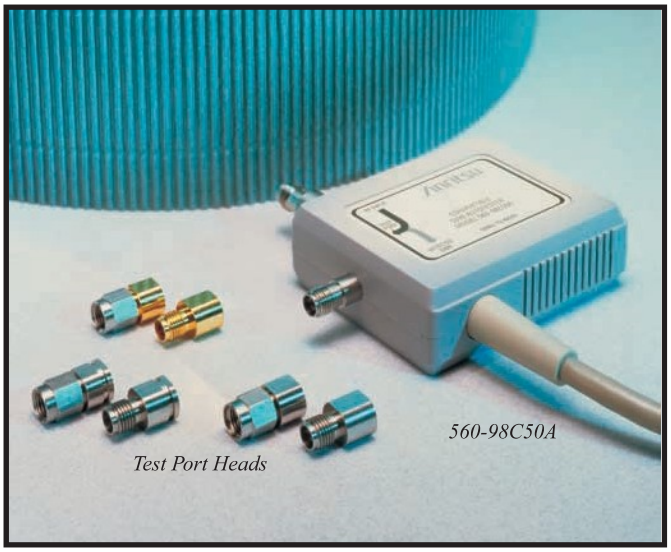
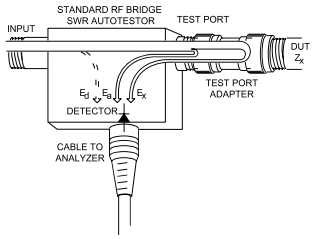
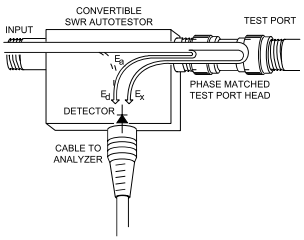
CONVERTIBLE SWR AUTOTESTER

560-98C50A and Test Port Heads 10 MHz to 40 GHz





A test port adapter on a standard SWR Autotester or RF Bridge creates an error vector Ea in addition to directivity, Ed.



The directivity response of a Convertible SWR Autotester is tuned to cancel the vector reflection response of the phase matched test port heads.

Convertible SWR Autotesters reduce capital equipment and maintenance costs. A single Convertible SWR Autotester accurately measures the Return Loss or SWR of devices with SMA, 3.5 mm, or K Connector®. Six interchangeable test port heads (male and female for each connector standard) are precision tuned to the Convertible SWR Autotester's internal bridge circuit.

The inexpensive test port heads save repair and calibration costs, because they are interchangeable. Repetitive connect/disconnect cycles will eventually wear out test port connectors — especially when excess torque is applied or the connector's mating surfaces are rotated against each other.

It is common practice today to avoid the subsequent maintenance cost by using adapters or "Connector Savers" on the test port of the directional device (RF Bridge, SWR Autotester, or Directional Coupler). Unfortunately, the adapters attached to a standard RF Bridge cause accuracy problems. Directional devices are tuned for optimum directivity at a specific phase reference point – this position is called the reference plane. Any test port adapter will degrade the effective directivity. The Convertible SWR Autotester's interchangable test port heads eliminate the accuracy problem.

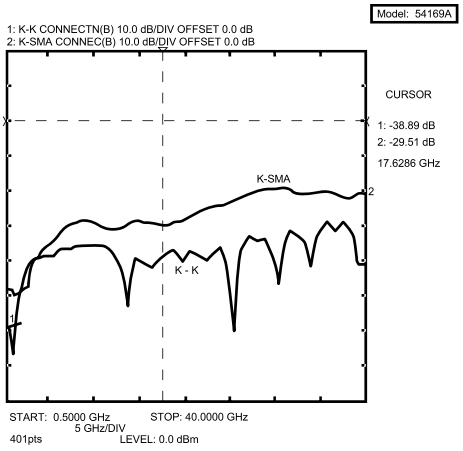
Adapter errors

In a standard RF bridge, measurement error increases when adapters or connector savers are used 1) to change the connector's sex and/or 2) to protect the test port from physical wear. The error effect is represented as a reduction to directivity. Effective Directivity is a measurement error term consisting of the directional device's directivity plus the SWR response of the test port adapter/ connector saver.

Effective-Directivity is illustrated in the following illustration. The Directivity Error, E_d, is caused by deviations from ideal within the directional device. The adapter's SWR is represented by E_a. Both E_d and E_a cause errors in the measurement of DUT's return loss, E_x. This error problem is compounded by production practices which use poor quality adapters and neglect calibration/verification cycles.

Accuracy improvement

The Convertible SWR Autotester improves the accuracy of SMA device tests. It is common practice to test SMA devices with either 3.5 mm or K test ports. The 3.5 mm and K Connector® standards offer rugged, instrument grade connections, but they are not designed for proper impedance match to a device that has SMA connectors. SMA, K, and 3.5 mm connectors are mechanically compatible, but lack electrical compatibility. The resulting connector mismatch causes a 10 to 15 dB degradation in measurement directivity.



The Directivity of a K - K connector interface is far superior to a mismatched K - SMA connection

The above graph illustrates the degradation to directivity when a K Connector® test port is used to measure a precision SMA device. A 3.5 mm interface causes similar errors. The directivity was measured using the precision return loss mode on a 54100A Series Network Analyzer.

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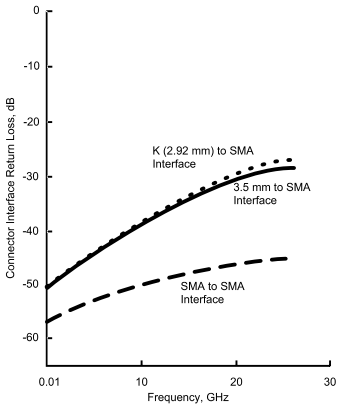
K - SMA or 3.5 mm - SMA interfaces.

Electrically, the convertible SWR Autotester provides a nearly perfect 50 Ω interface when connected to SMA devices – resulting in a typical 10 dB improvement in effective directivity performance as compared to other SMA compatible connectors.



The Convertible SWR Autotester with SMA Test Port Head provides significantly better directivity performance than test components with either K (2.92 mm) or 3.5 mm test port connectors.

SMA connections to either K (2.92 mm) or 3.5 mm connectors are inherently capacitive. Both K and 3.5 mm connectors use air dielectric. The Teflon® or foam polyethylene dielectric common to SMA connectors have different dielectric constants than air. Thus, the coaxial dimensions of the center and outer conductors must also be different to maintain a 50 Ω transmission line impedance. Since the K and 3.5 mm connector standards specify flush pin depths, a non-50 Ω capacitance develops between their relatively thick outer conductors to the center pin of an SMA connected device.

Anritsu's 25S50 and 25SF50 SMA Test Port Heads include an inductive connection to SMA connectors by virtue of a slight air gap at the center pin interface. The air gap negates excess capacitance caused by the 50 Ω dimensional transition from the test port head's air dielectric to the SMA connector's Teflon® dielectric.

SMA connectors are not used as a precision instrumentation connector for three important reasons. First, the dielectric tends to expand and contract slightly with temperature and humidity conditions; thus, it is difficult to adhere to dimensional standards traceability (typically, precision air lines are used as primary or secondary reference standards) over a reasonable range of manufacturing floor conditions. Second, as an inexpensive connector type, many manufacturers have taken liberties in the specification of dimensions, tolerances, dielectric types and metallurgic content. A precision standard for SMA connector design is not recognized by the microwave industry. Finally, SMA designs suffer from reliability problems when subjected to multiple connections. Center pins can back out easily and the thin outer conductor wall is easily crushed when subjected to excessive torque.

The Convertible SWR Autotester solves these problems. Air dielectric is used to eliminate the temperature and humidity variations suffered by Teflon® and other dielectrics. Dimensional tolerances and metallic composition are clearly specified in the product design and center pin dimensions are phase matched. Air dielectric also allows use of thicker outer conductors, drastically decreasing potential deformation from excessive torque.

The Convertible SWR Autotester reduces maintenance costs without using error prone test port adapters or connector savers.

Accuracy for SMA device test is also improved because the test port head is properly compensated for operation with standard SMA connector dimensions.

Specifications

Frequency Range	0.01 to 40 GHz
Directivity	> 34 dB 0.01 to 20 GHz > 32 dB 20.0 to 26.5 GHz > 29 dB 26.5 to 40.0 GHz
Test Port Match	> 21 dB 0.01 to 20.0 GHz > 18 dB 20.0 to 40.0 GHz
Maximum Input Power	+ 27 dBm
Source Input to Test Port Isolation	7.0 dB to 9.0 dB nominal insertion loss, frequency dependent.
Impedance	50 Ω
Input Connector	K(f), 2.92 mm with ruggedized threads
Compatibility	The 560-98C50 is compatible with the 560, 560A, 561, 5400A, 56100A, 562, 54100A and 54000A analyzers.
Dimensions	Autotester: 7.3 cm x 5.3 cm x 2.3 cm Test Port Heads: 16 mm(L) x 9 mm (dia.)

Temperature range: +25°C ±5°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
560-98C50A*	Convertible SWR Autotester
	Open/Shorts
22K50	Male Open/Short, (Included with 560-98C50A purchase.)
22KF50	Female Open/Short, (Not included with 560-98C50A purchase.)
	Test Port Heads
25S50	Precision Matched WSMA male
25SF50	Precision Matched WSMA female
25L50	Precision Matched 3.5 mm male
25LF50	Precision Matched 3.5 mm female
25K50	Precision Matched K male
25KF50	Precision Matched K female
25SKF50	Precision Matched Set, WSMA male & female, K male & female
25SLF50	Precision Matched Set, WSMA male & female, 3.5 mm male & female, K Connctor male & female

*The Convertible SWR Autotester must be used with a test head.