

54100A/56100A

Scalar Network Analyzers

1 MHz to 110 GHz

Technical Data Sheet



*For economic measurement of SWR, loss/gain,
relative group delay and distance-to-fault*

Introduction to Anritsu Scalar Analyzers

This data sheet details the potential applications and specifications of the Anritsu scalar network analyzer products. The reference table on pages 6 and 7 provides a guide to the accessories that you will need for your specific application.

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Accuracy of Scalar Measurements

Further information on Anritsu scalar analyzers, or other Anritsu products, can be found by contacting one of the offices listed on the back cover. For a full list of sales offices around the world, visit our web site at www.anritsu.com



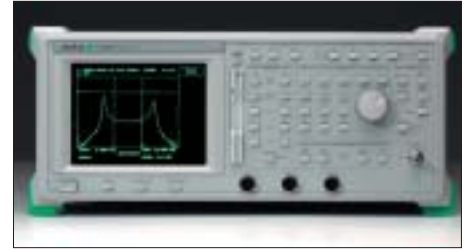
Anritsu offer a comprehensive range of scalar analyzers for economic network measurements to 110GHz.

The 56100A scalar analyzer used in conjunction with a 68C series synthesizer offers the very best RF performance in a scalar measurement system. The 68C series synthesizer and 56100A analyzer communicate over a private GPIB link to form an integrated scalar measurement system.

The 56100A/68C scalar measurement systems offers 10MHz to 50GHz frequency coverage with -40dBc harmonics, up to +17dBm levelled power and fully synthesized sweeps. This combination is ideal where the best possible frequency accuracy and dynamic range are required.

Mixers and other frequency conversion devices can also be characterised by using two synthesizers in the system to generate frequency sweeps with a fixed offset.

The 54100A series integrated scalar network analyzers have built in crystal referenced sources to provide an economical and compact solution. They are ideal for production of devices such as filters and amplifiers from 1MHz to 50GHz. Optional software adds; distance to fault measurements for field testing of waveguides, cables and antennas, relative group delay software for economic filter characterisation and precision return loss that adds up to 20dB directivity improvement to SWR measurements.



The 54100A Series Scalar Network Analyzers offer highly integrated and economic network measurements



The 56100A Scalar Network Analyzer operates with Anritsu's 68C and 69B series synthesizers. The separate source maximizes system performance and flexibility.

For scalar network measurements to 110GHz both 54100A and 56100A are complemented by the millimeter wave reflectometers.

| | 54100A | 56100A plus 68C synthesizer |
|---|--|---|
| Standard measurements supported | Return loss (SWR), insertion loss/gain, power Precision return loss | Return loss (SWR), insertion loss/gain, power |
| Additional measurements (optional) | Distance-To-Fault Relative group delay | |
| Source | Internal | External Anritsu 69A/B series Anritsu 68B/C series Anritsu 67XXA/B series Wiltron 6600A/B series HP 8340/8350 series |
| Two source control | No | Yes with synchronous sweeps for mixer measurements |
| Max source power | 10dBm @ 20GHz | 13dBm @20GHz 17dBm option (68C source) |
| Harmonics, 2 to 20GHz | -60dBc | -60dBc (68C source) |
| Frequency accuracy | Crystal controlled | Synthesized |
| 110GHz reflectometer support | Yes | Yes |
| Autotesters and detectors | Available to 50GHz | Available to 50GHz |
| 3.5 inch disk drive | Yes | No |
| Intelligent markers | Yes | Yes |
| GPIB as standard | Yes | Yes |
| Mean Time Between Failure (MTBF) | >10,000 hours | >10,000 hours |
| World-wide service and support | Yes | Yes |

Distance-To-Fault

The most common failure in a microwave radio link is the transmission line, the waveguide and/or coaxial cables which connect radio equipment to the antennas. With the 54100A Series optional Distance-To-Fault (DTF) Software you can install and maintain tower equipment with confidence.

Anritsu's precision calibration components and low source harmonics provide industry leading return loss (or SWR) accuracy. With 0.1% distance accuracy, you're sure to identify degraded components or moisture quickly – before the problem causes a failure. Automatic anti-aliasing software and windowing filters ensure the peaks on the DTF display are really there, not erroneous fault indications caused by re-reflections.

With most elliptical waveguide components meeting 30 dB return loss performance, it's absolutely critical that the precision load used for calibration is of the highest quality to achieve repeatable, accurate measurements. Using poor quality 50 W loads for DTF calibration will cause abnormally high test data variations



Distance-To-Fault mode simplifies problem identification. Superior accuracy, sensitivity and precision components ensure that comparison measurements clearly indicate performance degradation. Site technicians easily locate small problems before more serious failures result.

during maintenance test intervals. Instead of saving time, technicians may find themselves chasing non-existent problems.

Specifications

The optional Distance-To-Fault software displays impedance discontinuities versus distance based on a swept frequency measurement of transmission line mismatch. The software is available by ordering Option 7 with 54100A Series Network Analyzers.

Measurements: Distance-To-Fault (meters or feet), Return loss or SWR of fault.

Frequency Sampling:

256, 512, or 1024 frequency points.

Window Functions:

Hamming, 2-term, -42 dB sidelobes;

Blackman-Harris, 3-term, -67 dB sidelobes.

Anti-aliasing: Filtering of post detected data rejects indications of false faults caused by signal re-reflections during high reflection fault conditions or out of band sweep on antenna systems.

Distance Accuracy: < 0.1% of range or 2 mm dependent upon knowledge of the propagation velocity for the device under test and the frequency sweep range.

Dynamic Range: > 80 dB, depending upon calibration component return loss and operating frequency range.

Return Loss Amplitude Accuracy: Effective Directivity is dependent upon the return loss of the precision termination used during calibration.

Distance Range: 1 to 5000 meters depending on measurement frequency range and hardware configuration.

Distance Resolution (of one fault): 0.4% of total distance (256 frequency measurement points), 0.2% of total distance (512 frequency

measurement points), 0.1% of total distance (1024 frequency measurement points).

Transmission Lines Supported:

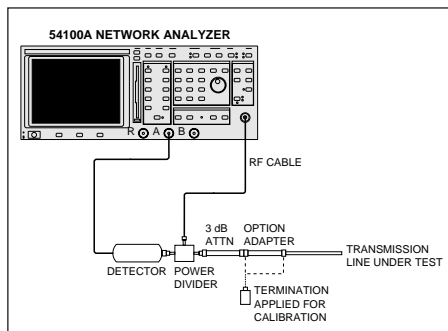
- Coaxial Cable
- Waveguide
- Waveguide with Coaxial Cable Input

Transmission line loss and velocity factor are corrected by the software. Waveguide dispersion is corrected based on the cutoff frequency, f_c . For waveguide with coaxial cable input, a special operating mode is utilized to automatically compensate for the length of non-dispersive coaxial cable in front of the waveguide transmission line.

Distance-To-Fault Measurement Accessories:

Anritsu Distance-To-Fault test systems utilize standard diode detectors and measurement accessories.

Non-Ratio Operation, Coaxial



POWER DIVIDERS

These signal dividers are symmetrical, three-resistor tee designs that are used with the Distance-To-Fault option and other applications

requiring two inputs to be combined into a single output.

Maximum Input Power: +30 dBm

| Power Divider Model | Frequency Range | Connectors | |
|---------------------|-----------------|------------|--------|
| | | Input | Output |
| 11N50B 50Ω | DC to 3 GHz | N (f) | N (f) |
| 11N75B 75Ω | DC to 3 GHz | N (f) | N (f) |
| 1091-29 50Ω | DC to 18 GHz | N (m) | N (f) |
| K240B 50Ω | DC to 26.5 GHz | K (f) | K (f) |
| K240C 50Ω | DC to 40 GHz | K (f) | K (f) |
| V240C 50Ω | DC to 65 GHz | V (f) | V (f) |

3 dB ATTENUATORS

| 3 dB Attenuator Model | Frequency Range | Connectors | |
|-----------------------|------------------|------------|--------|
| | | Input | Output |
| 1010-31 | 0.01 to 18 GHz | N (m) | N (f) |
| 43KB-3 | 0.01 to 26.5 GHz | K (m) | K (f) |
| 43KC-3 | 0.01 to 40 GHz | K (m) | K (f) |
| 41V-3 | 0.01 to 60 GHz | V (m) | V (f) |

PRECISION TERMINATIONS

Terminations are required for calibration and are occasionally used for terminating the output of the coaxial cable under test.

| Model | Frequency Range | Connector |
|--------------|-----------------|-----------|
| 26N75A 75Ω | DC to 3 GHz | N (m) |
| 26NF75A 75Ω | DC to 3 GHz | N (f) |
| 28N50-2 50Ω | DC to 18 GHz | N (m) |
| 28NF50-2 50Ω | DC to 18 GHz | N (f) |
| 28S50-1 50Ω | DC to 26.5 GHz | WSMA (m) |
| 28SF50-1 50Ω | DC to 26.5 GHz | WSMA (f) |
| 28K50 50Ω | DC to 40 GHz | K (m) |
| 28V50B 50Ω | DC to 65 GHz | V (m) |

54100A Series software

Precision Return Loss

Precision Return Loss (PRL) is a technique which uses vector signal addition principles to extend the directivity of scalar network analyzer (SNA) measurements. The 15 to 20 dB directivity improvement allows accurate verification and calibration of very high return loss devices such as terminations, attenuators, and adapters – components which are common to almost every RF test bench.

Test bench components are susceptible to a variety of problems including:

- 1) Repeated excess torque
- 2) Drops to the floor
- 3) Accumulation of dirt

Additionally, since adapters and attenuators are not always labeled for frequency range, they are occasionally used at frequency ranges beyond their specification.

PRL finds these problems quickly. The technique utilizes the same network analyzer which is used for the production process: test operators need only share an Airline and an Offset SWR Autotester.



PRL Accuracy

When testing single port RF devices such as terminations, the principle uncertainty terms are measurement directivity and channel accuracy. The directivity of a PRL measurement is limited by the return loss of the precision airline. Channel accuracy includes noise effects, logarithmic deviation, open/short cal uncertainty, linearity, and instrumentation stability. Additional second order uncertainty terms such as test port match and source match are typically negligible.

$$\text{Measurement Uncertainty (dB)} = \text{Channel Accuracy} + \text{Directivity Uncertainty}$$

$$\text{Measurement Uncertainty (dB)} = -0.5 - 20 \log(1 + 10^{-Ed/20})$$

$$\text{where, } Ed = \text{Airline Return Loss (dB)} - \text{Measured Return Loss (dB)}$$

When measuring two port devices such as adapters and attenuators, an additional term (load match) is required to account for the return loss of the precision termination which is attached to port two of the device.

$$\text{Measurement Uncertainty (dB)} = -0.5 - 20 \log(1 + 10^{-Ed/20}) - 20 \log(1 + 10^{-Et/20})$$

$$\text{where, } Et = \text{Termination's Return Loss (dB)} - \text{Measured Return Loss (dB)}$$

For ISO-9000 based manufacturing, the accuracy of production tests must be known. The PRL measurement technique helps to ensure test process compliance by verifying the

proper performance of test setup components. The use of NIST traceable Precision Airlines allow accurate calibration of those components.

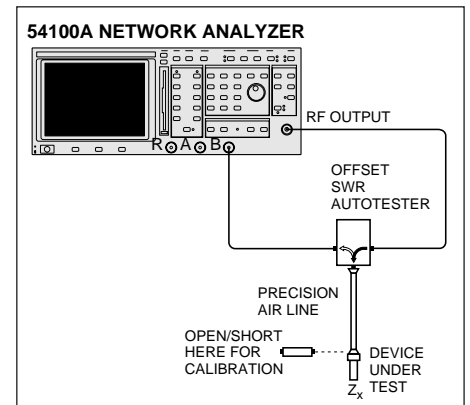
Components For High Return Loss Device Testing

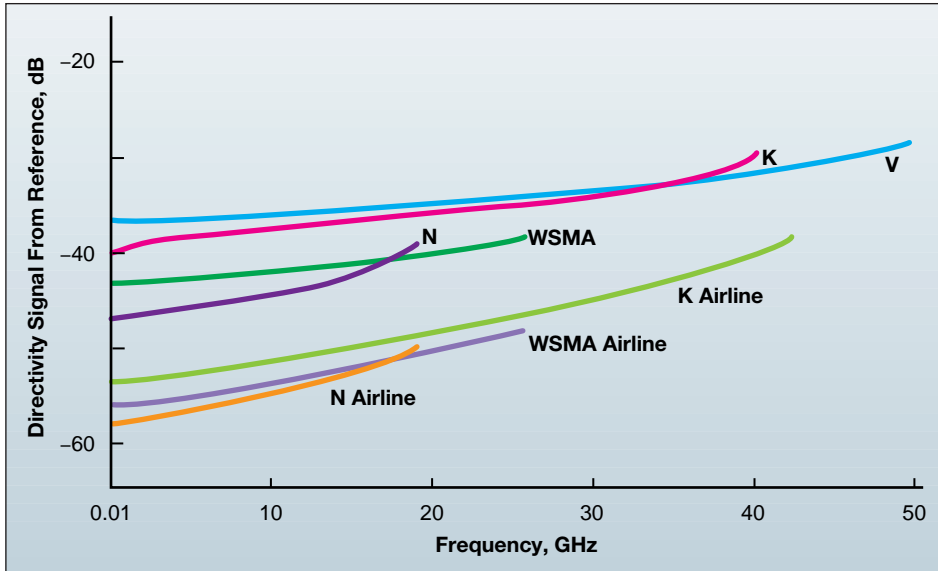
Standard SWR autotesters are internally terminated to a precision 50 ohm match. The Offset SWR autotester replaces this 50 ohm termination with a 15 dB or 20 dB offset termination. This produces a readily measurable reference vector.

During measurement, the S_{11} reflection vector of a high return loss will interfere with the reference - creating a ripple pattern on the display proportional to the DUT's return loss. The ripple pattern is automatically converted to a return loss display trace by the precision return loss mode's software.

With the implementation of ISO-9002, microwave test specialists must perform verification of common test stand components such as adapters and terminations on a daily or weekly basis rather than at annual calibration cycles. (Left) A technician tunes a precision termination in the Precision Return Loss TUNING mode.

Component Connections for Precision Return Loss Mode





Legend

- V-type SWR Autotester
- K-type SWR Autotester
- WSMA-type SWR Autotester
- N-type SWR Autotester
- K-type Offset SWR Autotester & K Airline
- K-type Offset SWR Autotester & WSMA Airline
- GPC-7 Offset SWR Autotester & N Airline

By utilizing the traceable performance of a Precision Airline, the Precision Return Loss technique overcomes the directivity limitations of standard SWR Autotesters (or bridges), allowing accurate calibration of very low return loss devices.

PRL ACCESSORY CONFIGURATION CHART

| DUT Connector | Offset SWR Autotester | Airline | Open Short | Precision Terminations ¹ |
|---------------|-----------------------|-----------------|------------|-------------------------------------|
| GPC-7 | 560-97A50-20 | 18A50 | 22A50 | 28A50 28A50-1 |
| N male | 560-97A50-20 | 18NF50 | 22N50 | 26N50 |
| N female | 560-97A50-20 | 18N50 | 22NF50 | 26NF50 |
| SMA male | 560-98KF50-15 | 19SF50 | 22S50 | 28S50 28S50-1 |
| SMA female | 560-98KF50-15 | 19S50 | 22SF50 | 28SF50 28SF50-1 |
| 3.5mm male | 560-98KF50-15 | 19LF50 (SC4127) | 22K50 | 28K50 |
| 3.5mm female | 560-98KF50-15 | 19L50 (SC3588) | 22KF50 | 28KF50 |
| K male | 560-98KF50-15 | 19KF50 | 22K50 | 28K50 |
| K female | 560-98KF50-15 | 19K50 | 22KF50 | 28KF50 |

¹Terminations are needed for adapter verification tests and other two port device testing.

AIRLINE SPECIFICATIONS

| Model | Freq. Range (GHz) | Test Port Connector | Beaded Port Connector | SWR | Dia. (mm) | Lgth (cm) |
|-----------------|-------------------|----------------------|-----------------------|---|-----------|-----------|
| 18A50 | 0.5 to 18 | GPC-7 | GPC-7 | 1.003 (Test Port) 1.020 (Beaded End) | 7 | 30 |
| 18N50 18NF50 | 0.5 to 18 | N (m) N (f) | GPC-7 | 1.006 | 7 | 30 |
| 19S50 19SF50 | 0.8 to 26.5 | WSMA (m) WSMA (f) | WSMA male | 1.006 to 18 GHz 1.010 to 26.5 GHz | 3.5 | 25 |
| 19K50 19KF50 | 0.8 to 40 | K (m) K (f) | 1.020 | 1.020 | 2.9 | 15 |

Relative Group Delay

Optional relative group delay software identifies signal distortion caused by bandpass devices such as filters, receivers, power amplifiers, and up/down converters. Group delay is a key cause of high Bit Error Rate (BER). Group delay is important for 1) CDMA and spread spectrum communications 2) phase radars 3) high capacity satellite and terrestrial microwave links 4) PAL and HDTV television components and other RF systems sensitive to phase distortion.

Group Delay results from deviation in the rate of change of phase response versus change in frequency, df/dw . It indicates that different frequencies travel at different speeds through an RF device. RF systems which depend upon phase coded information suffer degradation when group delay is excessive.

The growth in wireless communications places a heavy demand on available frequency spectrum. More efficient communications standards have digital phase modulation with

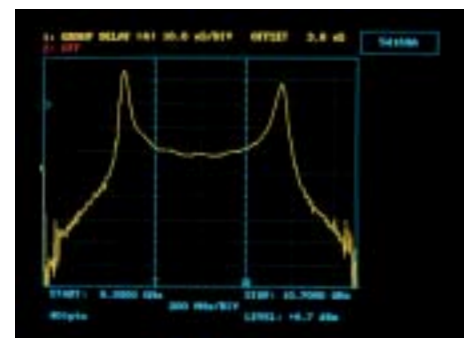
high bits-per-hertz specifications and high bandpass filter rolloff rates. Each of these conditions make the communications more susceptible to group delay induced bit error rate problems.

The 54100A saves time and expense by measuring group delay with the same, inexpensive network analyzer as is used for other tests.

Calibration requires only an RF path normalization with a standard RF detector. Relative group delay specifications assume measurement of bandpass devices. Frequency sweep must include at minimum 20 dB of transmission rolloff from mid-band response. For best results, set the frequency sweep to cover more than 20 dB rolloff is suggested.

Relative Group Delay Accuracy:

Typically < 1ns, < 5.0% of peak-to-valley range with noise averaged. Assumes the band limiting device within the DUT meets minimum phase shift design. Devices such as SAW filters, microwave phase equalizers, and branch



The 54100A utilizes transmission magnitude data to calculate relative group delay using a Hilbert transform software technique. No modulation is utilized. No aperture settings are necessary and frequency converter ALC loops are not disturbed during testing. The technique is applicable to devices with minimum phase transfer functions.

line couplers will have additional uncertainty.

Calibration: A transmission path normalization is required.

54100A/56100A Series Network Analyzer Configurati

| Model Number | Source Frequency | DUT's Input Connector | SWR Autotester | Detector | Power Splitter | Splitter Adapter | Ext. Leveling Detector |
|-------------------------------------|------------------|------------------------------|--|--------------------------|--|--------------------|------------------------|
| Connection Diagram Reference Letter | | | A | B | C | D | E |
| 54107A | 0.001 to 1.5 GHz | 50 Ω N (f) 50 Ω N (m) | 5400-6N50 5400-6NF50 | 5400-71N50 5400-71N50 | N241A50 N241A50 | 34NN50A 34NN50A | 75N50B 75N50B |
| 54109A | 0.001 to 2.2 GHz | 75 Ω N (f) | 5400-6N75 | 5400-71N75 | N241A75 | 34NN75B | n/a |
| 54111A | 0.001 to 3.0 GHz | 75 Ω N (m) | 5400-6NF75 | 5400-71N75 | N241A75 | 34NN75B | n/a |
| 54147A | 0.01 to 20 GHz | 50 Ω GPC-7 | 560-97A50-1 | 560-7A50 | 1091-28 | 34NN50A | 75N50B |
| 54137A | 2 to 20 GHz | 50 Ω N (f) 50 Ω N (m) | 560-97N50-1 560-97NF50-1 | 560-7N50B 560-7N50B | 1091-28 1091-28 | 34NN50A 34NN50A | 75N50B 75N50B |
| 56100A + 68147C | 0.01 to 20 GHz | 50 Ω SMA (f) 50 Ω SMA (m) | 560-98C50A ³ 560-98C50A ³ | 560-7S50B 560-7S50B | K241B K241B | 1091-27 1091-27 | 75KB50 75KB50 |
| 54169A | 0.01 to 40 GHz | 50 Ω SMA (f) 50 Ω SMA (m) | 560-98C50A ³ 560-98C50A ³ | 560-7S50-2 560-7S50-2 | K241C K241C | K220B K220B | 75KC50 75KC50 |
| 54163A | 2 to 40 GHz | 50 Ω K (f) 50 Ω K (m) | 560-98C50A ³ 560-98C50A ³ | 560-7K50 560-7K50 | K241C K241C | K220B K220B | 75KC50 75KC50 |
| 56100A + 68167C | 0.01 to 40 GHz | 50 Ω V (f) 50 Ω V (m) | 560-98VA50 560-98VFA50 | 560-7VA50 560-7VA50 | V241C ¹ V241C ¹ | 34VV50 34VV50 | n/a n/a |
| 54177A | 0.01 to 50 GHz | 50 Ω K (f) 50 Ω K (m) | 560-98C50 ³ 560-98C50 ³ | 560-7K50 560-7K50 | K241C ¹ K241C ¹ | K220B K220B | 75KC50 75KC50 |
| 56100A + 68177C | | 50 Ω V (f) 50 Ω V (m) | 560-98VA50 560-98VFA50 | 560-7VA50 560-7VA50 | V241C V241C | 34VV50 34VV50 | n/a n/a |

¹ V to K interconnections require male (source) to female power splitter adapters. ² Also requires a source adapter. ³ See page 12 to select appropriate test port heads.

(A) SWR Autotesters

For optimum accuracy, the SWR Autotester test port must mate to the DUT's input connector. If you must use an adapter at the SWR Autotester test port, use a precision low SWR adapter to minimize degradation of directivity.

(B) Detectors

One detector is required for transmission or DTF measurements in non-ratio configurations. Ratio measurements (monitors source output power) require a second detector.

(C) Power Splitter

Two resistor power splitters are used for ratio measurements and external leveling.

(D) Splitter Adapter

Adapter mates the power splitter output to the SWR Autotester input for Ratio and/or externally leveled measurements.

(F) Source Cable

In manufacturing applications, using the source cable from the source output to the power splitter input (or, in Non-Ratio applications to the

SWR Autotester input) helps minimize long term wear of the SWR Autotester's test port connector. The cable mates directly to power splitter's input. Connection directly to SWR Autotesters requires a male-male adapter for WSMA, K, and V type SWR Autotesters.

(G) Source Adapter

This adapter mates the source output directly to the SWR Autotester input.

(H) Power Divider

Distance-To-Fault testing procedures

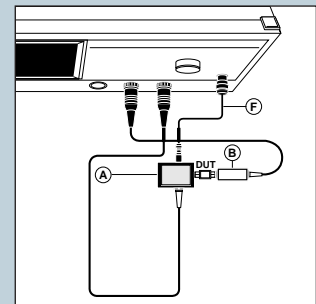
| Source Cable | Source Adapter | Power Divider | 3 dB Attenuator | DUT Adapter | Precision Termination |
|--------------|----------------|--------------------|-----------------|-------------|-----------------------|
| F | G | H | I | J | K |
| N120-6 | 34NN50A | 11N50B | 1010-31 | 34NN50A | 28NF50-2 |
| N120-6 | 34NN50A | 11N50B | 1010-31 | n/a | 28N50-2 |
| n/a | 34NN75B | 11N75B | 1010-53 | n/a | 26NF75A |
| n/a | 34NN75B | 11N75B | 1010-53 | n/a | 26N75A |
| N120-6 | 34NN50A | 1091-29 | 1010-31 | 34AN50 | 28A50-1 |
| N120-6 | 34NN50A | 1091-29 | 1010-31 | 34NN50A | 28NF50-2 |
| N120-6 | 34NN50A | 1091-29 | 1010-31 | n/a | 28N50-2 |
| NS120MF-6 | 34RSN50 | K240B | 43KB-3 | K220B | 28SF50-1 |
| NS120MF-6 | 34RSN50 | K240B | 43KB-3 | n/a | 28S50-1 |
| K120MF-15cm | K220B | K240C | 43KB-3 | K220B | 28SF50-1 |
| K120MF-15cm | K220B | K240C | 43KB-3 | n/a | 28S50-1 |
| K120MF-15cm | K220B | K240C | 43KC-3 | K220B | 28KF50 |
| K120MF-15cm | K220B | K240C | 43KC-3 | n/a | 28K50 |
| K120MF-15cm | 34RVRK50 | V240C ² | 41V-3 | 34VV50 | 28VF50B |
| K120MF-15cm | 34RVRK50 | V240C ² | 41V-3 | n/a | 28V50B |
| K120MF-15cm | 34RVRK50 | K240C ² | 43KC-3 | K220B | 28KF50 |
| K120MF-15cm | 34RVRK50 | K240C ² | 43KC-3 | n/a | 28K50 |
| K120MF-15cm | 34RVRV50 | V240C | 41V-3 | 34VV50 | 28VF50B |
| K120MF-15cm | 34RVRV50 | V240C | 41V-3 | n/a | 28V50B |

recommend use of a three resistor power divider. Except for the 1091-29, the power divider connection to the source output requires a male-male adapter or an RF extension cable with male connectors.

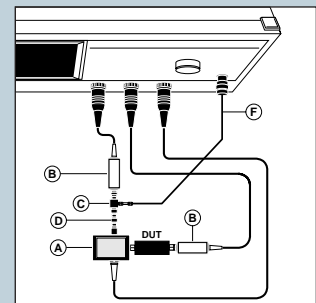
(I) 3 dB Attenuators, (J) DUT Adapters, (K) Terminations

These components are used during coaxial Distance-To-Fault applications. Waveguide DTF applications may require a coaxial to waveguide adapter.

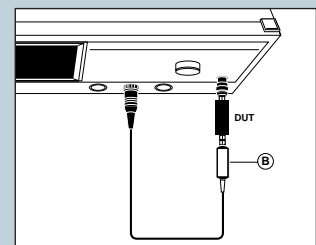
Connection Diagrams



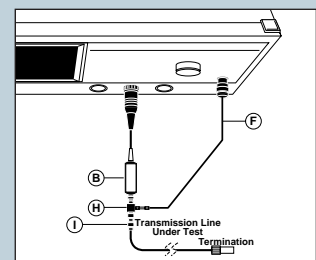
Non-Ratio Measurements: Eliminate one detector and the power splitter for measurements which do not need a source power reference detector.



Ratio Measurements: Use ratio techniques whenever source amplitude is adjusted during the measurement process.



Gain (or Loss), Group Delay and Output Power: An RF detector measures transmission characteristics. Group Delay measurement quality improves when a RF splitter and a second RF detector are used in a ratio configuration.



Distance-To-Fault: Faulty antenna systems and transmission lines are easily diagnosed with the 54100A Series optional Distance-To-Fault mode.

54100A Specification

Measurements

The 54100A Series Network Analyzer include models and measurement components from 1 MHz to 110 GHz.

Measurement Modes: Transmission (dB), Return Loss (dB), Precision Return Loss (dB), SWR (linear SWR), Power (dBm), **optional** Distance-To-Fault (feet or meters) and Relative Group Delay (ns),

Analyzer

Dynamic Range: -55 dBm to +16 dBm, Autozeroing implements AC detection on a single cycle per sweep basis using Anritsu 560 Series or 5400 Series Detectors and SWR Autotesters. DC detection is used during the sweep to improve accuracy and avoid disturbing automatic leveling controls in the device under test. Auto-zeroing can be disabled.

Inputs: Three. Two standard inputs, A and B, with an optional third reference channel, R (Option 5). Anritsu 560 Series and 5400 Series Detectors and Autotesters are designed to operate with the 54100A Network Analyzer. For millimeter wave applications, the 5400 Series Multiplier/Reflectometers provide integrated reference and return loss detection.

Channels: Two channels are used to select and simultaneously display any two inputs from A, B, or R. The inputs can also be displayed as ratios A/R or B/R.

Display Resolution:

Horizontal: 51, 101, 201, or 401 points.

Vertical: 0.025 dB, 0.0025 ns

Graticule: Ten vertical divisions. Horizontal axis automatically scales in frequency increments of 1, 2, 5. Graticule On/Off button turns all graticule lines off. Tick marks remain on axis to indicate graticule position.

Vertical Scaling:

Resolution: 0.1 dB(m) to 10 dB(m) per division. Independent control for each channel 0.1 to 100 ns per division.

Offset range: -99.9 dB to +99.9 dB, -99.9 to +99.9 ns.

Autoscale: Automatically selects offset and resolution to provide optimum display of test data.

External VGA Monitor Output: Rear panel connection is provided to drive a VGA color display. Trace colors are menu selectable.

Cursor: The numerical amplitude of the test data and frequency are displayed for both channels. Display range -99.9 to +99.9 dB or ns.

Relative Cursor: Displays the amplitude and frequency differences between the Cursor and Relative Cursor for both channels.

Cursor Functions: Automatic cursor searches for trace Maximum, Minimum, dB Level, dB Bandwidth, Next Marker, and Active Marker may be performed.

Display Data Correction: System frequency response errors are removed from measurements with a through-line transmission calibration and an open-short reflection calibration. Calibration data is stored at 0.002 dB resolution over the selected frequency range. Interpolation is used to maintain calibration as frequency sweep range is decreased.

Smoothing: Filtering, adjustable in five levels, to reduce noise and interference on low-level traces. Channels may be independently set.

Averaging: 2, 4, 8, 16, 32, 64, 128, or 256 successive traces may be averaged together to remove unwanted noise. Channels may be independently set.

Limit Lines: Two limit lines, either single value or multi-level segmented, for each trace. Complex lines may be made from up to 10 individually-editable segments.

Trace Mask: A swept measurement can be stored to a graticule Trace Mask for visual comparison to later measurements.

Save/Recall: Thirteen sets of front-panel set-ups and thirteen sets of trace memory can be stored in non-volatile instrument memory. Stored set-ups may be previewed on the CRT or printed prior to selection. Non-volatile memory can be erased for security purposes.

3.5 Inch DOS Disk Drive: Instrument configurations and trace data can be stored on a MS-DOS® compatible 3.5 inch, 1.44 MB floppy disk. Trace Data can be stored in a standardized ASCII format which easily reads into common PC spread sheets and word processing software.

Source

Frequency Range: 1 MHz to 50GHz internal (see millimeterwave reflectometer for 110GHz coverage).

Start-Stop: Sweeps from start frequency to stop frequency.

Center-Width: Sweeps from center - (width/2) to center + (width/2)

Alternate Sweep: Sweeps alternately between frequency ranges set differently for Channel 1 and Channel 2.

CW: Provides single frequency output (both channels turned off).

Frequency Resolution:

RF Models (54107A, 54109A, 54111A): ±10 kHz

Microwave Models: ±100 kHz

Start Frequency Accuracy:

RF Models (54107A, 54109A, 54111A): ±100 kHz

Microwave Models to 20 GHz: ±200 kHz

Microwave Models, 20 to 40 GHz: ±400 kHz

Microwave Models, 40 to 50 GHz: ±800 kHz

Sweep Time, Single Band: Typically less than 70 ms for single channel with 101 point horizontal resolution, depending on frequency,

averaging, and smoothing settings. Trace update time is typically 130 ms with similar system settings.

Residual FM:

1 MHz to 20 GHz < 10 kHz Peak

20 GHz to 40 GHz < 20 kHz Peak

40 GHz to 50 GHz < 40 kHz Peak

Measured in 30 Hz to 15 kHz post-detection BW.

Output Power: Maximum guaranteed leveled output power is model dependent. Typical unleveled output power exceeds the specified leveled output power. Operation with unleveled output power degrades rated specifications and is not recommended.

Reverse Power Protection: Up to 1 Watt.

Power Level Accuracy: ±1 dB, leveled. ±3.0 dB for models above 20 GHz, and ±4.0 dB for 50 GHz models. Add ±0.2 dB for Option 4-75Ω output.

Power Level Accuracy, Attenuator: Optional 70 dB Step Attenuator (10 dB steps). Leveled power accuracy degrades by ±1.5 dB for models below 20 GHz and ±1.9 dB for 20 GHz models.

Power Level Control, Internally Leveled:

Front panel control adjusts power over a 10 dB range (up to 20 dB in some models) or from -70.0 dBm to maximum leveled power when Option 2, 2A, 2B, 2C or 2D 70 dB Step Attenuator is installed.

Power Level Control, Externally Leveled

(Option 6): Front panel control adjusts power range determined by external leveling detector output. Flatness determined by leveling detector and coupler characteristics.

Leveling (With External Detector): Levels output power at DUT input positions other than near the 54100A source output. A leveling detector tracks the RF power level by providing a positive or negative polarity detected signal of 30 to 200 mV to a rear panel BNC connector.

Leveled Power Variation:

1.0 MHz to 1.0 GHz ± 0.3 dB ± 1.0 dB, Opt 2

1.0 MHz to 2.0 GHz ± 0.4 dB ± 1.1 dB, Opt 2

1.0 MHz to 3.0 GHz ± 0.6 dB ± 1.3 dB, Opt 2

10.0 MHz to 20 GHz ± 0.8 dB ± 1.0 dB, Opt 2A

10.0 MHz to 26.5 GHz ± 1.0 dB ± 2.5 dB, Opt 2B

10.0 MHz to 32 GHz ± 2.0 dB ± 2.0 dB, Opt 2C

10.0 MHz to 40 GHz ± 2.0 dB ± 2.0 dB, Opt 2C

10.0 MHz to 50 GHz ± 3.0 dB ± 3.0 dB, Opt 2D

Add ± 0.2 for 75 Ω sources

Markers: The numerical amplitude of the test data and frequency are displayed. Markers remain fixed at the set frequency, independent of displayed sweep frequency range.

Application Functions

Application functions speed and ease the task of characterizing antennas, filters, amplifiers, and other microwave devices.

Min/Max Hold: Save the minimum and

maximum values of successive sweeps or the combination of the two. Ideal for acquiring data on drift or gain variation against temperature.

Cursor Functions: Automatic cursor search updates the bandwidth, minimum, or maximum levels of the displayed trace, “X” dB above or below the min/max point, or a selected bandwidth. This function can be set to repeat continuously.

Compression Test Automation: Determines the gain compression point over the operating frequency range of an amplifier by successively incrementing the source power and measuring the amount of compression until a preset “X” dB limit is exceeded.

GPIB

Interface: IEEE-488.2 compliant interface with integrated GPIB Plotter Control is standard on all 54100A instruments. All front panel controls are GPIB-controllable except power on/off. Front panel configurable for instrument control or for control of GPIB plotter.

Printer/Plotter

Plotter: The GPIB interface is compatible with HPGL plotters. Display traces, markers, cursor, and graticule information can be plotted.

Printer: Parallel printer interface is compatible with the Cannon BJ85 and most Epson FX-compatible printers.

Internal Print and Plot Buffer: A new test can be conducted while previously taken test data are being printed or plotted from the internal printer buffer. Portable printers may be purchased locally or through Anritsu. When purchased separately, a Centronics-to-

Centronics Printer Interface Cable will be needed for operation with the 54100A.

I/O Connections

Horizontal Sweep Ramp Output: 0 to +10 V nominal.

GPIB: Connects 54100A to controller or plotter. Rear panel GPIB connector.

Parallel Printer (Centronics): Connects 54100A to printer. Rear panel.

VGA Output: Connects 54100A to external VGA color display (not supplied). Rear panel 15 pin “D” connector.

External Leveling: Option 6 adds external leveling capability. Levels output power at remote test position. (Rear panel BNC female connector).

General

Self Test: Performs a self test every time power is applied or when SELF TEST push button is pressed. If an error is detected, a diagnostic code appears, identifying the cause and location of the error.

Temperature Range:

Operating: 0°C to +50°C

Storage: -40°C to +70°C

Electromagnetic Compatibility: Complies with European Community requirements for CE marking

Power: 115V +10%/-20%, 230V +10%/-20%, 48-440 Hz, 300 VA maximum

Dimensions: 177 H x 426 W x 476 D mm + 51 mm for feet (7 H x 16.75 W x 18.75 D in. + 2.0 in. for feet)

Weight: Nominally 18 kg (39 lb.), 54147A

Measurement System Options:

- Option 1 Rack Mounting with Slides
- Option 2 70 dB RF Step Attenuator
- Option 2A 70 dB, 20 GHz Step Attenuator
- Option 2B 70 dB, 26.5 GHz Step Attenuator
- Option 2C 70 dB, 40 GHz Step Attenuator
- Option 2D 70 dB, 50 GHz Step Attenuator
- Option 4 75 ohm source output. (Available to 3.0 GHz)
- Option 5 Add Reference Channel
- Option 6 Add External Leveling
- Option 7 Internal Distance-To-Fault Software
- Option 8 Relative Group Delay Software
- Option 12 Add Front Panel Cover
- Option 13 Add Front Mounted Handles
- Option 16 +15 V DC Supply for Millimeter Wave Source Modules (Available with ≤ 20 GHz Models only)
- Option 25 Maintenance Manual
- Option 26 Extra Operation and GPIB Programming Manual
- Option 33 Ink-Jet Printer

Transit Case:

760-183 Transit Case: Hard shell case with custom foam inserts and carrying handle for maximum protection of the 54100A.

| Model | Frequency Range | Harmonic ² | Non Harmonic | Source SWR ¹ (Leveled) | Output Power ¹ | Connector |
|--------|------------------|--|--------------------------------------|-----------------------------------|------------------------------|-----------|
| 54107A | 0.001 to 1.5 GHz | -40 dBc | -60 dBc | < 1.5 | 12 dBm, 50 Ω 10 dBm, 75 Ω | N (f) |
| 54109A | 0.001 to 2.2 GHz | -40 dBc | -60 dBc | < 1.5 | 12 dBm, 50 Ω 10 dBm, 75 Ω | N (f) |
| 54111A | 0.001 to 3 GHz | -40 dBc | -60 dBc | < 1.5 | 12 dBm, 50 Ω 10 dBm, 75 Ω | N (f) |
| 54147A | 0.01 to 20 GHz | -60 dBc, > 2 GHz -40 dBc, < 2 GHz | -60 dBc, > 2 GHz -50 dBc, < 2 GHz | < 1.8 | 10 dBm, 50 Ω | N (f) |
| 54137A | 2 to 20 GHz | -60 dBc, > 2 GHz -40 dBc, < 2 GHz | -60 dBc, > 2 GHz -50 dBc, < 2 GHz | < 1.8 | 10 dBm, 50 Ω | N (f) |
| 54169A | 0.01 to 40 GHz | -60 dBc, 2-20 GHz -40 dBc, > 20 GHz -40 dBc, < 2 GHz | -50 dBc, > 2 GHz -50 dBc, < 2 GHz | < 1.8 | 4.0 dBm, 50 Ω | K (f) |
| 54163A | 2 to 40 GHz | -60 dBc, 2-20 GHz -40 dBc, > 20 GHz -40 dBc, < 2 GHz | -50 dBc, > 2 GHz -50 dBc, < 2 GHz | < 1.8 | 4.0 dBm, 50 Ω | K (f) |
| 54177A | 0.01 to 50 GHz | -60 dBc, 2-20 GHz -40 dBc, > 20 GHz -40 dBc, < 2 GHz | -50 dBc, > 2 GHz -50 dBc, < 2 GHz | < 2.0 | 1.0 dBm, 50 Ω | V (f) |

¹ At 25°C, internally leveled. Attenuator Options 2 through 2C reduce output power specification by 3.0 dB; 2D, 4.0 dB. ² Loaded at 50 Ω

56100A Specification

High Performance Scalar Measurements

The Anritsu 56100A Scalar Network Analyzer combined with a Anritsu 68C Series or 69B Series Synthesizer, forms a powerful swept frequency measurement system for both production and design applications.

Measure insertion loss, insertion gain, or RF power with 76 dB dynamic range over the 10 MHz to over 50 GHz frequency range—the widest frequency range available in coax. Measure device match as return loss in dB or as SWR.

Separate detectors can be used on all four inputs for multiple transmission measurements on duplexers or matched amplifiers. Direct detection allows simultaneous RF power measurement at different frequencies for example, at the RF, IF, and LO frequencies of mixers and converters.

Versatile

Transmission and reflection measurements can be viewed simultaneously. Both traces can be scaled independently in dB, dBm or SWR.

Measurement of the ratio of two detector inputs may be applied to either channel for enhancing accuracy or for viewing differences. Built-in calibration allows subtraction of the unwanted transmission frequency response and the average of open/short reflections.

A Volt Mode is available for displaying voltage (with Volt Mode Adapter Cable). A 0 to 10 Volt Sweep Ramp Output Mode is also available. These modes, combined with a versatile Trace Memory Mode, allow easy testing of VCOs, PIN diodes, and detectors.

Measurements

Measurement systems using the 56100A Scalar Network Analyzer include components from 1 MHz to 110 GHz.

Function: The 56100A has four detector inputs and two independent channels for measurement and display of detected RF power from Anritsu 560 Series Detectors and SWR Autotesters. Two independent channels display RF power (dBm), Transmission Gain or Loss in (dB), or reflected power. Voltage may be displayed with optional Volt Mode Adapter Cable.

Measurement Modes: Measures and displays in dB swept transmission and return loss characteristics. Power is displayed in dBm. Complete measurement parameters for all modes are displayed.

Frequency Range: 10 MHz to over 50 GHz in coax using Anritsu 560 Series Detectors and SWR Autotesters. Waveguide measurement components to 110 GHz support transmission, reflection, and power measurements.

Frequency Accuracy: Same as synthesizer frequency accuracy specification.

Inputs: Four inputs, A, B, R1, and R2 accept detected outputs from Anritsu 560 Series Detectors and SWR Autotesters.

Dynamic Range: 76 dB (-60 dBm to +16 dBm) on all channels, useable to -65 dBm.

Data Correction: System residuals, including the average of open and short reflections, are stored during normalization for automatic subtraction from test data.

Normalization: During the normalization sequence, each trace is stored with 0.002 dB resolution over any user-selected frequency range. Normalization data are automatically interpolated for ranges less than the original normalized range.

Save/Recall: Nine sets of front-panel settings can be stored for later recall. All stored data can be previewed on the CRT or printer output prior to selection. Four of the setups include their own calibration data.

Display

Channels: Two channels are used to select and simultaneously display any two inputs from A, B, R1, or R2. The same inputs can be displayed as ratios of A/R1, A/R2, B/R1, or B/R2.

Alternate Sweep: Displays alternate sweeps between the current front-panel setup and any of nine stored setups.

Graticule: Ten vertical divisions. Horizontal divisions are set automatically in frequency increments of a 1, 2, 5 sequence. Graticule On/Off control turns all graticule lines off. Tick marks remain on axis to indicate graticule position.

Display Resolution:

Horizontal: 101, 201, or 401 points over selected frequency range.

Vertical: 0.005 dB

Limit Lines: Two lines, either straight or complex, for each trace. Complex lines may be made from up to 10 segments. Measurement data may be compared with limit lines for Pass/Fail testing.

Scaling:

Resolution: 0.1 dB to 10 dB per division in 0.1 dB steps with independent control for each channel.

Offset Range: -99 dB to +99 dB in 0.1 dB steps.

Autoscale: Automatically selects offset and resolution to provide optimum display of test data.

Trace Update Time: Typically less than 100 ms, varying with frequency range and the averaging and smoothing settings.

Smoothing: Off, Minimum, and Maximum selections use analog techniques to reduce noise on low-level traces. Trace update time is automatically adjusted for any combination of averaging and smoothing.

Averaging: 4, 8, 16, 32, 64, 128, or 256 successive traces can be averaged to smooth the trace display.

CRT Intensity: Continuously adjustable from off to bright.

Markers and Cursor

Markers: Displays up to ten numerically identified markers (F1 thru F9) generated by the 68C or 69B Series Synthesizers. When a marker is selected as "Active", the cursor can be moved directly to the marker. The cursor can also be moved sequentially through markers until the desired marker is reached.

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

Relative Cursor: Displays the frequency and amplitude difference between the main Cursor and the Relative Cursor for both traces. A menu selection reverses the position of the two cursors.

Cursor Min/Max: Automatically moves the cursor to the minimum or maximum value of test data on either trace.

Cursor "X" dB: Automatically moves cursor on either trace to an amplitude that is equal to the entered value of "X" dB or dBm.

Cursor "X" Bandwidth: Automatically displays cursors to the right and left of the cursor at the frequencies where the test data are equal to the entered value of "X" dB. The frequencies of the low and high cursors and the bandwidth between them are displayed.

Cursor Next Marker: Moves cursor to next highest frequency marker.

Cursor Active Marker: Moves cursor to the frequency of the active marker.

Source

Internal software provides system compatibility with the following sources.

| | |
|-----------------|---------------------|
| Anritsu 69A/B | Anritsu 68B/C |
| Anritsu 67XXA/B | Anritsu 6600A/B |
| Anritsu 3690A | HP 8340/8350 series |

See individual source data sheet for specifications.

Superior Accuracy

The 56100A is designed to provide superior accuracy to 110 GHz. When used with a synthesizer's step sweep mode, all measurement frequencies, including markers and cursors, have synthesizer accuracy. The exceptional return-loss accuracy is attributable to the low synthesizer harmonics and spurious, the high directivity and exceptional test port match of the Anritsu SWR Autotesters. To avoid the use of error-producing adapters, SWR Autotesters are available with GPC-7, Type N,



Temperature Range:

Operating: 0°C to +50°C

Storage: -40°C to +70°C

Power: 100/120/220/240V AC +5%/-10%, 48-63 Hz, 100 VA maximum

Dimensions: 77 H x 426 W x 476 D mm +51 mm for feet(7 H x 16.75 W x 18.75 D in. +2.0 in. for feet)

Weight: 18 kg (39 lb.)

Options

Transit Case

40010 Transit Case: Hard shell case with custom foam inserts and carrying handle for maximum protection of the 56100A.

- Option 1 Rack Mounting 19 inch rack mount with slides optional
- Option 12 Front Panel Cover
- Option 13 Front Mounted Handles
- Option 25 Maintenance Manual
- Option 26 Extra Operation and GPIB Programming Manual
- Option 33 Ink-Jet Printer

WSMA, or K Connector® test ports, all with high directivity. The 560-98C50A Convertible SWR Autotester tests devices with SMA, 3.5 mm or K Connectors.

GPIB

Interface: IEEE-488 interface is standard. All front-panel controls are GPIB controllable except power on/off and CRT intensity.

Pass-through commands allow control of the -microwave signal source through the 56100A GPIB port.

Data Transfer: The 56100A does not require an external controller; nevertheless, it is capable of providing high speed data transfer of test data and normalization data to an external GPIB controller.

Printer/Plotter

Plotter: The GPIB interface is compatible with HPGL plotters. Display traces, markers, cursor, and graticule information can be plotted.

Printer: Parallel printer interface is compatible with the Canon BJ85 and most Epson FX-compatible printers.

Internal Print and Plot Buffer: A new test can be conducted while previously taken test data are printed or plotted from the internal printer buffer.

Portable printers may be purchased locally or through Anritsu. When purchased separately, a Centronics-to-Centronics Printer Interface Cable will be needed for operation with the 56100A.

I/O Connections

Horizontal Sweep Ramp Input: 0 to +10V nominal, +12V maximum

Sequential Sync Input: +3.5V to +10V blanks trace during synthesizer retrace or bandswitching. -3.5V to -10V defines a marker which when in the range of -8V to -10V is an active marker. Rear panel BNC connector.

Retrace Blanking Input: +5V blanks traces during retrace. Rear panel BNC connector.

Video Marker Input: ±1V to ±10V peak input. Rear panel BNC connector.

System GPIB: Connects 56100A to GPIB. Rear panel GPIB connector.

Dedicated GPIB: Connects 56100A to signal source and plotter. Rear panel GPIB connector.

Parallel Printer (Centronics): Connects 56100A to printer. Rear panel.

AUX I/O: Connects 56100A to compatible source. Rear panel.

General

Self Test: Performs a self test every time power is applied or when SELF TEST pushbutton is pressed. If an error is detected, a diagnostic code appears, identifying the cause and location of the error.

Electromagnetic Compatibility and Susceptibility:

Compliant with European Community requirements for CE marking.

Detectors and SWR Autotesters

Detectors

The 5400 and 560 Series Detectors use zero-biased Schottky diodes. Measurement range is -55 dBm to +16 dBm using single cycle per sweep AC detection, Auto-zeroing with DC detection during the frequency sweep. Optional extender cables of over 3000 feet can be used with the 54100A Series. Contact local sales representative for special cables.

Maximum Input Power: +20 dBm
Standard Cable Length: 122 cm (4 ft.)
Dimensions: 7.6 x 2.9 x 2.2 cm
 (3 x 1-1/8 x 7/8 in.)
Weight: 170 g (6 oz.)



Detectors

| Model | Frequency Range | Impedance | Return Loss | Input Connector | Frequency Response |
|------------|------------------|-----------|---|-----------------|---|
| 5400-71N50 | 0.001 to 3 GHz | 50 Ω | 26 dB | N(m) | ± 0.2 dB, < 1 GHz ± 0.3 dB, < 3 GHz |
| 5400-71N75 | 0.001 to 3 GHz | 75 Ω | 26 dB, ≤ 2 GHz 20 dB, ≤ 3 GHz | N(m) | ± 0.2 dB, < 1 GHz ± 0.5 dB, < 3 GHz |
| 560-7A50 | 0.01 to 18 GHz | 50 Ω | 15 dB, < 0.04 GHz 22 dB, < 8 GHz 17 dB, < 18 GHz | GPC-7 | ± 0.5 dB, < 3 GHz |
| 560-7N50B | 0.01 to 20 GHz | 50 Ω | 15 dB, < 0.04 GHz 22 dB, < 8 GHz 17 dB, < 18 GHz 14 dB, < 20 GHz | N(m) | ± 0.5 dB, < 18 GHz ± 1.25 dB, < 20 GHz |
| 560-7S50B | 0.01 to 20 GHz | 50 Ω | 15 dB, < 0.04 GHz 22 dB, < 8 GHz 17 dB, < 18 GHz 14 dB, < 20 GHz | WSMA(m) | ± 0.5 dB, < 18 GHz ± 2.0 dB, < 20 GHz |
| 560-7S50-2 | 0.01 to 26.5 GHz | 50 Ω | 16 dB, < 0.04 GHz 22 dB, < 8 GHz 17 dB, < 18 GHz 14 dB, < 26.5 GHz | WSMA(m) | ± 0.5 dB, < 18 GHz ± 2.0 dB, < 26.5 GHz |
| 560-7K50 | 0.01 to 40 GHz | 50 Ω | 13 dB, < 0.04 GHz 22 dB, < 8 GHz 17 dB, < 18 GHz 16 dB, < 26.5 GHz 15 dB, < 32 GHz 13 dB, < 40 GHz | K(m) | ± 0.5 dB, < 18 GHz ± 1.25 dB, < 26.5 GHz ± 2.2 dB, < 32 GHz ± 2.5 dB, < 40 GHz |
| 560-7VA50 | 0.01 to 50 GHz | 50 Ω | 19 dB, < 20 GHz 15 dB, < 40 GHz 10 dB, < 50 GHz | V(m) | ± 0.5 dB, < 18 GHz ± 1.25 dB, < 26.5 GHz ± 2.5 dB, < 40 GHz ± 3.0 dB, < 50 GHz |

SWR Autotesters

Autotesters are bridges with integrated detectors to simplify return loss measurements in coaxial systems. 5400 series RF autotesters and 560 series microwave autotesters have fixed test port connections. They offer the best possible directivity for accurate measurement of return loss.

When a variety of DUT's with differing test port connectors need to be measured, the 560-98C50 convertible SWR autotesters reduce capital equipment and maintenance costs. These autotesters accurately measure the return loss or SWR of devices with SMA, 3.5mm or K connectors. Six interchangeable test port heads (male and female for each connector standard) are precision tuned to the convertible autotesters internal bridge circuit.

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

It is common practice to reduce maintenance costs by using adapters or connector savers on the test port of the directional device. These adapters attached to the test port reduce measurement accuracy. Directional devices are tuned for optimum directivity at a specific phase reference point, known as the test port. Any test port adapter will degrade the effective directivity. Convertible autotesters from Anritsu with interchangeable test port heads eliminate this measurement degradation.

560-98C50A CONVERTIBLE AUTOTESTER



SWR Autotesters (Open/Short supplied with each)

| Model | Frequency Range | Directivity | Impedance | Test Port SWR | Connector | Input Connector |
|--------------|------------------|---|-----------|---|---|---------------------|
| 5400-6N50 | 0.001 to 3 GHz | 40 dB, < 3 GHz | 50 Ω | < 1.08, 2 GHz < 1.11, > 2 GHz | N (m) | N (f) |
| 5400-6NF50 | 0.001 to 3 GHz | 40 dB, < 3 GHz | | < 1.08, 2 GHz < 1.11, > 2 GHz | N (f) | N (f) |
| 5400-6N75 | 0.001 to 3 GHz | 40 dB, < 3 GHz | 75 Ω | < 1.10, 2 GHz < 1.17, > 2 GHz | N (m) | N (f) |
| 5400-6NF75 | 0.001 to 3 GHz | 40 dB, < 3 GHz | | < 1.10, 2 GHz < 1.17, > 2 GHz | N (f) | N (f) |
| 560-97A50 | 0.01 to 18 GHz | 36 dB | 50 Ω | < 1.10, 2 GHz | GPC-7 | N (f) |
| 560-97A50-1 | | 40 dB | | < 1.17, 2 GHz | | |
| 560-97N50 | 0.01 to 18 GHz | 35 dB | 50 Ω | < 1.10, 8 GHz | N (m) | N (f) |
| 560-97N50-1 | | 38 dB | | < 1.17, > 8 GHz | | |
| 560-97NF50 | | 35 dB | | < 1.17, 8 GHz | N (f) | |
| 560-97NF50-1 | | 38 dB | | < 1.27, > 8 GHz | | |
| 560-98S50 | 0.01 to 26.5 GHz | 37 dB, < 18 GHz 36 dB, < 26.5 GHz | 50 Ω | < 1.14, 8 GHz < 1.22, 18 GHz < 1.27, ≤ 26 GHz | WSMA (m) | Ruggedized K (f) |
| 560-98S50-1 | | 40 dB, < 18 GHz 38 dB, < 26.5 GHz | | < 1.14, 8 GHz < 1.22, 18 GHz < 1.27, ≤ 26 GHz | | |
| 560-98SF50 | | 37 dB, < 18 GHz 36 dB, < 26.5 GHz | | WSMA (f) | Ruggedized K (f) | |
| 560-98SF50-1 | | 40 dB, < 18 GHz 38 dB, < 26.5 GHz | | | | |
| 560-98K50 | 0.01 to 40 GHz | 35 dB, < 18 GHz 32 dB, < 32 GHz 30 dB, < 40 GHz | 50 Ω | < 1.14, 8 GHz < 1.26, 18 GHz < 1.29, 26.5 GHz < 1.33, 32 GHz < 1.38, 40 GHz | K (m) | Ruggedized K (f) |
| 560-98KF50 | | 35 dB, < 18 GHz 32 dB, < 32 GHz 30 dB, < 40 GHz | | K (f) | | |
| 560-98VA50 | 0.01 to 50 GHz | 30 dB, < 40 GHz 30 dB, < 50 GHz | 50 Ω | < 1.25, 40 GHz 1.25, 50 GHz | V (m) | Ruggedized V (f) |
| 560-98VFA50 | | 30 dB, < 40 GHz 30 dB, < 50 GHz | | < 1.25, 40 GHz 1.25, 50 GHz | V (f) | |
| 560-98C50A | 0.01 to 40 GHz | 34 dB, ≤ 20 GHz 32 dB, ≤ 26.5 GHz 29 dB, ≤ 40 GHz | 50 Ω | < 1.20, 20 GHz < 1.30, 40 GHz | WSMA (m and f) 3.5 mm (m and f) K (m and f) | Ruggedized K (f) |

CONVERTIBLE SWR AUTOTESTER TEST PORT HEADS

| DUT Connector | Test Head Model | Frequency Range | Open/Short Model |
|----------------------------------|-------------------------|--------------------------------|------------------|
| SMA (f) | 25S50 | DC to 26.5 GHz | 22KF50 |
| SMA (m) | 25SF50 | DC to 26.5 GHz | 22K50 |
| 3.5 mm (f) | 25LF50 | DC to 30 GHz | 22K50 |
| K (f) | 25K50 | DC to 40 GHz | 22KF50 |
| K (m) | 25KF50 | DC to 40 GHz | 22K50 |
| SMA (f), SMA (m) K (f), K (m) | 25SK50 (Set of Four) | DC to 26.5 GHz DC to 40 GHz | 22KF50 22K50 |



Millimeter Wave Reflectometers

Millimeter Wave Measurement Systems

The Anritsu Millimeter Wave Reflectometers are designed to operate with the 54100A and 56100A Scalar Measurement Systems. The system source must cover at least to 20 GHz to operate the millimeter wave reflectometers. The millimeter wave multiplier includes subharmonic filters and an isolator, to dramatically improve reflection accuracy.

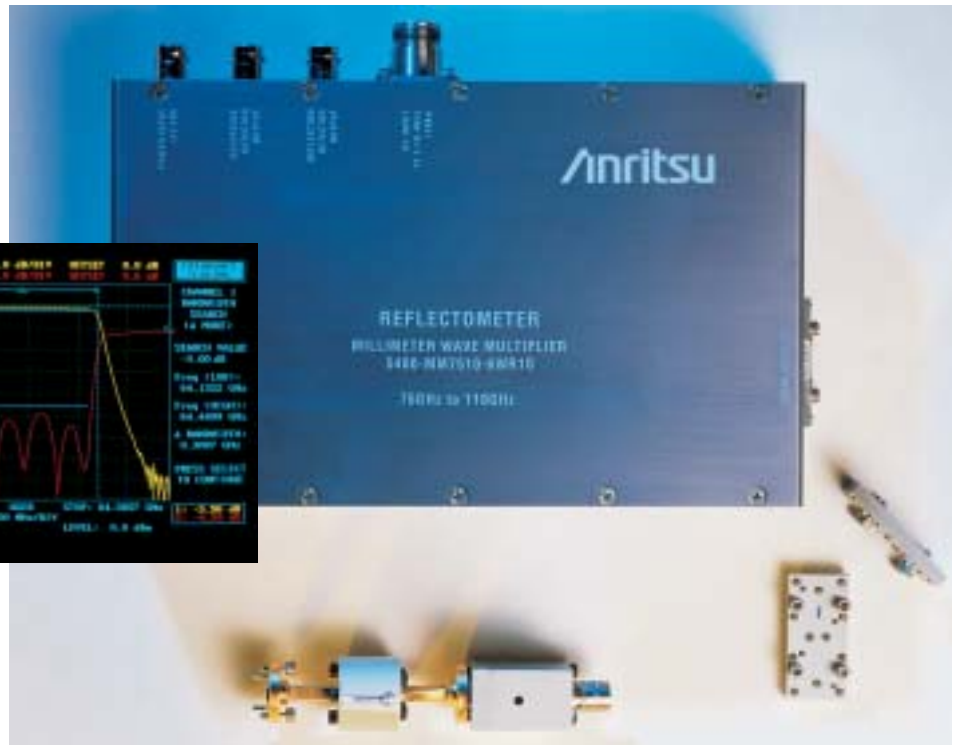
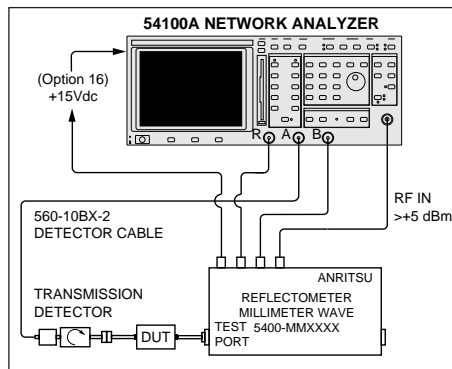
Excellent multiplier source match provided by the internal isolators and the improved detector return loss allow accurate, simultaneous return loss and transmission measurements.

110 GHz Reflectometers

54000 Series Millimeter extensions with ultra-low -55 dBc harmonics and > 40 dB typical directivity provide precision measurements in waveguide to > 110 GHz. The multiplier based reflectometers compact a bench full of waveguide test components into a single, rugged package.

Manufacturing and engineering benefit from the high accuracy and low cost of Anritsu's millimeter wave measurement systems. The multiplier based design offers low source harmonics, high reliability, rugged construction, small size, and fast setup.

The Reflectometers integrate amplifiers, multipliers, isolation, filters, couplers, detector, and detector matching circuits in one small package. High quality detectors maximize two port transmission measurement accuracy.



High Performance, Low Pricing – Anritsu's V-band and W-band Reflectometers are designed to operate with the 54147A Scalar Measurement System. Test port match is excellent and source harmonics are better than -55dBc.

Reflection Accuracy Characteristics

- Source Match:** < 1.9 (< 1.7 Typical)
- Directivity:** 35 dB (> 40 dB Typical)
- Dynamic Range:** > 56 dB
- Channel Accuracy:** Channel Accuracy is degraded by ± 0.4 dB from standard 54100A specifications
- Output Power, Minimum:** Leveled or Unleveled
- V-band:** 0.0 dBm min. (+ 4.0 dBm Typ.)
- W-band:** -5.0 dBm min. (+1.0 dBm Typ.)
- Power Flatness, Unleveled:** ± 3.0 dB Typ.
- Required Input Frequency:**
 - V-band:** 12.75 to 18.75 GHz
 - W-band:** 12.75 GHz to 18.33 GHz
- Required Input Harmonics:** < -60 dBc
- Spurious Signals:**
 - Harmonic:** < -55 dBc (< -60 dBc Typical)
 - Nonharmonic:** < -55 dBc (< -60 dBc Typical)
- Frequency Accuracy:** Source Dependent
- Frequency Resolution:** Source Dependent

Millimeter Reflectometer Accessories

- 12"N(m) to N(m) RF input cable:** PN: N120-12
- Precision Attenuators:** 1.08:1.0 SWR
 - Precision loads and attenuators allow low insertion loss devices such as couplers and waveguide sections to be accurately tested.
 - V band 3 dB: SM4784; 6 dB, SM4786
 - W band 3 dB: SM4785; 6 dB, SM4787
- Precision Loads:** 1.06: 1.0 SWR
 - V band, SM4782
 - W band, SM4783
- DC Power Connections:**
 - SM4819 Twinax (m) - Twinax (m) cable
 - SM4816 Twinax to Dual Banana Plug
 - SM4818 Twinax to Dual EZ Hooks
- Physical Characteristics**
 - Size:** 9.5 x 4.5 x 1.5 inches
- Millimeter Wave Detectors**
 - Maximum Input Power, Damage Level:** +21 dBm
 - Return Loss:** 17 dB

Special Waveguide Reflectometers Reflectometers have integrated multipliers/amplifiers. Input frequency is < 20 GHz

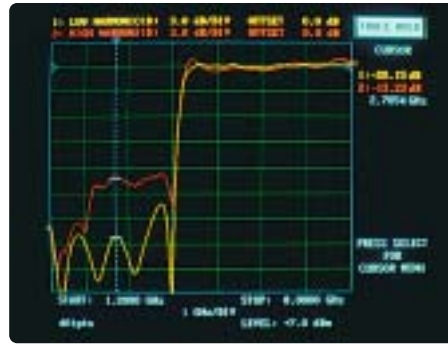
| Model | Frequency Range | Directivity | Test Port | | Input Connector |
|-------------|-----------------|-------------------|-----------------------|--------|-----------------|
| | | | Return Loss | Flange | |
| 54000-6WR15 | 50 to 75 GHz | 35 dB, 40 dB typ. | < 1.9 dB (< 1.7 typ.) | WR-15 | N (f) |
| 54000-6WR10 | 75 to 110 GHz | 35 dB, 40 dB typ. | < 1.9 dB (< 1.7 typ.) | WR-10 | N (f) |

Millimeter Wave Detectors

| Model | Frequency Range | Directivity | Input Port | | Input Connector |
|-------------|-----------------|--------------|-------------|--------|-----------------|
| | | | Return Loss | Flange | |
| 54000-7WR15 | 50 to 75 GHz | > 56 dB typ. | 17 dB | WR-15 | BNC (f) |
| 54000-7WR10 | 75 to 110 GHz | > 56 dB typ. | 17 dB | WR-10 | BNC (f) |



Errors due to source harmonics are most evident when testing wide band filters. As the source's fundamental frequency passes 2 GHz, the -33 dBc second harmonic is at 4 GHz – within the pass band of the wideband filter.



The Return Loss measurement of a low pass filter is grossly distorted when high harmonics are present. When the source's fundamental frequency passes 2 GHz, the second harmonic (at 4 GHz) enters the lowpass filter's reject band; thus, 100% of the second harmonic power is reflected back toward the source. Thus, the reflected harmonic power is measured and then erroneously displayed as the return loss characteristic between 2 and 4 GHz.



The Return Loss measurements (above) were created by the same bandpass filter. Measurement was performed with and without a test port adapter. Differences in the ripple display are caused by the vector error signal of the adapter's SWR reflection, which alternately adds and subtracts from the true return loss magnitude.

For a typical test system the most common causes of measurement uncertainty are:

- Excessive source harmonics
- Poor effective directivity due to test port adapters
- Poor quality test components

Transmission Loss or Gain Measurement

Uncertainties from the frequency response of components are automatically subtracted from test data during the path calibration procedure. Overall accuracy is then:

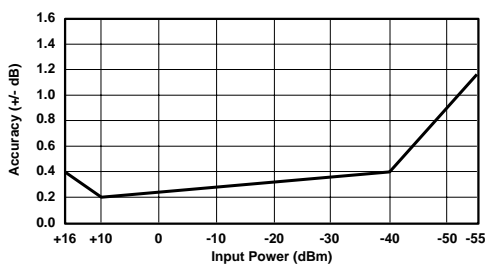
- + Channel Accuracy
- + Mismatch Uncertainty

+ Distortion From Source Harmonics

Transmission Measurement Accuracy

Effects of source, test device, SWR Autotester, and detector mismatch can be significant. This mismatch uncertainty is minimized by the exceptionally low reflection characteristics of Anritsu's detectors, sources, and SWR Autotesters. Anritsu's ultra low source harmonics maximize the accuracy of measurements on filters, receivers, mixers, and amplifiers.

Channel Accuracy (25°C):



Return Loss Measurement Accuracy

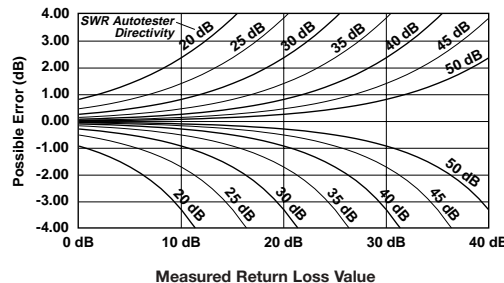
Uncertainties resulting from SWR Autotester and source frequency response and from system open and short characteristics are subtracted automatically from test data.

Overall accuracy is then:

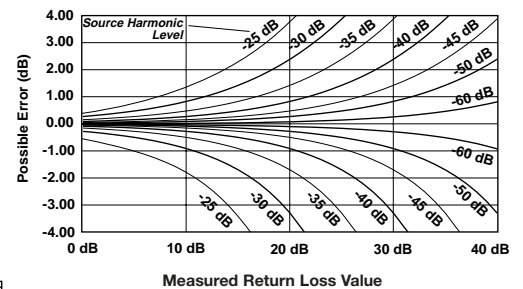
- + Channel Accuracy
 - + Autotester Accuracy
 - + Distortion From Source Harmonics
- ### Return Loss Measurement Accuracy

Autotester accuracy is composed of error due to directivity and error due to test port match. Unless the DUT has very poor return loss (high SWR), directivity will be largest source of error. When an adapter is used at the test port, use Effective Directivity to determine possible errors. Note: Return loss errors due to source harmonics will be significant when the harmonic level is within 10 dB of the DUT's measured return loss.

Return Loss Accuracy Due to Directivity



Return Loss Accuracy Due to Source Harmonics



This chart assumes full reflections of a single source harmonic at the DUT input. Multiple harmonics can cause additional measurement uncertainty. Source harmonics are a significant source of return loss measurement uncertainty when testing banded devices such as filters, receivers, transmitters, power amplifiers, and antennas.

SWR Autotester Accuracy, Microwave:

| Model | SWR Autotester Error Terms | | |
|--------------|----------------------------|----------------------------|----------------------------|
| | 10 MHz to 8 GHz | 8 GHz to 18 GHz | 18 GHz to 26.5 GHz |
| 560-97A50 | 0.016 ± 0.06Γ ² | 0.016 ± 0.10Γ ² | N/A |
| 560-97A50-1 | 0.016 ± 0.06Γ ² | 0.010 ± 0.10Γ ² | N/A |
| 560-97N50 | 0.018 ± 0.08Γ ² | 0.018 ± 0.12Γ ² | N/A |
| 560-97N50-1 | 0.013 ± 0.08Γ ² | 0.013 ± 0.12Γ ² | N/A |
| 560-97NF50 | 0.018 ± 0.08Γ ² | 0.018 ± 0.12Γ ² | N/A |
| 560-97NF50-1 | 0.013 ± 0.08Γ ² | 0.013 ± 0.12Γ ² | N/A |
| 560-98S50 | 0.014 ± 0.07Γ ² | 0.014 ± 0.10Γ ² | 0.016 ± 0.12Γ ² |
| 560-98S50-1 | 0.010 ± 0.07Γ ² | 0.010 ± 0.10Γ ² | 0.013 ± 0.12Γ ² |
| 560-98SF50 | 0.014 ± 0.07Γ ² | 0.014 ± 0.10Γ ² | 0.016 ± 0.12Γ ² |
| 560-98SF50-1 | 0.010 ± 0.07Γ ² | 0.010 ± 0.10Γ ² | 0.013 ± 0.12Γ ² |
| 560-98K50 | 0.018 ± 0.07Γ ² | 0.018 ± 0.12Γ ² | 0.025 ± 0.13Γ ² |
| 560-98K50-1 | 0.018 ± 0.07Γ ² | 0.018 ± 0.12Γ ² | 0.025 ± 0.13Γ ² |

Accuracy of Measured Reflection Coefficient (Γ) depends upon autotester directivity, test port reflection, output source SWR, and the SWR Autotester's insertion loss. The SWR Autotester Accuracy tables identify directivity (first term) and test port reflection (second term) return loss accuracy contributions.



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