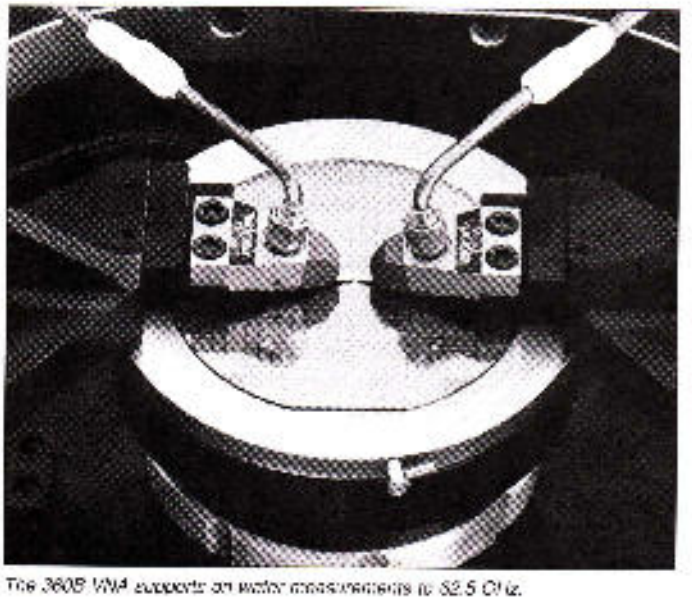
Measurement Applications

Active and Passive Components

Measure active and passive microwave components with real-time speed and phase locked accuracy. The 360B displays all four S-parameters simultaneously or overlays two data traces onto a single graph. Flat test port power correction allows for easier gain compression and absolute power measurements. View the complete characterization of amplifiers, filters, switches, isolators, cables — whatever you are testing.

On-Wafer Devices

Make fully error corrected measurements of your on-wafer devices to 62.5 GHz with the Wiltron 360B VNA and a wafer probing station. Air dielectric test port couplers offer excellent uncorrected directivity and test port match over the entire 40 MHz to 62.5 GHz frequency range. For best performance, every coaxial test set contains all necessary measurement components in a single, compact unit that can be easily located next to your wafer probing station. The 360B supports flexible OSL, LRL, and LRM calibration methods for optimal on-wafer accuracy.



The 360B VNA supports on-wafer measurements to 62.5 GHz.

Time Domain Analysis

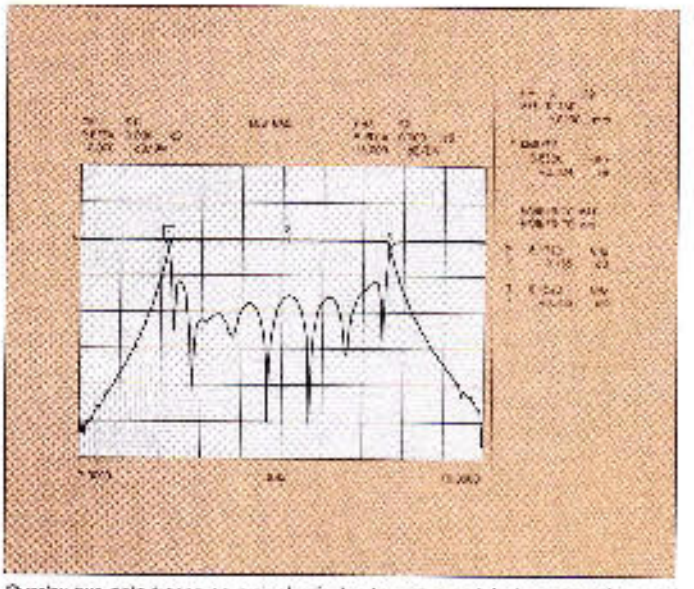
With the addition of Option 2A, High Speed Time (Distance) Domain Measurement Capability, your system displays discrete discontinuities as a function of time or distance. Unwanted reflections can be removed in the frequency domain by windowing and gating. The software provides four different windowing functions to reduce side lobes without compromising resolution. The exclusive Phasor Impulse mode enables you to measure the true impedance characteristics of a discontinuity in a dispersive or band-limited media such as waveguide.

Frequency Conversion Devices

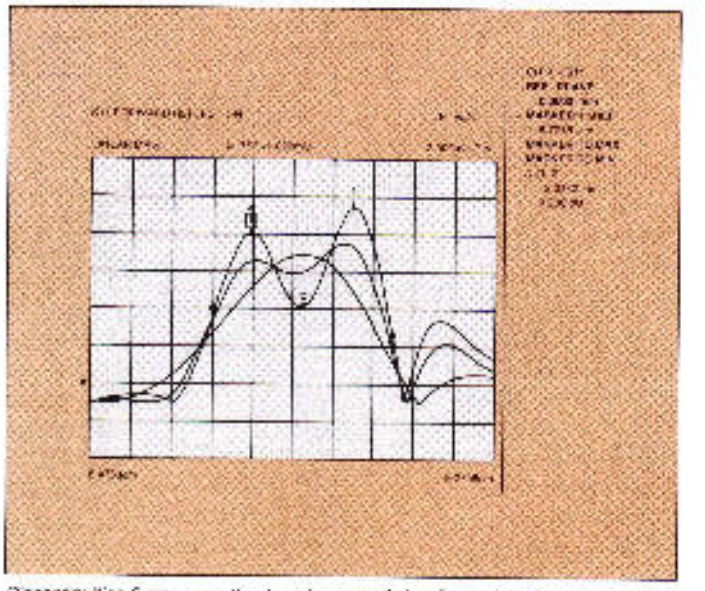
The Wiltron 3630A and 3631A Frequency Converter Test Sets provide three simultaneous measurement channels for convenient measurement of multi-port devices. The 360B VNA's multiple source control capability allows separate control of two sources and a receiver (test set) without an external controller. You can specify the frequency ranges and output powers of the sources and the frequency range and reference channel of the receiver. Test mixers, multipliers, diplexers, triplexers, and other frequency conversion devices with ease.

Fixtured Microstrip & Coplanar Waveguide

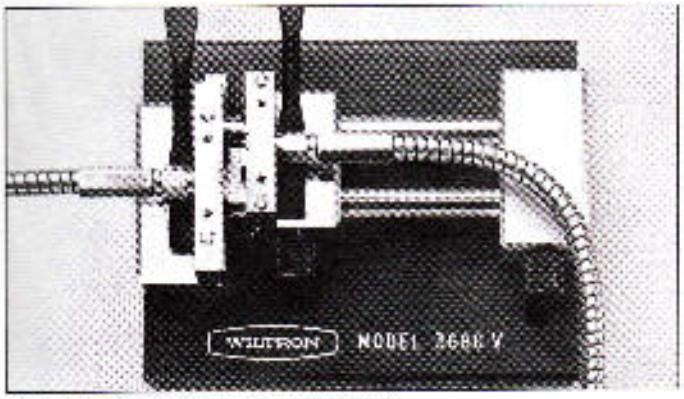
The Wiltron 3680 Series Universal Test Fixtures (UTF) allow you to adapt your coaxial system to measure virtually any microstrip or coplanar waveguide device. Three versions of the UTF are available: the 3680-20 covers dc to 20 GHz, the 3680K covers dc to 40 GHz, and the 3680V covers dc to 60 GHz.



Overlay two data traces on a single display for advanced device comparison and evaluation.



Discontinuities 2 mm apart (top trace) can easily be distinguished with High-Speed Time (Distance) Domain capability and 60 GHz coverage.



The Wiltron 3680 Series Universal Test Fixture.

The 360B VNA's ability to compensate for non-linear dispersion can dramatically improve vector measurement accuracy. Wiltron also offers a complete line of microstrip calibration kits which include all the components necessary for OSL, TRL, and LRM calibration of the 3680 Series UTF.

Antenna Pattern and RCS

The 3630A and 3637A Frequency Converter Test Sets simplify antenna pattern and radar cross-section measurements. In the "CW Draw" mode, a CW measurement can be triggered at as many as 501 equal intervals to provide a data plot as a function of time or antenna position.

Dual source control capability provides flexibility to use either harmonic or fundamental mixing for optimizing sensitivity and other measurement parameters. Option 5, Receiver Mode Capability allows you to locate the signal source a great distance away from the 360B VNA and/or test set as high level reference and phase lock signals are not needed.

Materials Measurement

Measure the complex permittivity (ε_r) and permeability (μ_r) of electronic materials with Wiltron's Model 2300-11A Materials Measurement Software Package. The unique reflection-only approach allows for easy sample preparation and non-destructive measurement of high loss, high $\varepsilon_r\mu_r$ product materials. A room temperature calibration plane can be accurately extended into a temperature chamber for extreme temperature measurements.

Harmonic Level Tests

The 360B VNA can be configured to measure the relative harmonic level of your test devices with the addition of Option 5, Receiver Mode Capability. The 360B VNA's unique phase locking scheme allows it to operate as a tuned receiver by locking all of its local oscillators to its internal crystal reference oscillator. Option 5, Receiver Mode Capability significantly increases the versatility of the 360B VNA in applications that check for harmonics, intermodulation products, spurious signals, and signals of known frequency.

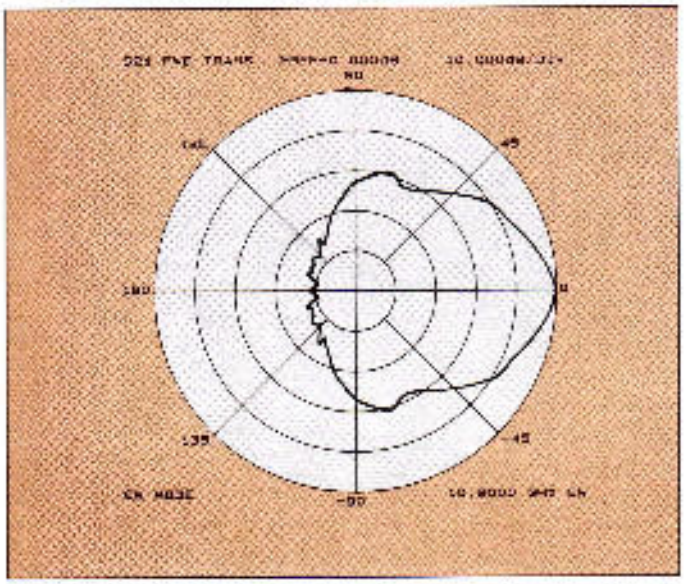
Waveguide Measurements with Adapters

The 360B system includes waveguide calibration and measurement capability up to 110 GHz. Direct waveguide measurements can be made using Wiltron V 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.

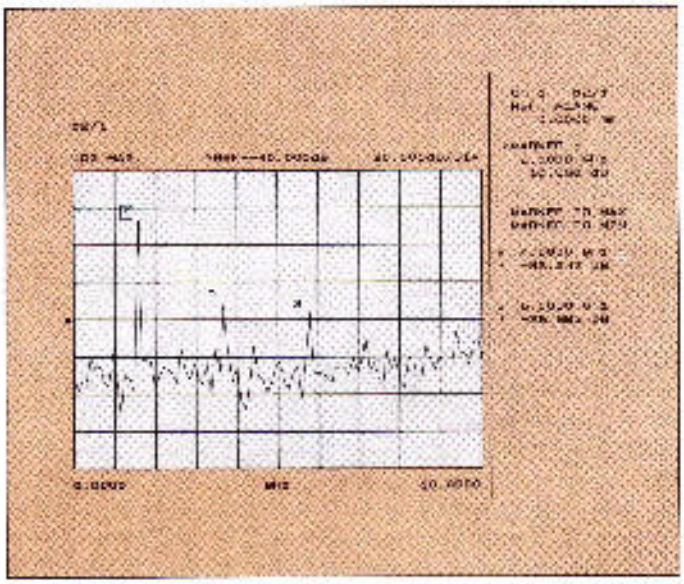
Millimeter-Wave Capability

The 360C3 Millimeter-Wave System Console provides full measurement coverage to 110 GHz. The 360B Millimeter-Wave system contains the 3655B Millimeter test set and companion 3640B/41B Series Modules for simple and direct measurement of waveguide networks to 110 GHz in four waveguide bands (Q, U, V, and W bands).

Millimeter-wave capability may be added to existing 360 systems with the addition of a 3655B, appropriate 3640/3641 Series Modules, and a 8729B Microwave Synthesizer.



A typical antenna radiation pattern shown in polar format using the 360B VNA's CW Draw capability.



The harmonic response of your test devices can be measured by the 360B VNA.

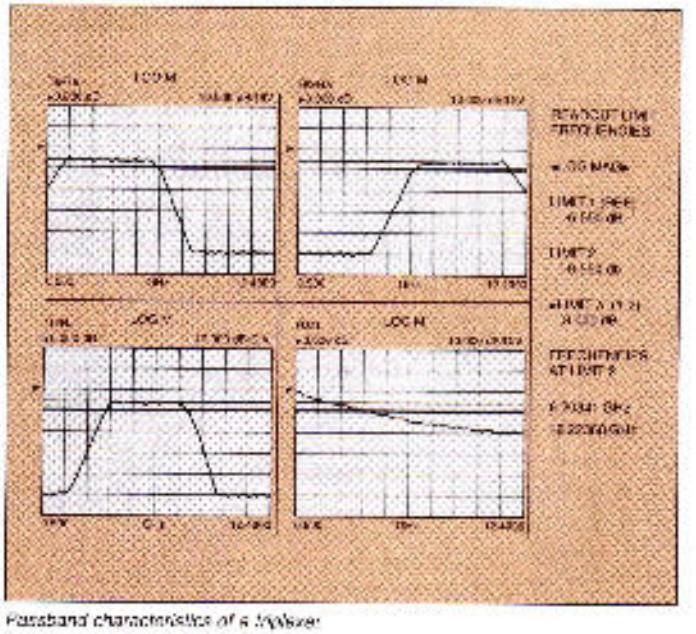
Vector Network Analyzers

Model 360B

Measurement Applications

Diplexers and Triplexers

With three simultaneous measurement channels the 360B can quickly characterize multi port devices. The 3630A and 3631A Frequency Converter Test Sets have four input ports and programmable source power control. The transmission characteristics of diplexers and triplexers can be completely characterized without time-consuming reconnections. The 3630A provides coverage from 10 MHz to 40 GHz and the 3631A provides coverage from 10 MHz to 60 GHz.



Passband characteristics of a triplexer

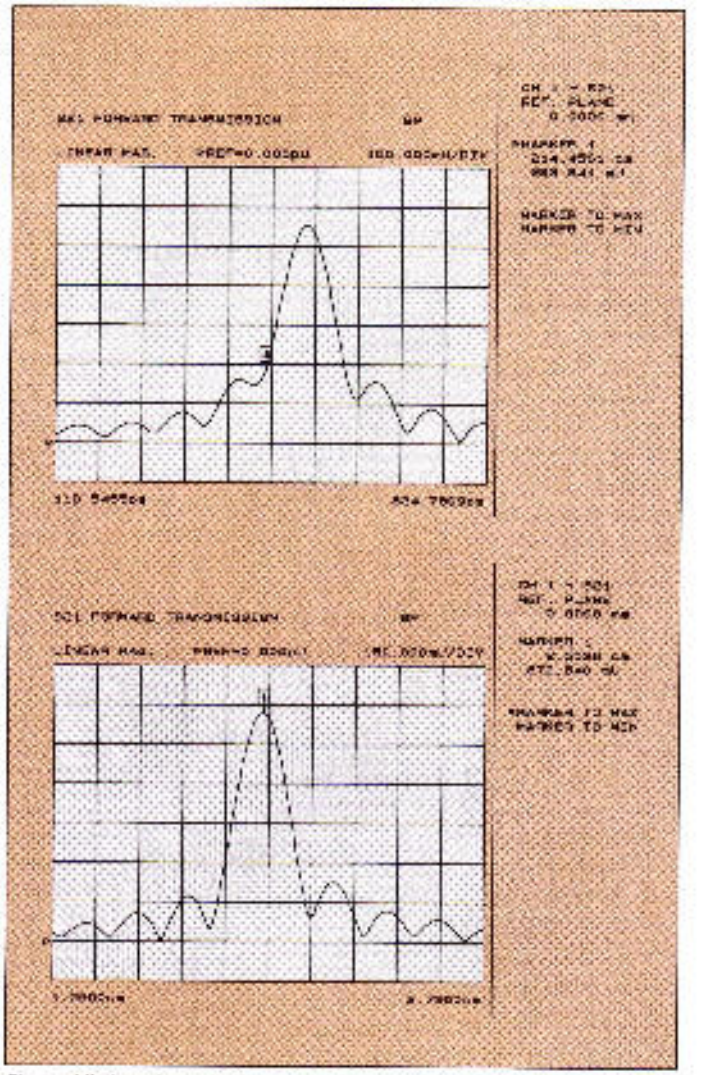
LRL/LRM Calibration

LRL/LRM calibration capability for making measurements in coaxial, microstrip, and waveguide transmission media. LRL/LRM 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 noncoaxial transmission lines and move the reference planes.

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

Through the use of LRL/LRM calibration and an external computer, in conjunction with ANACAT® software, multiple level de-embedding is possible. This calibration allows you to make semiconductor chip measurements with a single test fixture up to 60 GHz.



Phase shift through microstrip resonator line before (top display) and after (bottom display) dispersion compensation

Service Support

Built-In Diagnostics

Whenever the 360B VNA system is powered up, an extensive internal diagnostic routine makes 60 separate performance verification tests. Once in operation, a firmware resident Self Test program is constantly running in a "background" mode, making over 50 additional system checks to ensure proper operation. It will even alert the user to certain system configuration and setup problems.

Should the diagnostics indicate a problem, the process of identifying the cause is facilitated through an extensive library of "on screen" error messages and the use of 48 built-in status-indicating LEDs strategically located throughout the system.

Service Support

If a problem should occur, your 360B VNA system can be returned quickly to proper working order via one of the following:

- **On-Site Service:** If your system is covered under an On-Site Service Agreement (see the On-Site Support section on this page), just phone your nearest Wiltron Service Center and a Service Engineer will be sent to your site within the time frame specified on your agreement (typically, within 24 hours).
- **Return-to-Factory Service:** Simply return the faulty system or major subassembly to the closest Wiltron Factory Authorized Service Center with a description of the problem.
- **Assembly Exchange Service:** After determining the faulty assembly, contact the nearest Wiltron Service Center and order the exchange assembly you need. The exchange assembly is sent directly to you and, upon return of the replaced assembly, you receive a significant credit toward the cost of the exchange assembly. In the case of warranty service, full credit is issued.

On-site Support

A variety of on-site support services are available to help maximize 360B system up-time. These include:

- **On-Site Installation:** Available upon request with each 360B VNA system. A Wiltron Customer Service Representative will help set up and check out your 360B Network Analyzer System when it arrives at your plant. The Customer Service Representative will also provide a brief user orientation on 360B system operation.
- **On-Site Verification:** Ordered as 360MS Option 11, this service provides on-site verification of the 360B system performance by a Wiltron Customer Service Engineer. Broadband performance is verified via comparison measurements on K Connector®, V Connector®, GPC-3.5, or GPC-7® standards. A printout of verification data is provided for comparison with past and future results. (Required repairs discovered during the calibration process are extra to this service and will be billed separately unless the system is under warranty or covered by an on-site service agreement).
- **On-Site Service:** Ordered as 360MS Option 12, this service provides for repair service performed at the customer site within a specified time (typically 24 hours) after customer notification of a problem.

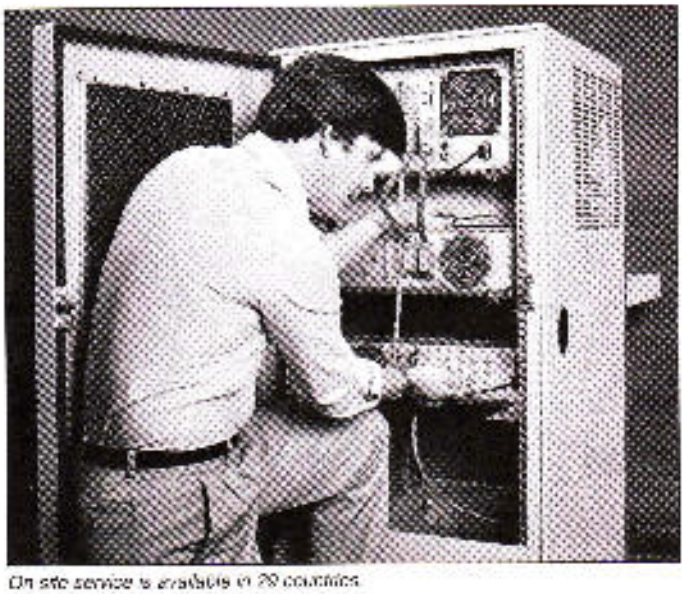
For a complete on-site support solution, both Option 11, On-Site Calibration and Option 12, On-Site Service should be ordered.

Warranty

The 360B system is covered by Wiltron's standard one-year, return-to factory warranty (two-years on YIG-tuned oscillators, 90 days on 3670 Series Test Port Cables). In most cases, by taking advantage of Wiltron's Exchange Assembly Service, repair can be accomplished without actually returning the system to the factory.

Warranty Conversion

For those customers preferring on-site warranty coverage, the one-year, return-to-factory warranty may be converted to a 90-day, on-site service warranty at no additional charge by ordering 360MS Option 13 at the time of purchase. For a continuation of on-site service after the 90-day warranty period, 360MS Option 11, On Site Calibration and 360MS Option 12, On Site Service are recommended.



On site service is available in 29 countries.

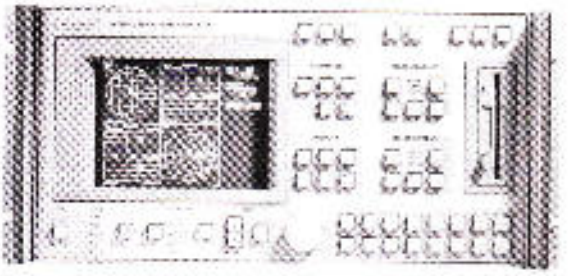
Vector Network Analyzers

Model 360B

System Composition

Network Analyzer

The 360B 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.



Model 360B Network Analyzer

Test Sets and Modules

There are several test sets from which to choose, depending upon your application. Most test set types include multiple models covering differing frequency ranges and corresponding connectors. Reversing and Active Device test sets include automatic signal reversing with which full S parameter tests can be made without manually reversing the test device. The 36358 Millimeter-Wave Test Set is the interface for the 3640B and 3641B Series (waveguide band) Modules.

Model	Frequency Range	Test Port Connectors
3610A Reversing Test Set	40 MHz to 20 GHz	K Connector (m)
3611A Reversing Test Set	40 MHz to 40 GHz	K Connector (m)
3612A Reversing Test Set	40 MHz to 60 GHz	V Connector (m)
3620A Pulse/CW Test Set	950 MHz to 20 GHz	K Connector (f)
3620A Active Device Test Set	40 MHz to 20 GHz	K Connector (f)
3621A Active Device Test Set	40 MHz to 40 GHz	K Connector (m)
3622A Active Device Test Set	40 MHz to 60 GHz	V Connector (m)
3630A Frequency Converter	10 MHz to 40 GHz	K Connector (f)
3631A Frequency Converter	10 MHz to 60 GHz	V Connector (f)
36358 mm-Wave Test Set	33 to 110 GHz	Waveguide (Q, U, V, W Bands)

Test port connectors can be converted to GPC-7 (3.5 mm) or Type N with the use of the 34L and 34N Series Test Port Connectors.

Reversing Test Sets

Reversing test sets provide basic S-parameter measurement capability. There are three coaxial models: 3610A (40 MHz to 20 GHz), 3611A (40 MHz to 40 GHz), and 3612A (40 MHz to 60 GHz).

Model 3611A Reversing Test Set

Active Device Test Sets

Models 3620A, 3621A, and 3622A include 70 dB step 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. Bias tees are included to superimpose dc bias upon each test port center conductor.

Model 3621A Active Device Test Set

Pulse/CW Test Set

The 3636A is the heart of the 3608*20A Pulse/CW VNA System. It can be configured in a wide variety of ways to offer maximum flexibility. The test set incorporates couplers capable of 20 Watts peak (10 Watts) average forward power. An additional coupler in Port 2 allows high-power forward measurements and low-power reverse measurements. Key nodes on the test set are available to allow addition of bias tees, high power amplifiers, and terminations.

Model 3636A Pulse/CW Test Set

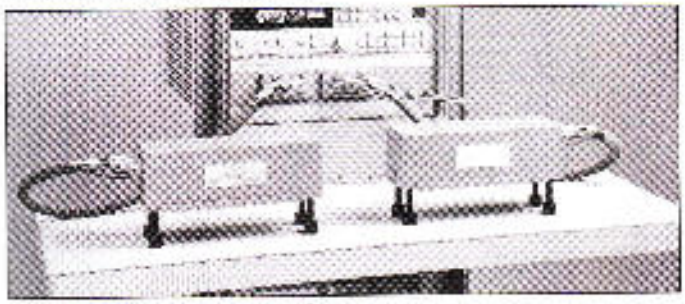
Frequency Converters

The 3630A and 3631A Frequency Converters are four-channel receivers that measure magnitude and phase of frequency conversion devices. Two different input frequencies (RF and LO) and the receiver frequency (IF) are controlled from the 360B front panel. With its exceptional versatility, the unit is also well suited to measuring multiple-output devices, high power TWTs, QPSK modulators, antenna patterns, and radar cross sections.

Model 3630A Frequency Converter

Millimeter-Wave Test Sets

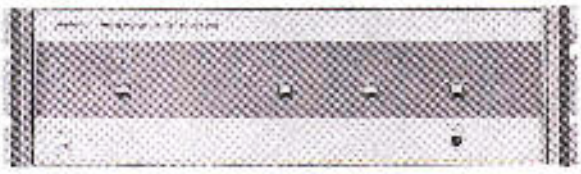
The 3635B Millimeter-Wave Test Set and 3640B and 3641B Series modules provide full test capability to 110 GHz in four waveguide bands. The 3635B interfaces with the 360 Network Analyzer and provides necessary DC, RF, and IF signals for the 3640B Series modules. 3640B Series Transmission/Reflection Modules provide RF stimulus to the device under test and measures relative forward and reflected power. A pair of 3640B modules allows measurement of all four S parameters on a two- port device without reversal of the test device. A 3640B module combined with a 3641B module allows measurement of S_{11} (input reflection) and S_{21} (forward transmission) characteristics.



Model 3635B Millimeter-Wave Test Set

Test Set Multiplexer

The 360TSM Test Set Multiplexer allows the use of two test sets and two sources with a single 360B Network Analyzer. From the 360TSM front panel, or from a 360B menu, an operator can select a different test set or source. Sources or test sets may be located up to 30 meters from the 360B. All IF and control circuitry is switched automatically. An output is provided for switching microwave signals through an external coaxial switch.



Model 360TSM Test Set Multiplexer

Signal Sources

Wiltron offers three different families of microwave sources that are compatible with the 360B. The System Signal Sources are designed specifically for use with the 360B and have no front panel control. Wiltron's 6700B Series Swept Frequency Synthesizers and 6600B Sweep Generators are also compatible with the 360B.

System Signal Sources

There are two System Signal Sources: The 360SS47 and the 360SS69, covering the 10 MHz to 20 GHz and 40 GHz ranges respectively. Both are controlled and phase locked by the 360B Network Analyzer to provide clean, phase-locked stimulus signals. Frequency resolution is 100 kHz. 60 GHz coverage is provided by using a standard 360SS69 with a 3612A, 3622A, or 3631A Test Set that includes a frequency tripler.

Model 360SS69 System Signal Source

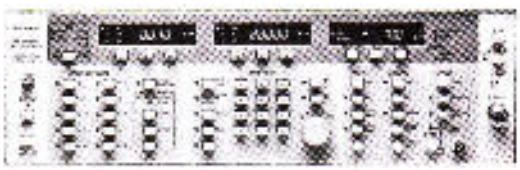
6700B Series Swept Frequency Synthesizers

The 360B controls the 6700B over it's GPIB interface. The 6700B Series offers 1 kHz resolution and internal pulse capability.

6700B Series Synthesizers

6600B Series Sweep Generators

Also compatible with the 360B are the 6600B Sweep Generators (with Option 14, 360 compatibility). The 360B controls the 6600B over its GPIB interface and phase locks the 6600B to 10C kHz resolution via the phase lock input.



6600B Series Sweep Generator

Cabinets

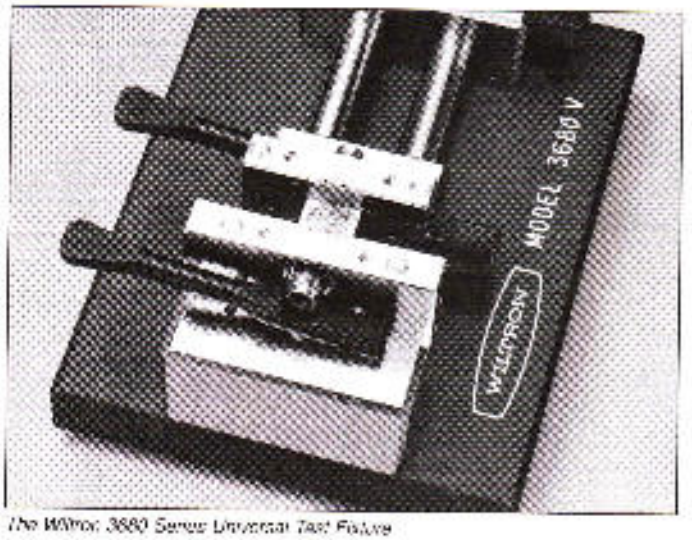
360B VNA systems, consisting of a 360B, test set(s), and source(s) are available either in the 360C2 System Console, 360C1 System Cabinet, or 360C3 Millimeter-Wave System Console.

Measurement Accessories

Wiltron offers a complete line of accessories to accommodate measurement of a wide variety of test devices.

3680 Series Universal Test Fixture (UTF)

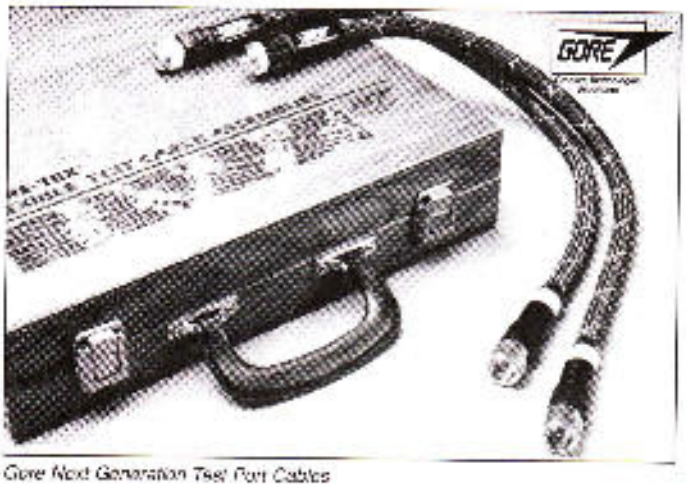
Wiltron's UTF provides an accurate, repeatable solution for measuring microstrip and coplanar waveguide devices.



The Wiltron 3680 Series Universal Test Fixture

Gore Next Generation Test Port Cables

Gore Next Generation flexible test port cables are available for use with the Wiltron 360B VNA. These test assemblies ensure precise, repeatable, broadband measurements to 62.5 GHz and can be configured for test sets covering 40 MHz to 20 GHz, 40 GHz, and 62.5 GHz. Standard lengths are 25 and 38 inches. The excellent phase and amplitude stability of Gore test assemblies helps maintain calibration to ensure test accuracy and productivity. For more information on Next Generation Series test port cables for use with the 360B VNA, contact your local Anritsu-Wiltron Sales Center or W.L. Gore & Associates at 800-356-4622.



Gore Next Generation Test Port Cables

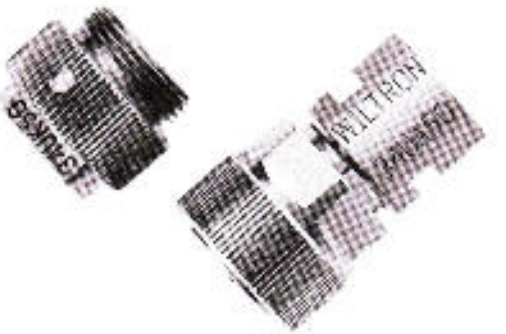
3670 Series Test Port Cables

Wiltron offers 1- and 2-foot lengths of these laboratory quality cables with GPC-7, K, or V connectors. Most applications require one 1-foot cable and one 2-foot cable.

Model 3670 Series Test Port Cable

34U & 34Y Series Test Port Converters

Test port converters allow you to change the test port connectors on a 360A Series test set. Converters are available with Type N, 2.4 mm, 3.5 mm, GPC-7, K, and V connectors.



Model 34U and 34Y Series Test Port Converters

35 Series Waveguide-to-Coaxial Adapters

The 35 Series precision waveguide-to-coaxial adapters transform standard or double ridge waveguide to coaxial K or V connectors. Sixteen different models cover the 7.5 to 60 GHz frequency range.

The 35 Series Waveguide-to-Coax Adapters include standard and double-ridge models

Specifications

MEASUREMENT CAPABILITIES

Number of Channels: Four measurement channels.
Parameters: S_{11}, S_{21}, S_{12}, S_{22}, or user defined, 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, CW Draw, and optional High Speed Time (Distance) Domain.
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, SWR
Data Points: 501 (MAXIMUM). Can be switched to a value of 168 (NORMAL) or 85 (MINIMUM) data (frequency) points without recalibration. In addition, the system accepts an arbitrary set of N discrete data points where: $2 \leq N \leq 501$. CW mode permits selection of a single data point 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 compensated 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 as the reference for the other five. Markers can be directed automatically to the minimum or maximum of a data trace.
Marker Sweep: Sweeps upward in frequency between any two markers. Recalibration is not required during the marker sweep.
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 $2 \leq N \leq 501$.
Dynamic Range: Table 1, on page 27, gives dynamic range in two manners. "Receiver Dynamic Range" is defined as the ratio of the maximum signal level at Port 2 for 0.1 dB compression to the noise floor at Port 2. "System Dynamic Range" is defined as the ratio of the power incident on Port 2 in a through line connection to the noise floor at Port 2 (forward measurements only). In preparing the table, minimum IF bandwidth and 1024 averages were used in calibration and measurement.

DISPLAY CAPABILITIES

Display Channels: Four, each of which can display any S-parameter or user defined 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 can be displayed simultaneously.
CRT: Color, 7.5" diagonal, VGA display. Graticules are displayed in green, measurement data in red, markers and limits in blue, and overlaid trace data in yellow. Trace data stored in memory are displayed in green.
Trace Overlay: Displays two traces on the active channel's graticule simultaneously. The overlaid trace is displayed in yellow and the primary trace is displayed in red.
Trace Memory: A separate memory for each channel can be used to store measurement data for later display or 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.

MEASUREMENT ENHANCEMENT

Data Averaging: Averaging of 1 to 4095 averages 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 MINIMUM selections correspond to approximately 10 kHz, 1 kHz, and 100 Hz, respectively.
Trace Smoothing: Functions similarly to Data Averaging but computes an average over a percentage range of the data trace. The percentage of trace 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 360B is compatible with the Wiltron 360SS System Sources and the 6500B Sweep Generators. The output frequency of both is phase locked by the 360B to the internal 10 MHz crystal standard, providing synthesizer stability. Phase-lock time is typically 2 ms. Frequency resolution is 100 kHz. The 360B is also compatible with the 6700B Series Sweep Frequency Synthesizers which offer 1 kHz frequency resolution.
Source Power Level: The source power (dBm) may be set from a 360B front panel menu. For active device test sets, the signal level at Port 1 or Port 2 can be controlled using the test set's internal step attenuators.
Power Flatness Correction: The 360B corrects for test port power variations and slope using an external Hewlett Packard 437B power meter. The 360B measures the power level at the test port, calculates the flatness correction offset at each frequency, and then passes the offset array to the 360B signal source. Once the test port power has been flattened, its level may be changed within the remaining power adjustment range of the signal source.
Dual Source Control Capability: Dual Source Control capability allows a user to separately control the frequency of up to two sources and a receiver without the need for an external controller. The frequency ranges and output powers of the two sources may be specified. A frequency sweep may be comprised of up to five separate bands, each with independent source and receiver settings, for convenient testing of frequency translation devices such as mixers. Up to five sub-bands may be tested in one sweep. Option 4 enables users to easily test mixers, up/down converters, multipliers, and other frequency converson devices.
Source #1: Any one of Wiltron's family of 360SS signal sources or any one of Wiltron's family of 6700B synthesizers
Source #2: Any of Wiltron's family of 6700B synthesizers
Receiver: Any one of Wiltron's family of 360XA Series VNA test sets

SOURCE FREQUENCY ACCURACY

Time Base Freq. Accuracy: Same as internal or external time base
Internal 10 MHz Time Base Stability:
With Aging: <1 x 10⁻⁹/day
With Temperature: < 5 x 10⁻⁸ over 0° to +55°C range

TEST PORT CHARACTERISTICS

The specifications in Table 2 apply when the proper Wiltron Model 34U or 34Y Universal Adapters are connected, with or without phase-equal insertables, to the test set ports and calibrated with the appropriate Wiltron or other designated calibration kit at 23°C ±3°C using the OSL calibration method with a sliding load to achieve 12-term error correction.

GROUP DELAY CHARACTERISTICS

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: Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range without recalibration. The frequency width of the aperture and the percent of the frequency range are 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. A frequency step size of 100 kHz 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:

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

* Signal source phase noise specification.

Accuracy:

$$\text{Error in } \tau_g = \frac{\text{Error in phase (deg)}}{360} - \frac{\tau_g \times \text{Aperture Freq. Error (Hz)}}{\text{Aperture (Hz)}}$$

VECTOR ERROR CORRECTION

There are three methods of calibration:
1) The standard Open Short Load (OSL) calibration method using short circuits, open circuits, and terminations (fixed or sliding);
2) Offset-Short (waveguide) calibration; and
3) LRL/LRM — Line-Reflect-Line or Line Reflect-Match calibration.

There are four vector error correction models available:
1) Full 12 Term
2) One Path/Two Port
3) Frequency Response (Transmission/Reflection)
4) Reflection Only

Full 12-Term can always be used, if desired, since all S-parameter test sets automatically reverse the test signal. Front-panel LEDs indicate the type of calibration that is stored in memory. Front-panel button selects whether calibration is to be applied, and an LED lights when error correction data are being applied.

Calibration Sequence: Prompts the user to connect the appropriate calibration standard to Port 1 and/or Port 2. Calibration standards may be measured simultaneously or one at a time.

Calibration Standards: For coaxial calibrations the user selects SMA, GPC–3.5, GPC–7, Type N, 2.4 mm, TNC, K Connector, or V Connector from a calibration menu. Use of fixed or sliding load can be selected for each connector type. Open circuit offset length and capacitance coefficients can be modified. Short circuit offset length may be modified. Throughline parameters may be modified by entering an offset length and/or by entering the dc coefficient (A), frequency coefficient (B), and frequency exponent (C) for a throughline loss equation as follows: $(A + B \times \text{Frequency}^C)$. In general, all calibration parameters may be modified manually or through the GPIB interface.

Reference Impedance: Modify the reference impedance of the measurement to other than 50Ω.

LRL/LRM Calibration Capability: The LRL calibration technique uses the characteristic impedance of a length of transmission line as the calibration standard. A full LRL calibration consists merely of two transmission line measurements, a high reflection measurement, and an isolation measurement. The LRM calibration technique is a variation of the LRL technique that utilizes a precision termination rather than a second length of transmission line. A third optional standard, either Line or Match, may be measured in order to extend the frequency range of the calibration. This extended calibration range is achieved by mathematically concatenating either two LRL, two LRM, or one LRL and one LRM calibration(s). Using these techniques, full 12 term error correction can be performed on the 360B VNA.

LRL/LRM Calibration Performance:

Calibration Performed: LRL + Isolation, or LRM + Isolation; two line, one-line/one-match, or concatenated calibration (LRLL, LRLM, LRML, or LRMM).

Dispesion Compensation: Selectable as Coaxial (non-dispersive), Waveguide, or Microstrip.

Reference Plane: Selectable as Middle of line 1 or Ends of line 1.

Corrected Impedance: Determined by Calibration Standards.

Accuracy: Determined by calibration components. For a GPC–7 calibration, when properly calibrated with an appropriate Maury Microwave LRL calibration kit, the specifications in Table 2 on page 28 apply.

HARD COPY

Printer: Menu selects full screen, graphical, tabular data, and printer type. The number of data points of tabular data can be selected as well as data at markers only. Compatible with the 2225C Ink Jet, HP QuietJet, HP DeskJet, HP LaserJet, and Epson compatible printers with Parallel (Centronics) interfaces.

GPIB Plotter: The 360B is compatible with HP Models 7440A, 7470A, 7475A, and 7550A and Tektronix Model HC100 plotters. Menu selects plotting of full or user-selected portions of graphical data. Plotter is connected to the dedicated system bus, which also controls the system signal source.

Buffer: Hard copy printed 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.

STORAGE

Internal Memory: Up to four front panel states (setup/calibration) can be stored and recalled from non-volatile memory locations. The current front panel setup is automatically stored in non-volatile memory at instrument power-down. When power is applied, the instrument returns to its last front panel setup (with no calibration or normalization data applied).

Internal Disk Drive: A 3.5-inch microdiskette drive with 1.44 Mbytes formatted capacity is used to load measurement programs and to store and recall measurement and calibration data and front-panel setups. This disk drive will also read from and write to 720 kbyte MS–DOS formatted disks. All files are MS–DOS compatible. File names can be 1 to 8 characters long.

Disk Drive File Size:

Measurement Data: 25.6K bytes per 501 point S-parameter data file.

Calibration Data: 61K bytes per 501 point (12-term cal setup).

Trace Memory File: 4K bytes per 501 point channel.

Table 1. Test Set Dynamic Range Summary

Test Set Model	Frequency (GHz)	Max. Signal into Port 2 (dBm)	Noise Floor (dBm)	Receiver Dynamic Range (dB)	Port 1 Power (dBm, typical)	System Dynamic Range (dB)
3810A Processing Test Set	0.04 1 20	20 0 0	−85 −118 −108	115 110 109	−4 −5 −7	81 105 101
3811A Processing Test Set	0.04 1 20 40	20 −3 −3 −3	−82 −109 −106 −101	112 112 109 104	6 7 −9 −10	88 102 96 90
3812A Processing Test Set	0.04 1 20 40 50 60[1] 62.5	+20 +3 +3 +3 +3 +2 +3	−86 −112 −106 −100 −90 −87 −82	116 115 111 108 92 89 88	10 −11 17 22 −15 17 18	86 101 91 83 75 70 67
3820A Active Device Test Set	0.04 1 20	+30 +20 +30	−98 −115 −110	128 145 140	−4 −5 8	94 110 102
3821A Active Device Test Set	0.04 1 20 40	+30 +20 +30 +30	−95 −112 −107 −103	125 142 137 133	−8 −7 10 −10	89 105 97 95
3822A Active Device Test Set	0.04 1 20 40 50 60[1] 62.5	+30 +30 +30 +30 +30 +30 +30	−95 −112 −107 −103 −99 −96 −94	125 142 137 133 119 116 114	−10 11 −16 −21 −15 −21 −22	95 131 93 73 70 66 62
3930A Frequency Converter	0.01 1 20 40	10 −10 −15 −7	−112 −117 −109 −97	102 102 98 87	n/a	n/a
3930A Frequency Converter	0.01 1 20 40 50 60	−10 −10 −10 −10 −10 −10	−117 −117 −115 −107 −85 −80	107 107 105 97 85 80	n/a	n/a
3940B-Q & 3941B-Q (WR-22) mm-Wave Modules[2]	33 to 50	1	−102	101	4	96
3940B-U & 3941B-U (WR-19) mm-Wave Modules[2]	40 to 60	11	−101	102	4	97
3940B-V & 3941B-V (WR-15) mm-Wave Modules[2]	50 to 75	7	−100	93	13	90
3940B-W & 3941B-W (WR-10) mm-Wave Modules[2]	75 to 110	4	−95	91	15	80

[1] Available with Test Set Option 8, 62.5 GHz Frequency Coverage.
[2] 3940B Series mm-Wave Modules are used with the 3935 mm-Wave Test Set.

Table 2. Test Port Characteristics

Connector	Frequency (GHz)	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Frequency Tracking (dB)	Transmission Frequency Tracking (dB)	Isolation (dB)
GPC-7	0.04 1.0 18	>52 >52 >52	>44 >44 >42	>52 >52 >52	±0.003 ±0.003 ±0.004	±0.004 ±0.004 ±0.012	>100 >116 >112
GPC-7[1] LRL Calibration	2 18	>60 >60	>60 >60	>60 >60	±0.001 ±0.001	±0.001 ±0.001	>115 >112
3.5 mm	0.04 1.0 20 26.5	>44 >44 >44 >44	>40 >40 >38 >34	>44 >44 >44 >44	±0.005 ±0.005 ±0.006 ±0.006	±0.030 ±0.030 ±0.050 ±0.070	>105 >115 >110 >102
K	0.04 1.0 20 40	>42 >42 >42 >38	>40 >40 >36 >33	>42 >42 >42 >38	±0.006 ±0.006 ±0.006 ±0.008	±0.030 ±0.050 ±0.070 ±0.080	>105 >115 >110 >100
V	0.01 1.0 20 40 50 60[2] 62.5	>40 >40 >40 >36 >34 >34 >34	>38 >38 >36 >32 >28 >28 >26	>40 >40 >40 >36 >34 >34 >34	±0.005 ±0.005 ±0.009 ±0.008 ±0.015 ±0.015 ±0.015	±0.030 ±0.050 ±0.060 ±0.080 ±0.100 ±0.100 ±0.100	>105 >115 >113 >97 >85 >77 >75
WR-22 Waveguide (LRL Calibration)	33 to 50	>30	>50	>50	±0.002	±0.009	>100
WR-22 Waveguide (Offset Short Cal.)		>50	>45	>50	±0.010	±0.030	>100
WR-19 Waveguide (LRL Calibration)	40 to 60	>50	>50	>50	±0.002	±0.009	>100
WR-19 Waveguide (Offset Short Cal.)		>50	>40	>50	±0.010	±0.040	>100
WR-15 Waveguide (LRL Calibration)	50 to 75	>50	>50	>50	±0.002	±0.002	>90
WR-15 Waveguide (Offset Short Cal.)		>50	>37	>50	±0.030	±0.060	>90
WR-10 Waveguide (LRL Calibration)	75 to 110	>46	>46	>46	±0.002	±0.002	>90
WR-10 Waveguide (Offset Short Cal.)		>46	>36	>46	±0.040	±0.070	>90

1. When used with an appropriate Agilent Microwave Calibration Kit (or equivalent).
2. Available with Test Set Option 510 (10 MHz Frequency Coverage).

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, or 64-bit floating point.
Speed: 40K bytes/s
Interface Function Codes: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DT1, DC1, C0.

MEASUREMENT ACCURACY

The graphs on the following pages give measurement accuracy after 12-term vector error correction. The errors are worst case contributions of residual directivity, osd and source match, frequency response, isolation, network analyzer dynamic accuracy, and connector repeatability. In preparing the following graphs, minimum video/IF bandwidth and averaging of 1024 points were used. Changes in the video IF bandwidth or averaging can result in variations at low levels.

GENERAL

360B Rear Panel Connectors and Controls:
CRT INTEN: Continuous control of CRT intensity.
CRT DEGAUSS: Pushbutton control degausses CRT.
PRINTER: Centronics interface for an external printer.
VGA IN: Accepts standard 15-pin external VGA signal input.
VGA OUT: Provides VGA output of 360B video display.
10 MHz REF IN: Connects to external reference frequency standard, 10 MHz, +5 to –5 dBm, 50Ω, BNC female.
10 MHz REF OUT: Connects to internal reference frequency standard, 10 MHz, 0 dBm, 50Ω, BNC female.
EXT ANALOG OUT: –10V to +10V with 5 mV resolution, varying in proportion to user-selected data (e.g., frequency, amplitude, phase). BNC female.
LINE SELECTION: Sets 100V, 120V, 220V, or 240V operation.
EXTERNAL DIGITAL CONTROL: External triggering for 360B measurement, BNC female, +1V trigger, 10 kΩ input impedance.
EXT FM PHASE LOCK OUTPUT: Connects to 8600B Series or 360SS signal source for phase locking.
SYSTEM BUS: Dedicated EEE–488 interface for the system signal source, plotter, and power meter.
TEST SET SIGNAL: Interconnects system components.
TEST SET CONTROL: Interconnects system components.
360B GPIB: IEEE-488 interface.

Test Set Rear Panel Connectors and Controls:
BIAS INPUTS, Ports 1 and 2: 0.5 A maximum, BNCs on test set front and rear panels.
REFERENCE EXTENSION: Provides access to reference samplers, K Connector, female.
360B SIGNAL: Interconnects system components.
360B CONTROL: Interconnects system components.
OPTION I/O: Dedicated I/O port for 360B module support.

Frequency Converter Rear Panel Connectors and Controls:
PORT 2 SOURCE ATTENUATOR: 14-pin DIP socket, used to control external Wiltron Step Attenuator.
PORT 2 TEST ATTENUATOR: 14-pin DIP socket, used to control external Wiltron Step Attenuator.
TRANSFER SWITCH: Connector used to control an external Wiltron transfer switch.
360B SIGNAL: Interconnects system components.
360B CONTROL: Interconnects system components.
OPTION I/O: Dedicated I/O port for 360B module support.

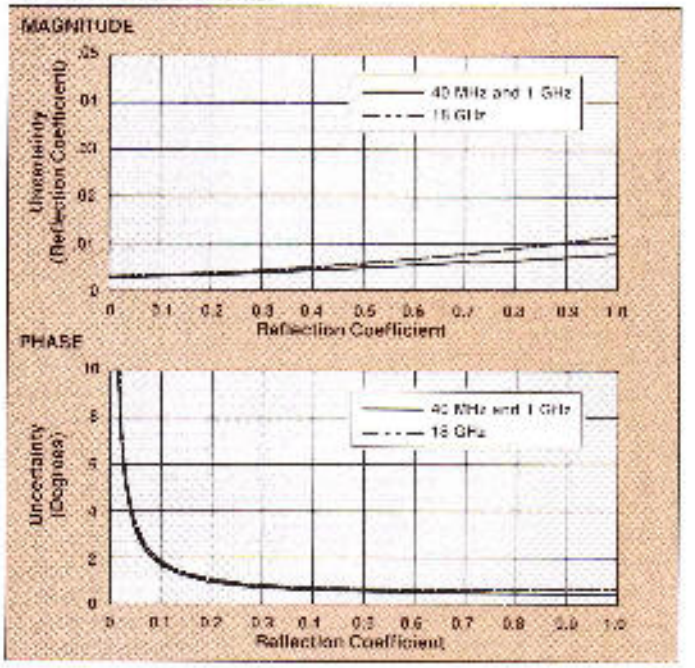
Temperature Range:
Operating: 0°C to 50°C (45°C maximum for disk drive)
Storage: –40°C to 75°C

Power Requirements:
Network Analyzer: 100V/120V/220V/240V +5% –10%, 48–63 Hz, 350 VA maximum
System Sources: 100V/120V/220V/240V +5% –10%, 48–63 Hz, 250 VA maximum
Test Sets & Freq. Converter: None; power supplied by 360.

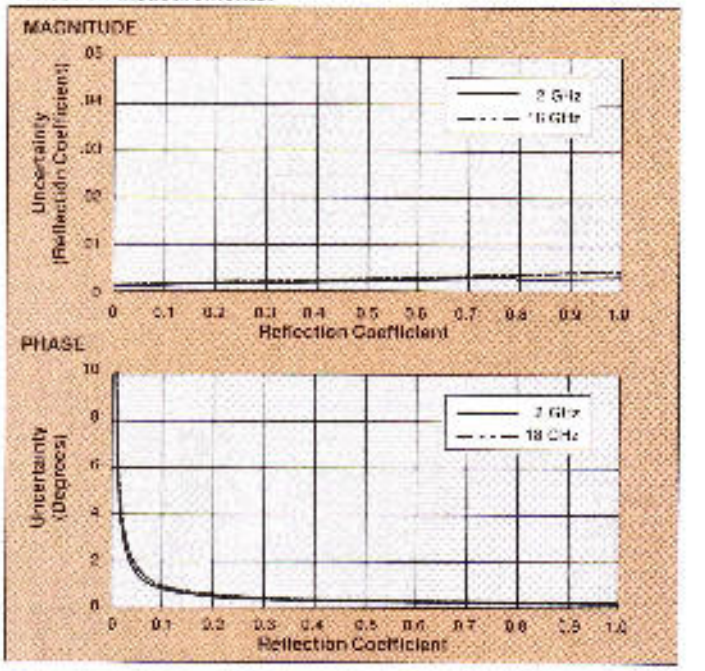
Dimensions:
360B VNA: 222H x 432W x 603D mm (8.75x17x23.75 in.)
System Sources: 133H x 432W x 476D mm (5.25x17x18.75 in.)
Test Sets and Frequency Converter: 133H x 432W x 603D mm (5.25x17x23.75 in.)
Printer: 89H x 292W x 203D mm (3.5x11.5x8 in.)
System Cabinet: 572H x 559W x 699D mm (22.5x22x27.5 in.)
System Console: 1245H x 559W x 699D mm (49x22x27.5 in.)

Weight:
Network Analyzer: 25 kg (55 lb.)
System Sources: 16 kg (35.4 lb.)
Test Sets and Frequency Converter: 14.3 kg (31.5 lb.)
Printer: 3.2 kg (7 lb.)
System Cabinet (empty): 40.8 kg (90 lb.)
System Console (empty): 59.4 kg (~95 lb.)

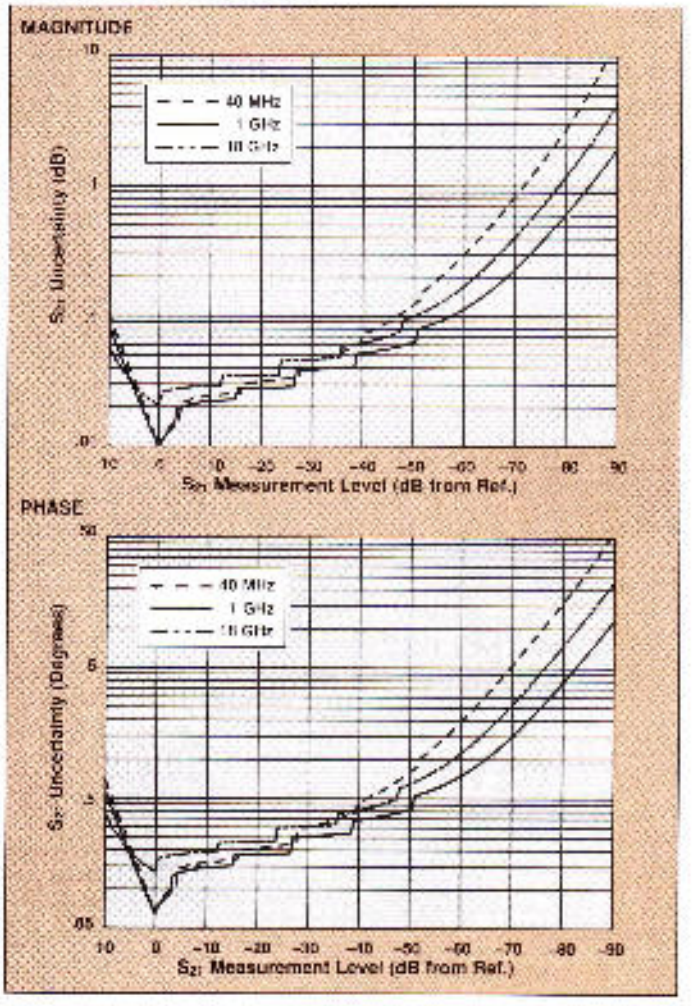
UNCERTAINTY CURVES
Models 3610A and 3620A Test Sets (GPC-7 Connectors)
Reflection Measurements:



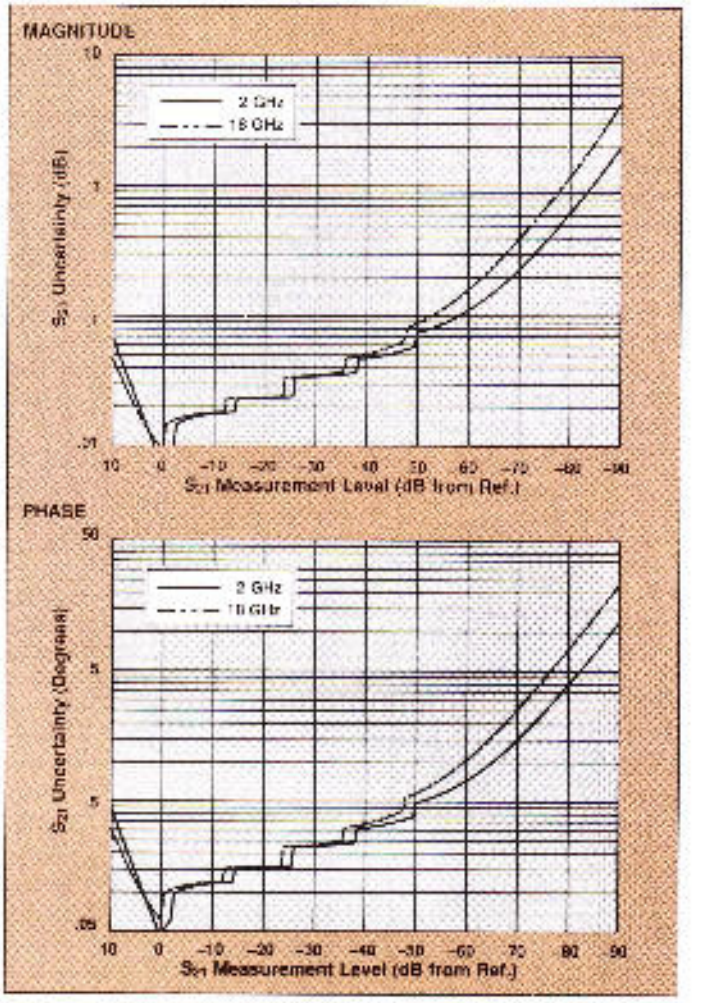
UNCERTAINTY CURVES
Models 3610A and 3620A (LRL Calibration; GPC-7 Connectors)
Reflection Measurements:



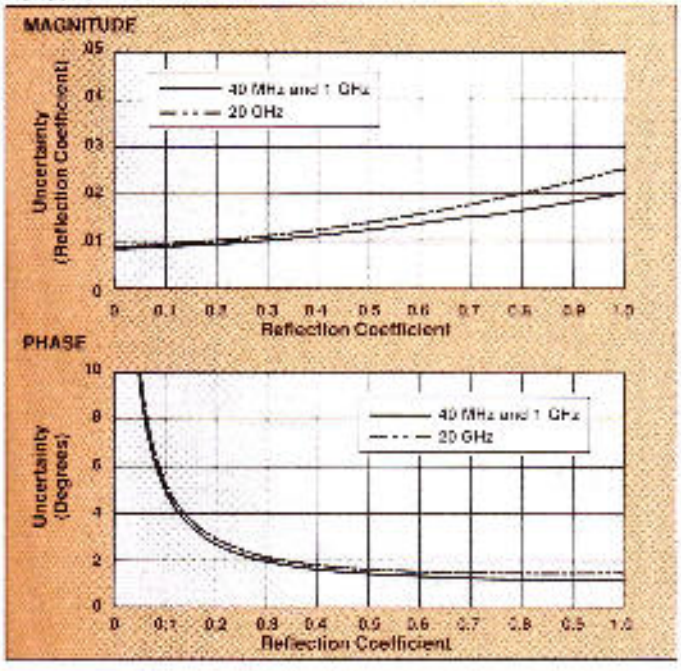
Transmission Measurements:



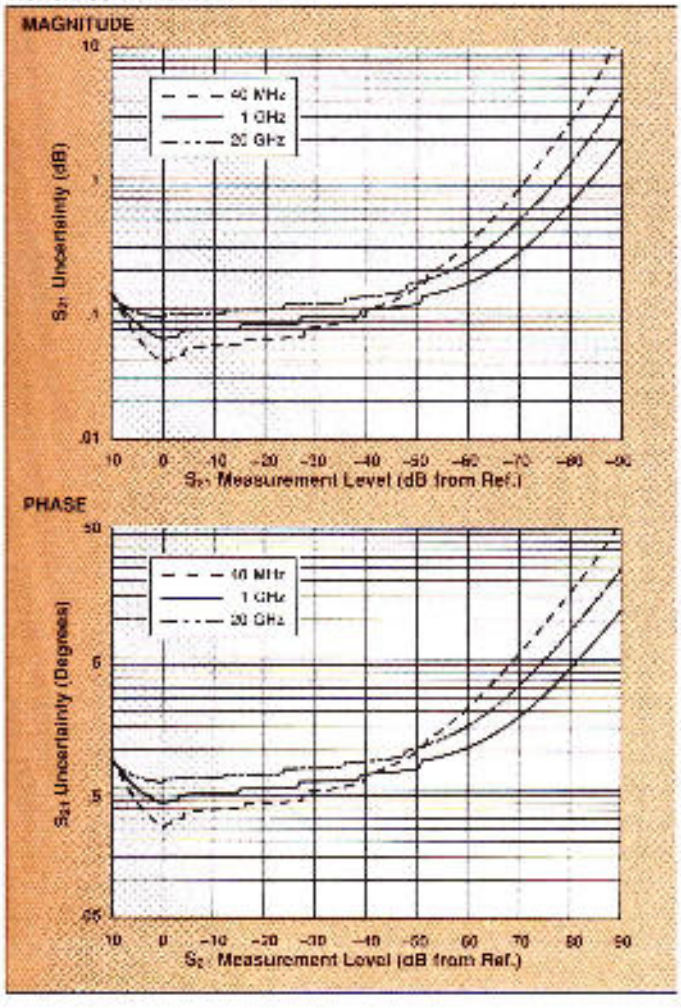
Transmission Measurements:



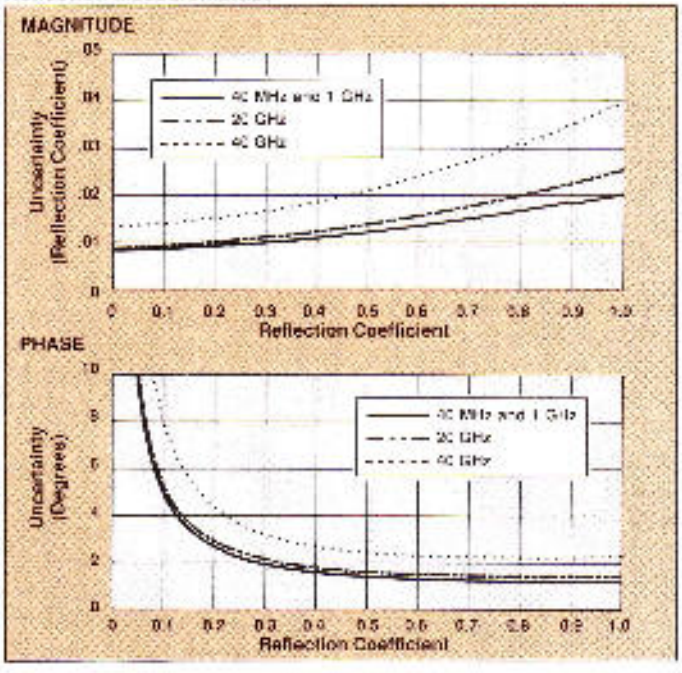
UNCERTAINTY CURVES
Models 3610A and 3620A Test Sets (K Connectors)
Reflection Measurements:



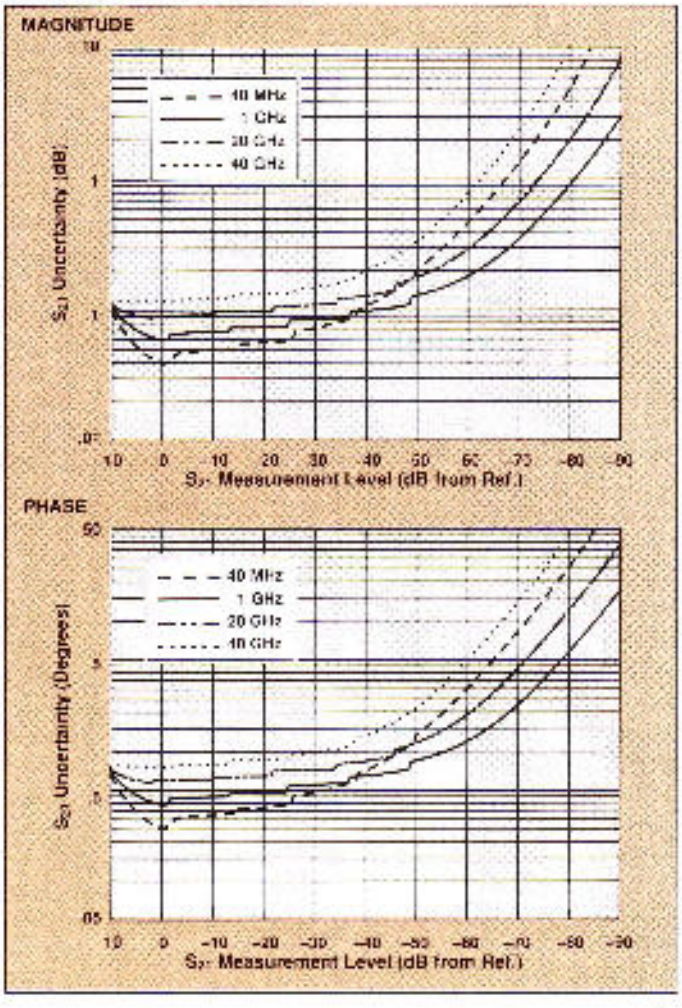
Transmission Measurements:



UNCERTAINTY CURVES
Models 3611A and 3621A Test Sets (K Connectors)
Reflection Measurements:

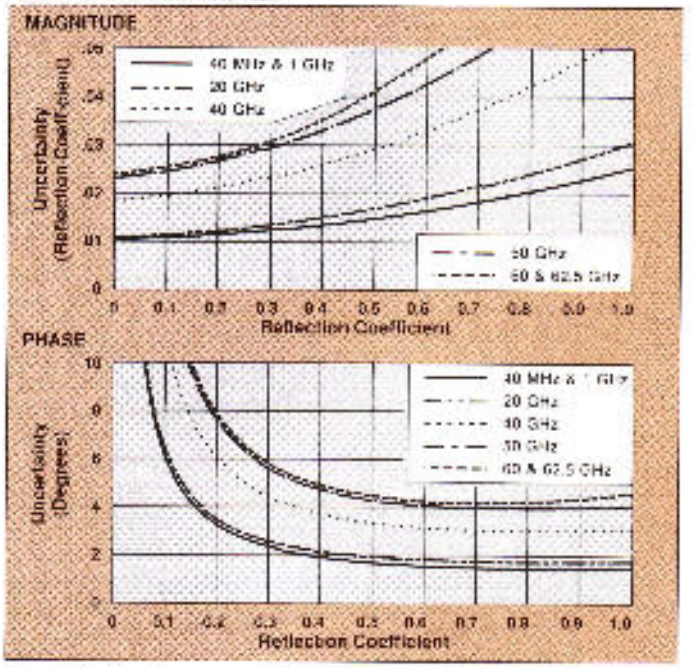


Transmission Measurements:

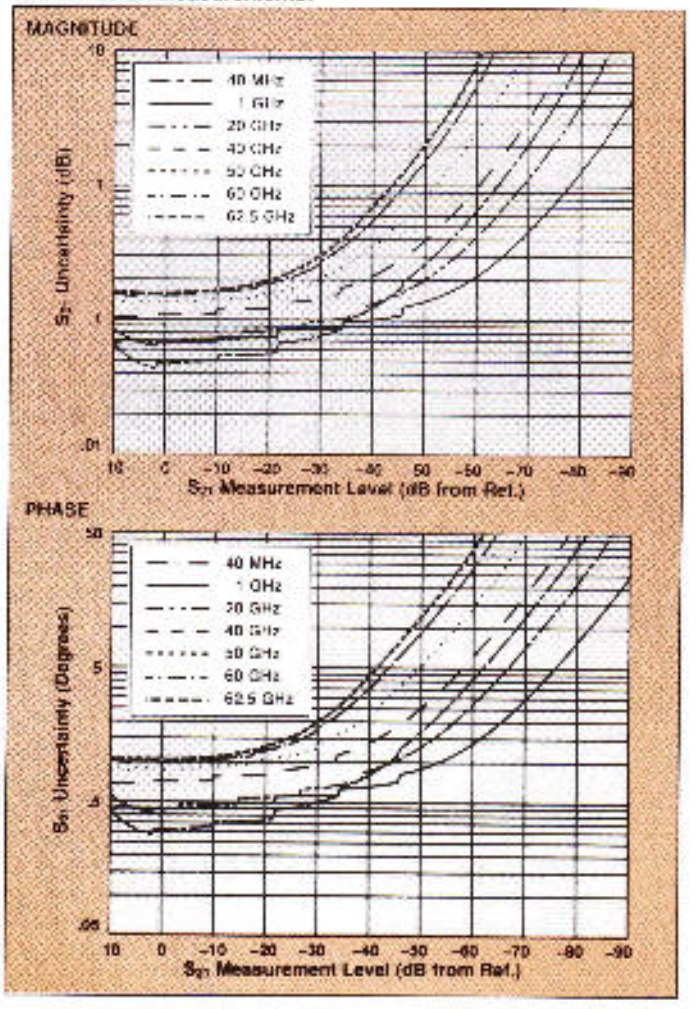


UNCERTAINTY CURVES

Models 3612A and 3622A Test Sets (V Connectors)
Reflection Measurements:

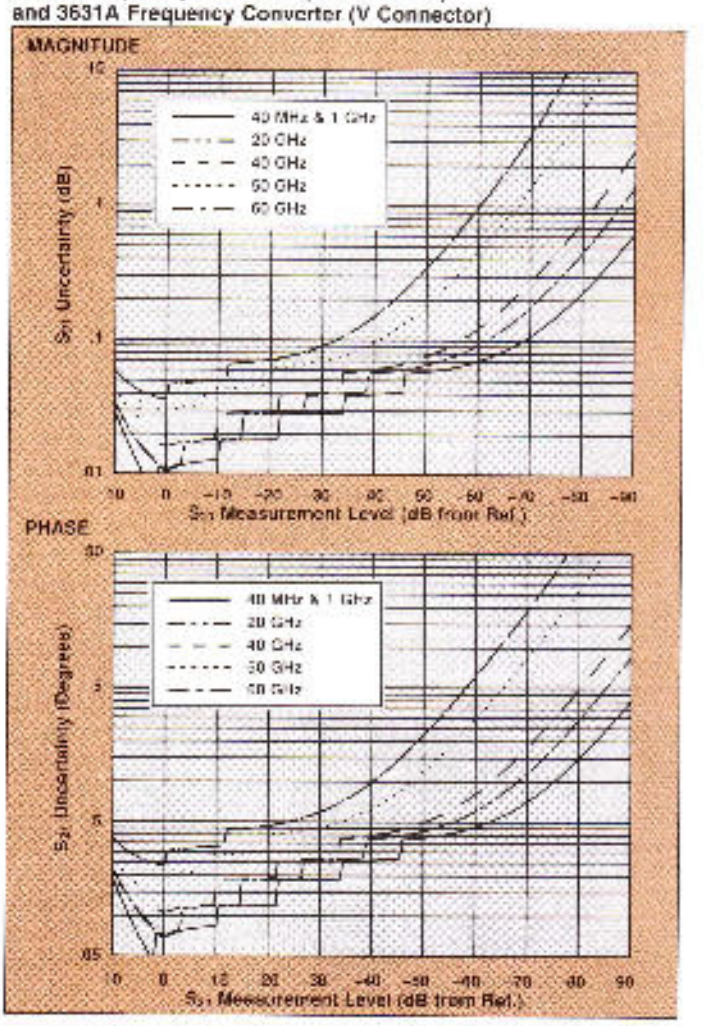


Transmission Measurements:



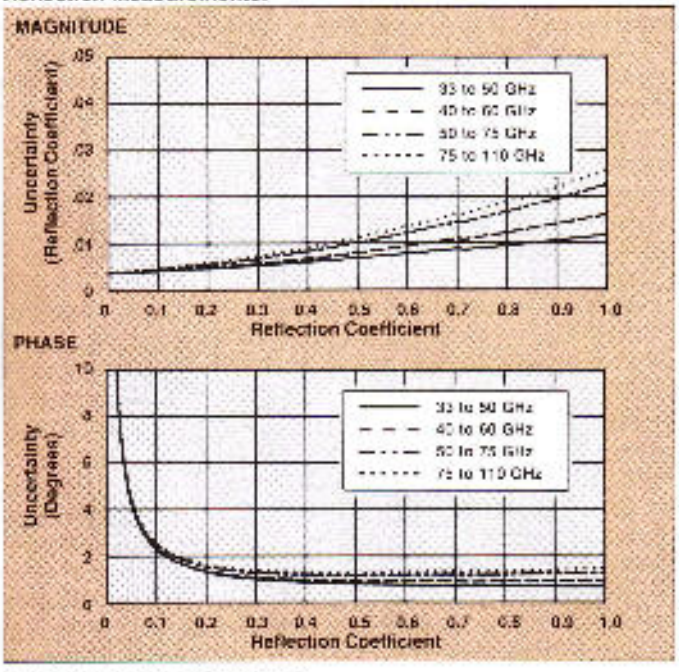
DYNAMIC ACCURACY CURVES

3630A Frequency Converter (K Connector)
and 3631A Frequency Converter (V Connector)

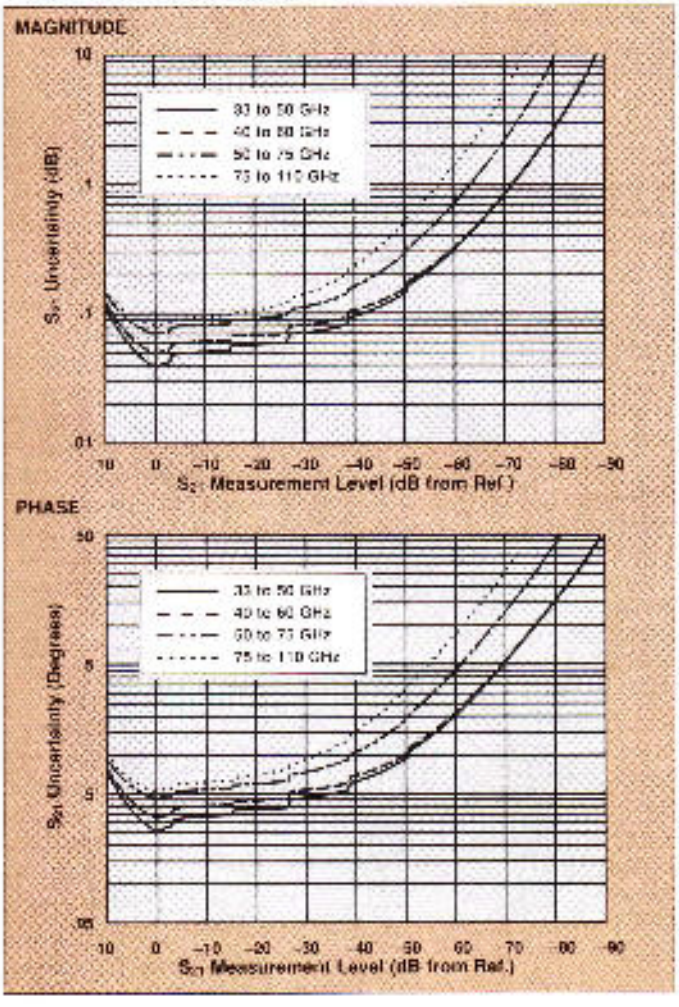


UNCERTAINTY CURVES

3640B and 3641B Series mm-Wave Modules (Q, U, V, W Bands)
Using Offset Short Calibration Method
Reflection Measurements:

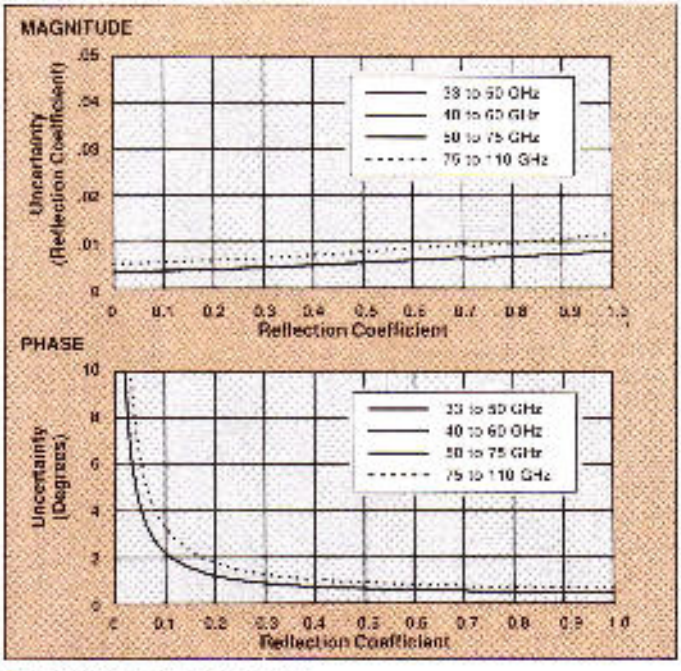


Transmission Measurements:

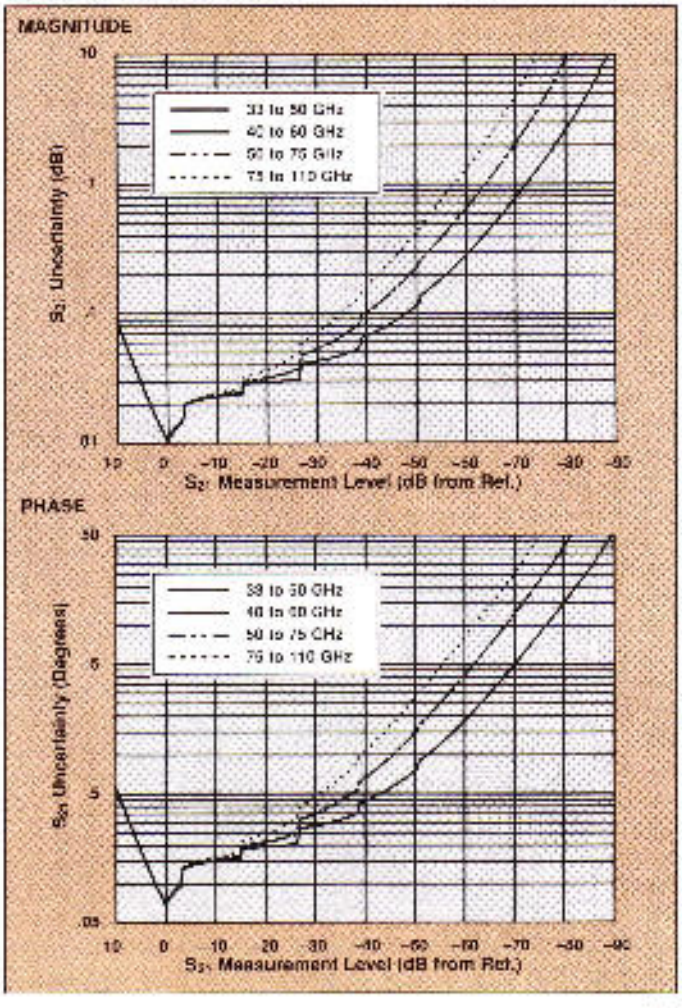


UNCERTAINTY CURVES

3640B and 3641B Series mm-Wave Modules (Q, U, V, W Bands)
Using LRL Calibration Method
Reflection Measurements:



Transmission Measurements:



360B Options

OPTION 2A — HIGH SPEED TIME (DISTANCE) DOMAIN MEASUREMENT CAPABILITY

Option 2A, High Speed Time (Distance) Domain software allows the conversion of reflection or transmission measurements from the frequency domain to the time domain. Measured S-parameter data is converted to the time domain by application of a Fast Fourier Transform (FFT) using the Chirp Z-Transform technique. Prior to conversion any one of seven selectable windowing functions may be applied. Once the data is converted to the time domain, a gating function may be applied to select the data of interest. The processed data may then be displayed in the time domain with display start and stop times selected by the user, or in the distance domain with display start and stop distance selected by the user. The data may also be converted back to the frequency domain with a time gate to view the frequency response of the gated data.

Lowpass Mode: This mode displays a response equivalent to the classic "TDR" (Time Domain Reflectometer) response of the device under test. Lowpass response may be displayed in either the impulse or step mode. This type of processing requires a sweep over a harmonic series of frequencies and an extrapolated or user-entered dc value.

Bandpass Mode: This mode displays a response equivalent to the time response of the device under test to a band limited impulse. This type of processing may be used with any arbitrary frequency sweep range, limited only by the test set range or device under test response.

Phasor Impulse Mode: This mode displays a response similar to the Lowpass impulse response, using data taken over an arbitrary (band limited) sweep range. Detailed information, similar to that contained in the lowpass impulse response may be used to identify the nature of impedance discontinuities in the device under test. Now, with Phasor Impulse, it is possible to characterize complex impedances on band-limited devices.

Windowing: Any one of four window functions may be applied to the initial frequency data, to counteract the effects of processing data with a finite bandwidth. These windows provide a range of tradeoffs of main lobe width versus sidelobe level (ringing). The general type of function used is the Blackman-Harris window, with the number of terms being varied from one to four. Typical performance follows:

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

*Where W (BW) = 1/(Full sweep width).
Example: when W = 40 MHz to 40 GHz, W = 12.5 ps.

Gating: A selective gating function may be applied to the time domain data to remove the responses of all but one desired time range. This gating function may be chosen as the convolution of any of the above window types with a rectangular gate of user defined position and width. The gate may be specified by entering start and stop times or center and span. The gated data may be displayed in the time domain, or converted back to the frequency domain.

Time Domain Display: Data processed to time domain may be displayed as a function of time or as a function of distance, provided the dielectric constant of the transmission media is entered correctly. In the case of dispersive media such as waveguide or microstrip, the true distance to a discontinuity is displayed in the distance mode. The time display may be set to any arbitrary range by specifying either the start and stop times or the center time and span.

The unaliased (non-repeating) time range is given by the formula:

$$\text{Unaliased Range (ns)} = \frac{\text{Number of Frequency Data Points}}{\text{Frequency Sweep Range (GHz)}}$$

The resolution is given by the formula:

$$\text{Main Lobe Width (null–null) in ns} = \frac{Kw}{\text{Freq. Sweep Range (GHz)}}$$

where Kw is two times the number of window terms.
(for example, four for a two-term window)

For a 40 GHz sweep range with 501 data points, the unaliased range is 12.525 nanoseconds.

Frequency with Time Gate: Data that has been converted to time domain and selected by the application of gating function may be converted back to the frequency domain. This allows the display of the frequency response of a single element contained in the device under test. Frequency response accuracy is a function of window and gate type, and gate width. For a full reflection, minimum gate and window accuracy is within 0.2 dB of the ungated response over a 40 GHz range.

OPTION 5 — RECEIVER MODE CAPABILITY

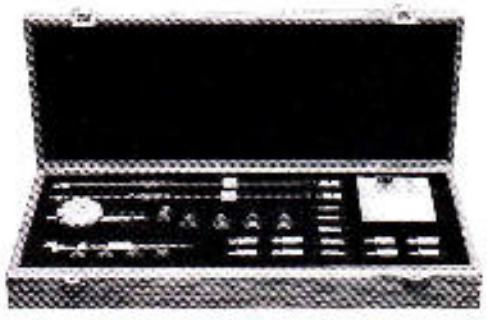
Option 5 for the Wiltron 360B VNA allows a user to select the mode in which an incoming signal is coherently detected. A user may select one of three modes of phase-lock operation:

Source Lock Mode: In this mode, the 360B can phase lock any frequency source capable of being controlled by an analog output. The 360B detects the frequency error of the source, and sends a dc correction voltage to the External Phase Lock Input of the 360B System Signal Source. The constraints imposed on the signal source analog output are 1) >10 kΩ input impedance, 2) <100 pF input capacitance, 3) >500 kHz 3 dB Bandwidth, 4) –6 MHz/volt sensitivity. The absolute accuracy of the signal source must also be better than ±25 MHz. Source lock can only be achieved if the source frequency is available to one of the reference receive channels. The power level needed at the sampler input is –10 to –30 dBm. All other receive channels will operate over their full dynamic range. Due to the inherent resolution of the 360's synthesized local oscillators, frequency resolution is limited to 100 kHz intervals over the full frequency range of the test set.

Tracking Mode: This mode is used to phase lock the 360B receivers to a known frequency source. Specifically, The 360B steers its local oscillator frequencies to phase lock itself to a reference signal from the signal source. Typically, the signal source is a swept frequency synthesizer. The accuracy of the source must be within ±10 MHz of the desired receive frequency to achieve 360B phase lock. The source frequency must be available to one of the reference receive channels for phase lock to occur. The power level needed at the sampler input is –10 to –30 dBm. All other receive channels will operate over their full dynamic range. Frequency resolution is determined by the resolution of the signal source. This resolution is available over the full frequency range of the test set.

Set-On Mode: In this mode, the source lock circuitry of the 360B is completely disabled, allowing all four samplers to operate over their full dynamic range. All of the 360's internal local oscillators are locked to its internal oven-ized crystal reference oscillator. A reference signal from the signal source is no longer necessary for system operation. Only synthesized sources may be used in this mode. The lack of a reference signal to derive frequency correction prevents the use of the 360SS Series signal source. The 360B 10 MHz time base must be common to the synthesized source's time base for coherent detection to occur. The inherent resolution of the 360B's synthesized local oscillators limit the receiver resolution to 100 kHz. This resolution is available over the full frequency range of the test set. Transmission Frequency Tracking is typically degraded by 0.1 dB (see Table 2 on page 28). This feature is valuable for applications in which the signal source must be located a great distance away from the 360B Network Analyzer. Additionally, the 360B receivers can be tuned to measure the harmonic content of a test device at a known source frequency. When used in conjunction with Option 4, Dual Source Control Capability, the 360B receivers can be set at a fixed offset from the source frequency to provide sweet harmonic level measurement.

Calibration Kits



These Wiltron Calibration Kits contain all the precision components and tools required to calibrate for 12-term error-corrected measurements in the connector style of your choice. Components are included for calibrating male and female test ports as required. The kit supports calibration with broadband loads. Option 1 adds sliding loads and a pin depth guage when required.

3650 SMA/3.5 mm Calibration Kit

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)
34ASF50-2	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: Add the following.

17S50	Sliding Load, SMA Male
17SF50	Sliding Load, SMA Female
01-211	Female Flush Short
01-212	Male Flush Short

3651 GPC-7 Calibration Kit

Consisting of:

23A50	Short, GPC-7
24A50	Open, GPC-7
28A50-2	Termination, GPC-7 (dc-18 GHz) (2 each)
01-200	Torque Wrench
01-221	Collet Extractor Tool and Vial of 4 Collets

Option 1: Add the following.

17A50	Sliding Load, GPC-7
01-210	Reference Flat
01-220	GPC-7 Connector Gauge

3652 K Connector® Calibration Kit

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: Add the following

17K50	Sliding Load, K Male
17KF50	Sliding Load, K Female
01-211	Female Flush Short
01-212	Male Flush Short

3653 Type N Calibration Kit

Consisting of:

23N50	Short, N Male
23NF50	Short, N Female
24N50	Open, N Male
24NF50	Open, N Female
28N50-2	Termination, N Male (dc-18 GHz) (2 each)
28NF50-2	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
01-221	Type N Connector Gauge

3654 V Connector® Calibration Kit

Consisting of:

23V50	Short, V Male
23VF50	Short, V Female
24V50	Open, V Male
24VF50	Open, V Female
28V50	Termination, V Male (dc-60 GHz) (2 each)
28VF50	Termination, V Female (dc-60 GHz) (2 each)
33VV50	Insertable, V Male/Male
33VFVF50	Insertable, V Female/Female (2 each)
33VVF50	Insertable, V Male/Female (2 each)
01-201	Torque Wrench
01-210	Reference Flat
01-322	Connector Gauge
01-323	Gauge Kit Adapter
17V50	Sliding Load, V Male
17VF50	Sliding Load, V Female
01-311	Female Flush Short
01-312	Male Flush Short

3655 Waveguide Calibration Kit

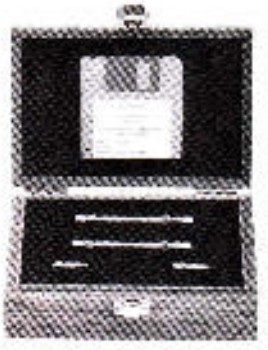
The 3655 Calibration Kit contains all the precision components and tools required to calibrate for 12-term error-corrected measurements of test devices with the appropriate waveguide designation. Components are included for calibrating both module ports. The kit supports calibration with broadband loads. Option 1 adds a sliding termination.

Consisting of:

Short, Fixed, 2 each
Offset, 1/4-Wavelength
Termination, Fixed (2 each)
Test Port Section (2 each)

Option 1: Add the following.
Sliding Termination

Verification Kits



These Wiltron Verification Kits contain precision components with characteristics that are traceable to NIST. 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 by Wiltron Service personnel.

3665 Waveguide Verification Kit

Consisting of:

Attenuator, 20 dB
Attenuator, 40 dB
Section, Precision Straight
Mismatch Section

3666 3.5 mm Verification Kit

Consisting of:

19S50-7	7.5 cm Air Line
19S50-7B	7.5 cm Stepped Impedance Air Line (Beatty Standard)
42S-20	20 dB Attenuator
42S-50	50 dB Attenuator

3667 GPC–7 Verification Kit

Consisting of:

18A50-10	10 cm Stepped Impedance Air Line (Beatty Standard)
18A50-10B	10 cm Air Line
42A-20	20 dB Attenuator
42A-50	50 dB Attenuator

3668 K Connector® Verification Kit

Consisting of:

18K50-7	7.5 cm Air Line
18K50-7B	7.5 cm Stepped Impedance Air Line (Beatty Standard)
42K-20	20 dB Attenuator
42K-50	50 dB Attenuator

3669 V Connector™ Verification Kit

Consisting of:

19V50-5	5 cm Air Line
19V50-5B	5 cm Stepped Impedance Air Line (Beatty Standard)
42V-20	20 dB Attenuator
42V-40	40 dB Attenuator

Ordering Information

NETWORK ANALYZER (One Required)

360B Vector Network Analyzer
360B Option 1: The 360B instrument is supplied with rack-mount slides and ears.
360B Option 2A: High Speed Time (Distance) Domain Measurement Capability.
360B Option 5: Receiver Mode Capability.
360C1 System Console, including support rails, component storage drawer, and power distribution.
360C2 System Cabinet, including support rails and power distribution.
360C3 Millimeter-Wave System Console, including support rails and power distribution.

TEST SETS (One Required)

Model	Frequency Range	Test Port Connectors
3610A Reversing Test Set	40 MHz to 20 GHz	K Male
3611A Reversing Test Set	40 MHz to 40 GHz	K Male
3612A Reversing Test Set	40 MHz to 60 GHz	V Male
3620A Active Device Test Set	40 MHz to 20 GHz	K Male
3621A Active Device Test Set	40 MHz to 40 GHz	K Male
3622A Active Device Test Set	40 MHz to 60 GHz	V Male
3630A Frequency Converter	10 MHz to 40 GHz	K Female
3631A Frequency Converter	10 MHz to 60 GHz	V Female

Test Set Options:
Option 1: Supplied with rack-mount slides and ears.
Option 3: Asymmetrical configuration, optimizes dynamic range and performance for the forward parameters (Not available for the 3630A and 3631A Test Sets).
Option 4: 10 MHz Frequency Coverage (Available for Models 3610A and 3611A only).
Option 5: 62.5 GHz Frequency Coverage (Available for Model 3612A and 3622A only).

MILLIMETER TEST SETS and MODULES

3635B Millimeter Test Set, Interfaces with 360B Network Analyzer to provide necessary DC, RF, and IF signals for 3640B and 3641B Series modules.

3640B Series Transmission/Reflection Modules (One Required), Provide RF stimulus to device under test and measures relative forward and reflected power.
3640B-Q Transmission/Reflection Module, (33-50 GHz)
3640B-U Transmission/Reflection Module, (40-60 GHz)
3640B-V Transmission/Reflection Module, (50-75 GHz)
3640B-W Transmission/Reflection Module, (75-110 GHz)
3641B Series Transmission Modules Measure relative forward power.
3641B-Q Transmission Module, (33-50 GHz)
3641B-U Transmission Module, (40-60 GHz)
3641B-V Transmission Module, (50-75 GHz)
3641B-W Transmission Module, (75-110 GHz)

TEST SET MULTIPLEXER

360TSM Test Set Multiplexer. Enables a 360B Network Analyzer to control two test sets and two signal sources.

SYSTEM SOURCES (One Required)

360SS47 Signal Source. 10 MHz to 20 GHz, 100 kHz frequency resolution, +10 dBm output power.
360SS69 Signal Source. 10 MHz to 40 GHz, 100 kHz frequency resolution, +5 dBm output power.

System Source Options:
Option 1S: Configured for Wiltron 360C1 System Console, 360C2 System Cabinet, or 360C3 Millimeter System Console.
Option 1: Supplied with rack-mount slides and ears.
Wiltron Swept Frequency Synthesizers and Sweep Generators: The Wiltron 6700B Series Swept Frequency Synthesizers (see page 82) with 1 kHz resolution for high resolution measurements and the 6600B Series Sweep Generators (see page 92) are also compatible with the 360B. Please consult your local representative for additional information.

CALIBRATION KITS

3650 SMA/3.5 mm Calibration Kit
Option 1: Male and female Sliding Terminations
3651 GPC-7 Calibration Kit
Option 1: Sliding Termination, Connector Gauge, and Reference Flat
3652 K Connector Calibration Kit
Option 1: Male and female Sliding Terminations
3653 Type N Calibration Kit
3654 V Connector Calibration Kit Includes male and female Sliding Terminations
3655Q WR-22 Calibration Kit (33-50 GHz)
Option 1: Sliding Termination
3655U WR-19 Calibration Kit (40-60 GHz)
Option 1: Sliding Termination
3655V WR-15 Calibration Kit (50-75 GHz)
Option 1: Sliding Termination
3655W WR-10 Calibration Kit (75-110 GHz)
Option 1: Sliding Termination

Vector Network Analyzers

VERIFICATION KITS

3666 3.5 mm Verification Kit
3667 GPC-7 Verification Kit
3668 K Connector Verification Kit
3669 V Connector Verification Kit
3665Q WR-22 Verification Kit (33-50 GHz)
3665U WR-19 Verification Kit (40-60 GHz)
3665V WR-15 Verification Kit (50-75 GHz)
3665W WR-10 Verification Kit (75-110 GHz)

TEST PORT CABLES

3670A50-1 Test Port Cable, dc to 18 GHz, GPC-7 connectors, 1 foot long, two required.
3670A50-2 Test Port Cable, dc to 18 GHz, GPC-7 connectors, 2 feet long.
3670K50-1 Test Port Cable, dc to 40 GHz, K Connectors, 1 foot long, male/female, two required.
3670K50-2 Test Port Cable, dc to 40 GHz, K Connectors, 2 foot long, male/female.
3670V50-1 Test Port Cable, dc to 60 GHz, V Connectors, 1 foot long, male/female, two required.
3670V50-2 Test Port Cable, dc to 60 GHz, V Connectors, 2 feet long, male/female.

TEST PORT CONVERTERS

Test port converters for 3610A, 3611A, 3620A, and 3621A Test Sets.
34UA50 Test Port Converter, Universal/GPC-7
34UK50 Test Port Converter, Universal/K Connector, male
34UN50 Test Port Converter, Universal/N, male
34UNF50 Test Port Converter, Universal/N, female
34UQ50 Test Port Converter, Universal/2.4 mm, male
34US50 Test Port Converter, Universal/3.5 mm, male

Test port converters for 3612A and 3622A Test Sets
34YA50 Test Port Converter, Universal/GPC-7
34YK50 Test Port Converter, Universal/K Connector, male.
34YS550 Test Port Converter, Universal/SSMA, male
34YV50 Test Port Converter, Universal/V Connector, male

01-202 Wrench for changing test set Test Port Converters

SOFTWARE

2300-10 ANACAT™ Software
2300-11A Materials Measurement Package

REPLACEMENT GPIB CABLES

2100-1 GPIB Cable, 1 m (3.3 ft.)
2100-2 GPIB Cable, 2 m (6.6 ft.)
2100-4 GPIB Cable, 4 m (13.2 ft.)
2100-5 GPIB Cable, 0.5 m (1.65 ft.)

ACCESSORIES

2225C Ink Jet Dot-Matrix Printer, including 2225-1 Interface Cable, 1 Ink Jet Cartridge, and 500 sheets of Ink Jet Printer Paper
2225-1 Spare Printer Interface Cable
2225-2 Replacement Ink Jet Cartridge
2225-3 Fan-Fold Ink Jet Printer Paper (500 sheets)
2000-209 3.5-inch Blank Diskettes (Box of 10)

TRAINING

360MS Option 10: Two-Day Training Course. A two-day user training course covering basic 360B features, operation and measurements. Enrollment for two operators is provided at no charge with the purchase of each 360B system.

ON-SITE SUPPORT

360MS Option 11: On-Site Verification, On-site 360B system verification performed by a Wiltron service engineer using traceable devices from a Wiltron Verification Kit. Includes both tabular and graphic hardcopy data output.
360MS Option 12: On-Site Service, One year on-site service support for the 360B, test set, and system signal source. Includes all labor and material. Available throughout the USA and in most international areas. Please check availability with your local representative.

EXTENDED SERVICE OPTIONS

Additional, one year and two year "return to Wiltron" service is available, as an option for 360B systems and components. Prices and details are available from your Anritsu-Wiltron Sales Representative or by contacting the factory.