Anritsu

# Precision RF & Microwave Components

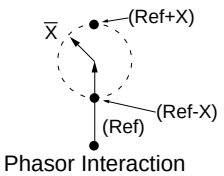
*The Industry Leader for High Frequency Components*

# RF MEASUREMENT CHART

| | | | Relative to Unity Reference | | | |
|---|---|---|---|---|---|---|
| SWR | Reflection Coefficient | Return Loss (dB) | X dB Below Reference | Ref +X (dB) | Ref –X (dB) | Ref ±X (dB) |
| 17.3910 | 0.8913 | 1 | 1 | 5.5350 | 19.2715 | 24.8065 |
| 8.7242 | 0.7943 | 2 | 2 | 5.0780 | 13.7365 | 18.8145 |
| 5.8480 | 0.7079 | 3 | 3 | 4.6495 | 10.6907 | 15.3402 |
| 4.4194 | 0.6310 | 4 | 4 | 4.2489 | 8.6585 | 12.9073 |
| 3 5698 | 0.5623 | 5 | 5 | 3.8755 | 7.1773 | 11.0528 |
| 3.0095 | 0.5012 | 6 | 6 | 3.5287 | 6.0412 | 9.5699 |
| 2.6146 | 0.4467 | 7 | 7 | 3.2075 | 5.1405 | 8.3480 |
| 2.3229 | 0.3981 | 8 | 8 | 2.9108 | 4.4096 | 7.3204 |
| 2.0999 | 0.3548 | 9 | 9 | 2.6376 | 3.8063 | 6.4439 |
| 1.9250 | 0.3162 | 10 | 10 | 2.3866 | 3.3018 | 5.6884 |
| 1.7849 | 0.2818 | 11 | 11 | 2.1567 | 2.8756 | 5.0322 |
| 1.6709 | 0.2512 | 12 | 12 | 1.9465 | 2.5126 | 4.4590 |
| 1.5769 | 0.2239 | 13 | 13 | 1.7547 | 2.2013 | 3.9561 |
| 1.4985 | 0.1995 | 14 | 14 | 1.5802 | 1.9331 | 3.5133 |
| 1.4326 | 0.1778 | 15 | 15 | 1.4216 | 1.7007 | 3.1224 |
| 1.3767 | 0.1585 | 16 | 16 | 1.2778 | 1.4988 | 2.7766 |
| 1.3290 | 0.1413 | 17 | 17 | 1.1476 | 1.3227 | 2.4703 |
| 1.2880 | 0.1259 | 18 | 18 | 1.0299 | 1.1687 | 2.1986 |
| 1.2528 | 0.1122 | 19 | 19 | 0.9237 | 1.0337 | 1.9574 |
| 1.2222 | 0.1000 | 20 | 20 | 0.8279 | 0.9151 | 1.7430 |
| 1.1957 | 0.0891 | 21 | 21 | 0.7416 | 0.8108 | 1.5524 |
| 1.1726 | 0.0794 | 22 | 22 | 0.6639 | 0.7189 | 1.3828 |
| 1.1524 | 0.0708 | 23 | 23 | 0.5941 | 0.6378 | 1.2319 |
| 1.1347 | 0.0631 | 24 | 24 | 0.5314 | 0.5661 | 1.0975 |
| 1.1192 | 0.0562 | 25 | 25 | 0.4752 | 0.5027 | 0.9779 |
| 1.1055 | 0.0501 | 26 | 26 | 0.4248 | 0.4466 | 0.8714 |
| 1.0935 | 0.0447 | 27 | 27 | 0.3798 | 0.3969 | 0.7765 |
| 1.0829 | 0.0398 | 28 | 28 | 0.3391 | 0.3529 | 0.6919 |
| 1.0736 | 0.0355 | 29 | 29 | 0.3028 | 0.3138 | 0.6166 |
| 1.0653 | 0.0316 | 30 | 30 | 0.2704 | 0.2791 | 0.5495 |
| 1.0580 | 0.0282 | 31 | 31 | 0.2414 | 0.2483 | 0.4897 |
| 1.0515 | 0.0251 | 32 | 32 | 0.2155 | 0.2210 | 0.4365 |
| 1.0458 | 0.0224 | 33 | 33 | 0.1923 | 0.1967 | 0.3890 |
| 1.0407 | 0.0200 | 34 | 34 | 0.1716 | 0.1751 | 0.3467 |
| 1.0362 | 0.0178 | 35 | 35 | 0.1531 | 0.1558 | 0.3090 |
| 1.0322 | 0.0158 | 36 | 36 | 0.1366 | 0.1388 | 0.2753 |
| 1.0287 | 0.0141 | 37 | 37 | 0.1218 | 0.1236 | 0.2454 |
| 1.0255 | 0.0126 | 38 | 38 | 0.1087 | 0.1100 | 0.2187 |
| 1.0227 | 0.0112 | 39 | 39 | 0.0969 | 0.0980 | 0.1949 |
| 1.0202 | 0.0100 | 40 | 40 | 0.0864 | 0.0873 | 0.1737 |
| 1.0180 | 0.0089 | 41 | 41 | 0.0771 | 0.0778 | 0.1548 |
| 1.0160 | 0.0079 | 42 | 42 | 0.0687 | 0.0693 | 0.1380 |
| 1.0143 | 0.0071 | 43 | 43 | 0.0613 | 0.0617 | 0.1230 |
| 1.0127 | 0.0063 | 44 | 44 | 0.0546 | 0.0550 | 0.1096 |
| 1.0113 | 0.0056 | 45 | 45 | 0.0487 | 0.0490 | 0.0977 |
| 1.0101 | 0.0050 | 46 | 46 | 0.0434 | 0.0436 | 0.0871 |
| 1.0090 | 0.0045 | 47 | 47 | 0.0387 | 0.0389 | 0.0776 |
| 1.0080 | 0.0040 | 48 | 48 | 0.0345 | 0.0346 | 0.0692 |
| 1.0071 | 0.0035 | 49 | 49 | 0.0308 | 0.0309 | 0.0616 |
| 1.0063 | 0.0032 | 50 | 50 | 0.0274 | 0.0275 | 0.0549 |
| 1.0057 | 0.0028 | 51 | 51 | 0.0244 | 0.0245 | 0.0490 |
| 1.0050 | 0.0025 | 52 | 52 | 0.0218 | 0.0218 | 0.0436 |
| 1.0045 | 0.0022 | 53 | 53 | 0.0194 | 0.0195 | 0.0389 |
| 1.0040 | 0.0020 | 54 | 54 | 0.0173 | 0.0173 | 0.0347 |
| 1.0036 | 0.0018 | 55 | 55 | 0.0154 | 0.0155 | 0.0309 |
| 1.0032 | 0.0016 | 56 | 56 | 0.0138 | 0.0138 | 0.0275 |
| 1.0028 | 0.0014 | 57 | 57 | 0.0123 | 0.0123 | 0.0245 |
| 1.0025 | 0.0013 | 58 | 58 | 0.0109 | 0.0109 | 0.0219 |
| 1.0022 | 0.0011 | 59 | 59 | 0.0097 | 0.0098 | 0.0195 |
| 1.0020 | 0.0010 | 60 | 60 | 0.0087 | 0.0087 | 0.0174 |

- *The first three columns are conversion tables for return loss, reflection coefficient, and SWR.*
- *The last four columns are values for interactions of a small phasor X with a large phasor (unity reference) expressed in dB related to reference.*

The RF Measurement Chart can be used to determine the uncertainty due to bridge/autotester VNA directivity. The "X dB Below Reference" column represents the difference between the directivity and the measured reflection (return loss). The "ref + X dB" and "ref – X dB" values are the algebraic sum of the error signal and the measured reflected signal as their phase relationship varies over 360˚. Therefore, the peak-to-peak ripple (1 ± X) is the total measurement uncertainty caused by the error signal.



Phasor Interaction

For example, if a 30 dB return loss is measured with a 40 dB directivity autotester, the X dB Below Reference value is 10 dB. Ref + X dB is 2.3866 dB and ref – X dB is 3.3018 dB. The actual return loss is between 27.6134 dB (– 30 + 2.3866) and 33.3018 dB (– 30 – 3.3018). The peak to peak ripple on a swept measurement will be 5.6884 dB. If the error and directivity signals are equal, ref +X dB equals 6 dB (voltage doubled causes 6 dB change) and ref – X dB becomes infinite, since the two signals are equal in amplitude and 180° out of phase (zero voltage).

## ANSI Standard

| | |
|---|---|
| **X mm** | ±5 mm |
| **X.X mm** | ±0.5 mm |
| **X.XX mm** | ±0.15 mm |
| **X.XXX mm** | ±0.05 mm |

Above ANSI Standard tolerance applies to all components unless otherwise noted.

# TABLE OF CONTENTS

# OUTLINE OF PRECISION MEASUREMENT COMPONENTS

## Precision Components-Precision Measurements

Anritsu is a leader in the design and production of precision microwave components.

- *Precision Coaxial Connector Systems to 65 GHz*
- *Precision Coaxial and Waveguide to Coax Adapters*
- *High Directivity SWR Autotesters and Bridges*
- *RF Detectors*
- *Precision Terminations and Air lines*
- *Precision Fixed Attenuators*
- *Precision Step Attenuators*
- *Precision Power Dividers and Splitters*
- *Precision Bias Tees*
- *Broadband Microwave Limiters*

## Connector Design Leadership

Anritsu is the leader of high frequency microwave connector technology and is driven by an ongoing commitment to exceed customer needs. Anritsu created and trademarked the K Connector® with coverage to 40 GHz, along with a complete family of 40 GHz test equipment. It was an immediate success and today is used on many commercial components, test fixtures, and military systems.

The V Connector® offers coaxial coverage to 65 GHz and uses a 1.85 mm geometry endorsed by the International Electrotechnical Commission (IEC). It mates with commercially available 2.4 mm connectors.

Anritsu continues its leadership role with the introduction of the Integrated V Connector, which combines compatibility with V Connectors with easy installation and consistent excellent performance.

The VP™ Connector delivers push-on simplicity with excellent performance to 65 GHz.

The W1 Connector™ provides mode-free performance to 110 GHz and uses a 1.00 mm coaxial connector front side interface.

## Coaxial and Waveguide to Coax Adapters

A series of precision measurement adapters are available to adapt one connector type to another. Poor adapter VSWR (or poor return loss) can be a major source of measurement error and, therefore adapters, must be carefully selected. Anritsu precision adapters typically have 6-12 dB better return loss than competitive units. Waveguide-to-Coax Adapters are available to 65 GHz.

## Precision Terminations and Air Lines

Anritsu is recognized as the leader in the field of impedance standards. Anritsu air lines and terminations are unsurpassed for accuracy and impedance match. Not only do these products increase measurement accuracy, they also provide the only method of certifying the performance of SWR Autotesters, bridges, directional couplers, and other devices.

## Precision Fixed Attenuators

Anritsu attenuators offer superior performance in a low cost package. The low VSWR (excellent return loss) minimizes signal reflections and simultaneously reduces ripple effects in the output frequency response. This assures flat, consistent attenuation characteristics regardless of other devices reflection characteristics. One of the simplest ways to improve impedance match is to insert a precision attenuator between the device under test and the source or RF detector. The 41K and 41V Series attenuators are specifically designed for such applications where accuracy is a basic requirement.

In addition to being available as individual units of 3, 6, 10, or 20 dB, the 41K and 41V Series Fixed Attenuators are also available in sets with certified calibration data. Available frequency ranges cover DC to 26.5 GHz, 40 GHz, or 65 GHz.

Many other attenuator applications have as their principal objective the reduction of power. Since the attenuator might not be inserted at a measurement point, the measurement precision discussed earlier is not required. In such a power-reducing system application, attenuators are often required in large quantities, making price an important consideration. The 43K Series includes models covering DC to 26.5 GHz, and DC to 40 GHz. All are available with 3, 6, 10, or 20 dB attenuation values. All have the Anritsu K Connectors and are compatible with SMA connectors.

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


## Precision Step Attenuators

Anritsu offers low loss, high precision step attenuators. These programmable step attenuators are available with 10 dB steps from 0 to 70 dB or 0 to 110 dB ranges. DC to 40 GHz frequency range ensures the broadest attenuation and frequency coverage available. Contact Anritsu for needs above 40 GHz.

## Precision Power Dividers and Splitters

Anritsu produces precision V Connector® dividers and splitters to 65 GHz and precision K Connector® dividers and splitters to 40 GHz.

All Anritsu power dividers are 3-resistor symmetrical designs with excellent amplitude and phase tracking. Anritsu power splitters are 2-resistor designs, used to accurately split signals for ratio measurements.

## Precision Bias Tees

Anritsu Bias Tees are used to combine DC and RF for active device measurements. Low RF throughline loss and low SWR ensure negligible effect on measurements from 50 kHz to 60 GHz.

## Broadband Microwave Limiters

Anritsu broadband microwave limiters provide the widest frequency range available in a limiter. Designed to protect sensitive microwave equipment, these limiters incorporate unique single-side limiting to provide soft limiting characteristics over 10 MHz to 26.5 GHz.

## High Directivity SWR Autotesters and Bridges

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

An SWR bridge has a precision termination inside the bridge, eliminating the need for an external reference. An autotester further simplifies the user interface by incorporating a detector into the RF output that provides a DC output proportional to the DUT mismatch.

The directivity of the SWR Autotester or bridge is the measure of how well the incident and reflected signals can be separated. For example, 40 dB directivity means that the error signal in the output is 40 dB below the reflected signal to be measured.

Anritsu's high directivity bridges and autotesters set the standards for reflection measurements. High directivity translates to accurate measurements. Anritsu high directivity bridges are available for GPC-7, 50 Ω and 75 Ω Type N. High directivity autotesters are available with GPC-7, Type N, and SMA, 3.5, K Connectors®, and V Connectors®.

## RF Detectors

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

Anritsu offers a complete line of coaxial RF detectors covering from 100 kHz to 50 GHz with the lowest SWR available. The excellent impedance match of the detectors, along with that of the test port on the SWR Autotesters and bridges, minimize errors when making simultaneous transmission and measurements.

## Calibration and Verification Kits

Anritsu offers calibration kits which contain all the precision components and tools required to calibrate an Anritsu VNA in a connector style of your choice.

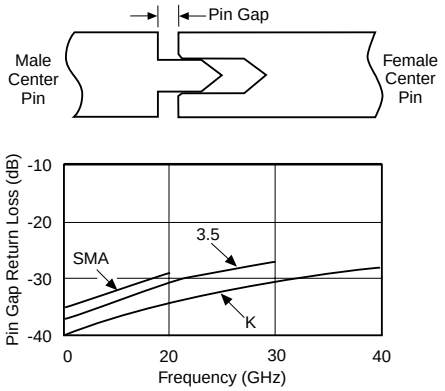
## Specials

Anritsu also manufactures assemblies and components to meet specific customer requirements in both coaxial and waveguide structures. These include such components as Connectors, Bias Tee, Step Attenuator, Detector, Power Sensors, Waveguide, Coaxial Adapters, and RF Cables etc.

When requesting quotations on special assemblies, as a minimum please provide this information: frequency range, electrical characteristics, mechanical details and outline dimensions if any.

# K CONNECTOR®

DC to 40 GHz




*Effect of Pin Gap*

The K Connector® is a precision coaxial connector system that operates up to 40 GHz. It is compatible with SMA, WSMA, and 3.5 mm connectors. It is well suited to applications in components, systems, or instrumentation.

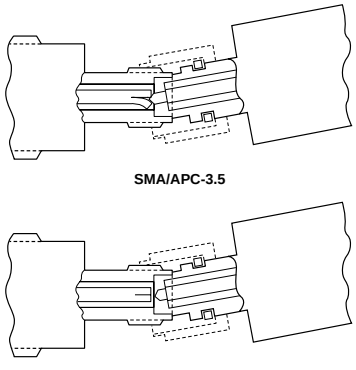
## K Connector® features

- *Excellent performance up to 40 GHz*
- *Performance exceeding SMA below 18 GHz*
- *Superior reliability*
- *Compatibility with SMA, WSMA, and 3.5 mm*
- *Complete testability on existing network analyzers*

## Exceptional reliability and repeatability

Microwave connector reliability is affected by insertion force, outer conductor strength, stress relief while mating, and mating alignment. The K Connector exhibits exceptional performance in all of these areas.

For proper seating, a standard SMA or 3.5 mm connector can require in excess of 27N* of insertion force, In contrast, the K Connector requires only 2.3N*. The reduced wear on the female center conductor improves reliability. In addition, the K Connectors outer conductor is four times thicker than that of SMA. Taken together, the lower insertion force and the thicker wall offer more reliable connections than available from an SMA connector. Life tests show that the K Connector makes greater than 10,000 connections with negligible change in electrical characteristics.




*Shortened Male Pin Eliminates Damage to Female K Connector*

*Force is measured in Newtons (N).

All K Connectors, including the cable connectors, incorporate a feature that eliminates a major cause of connector failure; misalignment of the male pin with respect to the female contacts. To solve the problems the K Connector male pin is deliberately made shorter than the SMA or 3.5 mm pin. With this arrangement, the outer housing is properly aligned prior to the mating of the center conductors. Thus a proper, non-destructive alignment before mating is ensured.

The effect of pin gap on a connection is often overlooked, but is the dominant source of error in many connection systems. Pin gap is the short length of smaller diameter caused when a connector pair is mated. Pin gap causes a discontinuity at the connector interface. The K Connector has considerably less susceptibility to pin gap than either SMA or 3.5 mm connectors.

Many connector manufacturers specify connector performance assuming no pin gap, an unrealistic assumption. K Connectors are specified assuming pin gap to be at its maximum tolerance, to provide you the assurance of real-world specifications.

## Compatibility

The K Connector interfaces electrically and mechanically with 3.5 mm connectors, including SMA and 3.5 mm without degradation in performance.

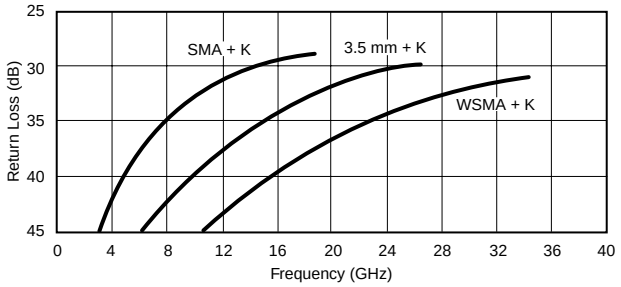
## Launcher design

At the heart of the K Connector product line are the launchers. As their name implies, the launchers “launch” (make the transition) from a microwave circuit (microstrip, suspended substrate, stripline, or coplanar waveguide) to a coaxial connector and an outside transmission line. The key to making the transition without compromising electrical and mechanical objectives is the glass bead in the launcher assembly.

## Low-reflection bead

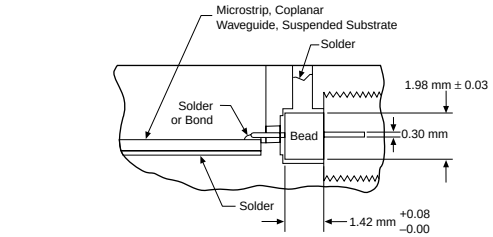
The K Connector®'s standard glass bead has a 0.30 mm center conductor and readily connects to fragile devices. The bead is appropriate for most applications employing Duroid® and ceramic (Alumina) microstrip, such as the 0.25 mm wide transmission line on a 0.25 mm thick Alumina substrate. Applications using suspended substrate geometry are equally well satisfied. The bead is constructed of Corning 7070 glass and has a gold-plated center conductor and a gold-plated Kovar® collar.

The outstanding design of the bead is largely accountable for the excellent performance of the K Connector launchers. Because the small 0.30 mm pin introduces minimal discontinuity, return loss is typically better than 20 dB at 40 GHz and better than 25 dB below 18 GHz. In addition, the design provides for soldering the bead to achieve a hermetic seal. 310°C max. soldering temperature is recommended.




*Return Loss Characteristics*

Both the sparkplug (screw-in) and the flange-mount K Connector launchers offer an additional advantage over existing designs. These launchers do not use an epoxy pin to secure the center conductor, as used in some SMA designs. Without an epoxy pin, the outer conductor remains solid, and thereby eliminates the leakage path common to pin-captivated designs. Furthermore, K launchers have a wall thickness that is four times that of typical launchers (0.8 vs. 0.2 mm). The heavier wall results in superior resistance to over-torquing. Finally, the K Connector launcher can be removed for repair without removal of the glass bead. This ensures that during removal the critical microcircuit-to-glass bead interface is not disturbed, hermeticity is preserved, and the micro-circuit will not be subjected to the additional stress caused by heating to soldering temperature. Hardware locking compound such as "Removable Loctite®" should be used to further secure the screw-in launcher in its housing.




*Transition from Microcircuit to External Transmission Line*

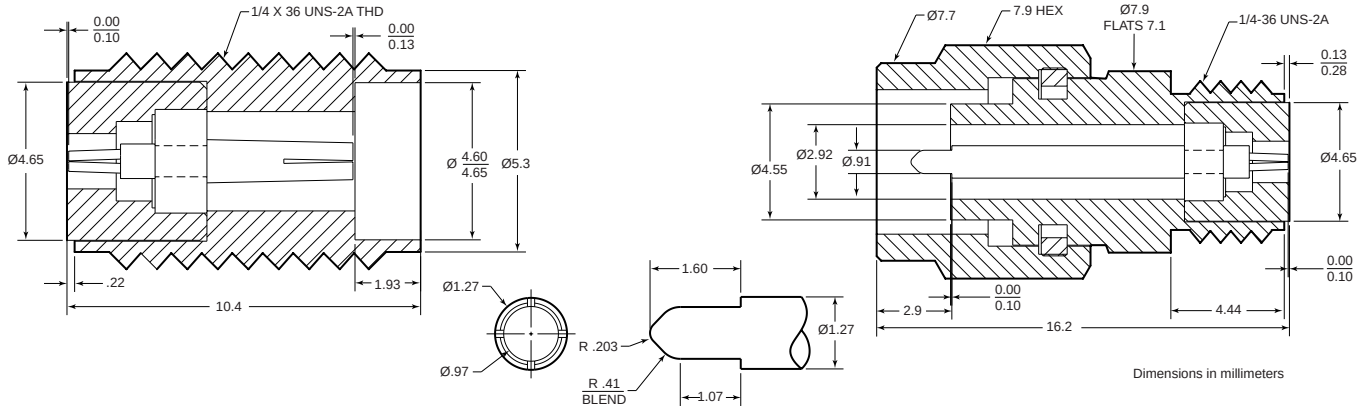
## Complete family

Virtually every interface need can be satisfied by one or more of the K Connector items offered. There are six different models of K Connector launchers. Two sparkplug (screw-in) launchers are available, the K102F female version and the K102M male version. Both screw into the housing that encloses the microwave circuit, and, like all Anritsu launchers, they can be easily removed for replacement or repair without unsoldering the glass bead and its interface to the microwave circuit.

When the housing that encloses the microwave circuit is not thick enough to support a threaded, screw-in launcher, flush-mounted (flange) launchers are required. Models with two mounting holes are available in both male and female versions, K103M and K103F. Two other models, the K104F and K104M, have four mounting holes. Mounting hole spacing is identical to that of similar SMA flange launchers. The glass bead interface, of course, is the same design used for the sparkplug launcher.

## Cable connectors

Both male and female cable connectors are available. The cable connectors, K101M and K101F, use gold-plated, beryllium-copper center conductors for optimum performance and wear characteristics, Typical return loss at 40 GHz for finished cables exceeds 16 dB (1.35 SWR).




*K Connector® interface dimensions in metric measurements*

# K CONNECTOR®

DC to 40 GHz

## Evaluation kit

***01-101A***
***Evaluation Kit***
*Kit contains one K120 25 cm Male/Male Cable Assembly, two K102F Female Sparkplug Launcher Connector Assemblies, two K104F Female Flange Launcher Connector Assemblies, five K100 Glass Beads, one 01-102A Test Fixture, one 01-104 Drill and Tap Set, five K110-1 Microstrip Sliding Contacts, and all other parts and fixtures required to assemble launchers with or without sliding contacts.*

## Tools and fixtures

***01-103***
*Soldering Fixture for sparkplug launcher glass beads, package of 10*

***01-104***
***Drill and Tap Set***
*for precision machining of concentric holes for mounting K Connector® in microwave housing. (Drill Part No. B14094) (Tap Part No. 783-255)*

***01-105A***
*Male and Female Sparkplug Torquing Kit*

***01-106***
*K Soldering Fixture for flange launcher glass bead, package of 5.*

***01-107M or 01-107F***
*Cable Sleeve Soldering Fixture for K101M Male and K101F Female Cable Connectors, package of 10.*

***01-108***
***Drill and Tap Set***
*For precision machining of concentric holes for mounting K Connector® in microwave housing in applications where stress relief contacts are used. (Drill Part No. B16526) (Tap Part No. 783-255)*


***01-118***
*K Connector® Cable Assembling Fixture Kit for K118 semi-rigid coaxial cable.*

*01-201*

Anritsu provides two connector tools that make connecting and disconnecting tiny connectors more easily and surely accomplished. These tools are featured below.


*01-204*

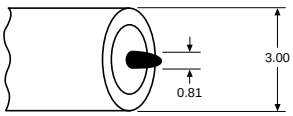
## Features

- *01-201 Torque wrench: 0.9 N-M (8 in-lb) for standard SMA and 3.5 mm connectors, and for the Anritsu K Connector® and V Connector®.*
- *01-204 Handy stainless steel connector wrench for standard SMA, 3.5 mm, and 2.4 mm connectors, and for the Anristu K Connector® and V Connector®.*

## Semi-rigid coaxial cable

| | |
|---|---|
| **Type** | Semi-rigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor. |
| **Impedance** | 50 ± 2 Ω |
| **Dielectric type** | Microporous Teflon, 0.24 cm diameter |
| **Dielectric constant** | 1.687 |
| **Relative velocity** | 0.77 |
| **Outside diameter** | 3.00 mm |
| **Center conductor diameter** | 0.81 mm |
| **Minimum bend radius** | 0.65 cm |
| **Attenuation** | 1.6 dB/m at 10 GHz<br>2.3 dB/m at 20 GHz<br>3.3 dB/m at 30 GHz<br>4.7 dB/m at 40 GHz |

***K118***
***Semi-rigid Coaxial Cable***
*1.5m length of 3.00 mm semi-rigid cable for K101 series connector*




Dimensions in millimeters

# K CONNECTOR®

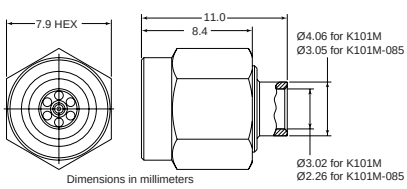
DC to 40 GHz

## Launchers and cable connectors

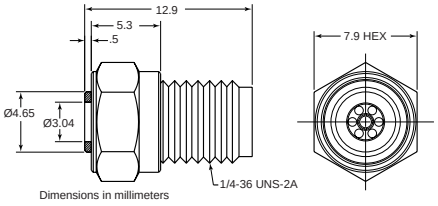
| | |
|---|---|
| **Coupling nut tightening torque** | 1.36 N-m max |
| **Material** | Passivated stainless steel with heat-treated beryllium copper center conductors |
| **Pin depth** | 0.000 to -0.13 mm for male and female connectors |
| **Temperature range** | -55°C to +125°C (200°C available; contact factory) |

***K101M***④⑥
*K Male In-Line Cable Connector, DC-40 GHz for 3 mm cable*

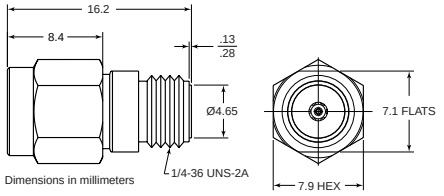
***K101M-085***④
*for 2.16 mm cable*



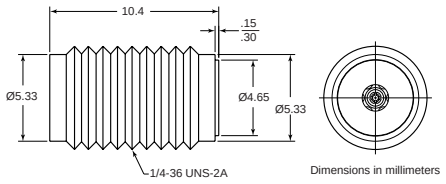

***K101F***⑤⑥
*K Female In-Line Cable Connector, DC-40 GHz for 3 mm cable*



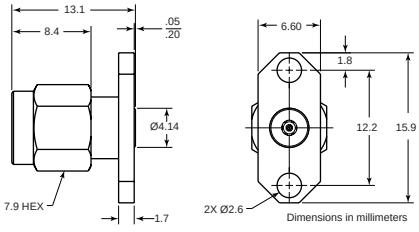

***K102M***③
*K Male Sparkplug Launcher Connector, DC-40 GHz*



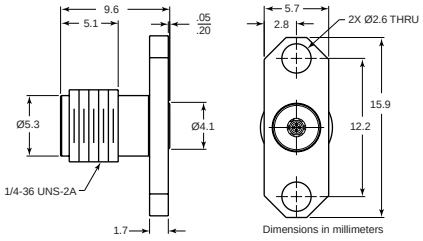

***K102F***③
*K Female Sparkplug Launcher Connector, DC-40 GHz*



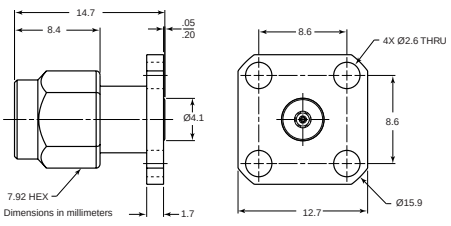

***K103M***
*K Male Flange Launcher, two-hole, DC-40 GHz*



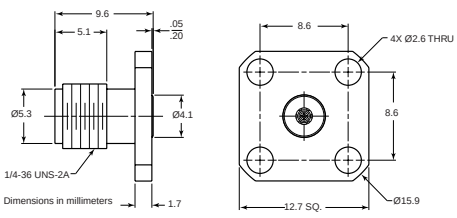

***K103F***
*K Female Flange Launcher, two-hole, DC-40 GHz*




***K104M***
*K Male Flange Launcher, four-hole, DC-40 GHz*




***K104F***
*K Female Flange Launcher, four-hole, DC-40 GHz*



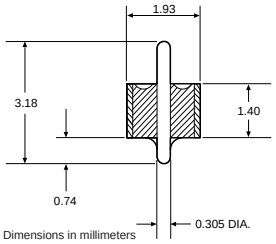

① Use with 01-104 or 01-108 Drill and Tap Sets
② Use with 01-103 or 01-106 Soldering Fixtures
③ Use with 01-105A Male and Female Sparkplug Torquing Kit
④ Use with 01-107M Cable Sleeve Fixture
⑤ Use with 01-107F Cable Sleeve Fixture
⑥ Use with 01-118 Cable Assembly Fixture Kit

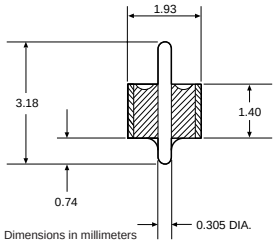
# K CONNECTOR®

DC to 40 GHz

***K100***[①②]
*Glass Beads for K102, K103, and K104 connectors*
*Note: Glass Beads can be purchased through recommended vendors. For more information visit www.anritsu.com.*

***K100B***[①②]
*High Hermeticity* Glass Beads for K102, K103, and K104 connectors*
*Note: Glass Beads can be purchased through recommended vendors. For more information visit www.anritsu.com.*



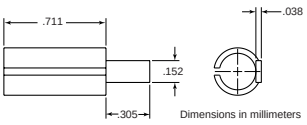




*Glass Bead Hermeticity Spec: Hermetic to 1 x 10-8 std cc He/sec at 1 atm differential

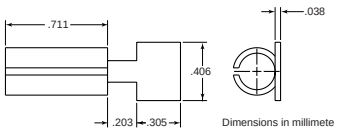
## Stress relief contacts

Stress Relief Contacts provide an elegant yet simple solution to relieving stress at the interface of the microcircuit and its connecting coaxial conductor. These contacts simply slide onto the standard K100 and K100B glass bead pins.

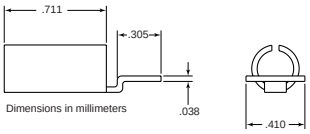
| | |
|---|---|
| **Frequency range** | DC to 40 GHz |
| **Material** | 0.025 mm heat-treated BeCu |
| **Plating** | Bondable gold over nickel |



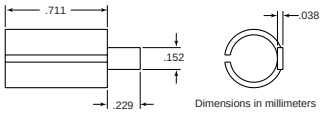

***K110-1***[①] *Microstrip and Coplaner Waveguide*



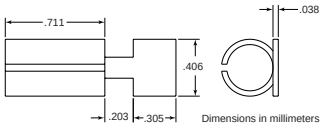

***K110-3***[①] *Microstrip*




***K110-2***[①] *Stripline*




***S110-1*** *Microstrip and Coplaner Waveguide for 0.38 mm glass feedthru center conductor*




***S110-3*** *Microstrip and Coplaner Waveguide for 0.38 mm glass feedthru center conductor*

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| 01-101A | K Connector® (evaluation kit) |
| 01-103 | Soldering fixture for sparkplug launcher glass bead |
| 01-104 | Drill and tap set |
| 01-105A | Male and female sparkplug torquing kit |
| 01-106 | Soldering fixture for flange launcher glass bead |
| 01-107F | Cable sleeve soldering fixture, female connector |
| 01-107M | Cable sleeve soldering fixture, male connector |
| 01-108 | Drill and tap set |
| 01-118 | Cable assembling fixture for K118 semi-rigid coax cable |
| 01-201 | Torque wrench, for SMA, 3.5mm, and K Connector and V Connector |
| 01-204 | Anritsu stainless steel connector wrench |
| K110-1 | Microstrip stress relief contact |
| K110-2 | Stripline stress relief contact |
| K110-3 | Microstrip stress relief contact |
| K101M | K(m) in-line cable connector, DC to 40 GHz for K118 cable |
| K101M-085 | K(m) in-line cable connector, DC to 40 GHz for V085 cable |
| K101F | K(f) in-line cable connector, DC to 40 GHz |
| K102M | K(m) sparkplug launcher connector, DC to 40 GHz |
| K102F | K(f) sparkplug launcher connector, DC to 40 GHz |
| K103M | K(m) flange launcher connector, DC to 40 GHz, 2 mounting holes |
| K103F | K(f) flange launcher connector, DC to 40 GHz, 2 mounting holes |
| K104M | K(m) flange launcher connector, DC to 40 GHz, 4 mounting holes |
| K104F | K(f) flange launcher connector, DC to 40 GHz, 4 mounting holes |
| K118 | Coaxial cable, 1.5m of 3.00 mm semi-rigid cable for K101 series connector |
| S110-1 | Microstrip and coplaner waveguide stress relief contact for 0.38 mm glass feedthru center conductor |
| S110-3 | Microstrip and coplaner waveguide stress relief contact for 0.38 mm glass feedthru center conductor |

① Use with 01-108 Drill and Tap Set

# V CONNECTOR®

DC to 65 GHz

The V Connector® is a reliable 1.85 mm device that operates up to 65 GHz. It is compatible with 2.4 mm connectors and is assembled using procedures that are similar to those used on K Connectors. It is well suited to applications in components, systems, or instrumentation.

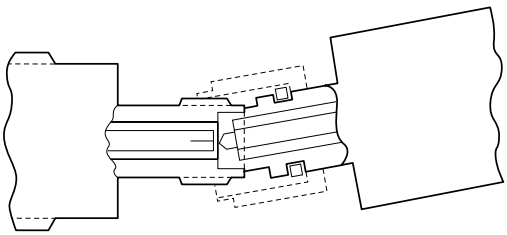
## V Connector® features

- *Excellent performance up to 65 GHz*
- *Low VSWR*
- *Superior reliability*
- *Low Loss*

## Exceptional reliability and repeatability

Microwave connector reliability is affected by insertion force, outer conductor strength, stress relief while mating, and mating alignment. The V Connector exhibits exceptional performance in all of these areas.

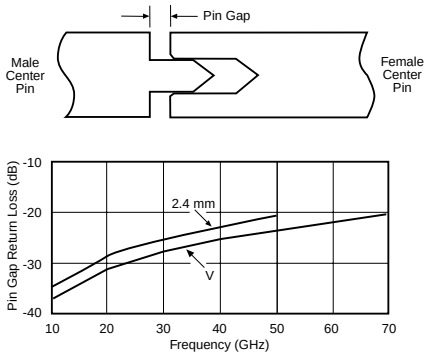
For proper seating, the V Connector requires only 1/2 the insertion force of a 2.4 mm connector. The reduced wear on the center conductor equates to greater reliability. All V Connectors, including the cable connectors, incorporate another feature that eliminates a major cause of connector failure; misalignment of the male pin with respect to the female. To solve the problem, the V Connector male pin is deliberately made sufficiently short to prevent damage to the female connector by misalignment. With this arrangement, the outer housing must be properly aligned prior to the mating of the center conductors. Thus a proper, non-destructive alignment before mating is ensured.




*Shortened Male Pin Eliminates Damage to Female V Connector*

The effect of pin gap on a connection is often overlooked, but is the dominant source of error in many connection systems. Pin gap is the short length of smaller diameter created when a connector pair is mated. Pin gap causes a discontinuity at the connector interface. The V Connector has considerably less susceptibility to pin gap than 2.4 mm connectors.

Many connector manufacturers specify connector performance assuming no pin gap, an unrealistic assumption. V Connectors are specified assuming pin gap to be at its maximum tolerance, to provide you the assurance of real-world specifications.




*Effect of Pin Gap*

## Launcher design

At the heart of the V Connector product line are the launchers. As their name implies, the launchers "launch" (make the transition) from a microwave circuit (microstrip, suspended substrate, stripline, or coplanar waveguide) to a coaxial connector and an outside transmission line. The key to making the transition without compromising electrical and mechanical objectives is the glass bead in the launcher assembly.

## Low-reflection glass bead

The V Connector's standard glass bead has a unique 0.24 mm center conductor and readily connects to fragile devices. The bead is appropriate for most applications employing Duroid and ceramic (Alumina) microstrip, such as the 0.25 mm wide center conductor on a 0.25 mm thick Alumina substrate. Applications using suspended substrate geometry are equally well satisfied. The bead is constructed of Corning 7070 glass and has a gold-plated center conductor and a gold-plated Kovar® collar.

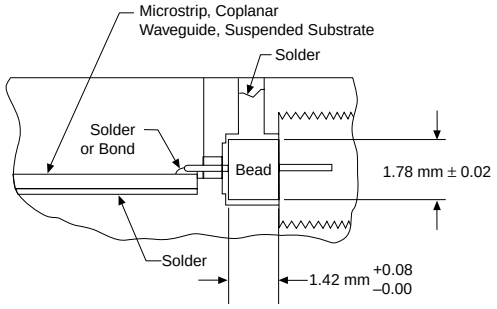
The outstanding design of the bead is largely accountable for the excellent performance of the V Connector launchers. In addition, the design provides for soldering the bead to achieve a hermetic seal. 310°C max. soldering temperature is recommended. The V Connector® launchers can be removed for repair without removal of the glass bead. This ensures that during removal the critical microcircuit-to-glass bead interface is not disturbed, that hermeticity is preserved, and that the microcircuit will not be subjected to the additional stress caused by heating to soldering temperature. Hardware locking compound such as "Removable Loctite®" should be used to further secure the launcher in its housing.

# V CONNECTOR®

DC to 65 GHz

## Complete family

Anritsu's family of V Connector® products is large and growing. Virtually every interface need can be satisfied by one or more of the items offered. As a convenience to the design engineer, each item is completely specified with both guaranteed and typical performance. There are four different models of V Connector launchers. Two types of sparkplug (screw-in) launchers are available; the V102F female version and the V102M male version. Both screw into the housing that encloses the microwave circuit. And, like all Anritsu launchers, they can be easily removed for replacement or repair without unsoldering the glass bead and its interface to the microwave circuit.



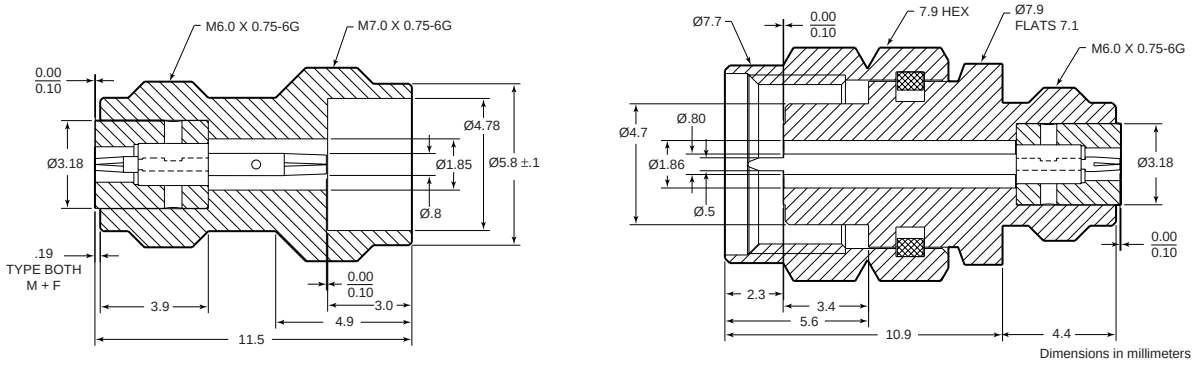

*Transition from Microcircuit to Outside Transmission Line*

When the housing that encloses the microwave circuit is not thick enough to support a threaded, screw-in launcher, flush-mounted (flange) launchers are required. Models with two mounting holes are available in both male and female versions, V103M and V103F. The mounting hole spacing is identical to that of similar SMA flange launchers. The glass bead interface, of course, is the same design used for the sparkplug launcher.

## Cable connectors

To complement high performance V085 cable, both male and female cable connectors are available. Typical return loss at 65 GHz for finished cables exceeds 16 dB (1.35 SWR).

The V Connector® coaxial cable connectors use a 2.16 mm cable with a microporous Teflon dielectric and a copper center conductor. The cable assemblies use the center conductor of the coax as the male pin. This is similar to the UT-141 SMA-type assembly and 2.4 mm cable assemblies. The microporous Teflon dielectric has maximum phase stability and minimum insertion loss. This type of cable assembly allows for easy assembly and maximum RF performance; however, since the male pin is copper, the cable assemblies are not suitable for repeated connections. In applications where the cable will be subject to more than 100 connections, we recommend that a connector saver be used.




*V Connector interface dimensions*

## Evaluation kit

***01-301***

*V Connector Evaluation Kit contains one V120MM - 25CM Male/Male Cable Assembly, two V102F Female Sparkplug Launcher Connector Assemblies, two V103F Female Flange Launcher Connector Assemblies, two V101M Male In-line Cable Connector Assemblies, five V100 Glass Beads, one 01-304 Drill and Tap Set, one 01-302 Test Fixture, two 01-303 Soldering Fixtures.*

## Tools and fixtures

***01-303***

*Soldering Fixture for sparkplug launcher glass beads, package of 10.*

***01-304***

*Drill and Tap Set for precision machining of concentric holes for mounting V Connector in microwave housing. (Drill Part No. 783-568) (Tap Part No. 783-569)*

# V CONNECTOR®

DC to 65 GHz

***01-105A***
*K and V Connector® Male and Female Sparkplug Torquing Kit.*

***01-306***
*Soldering Fixture for flange launcher glass bead, package of 5.*

***01-307M or 01-307F***
*Cable Sleeve Soldering Fixture for V101M Male and V101F Female Cable Connectors, package of 10.*

***01-308***
*Drill and Tap set for precision machining of concentric holes for mounting V Connector in microwave housing in applications where stress-relief contacts are used.*
*(Drill Part No. 55300) (Tap Part No. 783-569)*

***01-309***
*V Connector Cable Assembling Fixture for V085 semi-rigid cable.*

*01-201*

Anritsu provides two connector tools that make connecting and disconnecting tiny connectors more easily and surely accomplished. These tools are featured below.


*01-204*

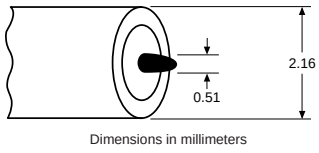
## Features

- *01-201 Torque wrench: 0.9 N-M (8 in-lb) for standard SMA and 3.5 mm connectors, and for the Anritsu K Connector® and V Connector®.*
- *01-204 Handy stainless steel connector wrench for standard SMA, 3.5 mm, and 2.4 mm connectors, and for the Anritsu K Connector® and V Connector®.*

## Semi-rigid coaxial cable

| | |
|---|---|
| **Type** | Semi-rigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor. |
| **Impedance** | 50 ± 2 Ω |
| **Dielectric type** | Microporous Teflon, 0.14 cm diameter |
| **Dielectric constant** | 1.687 |
| **Relative velocity** | 0.77 |
| **Outside diameter** | 2.16 mm |
| **Center conductor diameter** | 0.51 mm |
| **Minimum bend radius** | 0.65 cm |
| **Attenuation** | 2.3 dB/m at 10 GHz<br>3.6 dB/m at 20 GHz<br>4.3 dB/m at 30 GHz<br>5.2 dB/m at 40 GHz<br>7.2 dB/m at 60 GHz |

***V085***
*semirigid coaxial cable*
*1.5m length of 2.16 mm semirigid cable for V101 series connector*

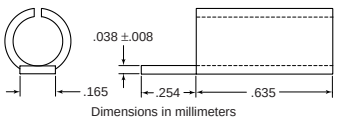



Dimensions in millimeters

## Stress relief contacts

Stress Relief Contacts provide an elegant yet simple solution to relieving stress at the interface of the microcircuit and its connecting coaxial conductor. These contacts simply slide onto the standard glass bead pins and can be soldered, bonded or parallel-gap welded to a circuit trace.

| | |
|---|---|
| **Frequency range** | DC to 67 GHz |
| **Material** | 0.025 mm heat-treated BeCu |
| **Plating** | Bondable gold |
| **Packaging** | Lots of 25 |




Dimensions in millimeters

***V110-1***
*Microstrip and Coplanar Waveguide when using the V110-1, use 01-308 Drill and Tap set to make the required concentric holes.*

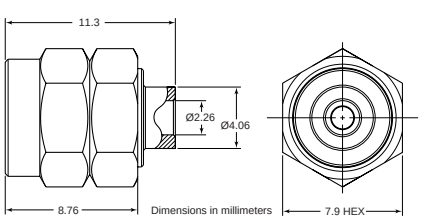
## Launchers and cable connectors

| | |
|---|---|
| **Return loss (launchers only)** | 15 dB up to 65 GHz |
| **Coupling nut tightening torque** | 1.36 N-m max |
| **Material** | Passivated stainless steel with heat-treated beryllium copper center conductors |
| **Pin depth** | 0.000 to -0.130 mm for male and female connectors |
| **Temperature range** | -55°C to +125°C |

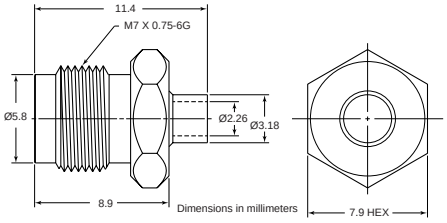
# V CONNECTOR®

DC to 65 GHz

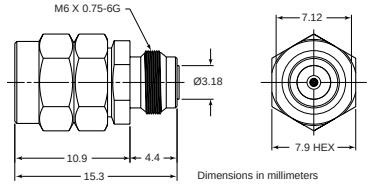
***V101M***②④
*V Male In-Line Cable Connector, DC-65 GHz for V085 cable*



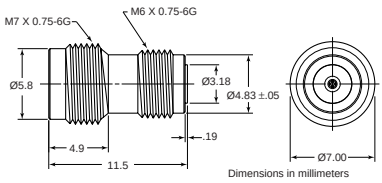

***V101F***③④
*V Female In-Line Cable Connector, DC-65 GHz for V085 cable*



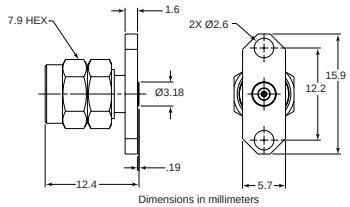

***V102M***①
*V Male Sparkplug Launcher Connector, DC-65 GHz*



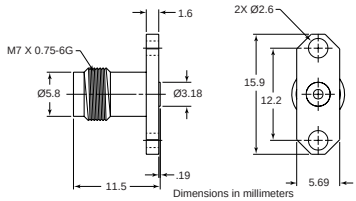

***V102F***①
*V Female Sparkplug Launcher Connector, DC-65 GHz*



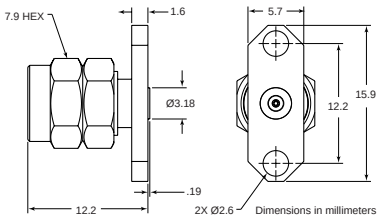

***V103M***
*V Male Flange Launcher, two-hole, DC-65 GHz*



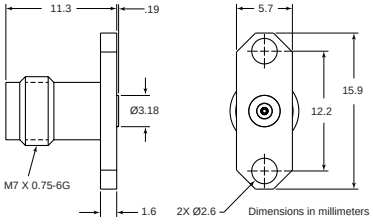

***V103F***
*V Female Flange Launcher, two-hole, DC-65 GHz*




***V103M-012***
*V Male Flange Launcher, two-hole for 0.30 mm glass bead pin, DC-65 GHz*




***V103F-012***
*V Female Flange Launcher, two-hole for 0.30 mm glass bead pin, DC-65 GHz*



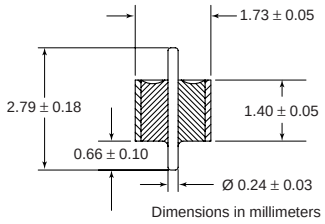

① Use with 01-105A Male and Female Sparkplug Torquing Kit
② Use with 01-307M Cable Sleeve Fixture
③ Use with 01-307F Cable Sleeve Fixture
④ Use with 01-309 Cable Assembling Fixture

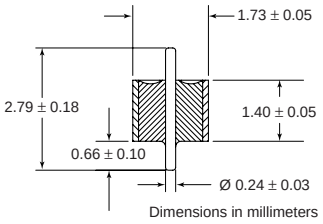
# V CONNECTOR®

DC to 65 GHz

***V100***[①②]
*Glass Beads for V102, and V103 connectors (package of 5)*
*Note: Glass Beads can be purchased through recommended vendors. For more information visit www.anritsu.com.*

***V100B***[①②]
*High Hermeticity* Glass Beads for V102, and V103 connectors (package of 5)*
*Note: Glass Beads can be purchased through recommended vendors. For more information visit www.anritsu.com.*




*Glass Bead Hermeticity Spec: Hermetic to 1 x $10^{-8}$ std cc He/sec at 1 atm differential

① Use with 01-303 or 01-306 Soldering Fixtures
② Use with 01-304 or 01-308 Drill and Tap Sets

## Environmental information

Tests are performed per MIL-STD-202F.

| | |
|---|---|
| **Operating Temperature Range** | –55°C to +125° |
| **Temperature Shock** | –55°C to +150° |
| **Humidity** | 95% at 40°C, 96 hours, Test 103B, Condition B |
| **Shock** | 100 G peak sawtooth, method 213, Test condition 1 |
| **Vibration** | Sinewave: 10 Hz to 2000 Hz, 0.06" DA, method 204, test condition D<br>Random: 50 Hz to 2000 Hz, 11.6 Grms, Power Spectral Density 0.1 Grms 2 Hz, Method 214, Test Condition 1, Letter D |
| **Salt Spray** | 5% concentration for 48 hours, Method 101D, Condition B |
| **Voltage withstanding** | 500 Vac RMS, 60 seconds, method 301 |

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| 01-105A | Male and female sparkplug torquing kit |
| 01-201 | Torque wrench, for SMA, 3.5mm, and K Connector and V Connector |
| 01-204 | Anritsu stainless steel connector wrench |
| 01-301 | V Connector® (evaluation kit) |
| 01-303 | Soldering fixture for sparkplug launcher glass bead |
| 01-304 | Drill and tap set |
| 01-306 | Soldering fixture for flange launcher glass bead |
| 01-307M | Cable sleeve soldering fixture, male connector |
| 01-307F | Cable sleeve soldering fixture, female connector |
| 01-308 | Drill and tap set |
| 01-309 | Cable assembling fixture |
| V085 | Coaxial cable, 152 cm (5 feet) length of 2.16 mm semi-rigid cable |
| V101M | V(m) in-line cable connector, DC to 65 GHz |
| V101F | V(f) in-line cable connector, DC to 65 GHz |
| V102M | V(m) sparkplug launcher connector, DC to 65 GHz |
| V102F | V(f) sparkplug launcher connector, DC to 65 GHz |
| V103M | V(m) flange launcher connector, DC to 65 GHz, 2 mounting holes |
| V103M-012 | V(m) flange launcher, 2 mounting holes for 0.30 mm glass bead pin, DC to 65 GHz |
| V103F-012 | V(f) flange launcher, 2 mounting holes for 0.30 mm glass bead pin, DC to 65 GHz |
| V103F | V(f) flange launcher connector, DC to 65 GHz, 2 mounting holes |
| V110-1 | Microstrip stress relief contact |

# INTEGRATED V CONNECTORS

DC to 65 GHz

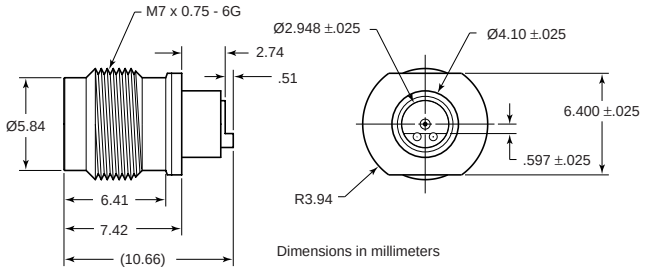
***V115FMS10***
*Integrated V Female solder-in connector, with ground lip, DC to 65 GHz. Designed for Microstrip. For use with 0.25 mm (10 mil) substrates.*

***V115FMS75***
*Integrated V Female solder-in connector, with ground lip, DC to 65 GHz. Designed for Microstrip. For use with 0.19 mm (7.5 mil) substrates.*

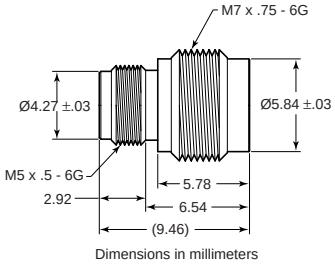
***V115FCPW***
*Integrated V Female solder-in connector, with ground lip, DC to 65 GHz. Designed for Coplanar Waveguide.*

***V116F***
*Integrated V Female Sparkplug (screw-in) connector, DC to 65 GHz.*

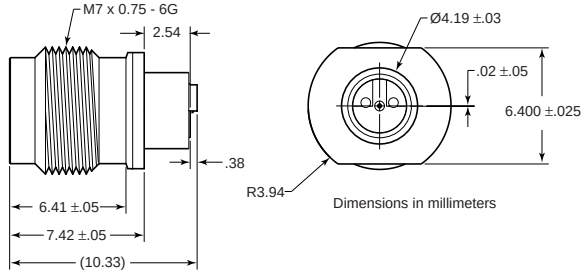
The Integrated V Connector® family is a group of female connectors which have the launcher and the glass bead integrated into one piece. All compensation steps for matching to Microstrip or Coplanar Waveguide (CPW) are included in the solder-in hermetic* connectors, ensuring that they deliver excellent performance. The integrated V connectors come in two easy-to-install styles: the solder-in version, which is the V115F group, and the V116F screw-in version, which allows more versatility of microcircuit launch design. In addition, the V116F can be soldered in for hermeticity. These connectors, except for the CPW version, are designed to be used with the V110-1 Stress Relief Contacts. The Integrated V connectors are compatible with other V Connectors.



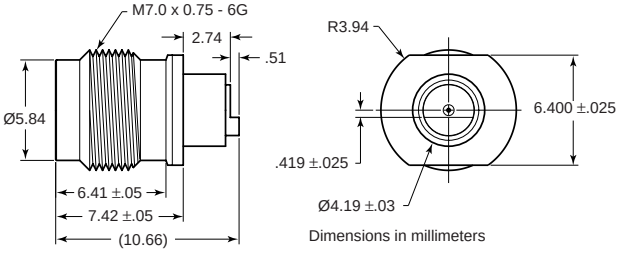

*V115FMS10* outline*




*V116F* outline*




*V115FCPW* outline*




*V115FMS75* outline*

* Hermeticity specification: 1 x10-8 std cc He/sec at 1 atm differential.

## Environmental information

Tests are performed per MIL-STD-202F.

| | |
|---|---|
| **Operating Temperature Range** | –55°C to +125° |
| **Temperature Shock** | –55°C to +150° |
| **Humidity** | 95% at 40°C, 96 hours, Test 103B, Condition B |
| **Shock** | 100 G peak sawtooth, method 213, Condition B, Test condition 1 |
| **Vibration** | Sinewave: 10 Hz to 2000 Hz, 0.06" DA, method 204, test condition D<br>Random: 50 Hz to 2000 Hz, 11.6 Grms, Power Spectral Density 0.1 Grms 2 Hz, Method 214, Test Condition 1, Letter D |
| **Salt Spray** | 5% concentration for 48 hours, Method 101D, Condition B |
| **Voltage withstanding** | 500 Vac RMS, 60 seconds, method 301 |

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| V115FMS10 | Integrated V(f) solder-in connector for use with 0.25 mm (10 mil) substrates |
| V115FMS75 | Integrated V(f) solder-in connector for use with 0.19 mm (7.5 mil) substrates |
| V115FCPW | Integrated V(f) solder-in connector for Coplanar Waveguide |
| V116F | Integrated V(f) sparkplug connector |

# VP™ CONNECTOR

DC to 65 GHz

The VP Connector family, with shrouds and adapters, is well suited for applications in components, systems and instrumentation to 65 GHz. Anritsu's family of VP Connectors satisfies virtually every interface and provides excellent and reliable performance.

## VP™ Connector features

- *Superior RF Performance to 65 GHz*
- *Hermetic Connection*
- *Sliding Contact Connection to Microstrip*
- *Ground lip for handling substrates on carriers*
- *Testing capabilities using VP-VF Adapter*
- *Auto alignment capabilities on VP-VF Adapters*

## VP Bullet

The VP Bullet is a VP-VP adapter, designed to connect two modules with shrouds, back to back. The VP Bullet exhibits exceptional performance due to it's unique design concept.

The VP Bullet is designed with six slots in the outer conductor and four slots in the center conductor. The increase in the number of slots in the outer conductor reduces the insertion and extraction force to less than one half of the force required for conventional SMP connectors and thus reduces wear and tear. In the lab VP Bullets have been tested to 1000 insertions with no degradation in performance. Anritsu guarantees at least 500 connections. In addition, the VP Bullet provides a positive stop so that fingers can not be damaged during insertion.

## VP Shroud Design

Anritsu VP Shrouds are based on the design concept first used in Anritsu's Integrated V Connector®. VP Shrouds use the standard V Glass bead and the critical compensation steps required to install the glass bead in the housing are a part of the hermetic shroud design. Since Anritsu controls the critical internal dimensions, consistent performance is assured.

Additionally, the ground lip allows the substrate ground to be attached directly to the connector, eliminating the long ground path common to other connector families. This short ground path improves return loss performance, especially at the high end of the frequency range.

The VP Shrouds, except for the CPW version, are designed to be used with the Anritsu V110-1 Stress Relief Contact (sliding contact). The CPW Shrouds backside interface is a pin overlap design, so the center pin is directly connected to the transmission line and the substrate ground is directly attached to the ground lip.

## Cable Connector

The VP Cable connector uses standard semi-rigid 2.16 mm cable just like the V cable Connectors. One can install a standard V Cable connector on the opposite end which makes the testing of modules much easier. The VP cable connector has a flange to ensure a rigid connection to the module. The cable connectors can also be utilized for connecting two modules back to back.

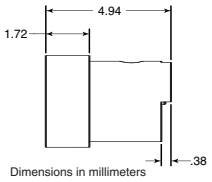
## VP-VF Adapters

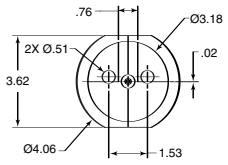
VP-VF Adapters are specifically designed for testing the modules using the Precision V Connector. The VP-VF Adapter can be replaced with a VP Bullet or VP Cable Connector.

***01-501***
*Bullet Insertion and Removal Tool*

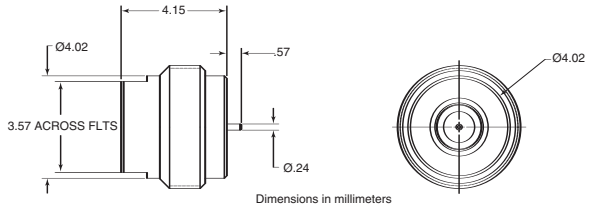
***01-502***
*Torque screwdriver adapter*

***VP100BCPW***
*Solder-in CPW hermetic shroud*



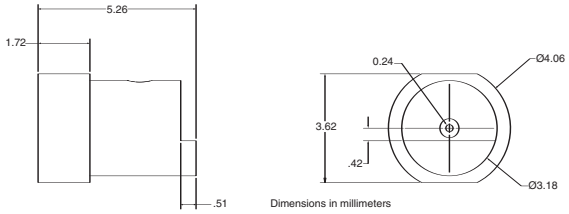

***VP100B***
*Screw-in hermetic shroud*



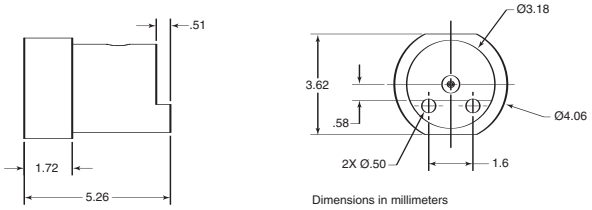
# VP™ CONNECTOR

DC to 65 GHz

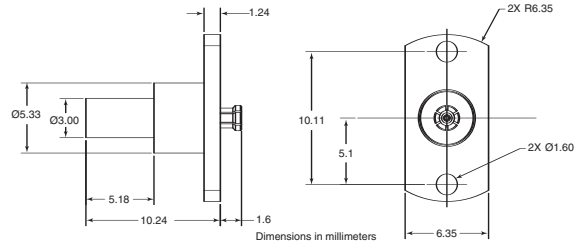
***VP100BMS75***
*Solder-in*
*7.5 mil Microstrip*
*hermetic shroud*



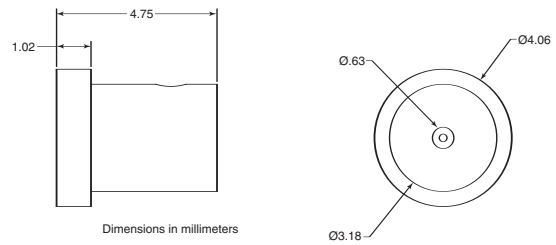

***VP100BMS10***
*Solder-in*
*10 mil Microstrip*
*hermetic shroud*



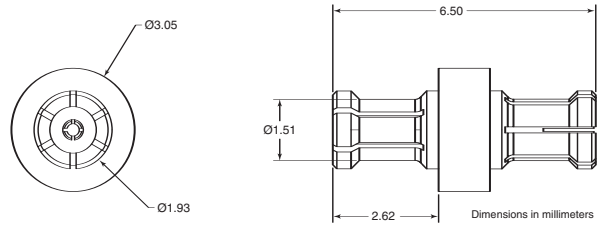

***VP101F***
*VP cable adapter*



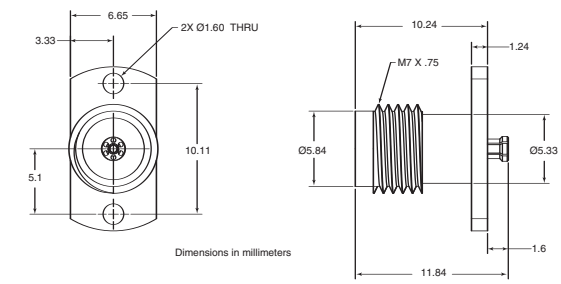

***VP100BNL***
*No lip hermetic*
*shroud*



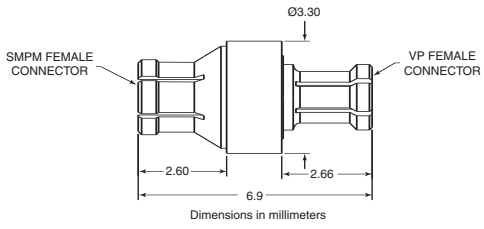

***VP102F***
*VP Bullet*




***VP103F***
*VP-VF Adapter*

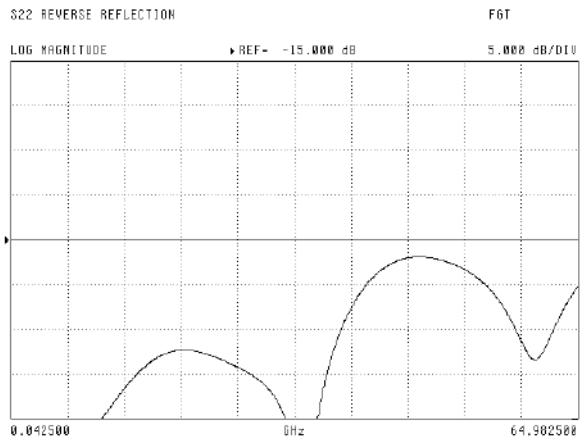



***VP104F***
*VP to SMPM Bullet*



# VP™ CONNECTOR

DC to 65 GHz




*Typical High Frequency Return-Loss measured on VP102F over the range of 40 MHz to 65 GHz.*

## Specifications:

| | |
|---|---|
| **Impedance** | 50 Ω |
| **Frequency** | DC to 65 GHz |
| **Insertion Loss** | 0.05 √ f (GHz) |
| **VSWR: VP102F** | 1.43 typical |
| **Insulation Resistance** | > 1200 MΩ |
| **Center conductor contact resistance** | 6 mΩ typical |
| **Force to engage** | 4.2 N typical (1 lbf typical) |
| **Force to disengage** | 7 N typical. (1.5 lbf typical) |
| **Center contact Retention** | 83 N typical. (18 lbf typical) |
| **Radial Misalignment** | 0.25 mm (0.010*) for VP102F |
| **Axial Misalignment** | 0-0.15 mm (0 to 0.006*) for VP102F |
| **Hermeticity** | 1 x$10^{-8}$ std cc He/sec at 1 atmosphere differential for all shrouds |

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| VP100BCPW | Solder-in CPW hermetic shroud |
| VP100BMS10 | Solder-in 10 mil microstrip hermetic shroud |
| VP100BNL | No lip hermetic shroud |
| VP100B | Screw-in hermetic shroud |
| VP101F | VP cable adapter |
| VP102F | VP bullet |
| VP103F | VP-VF adapter |
| VP104F | VP to SMPM bullet |
| 01-501 | Bullet insertion and removal tool |
| 01-502 | V100B Torque tool adapter |

## Materials:

| | |
|---|---|
| **VP100B Shroud** | Outer conductor: Brass, gold plated over nickel per Mil-G-45204C<br>Bead body: Kovar, gold plated over nickel per Mil-G-45204C<br>Center pin: Kovar, gold plated over nickel per Mil-G-45204C<br>Bead dielectric: Corning 7070 glass |
| **VP100BCPW, VP100BMS10, VP100BNL Shrouds** | Outer conductor: Steel, gold plated over nickel per Mil-G-45204C<br>Center pin: Kovar, gold plated over nickel per Mil-G-45204C<br>Bead dielectric: Corning 7070 glass |
| **VP101F VP Cable adapter** | Beryllium-copper, gold plated over nickel per Mil-G-45204C |
| **VP102F VP Bullet, VP104F VP to SMPM Bullet** | Heat treated Beryllium-copper, gold plated over nickel per Mil-G-45204C<br>Dielectric: Polyphenylene Oxide Noryl (PPO) |
| **VP103F, VP-VF adapter** | Body: Passivated stainless steel<br>Bead: Polyphenylene Oxide Noryl (PPO)<br>Center conductor: Beryllium-copper, gold plated over nickel per Mil-G-45204C |

## Environmental Information:

Tests are performed per MIL-STD-202F

| | |
|---|---|
| **Operating Temperature Range** | –54° to +125°C |
| **Temperature Shock** | 25° C to –55° C and 25° C to +200° C, method 107G, Condition B for shrouds to +125°C for bullet and cable adapter |
| **Humidity** | 95% at 40°C, 96 hours, Test 103B, Condition B |
| **Shock** | 100 G peak sawtooth, method 213, test condition 1 |
| **Vibration** | Sinewave: 10 Hz to 2000 Hz, 0.06* DA, method 204, test condition D<br>Random: 50 Hz to 2000 Hz, 11.6 Grms, Power Spectral Density 0.1 Grms2/Hz,<br>Method 214, Test Condition I, Letter D |
| **Salt Spray** | 5% concentration for 48 hours,<br>Method 101D, Condition B |
| **Voltage withstanding** | 500 Vac RMS, 60 seconds, method 301 |

# W1 CONNECTOR®

DC to 110 GHz

The W1 Connector® Family is a complete coaxial connector system with mode-free performance to 110 GHz. Based on the 1.00 mm coaxial connector front side interface as specified by IEEE Std 287, the W1 Connector is well suited for high frequency applications ranging from components to systems and instrumentation.

## W1 Connector® features

- *Excellent RF Performance to 110 GHz*
- *50 Ω Impedance*
- *Low VSWR*
- *Standard 1 mm Interface*
- *Accurate Testing Capability*
- *Broadband Load for Instrument and Device Under Test*

## Connector Launchers

The W1 Connector® launcher family includes both male and female W1 Connectors. The W1 Connector® has an air dielectric interface similar to K and V connectors. The center conductor is supported by Anritsu's proprietary low-loss high temperature support bead on one end and a glass bead (W1-102F and W1-102M ) or a Teflon bead (W1-105F and W1-105M) on the other end. The use of the high temperature support bead allows the connector to be subjected to temperature ranges up to 200°C for a short period. The center conductor extends outside of the connector and allows the user to make a direct pin overlap connection to the microwave circuit. The threads on the backside of the W1 Connector® allow the user to install the W1 Connector® by screwing it into the housing wall. Since Anritsu's proprietary low-loss high temperature plastic bead is used, the user can solder the connector which has the glass bead into the housing to achieve a hermetic connection.

## Flange Mount Connector

W1 two-hole Flange Mount female Connector is also available. The center conductor of the connector is supported by a PPO® bead on the front-end and by a Teflon bead on the back end. The center conductor extends outside the connector, allowing for a direct pin overlap connection to the microwave circuit.

## Cable Connector

Both the male and female cable connectors are available. Typical return loss at 110 GHz for finished cables exceeds 16 dB (1.35 SWR).

## Tools

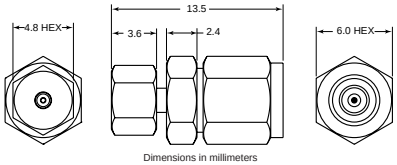
***01-504, W1-6 mm***
*Torque Wrench*

***01-506, W1-7 mm***
*Torque Wrench*

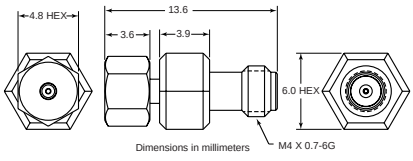
***01-505, W1-6-7 mm***
*Open end Wrench*

## Connectors

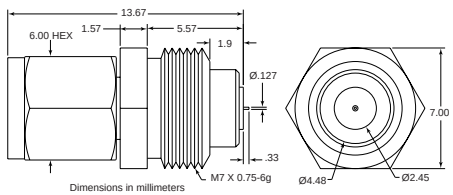
***W1-101M***
*W1 Male In-line Cable Connector, DC-110 GHz*




***W1-101F***
*W1 Female In-line Cable Connector, DC-110 GHz*




***W1-102M, W1-105M***
*W1 Male Sparkplug Connector, DC-110 GHz*



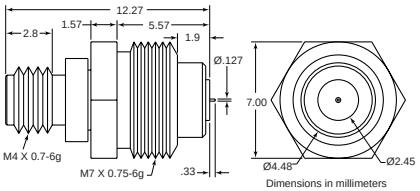
# W1 CONNECTOR®

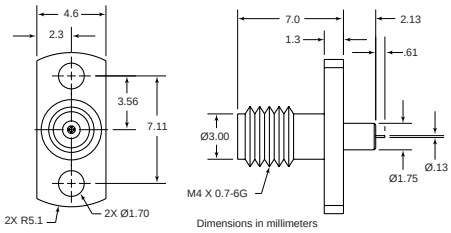
DC to 110 GHz

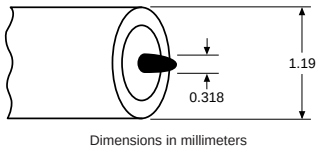
***W1-102F, W1-105F***
*W1 Female Sparkplug Connector, DC-110 GHz*

***W1-103F***
*W1 Female Flange Connector, DC-110 GHz*

***W047-2***
*Semi-rigid coaxial cable, 1.52 m length of 1.19 mm semi-rigid cable for W1-101 series connector*




## Specifications

| | |
|---|---|
| **Impedance** | 50 Ω |
| **Frequency** | DC to 110 GHz |
| **Insertion Los** | 0.70 dB typical |
| **Return Loss** | 1.38 to 110 GHz typical<br>1.24 to 110 GHz typical (W1-101F, W1-101M) |
| **Insulation Resistance** | >1200 MΩ |
| **Center Conductor Contact Resistance** | 6 mΩ typical |
| **Maximum Power CW** | 6 W |
| **Frontside Pin Depth** | 0 to 0.076 mm maximum |
| **Backside Pin Protrusion** | 0.33 mm typical for W1-102F, W1-102M, W1-105F, W1-105M, 0.61 mm typical for W1-103F |
| **Torque Coupling Nut** | 4 in-lb maximum |
| **Torque W1 Connector Installation** | 5 in-lb maximum |
| **Hermeticity (W1-102F, W1-102M)** | 1 x $10^{-8}$ std cc He/sec at atmosphere differential |

## Environmental information

Tests are performed per MIL-STD-202F.

| | |
|---|---|
| **Operating Temperature Range** | 0° to +85°C |
| **Storage Temperature Range** | -54° to +125°C for W1-102F, W1-102M, W1-105F, W1-105M<br>-54° to +85°C for W1-103F |
| **Humidity** | 25° to -40° and 25° to 125°C, method 107G, condition B |
| **Shock** | 100G peak sawtooth, method 213, test condition 1 |
| **Vibration** | Sinewave: 10 Hz to 2000 Hz, 0.06" DA, method 204, test condition D<br>Random: 50 Hz to 2000 Hz, 11.6 Grams, Power Spectral Density 0.1 Grams²/Hz, Method 214, Test Condition 1, Letter D |
| **Salt Spray** | 5% concentration for 48 hours, Method 101D, Condition B |
| **Dielectric Withstanding Voltage** | 500 Vac RMS, 60 seconds, method 301 |

## Materials

| | |
|---|---|
| **W-101F<br>W1-101M** | Outer Conductor: Passivated Stainless Steel<br>Center Conductor: Beryllium-copper, gold plated over nickel per Mil-G-45204C<br>Coupling Nut: Passivated Stainless Steel<br>Sleeve: Beryllium-copper, gold plated over nickel per Mil-G-45204C<br>Lock Screw: Passivated Stainless Steel |
| **W1-102F<br>W1-102M** | Outer Conductor: Beryllium-copper, gold plated over nickel per Mil-G-45204C<br>Center Conductor: Beryllium-copper, gold plated over nickel per Mil-G-45204C<br>Coupling Nut: Passivated Stainless Steel<br>Glass Bead Center Pin: Kovar, gold plated over nickel per Mil-G-45204C<br>Glass Bead Outer Conductor: Kovar, gold plated over nickel per Mil-G-45204C<br>Glass Bead Dielectric: Corning 7070 Glass<br>Plastic Bead Dielectric: Proprietary |
| **W1-103F** | Outer Conductor: Passivated stainless steel<br>Center Conductor: Beryllium-copper, gold plated over nickel per Mil-G-45204C<br>Coupling Nut: Passivated Stainless Steel<br>Plastic Support Bead Dielectric: Polyphenylene Oxide Noryl |
| **W1-105F<br>W1-105M** | Outer Conductor: Passivated stainless steel<br>Center Conductor: Beryllium-copper, gold plated over nickel per Mil-G-45204C<br>Coupling Nut: Passivated Stainless Steel<br>Glass Bead Center Pin: Kovar, gold plated over nickel per Mil-G-45204C<br>Glass Bead Outer Conductor: Kovar, gold plated over nickel per Mil-G-45204C<br>Glass Bead Dielectric: Corning 7070 Glass<br>Plastic Support Bead Dielectric: Proprietary |

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| W1-101F | W1 Male In-line Cable Connector, DC-110 GHz |
| W1-101M | W1 Female In-line Cable Connector, DC-110 GHz |
| W1-102F | W1 Female Sparkplug Connector, Hermetic, DC-110 GHz |
| W1-102M | W1 Male Sparkplug Connector, Hermetic, DC-110 GHz |
| W1-103F | W1 Female Flange Connector, DC-110 GHz |
| W1-105F | W1 Female Sparkplug Connector, DC-110 GHz |
| W1-105M | W1 Male Sparkplug Connector, DC-110 GHz |
| W047-2 | Semi-rigid Coaxial Cable |
| 01-504 | W1 6 mm Torque Wrench |
| 01-505 | W1 6-7mm Open end Wrench |
| 01-506 | W1 7 mm Torque Wrench |

# RF CABLES

K120, V120 DC to 65 GHz

*K120*

*V120*

## Semi-rigid RF cable features

- *Up to 65 GHz frequency ranges*
- *Type N, K Connector®, and V Connector®*
- *K Connector® compatibility with SMA and 3.5 mm*
- *V Connector® compatibility with 2.4 mm*

## Specifications

| Model | Frequency range (GHz) | Impedance (Ω) | Length | Connectors |
|---|---|---|---|---|
| N120-6 | DC to 18 | 50 | 15 cm | N(m) - N(m) |
| NS120MF-6 | DC to 18 | 50 | 15 cm | N(m) - SMA(f) |
| K120MM | DC to 40 | 50 | See table | K(m) - K(m) |
| K120MF | DC to 40 | 50 | See table | K(m) - K(f) |
| K120FF | DC to 40 | 50 | See table | K(f) - K(f) |
| V120MM | DC to 65 | 50 | See table | V(m) - V(m) |
| V120MF | DC to 65 | 50 | See table | V(m) - V(f) |
| V120FF | DC to 65 | 50 | See table | V(f) - V(f) |

**Temperature range:** –55°C to +125°C

## Semi-rigid coaxial cable specifications for K Connectors®

| | |
|---|---|
| **Type** | Semi-rigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor. |
| **Impedance** | 50 ± 2 Ωs |
| **Dielectric type** | Microporous Teflon, 0.24 cm diameter |
| **Dielectric constant** | 1.687 |
| **Relative velocity** | 0.77 |
| **Outside diameter** | 3.00 mm |
| **Center conductor diameter** | 0.81 mm |
| **Minimum bend radius** | 0.65 cm |
| **Attenuation** | 1.6 dB/m at 10 GHz<br>2.3 dB/m at 20 GHz<br>3.3 dB/m at 30 GHz<br>4.7 dB/m at 40 GHz |
| **K118 semirigid coaxial cable** | 1.52 m length of 3.00 mm<br>Semirigid cable for K101 series connector |

Contact the Anritsu Company for low loss, low VSWR cable bending services.

## Semi-rigid coaxial cable specifications for V Connectors®

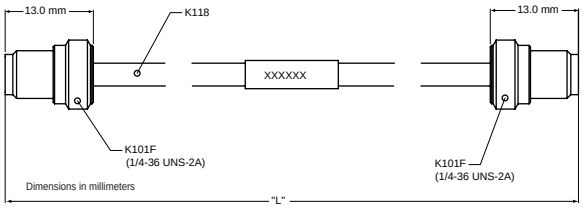
| | |
|---|---|
| **Type** | Semi-rigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor. |
| **Impedance** | 50 ± 2 Ωs |
| **Dielectric type** | Microporous Teflon, 0.14 cm diameter |
| **Dielectric constant** | 1.687 |
| **Relative velocity** | 0.77 |
| **Outside diameter** | 2.18 mm |
| **Center conductor diameter** | 0.51 mm |
| **Minimum bend radius** | 0.65 cm |
| **Attenuation** | 2.3 dB/m at 10 GHz<br>3.6 dB/m at 20 GHz<br>4.3 dB/m at 30 GHz<br>5.2 dB/m at 40 GHz<br>7.2 dB/m at 60 GHz |

# RF CABLES

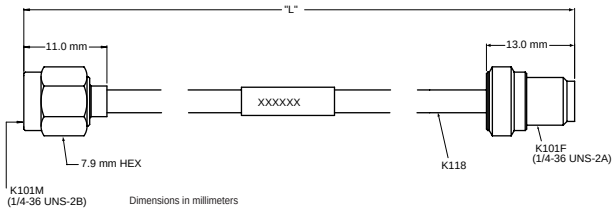
K120, V120 DC to 65 GHz

## Cable assembly part number reference

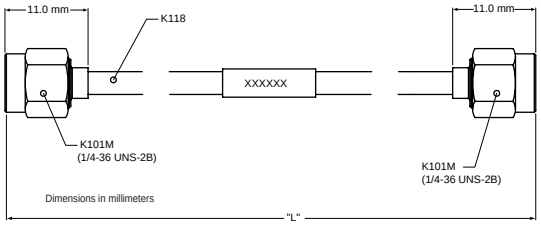
| Length | Metric cable assemblies | | | | | |
|---|---|---|---|---|---|---|
| cm | K120MM | K120MF | K120FF | V120MM | V120MF | V120FF |
| 5 | K120MM-5CM | K120MF-5CM | K120FF-5CM | V120MM-5CM | V120MM-5CM | V120FF-5CM |
| 10 | K120MM-10CM | K120MF-10CM | K120FF-10CM | V120MM-10CM | V120MM-10CM | V120FF-10CM |
| 15 | K120MM-15CM | K120MF-15CM | K120FF-15CM | V120MM-15CM | V120MM-15CM | V120FF-15CM |
| 20 | K120MM-20CM | K120MF-20CM | K120FF-20CM | V120MM-20CM | V120MM-20CM | V120FF-20CM |
| 25 | K120MM-25CM | K120MF-25CM | K120FF-25CM | V120MM-25CM | V120MM-25CM | V120FF-25CM |
| 30 | K120MM-30CM | K120MF-30CM | K120FF-30CM | V120MM-30CM | V120MM-30CM | V120FF-30CM |
| 35 | K120MM-35CM | K120MF-35CM | K120FF-35CM | V120MM-35CM | V120MM-35CM | V120FF-35CM |
| 40 | K120MM-40CM | K120MF-40CM | K120FF-40CM | V120MM-40CM | V120MM-40CM | V120FF-40CM |
| 45 | K120MM-45CM | K120MF-45CM | K120FF-45CM | V120MM-45CM | V120MM-45CM | V120FF-45CM |
| 50 | K120MM-50CM | K120MF-50CM | K120FF-50CM | V120MM-50CM | V120MM-50CM | V120FF-50CM |
| 60 | K120MM-60CM | K120MF-60CM | K120FF-60CM | V120MM-60CM | V120MM-60CM | V120FF-60CM |
| 70 | K120MM-70CM | K120MF-70CM | K120FF-70CM | V120MM-70CM | V120MM-70CM | V120FF-70CM |
| 80 | K120MM-80CM | K120MF-80CM | K120FF-80CM | V120MM-80CM | V120MM-80CM | V120FF-80CM |
| 90 | K120MM-90CM | K120MF-90CM | K120FF-90CM | V120MM-90CM | V120MM-90CM | V120FF-90CM |
| 100 | K120MM-100CM | K120MF-100CM | K120FF-100CM | V120MM-100CM | V120MM-100CM | V120FF-100CM |
| 125 | K120MM-125CM | K120MF-125CM | K120FF-125CM | V120MM-125CM | V120MM-125CM | V120FF-125CM |
| 150 | K120MM-150CM | K120MF-150CM | K120FF-150CM | V120MM-150CM | V120MM-150CM | V120FF-150CM |



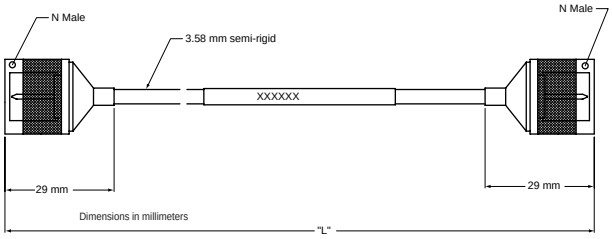

*K120FF outline*



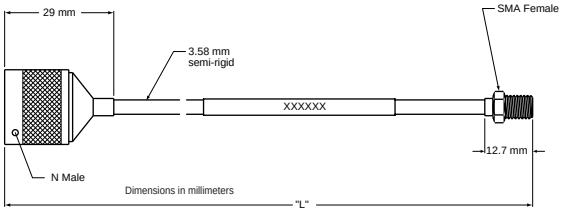

*K120MF outline*



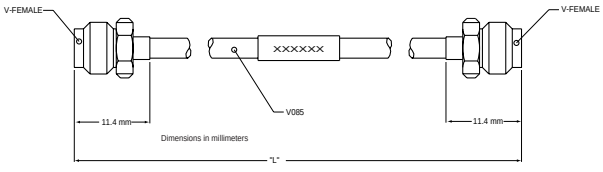

*K120MM outline*



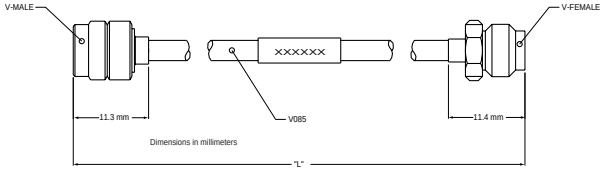

*N120-6 outline*



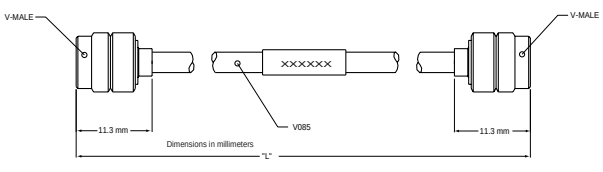

*NS120MF-6 outline*




*V120FF outline*




*V120MF outline*




*V120MM outline*

# RF CABLES

K120, V120 DC to 65 GHz

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Cable, semi-rigid** |
| N120-6 | 001 to 18 GHz, 50 Ω, 15 cm, N(m) to N(m) |
| NS120MF-6 | 0.01 to 18 GHz, 50 Ω, 15 cm, N(m) to SMA(f) |
| K120MM-5CM | DC to 40 GHz, 50 Ω, 5 cm, K(m) to K(m) |
| K120MM-10CM | DC to 40 GHz, 50 Ω, 10 cm, K(m) to K(m) |
| K120MM-15CM | DC to 40 GHz, 50 Ω, 15 cm, K(m) to K(m) |
| K120MM-20CM | DC to 40 GHz, 50 Ω, 20 cm, K(m) to K(m) |
| K120MM-25CM | DC to 40 GHz, 50 Ω, 25 cm, K(m) to K(m) |
| K120MM-30CM | DC to 40 GHz, 50 Ω, 30 cm, K(m) to K(m) |
| K120MM-35CM | DC to 40 GHz, 50 Ω, 35 cm, K(m) to K(m) |
| K120MM-40CM | DC to 40 GHz, 50 Ω, 40 cm, K(m) to K(m) |
| K120MM-45CM | DC to 40 GHz, 50 Ω, 45 cm, K(m) to K(m) |
| K120MM-50CM | DC to 40 GHz, 50 Ω, 50 cm, K(m) to K(m) |
| K120MM-60CM | DC to 40 GHz, 50 Ω, 60 cm, K(m) to K(m) |
| K120MM-70CM | DC to 40 GHz, 50 Ω, 70 cm, K(m) to K(m) |
| K120MM-80CM | DC to 40 GHz, 50 Ω, 80 cm, K(m) to K(m) |
| K120MM-90CM | DC to 40 GHz, 50 Ω, 90 cm, K(m) to K(m) |
| K120MM-100CM | DC to 40 GHz, 50 Ω, 100 cm, K(m) to K(m) |
| K120MM-125CM | DC to 40 GHz, 50 Ω, 125 cm, K(m) to K(m) |
| K120MM-150CM | DC to 40 GHz, 50 Ω, 150 cm, K(m) to K(m) |
| K120MF-5CM | DC to 40 GHz, 50 Ω, 5 cm, K(m) to K(f) |
| K120MF-10CM | DC to 40 GHz, 50 Ω, 10 cm, K(m) to K(f) |
| K120MF-15CM | DC to 40 GHz, 50 Ω, 15 cm, K(m) to K(f) |
| K120MF-20CM | DC to 40 GHz, 50 Ω, 20 cm, K(m) to K(f) |
| K120MF-25CM | DC to 40 GHz, 50 Ω, 25 cm, K(m) to K(f) |
| K120MF-30CM | DC to 40 GHz, 50 Ω, 30 cm, K(m) to K(f) |
| K120MF-35CM | DC to 40 GHz, 50 Ω, 35 cm, K(m) to K(f) |
| K120MF-40CM | DC to 40 GHz, 50 Ω, 40 cm, K(m) to K(f) |
| K120MF-45CM | DC to 40 GHz, 50 Ω, 45 cm, K(m) to K(f) |
| K120MF-50CM | DC to 40 GHz, 50 Ω, 50 cm, K(m) to K(f) |
| K120MF-60CM | DC to 40 GHz, 50 Ω, 60 cm, K(m) to K(f) |
| K120MF-70CM | DC to 40 GHz, 50 Ω, 70 cm, K(m) to K(f) |
| K120MF-80CM | DC to 40 GHz, 50 Ω, 80 cm, K(m) to K(f) |
| K120MF-90CM | DC to 40 GHz, 50 Ω, 90 cm, K(m) to K(f) |
| K120MF-100CM | DC to 40 GHz, 50 Ω, 100 cm, K(m) to K(f) |
| K120MF-125CM | DC to 40 GHz, 50 Ω, 125 cm, K(m) to K(f) |
| K120MF-150CM | DC to 40 GHz, 50 Ω, 150 cm, K(m) to K(f) |
| K120FF-5CM | DC to 40 GHz, 50 Ω, 5 cm, K(f) to K(f) |
| K120FF-10CM | DC to 40 GHz, 50 Ω, 10 cm, K(f) to K(f) |
| K120FF-15CM | DC to 40 GHz, 50 Ω, 15 cm, K(f) to K(f) |
| K120FF-20CM | DC to 40 GHz, 50 Ω, 20 cm, K(f) to K(f) |
| K120FF-25CM | DC to 40 GHz, 50 Ω, 25 cm, K(f) to K(f) |
| K120FF-30CM | DC to 40 GHz, 50 Ω, 30 cm, K(f) to K(f) |
| K120FF-35CM | DC to 40 GHz, 50 Ω, 35 cm, K(f) to K(f) |
| K120FF-40CM | DC to 40 GHz, 50 Ω, 40 cm, K(f) to K(f) |
| K120FF-45CM | DC to 40 GHz, 50 Ω, 45 cm, K(f) to K(f) |
| K120FF-50CM | DC to 40 GHz, 50 Ω, 50 cm, K(f) to K(f) |
| K120FF-60CM | DC to 40 GHz, 50 Ω, 60 cm, K(f) to K(f) |
| K120FF-70CM | DC to 40 GHz, 50 Ω, 70 cm, K(f) to K(f) |
| K120FF-80CM | DC to 40 GHz, 50 Ω, 80 cm, K(f) to K(f) |
| K120FF-90CM | DC to 40 GHz, 50 Ω, 90 cm, K(f) to K(f) |
| K120FF-100CM | DC to 40 GHz, 50 Ω, 100 cm, K(f) to K(f) |
| K120FF-125CM | DC to 40 GHz, 50 Ω, 125 cm, K(f) to K(f) |
| K120FF-150CM | DC to 40 GHz, 50 Ω, 150 cm, K(f) to K(f) |

| Model/Order No. | Name |
|---|---|
| | **Cable, semi-rigid** |
| V120MM-5CM | DC to 65 GHz, 50 Ω, 5 cm, V(m) to V(m) |
| V120MM-10CM | DC to 65 GHz, 50 Ω, 10 cm, V(m) to V(m) |
| V120MM-15CM | DC to 65 GHz, 50 Ω, 15 cm, V(m) to V(m) |
| V120MM-20CM | DC to 65 GHz, 50 Ω, 20 cm, V(m) to V(m) |
| V120MM-25CM | DC to 65 GHz, 50 Ω, 25 cm, V(m) to V(m) |
| V120MM-30CM | DC to 65 GHz, 50 Ω, 30 cm, V(m) to V(m) |
| V120MM-35CM | DC to 65 GHz, 50 Ω, 35 cm, V(m) to V(m) |
| V120MM-40CM | DC to 65 GHz, 50 Ω, 40 cm, V(m) to V(m) |
| V120MM-45CM | DC to 65 GHz, 50 Ω, 45 cm, V(m) to V(m) |
| V120MM-50CM | DC to 65 GHz, 50 Ω, 50 cm, V(m) to V(m) |
| V120MM-60CM | DC to 65 GHz, 50 Ω, 60 cm, V(m) to V(m) |
| V120MM-70CM | DC to 65 GHz, 50 Ω, 70 cm, V(m) to V(m) |
| V120MM-80CM | DC to 65 GHz, 50 Ω, 80 cm, V(m) to V(m) |
| V120MM-90CM | DC to 65 GHz, 50 Ω, 90 cm, V(m) to V(m) |
| V120MM-100CM | DC to 65 GHz, 50 Ω, 100 cm, V(m) to V(m) |
| V120MM-125CM | DC to 65 GHz, 50 Ω, 125 cm, V(m) to V(m) |
| V120MM-150CM | DC to 65 GHz, 50 Ω, 150 cm, V(m) to V(m) |
| V120MF-5CM | DC to 65 GHz, 50 Ω, 5 cm, V(m) to V(f) |
| V120MF-10CM | DC to 65 GHz, 50 Ω, 10 cm, V(m) to V(f) |
| V120MF-15CM | DC to 65 GHz, 50 Ω, 15 cm, V(m) to V(f) |
| V120MF-20CM | DC to 65 GHz, 50 Ω, 20 cm, V(m) to V(f) |
| V120MF-25CM | DC to 65 GHz, 50 Ω, 25 cm, V(m) to V(f) |
| V120MF-30CM | DC to 65 GHz, 50 Ω, 30 cm, V(m) to V(f) |
| V120MF-35CM | DC to 65 GHz, 50 Ω, 35 cm, V(m) to V(f) |
| V120MF-40CM | DC to 65 GHz, 50 Ω, 40 cm, V(m) to V(f) |
| V120MF-45CM | DC to 65 GHz, 50 Ω, 45 cm, V(m) to V(f) |
| V120MF-50CM | DC to 65 GHz, 50 Ω, 50 cm, V(m) to V(f) |
| V120MF-60CM | DC to 65 GHz, 50 Ω, 60 cm, V(m) to V(f) |
| V120MF-70CM | DC to 65 GHz, 50 Ω, 70 cm, V(m) to V(f) |
| V120MF-80CM | DC to 65 GHz, 50 Ω, 80 cm, V(m) to V(f) |
| V120MF-90CM | DC to 65 GHz, 50 Ω, 90 cm, V(m) to V(f) |
| V120MF-100CM | DC to 65 GHz, 50 Ω, 100 cm, V(m) to V(f) |
| V120MF-125CM | DC to 65 GHz, 50 Ω, 125 cm, V(m) to V(f) |
| V120MF-150CM | DC to 65 GHz, 50 Ω, 150 cm, V(m) to V(f) |
| V120FF-5CM | DC to 65 GHz, 50 Ω, 5 cm, V(f) to V(f) |
| V120FF-10CM | DC to 65 GHz, 50 Ω, 10 cm, V(f) to V(f) |
| V120FF-15CM | DC to 65 GHz, 50 Ω, 15 cm, V(f) to V(f) |
| V120FF-20CM | DC to 65 GHz, 50 Ω, 20 cm, V(f) to V(f) |
| V120FF-25CM | DC to 65 GHz, 50 Ω, 25 cm, V(f) to V(f) |
| V120FF-30CM | DC to 65 GHz, 50 Ω, 30 cm, V(f) to V(f) |
| V120FF-35CM | DC to 65 GHz, 50 Ω, 35 cm, V(f) to V(f) |
| V120FF-40CM | DC to 65 GHz, 50 Ω, 40 cm, V(f) to V(f) |
| V120FF-45CM | DC to 65 GHz, 50 Ω, 45 cm, V(f) to V(f) |
| V120FF-50CM | DC to 65 GHz, 50 Ω, 50 cm, V(f) to V(f) |
| V120FF-60CM | DC to 65 GHz, 50 Ω, 60 cm, V(f) to V(f) |
| V120FF-70CM | DC to 65 GHz, 50 Ω, 70 cm, V(f) to V(f) |
| V120FF-80CM | DC to 65 GHz, 50 Ω, 80 cm, V(f) to V(f) |
| V120FF-90CM | DC to 65 GHz, 50 Ω, 90 cm, V(f) to V(f) |
| V120FF-100CM | DC to 65 GHz, 50 Ω, 100 cm, V(f) to V(f) |
| V120FF-125CM | DC to 65 GHz, 50 Ω, 125 cm, V(f) to V(f) |
| V120FF-150CM | DC to 65 GHz, 50 Ω, 150 cm, V(f) to V(f) |

# ARMORED SEMI-RIGID TEST PORT CABLES

3670 Series DC to 65 GHz


*3670K50*

The 3670 series cables are laboratory quality cables that contain General Precision Connectors. These cables are used to connect VNA Test Sets to the device under test (DUT). They are also used to connect to a 3680 Universal Test Fixture or other test interface devices.

## Features:

- *Up to 65 GHz frequency range*
- *Type GPC-7, N, K Connector®, and V Connector® Precision Connectors*
- *Excellent return loss performance to 65 GHz*

## Specifications

| Model | Frequency Range (GHz) | Impedance | Connector Types | Length (Feet) | Return Loss |
|---|---|---|---|---|---|
| 3670A50-1 | DC to 18 | 50 | GPC-7 | 1 | 17 dB |
| 3670A50-2 | DC to 18 | 50 | GPC-7 | 2 | |
| 3670N50-1 | DC to 18 | 50 | N(m)-N(f) | 1 | 17 dB |
| 3670N50-2 | DC to 18 | 50 | N(m)-N(f) | 2 | |
| 3670NN50-1 | DC to 18 | 50 | N(m)-N(m) | 1 | 17 dB |
| 3670NN50-2 | DC to 18 | 50 | N(m)-N(m) | 2 | |
| 3670K50-1 | DC to 40 | 50 | K(m)-K(f) | 1 | 16 dB |
| 3670K50-2 | DC to 40 | 50 | K(m)-K(f) | 2 | |
| 3670KF50-1 | DC to 40 | 50 | K(f)-K(f) | 1 | 16 dB |
| 3670KF50-2 | DC to 40 | 50 | K(f)-K(f) | 2 | |
| 3670V50-1 | DC to 65 | 50 | V(m)-V(f) | 1 | 16 dB |
| 3670V50-2 | DC to 65 | 50 | V(m)-V(f) | 2 | |

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| 3670A50-1 | GPC-7, 1 Foot |
| 3670A50-2 | GPC-7, 2 Foot |
| 3670N50-1 | N(m) - N(f), 1 Foot |
| 3670N50-2 | N(m) - N(f), 2 Foot |
| 3670NN50-1 | N(m)-N(m), 1 Foot |
| 3670NN50-2 | N(m)-N(m, 2 Foot |
| 3670K50-1 | K(m)-K(f), 1 Foot |
| 3670K50-2 | K(m)-K(f), 2 Foot |
| 3670KF50-1 | K(f) - K (f) Cable, 1 Foot |
| 3670KF50-2 | K(f) - K (f) Cable, 2 Foot |
| 3670V50-1 | V(m)-V(f), 1 Foot |
| 3670V50-2 | V(m)-V(f), 2 Foot |

# COAXIAL ADAPTERS

K, V, K to V DC to 65 GHz


K222B


V230


K224B


K230B

The K220 and 34V Series of precision adapters enable accurate measurements with K or V connectors. Every adapter is fully specified and 100% tested to ensure low reflections and optimum performance over the DC to 65 GHz range.

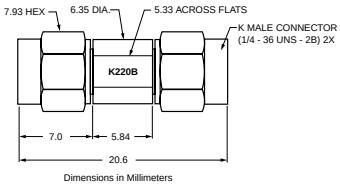
## Precision K and V adapter features

- *K Connector® DC to 40 GHz frequency range*
- *V Connector® DC to 65 GHz frequency range*
- *Low SWR and insertion loss*

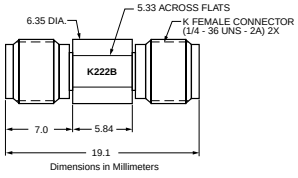
## Specifications

| Model | Frequency range (GHz) | Connectors | SWR |
|---|---|---|---|
| K220B<br>K222B<br>K224B | DC to 40 | K(m) to K(m)<br>K(f) to K(f)<br>K(f) to K(m) | 1.12 |
| 34VK50<br>34VKF50 | DC to 40 | V(m) to K(m)<br>V(m) to K(f) | 1.3 |
| 34VFK50<br>34VFKF50 | DC to 40 | V(f) to K(m)<br>V(f) to K(f) | 1.3 |
| 34VV50<br>34VFVF50<br>34VVF50 | DC to 65 | V(m) to V(m)<br>V(f) to V(f)<br>V(m) to V(f) | 1.5 |

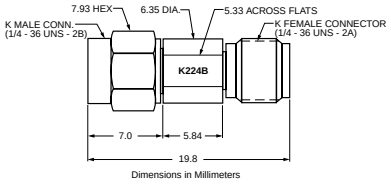
**Temperature range:** –55°C to +125°C



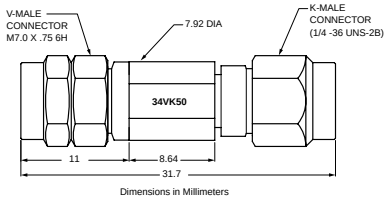

*K220B outline*



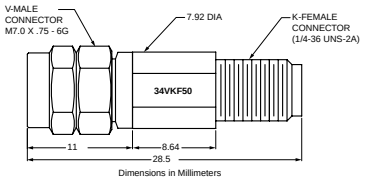

*K222B outline*



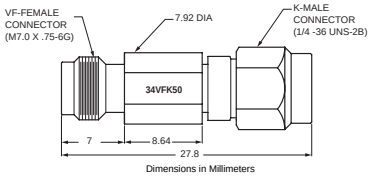

*K224B outline*



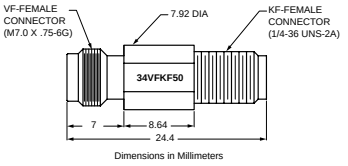

*34VK50 outline*



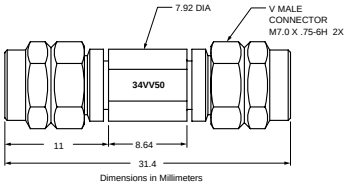

*34VKF50 outline*



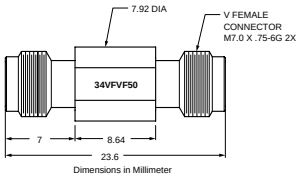

*34VFK50 outline*



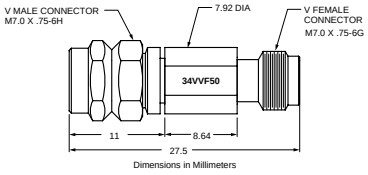

*34VFKF50 outline*




*34VV50 outline*




*34VFVF50 outline*




*34VVF50 outline*

# COAXIAL ADAPTERS

K, V, K to V DC to 65 GHz

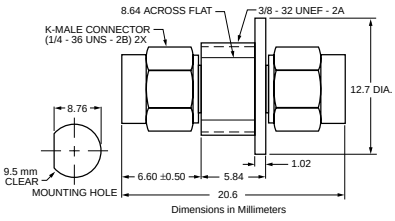
The K230 Series is the panel-mount version of the K220 Series Adapters. These units mount in a standard 9.5 mm "D" hole.

## K and V panel adapter features

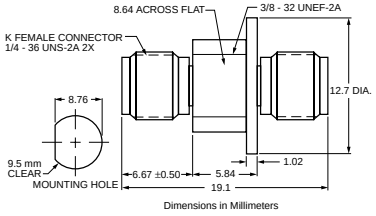
- *Precision, panel-mounted feedthru adapter*
- *Broad, DC to 65 GHz frequency range*

## K panel adapter specifications

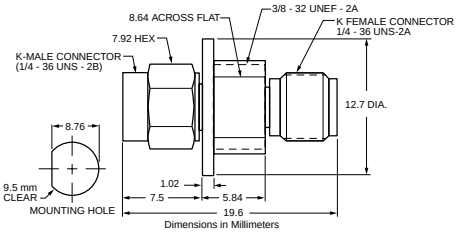
| Model | Frequency range (GHz) | Connectors | SWR |
|---|---|---|---|
| K230B | DC to 40 | K(m) to K(m) | 1.12 |
| K232B | | K(f) to K(f) | |
| K234B | | K(f) to K(m) | |




*K230B outline*



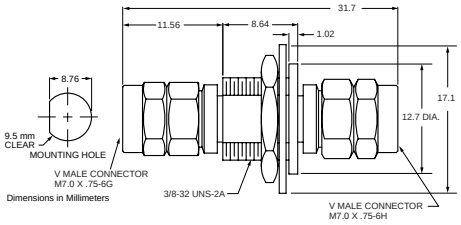

*K232B outline*



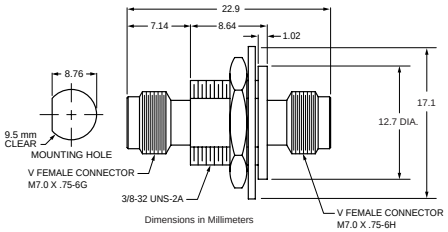

*K234B outline*

## V panel adapter specifications

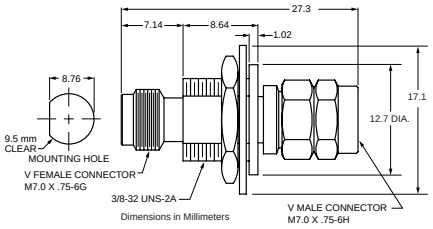
| Model | Frequency range (GHz) | Connectors | SWR |
|---|---|---|---|
| V230 | DC to 65 | V(m) to V(m) | 1.5 |
| V232 | | V(f) to V(f) | |
| V234 | | V(f) to V(m) | |




*V230 outline*




*V232 outline*




*V234 outline*

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Precision adapter** |
| K220B | DC to 40 GHz, 50 Ω, K(m)-K(m) |
| K222B | DC to 40 GHz, 50 Ω, K(f)-K(f) |
| K224B | DC to 40 GHz, 50 Ω, K(m)-K(f) |
| K230B | DC to 40 GHz, 50 Ω, K(m)-K(m) |
| K232B | DC to 40 GHz, 50 Ω, K(f)-K(f) |
| K234B | DC to 40 GHz, 50 Ω, K(f)-K(m) |
| 34VK50 | DC to 46.5 GHz, 50 Ω, V(m)-K(m) |
| 34VKF50 | DC to 40 GHz, 50 Ω, V(m)-K(f) |
| 34VFK50 | DC to 40 GHz, 50 Ω, V(f)-K(m) |
| 34VFKF50 | DC to 40 GHz, 50 Ω, V(f)-K(f) |
| 34VV50 | DC to 65 GHz, 50 Ω, V(m)-V(m) |
| 34VVF50 | DC to 65 GHz, 50 Ω, V(m)-V(f) |
| 34VFVF50 | DC to 65 GHz, 50 Ω, V(f)-V(f) |
| V230 | DC to 65 GHz, 50 Ω, V(m)-V(m) |
| V232 | DC to 65 GHz, 50 Ω, V(f)-V(f) |
| V234 | DC to 65 GHz, 50 Ω, V(f)-V(m) |

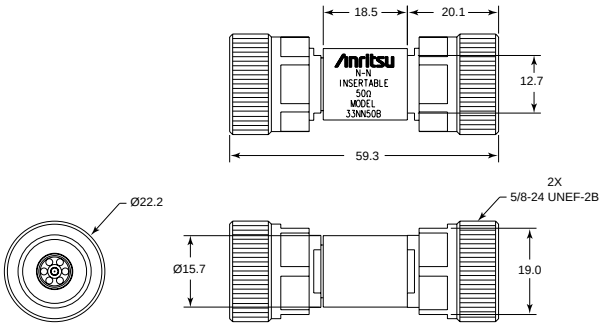
# CALIBRATION GRADE ADAPTERS

33 Series DC to 110 GHz

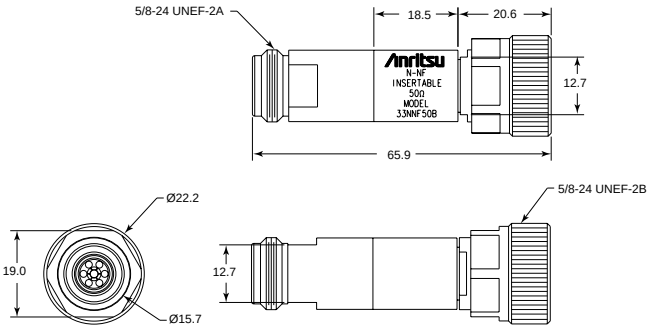

The 33 Series of precision adapters enable accurate measurements with Anritsu V Connector®, K Connector®, W1 Connector®, WSMA, and Type N interfaces. Every adapter is fully specified and 100% tested to ensure low reflections and optimum phase performance over a broad frequency range.

## Features

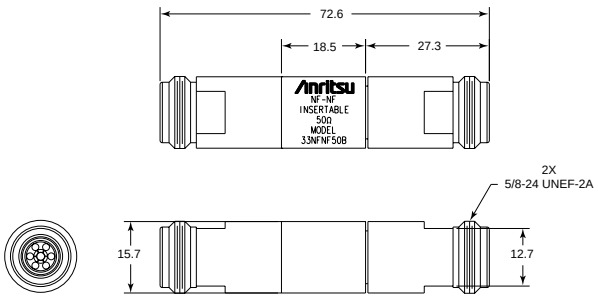
- *Low SWR and insertion loss*
- *DC to 110 GHz, with W1 Connector® interface*
- *DC to 65 GHz, with V Connector® interface*
- *DC to 40 GHz, with K Connector® interface*
- *50 Ω impedance*



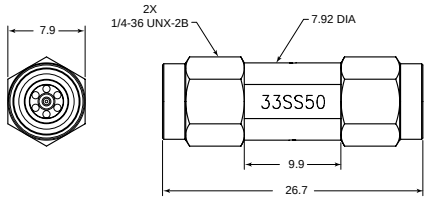

*33NN50B outline*



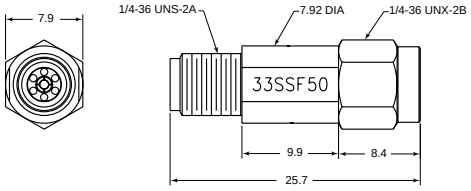

*33NNF50B outline*



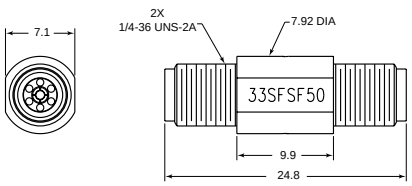

*33NFNF50B outline*




*33SS50 outline*



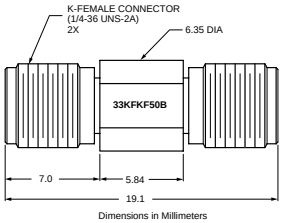

*33SSF50 outline*



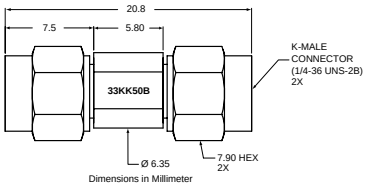

*33SFSF50 outline*

# CALIBRATION GRADE ADAPTERS

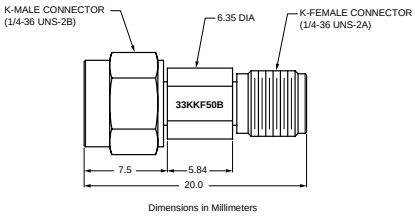
33 Series DC to 110 GHz



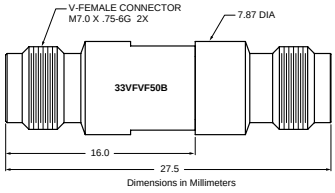

*33KFKF50B outline*



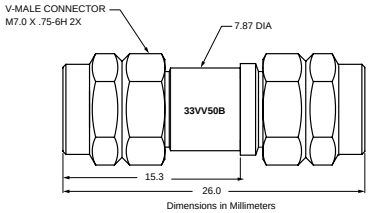

*33KK50B outline*



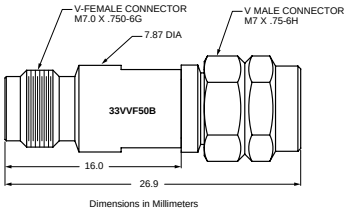

*33KKF50B outline*




*33VFVF50B outline*

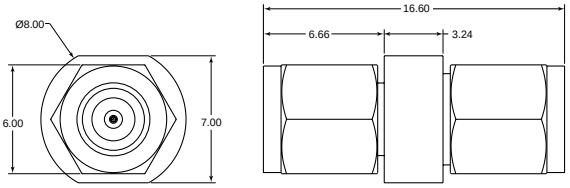



*33VV50B outline*

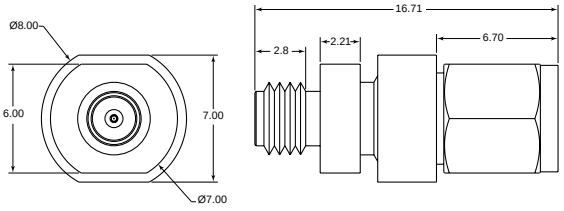



*33VVF50B outline*

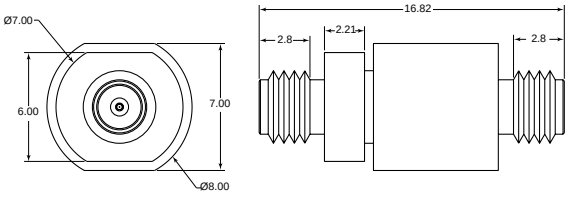
***33WW50***
*Precision W1 Male to W1 Male Adapter, DC to 110 GHz*




***33WWF50***
*Precision W1 Male to W1 Female Adapter, DC to 110 GHz*




***33WFWF50***
*Precision W1 Female to W1 Female dapter, DC to 110 GHz*



# CALIBRATION GRADE ADAPTERS

33 Series DC to 110 GHz

## Specifications

| Model | Frequency range (GHz) | Impedance (Ω) | Connectors | SWR |
|---|---|---|---|---|
| 33NN50B | DC to 18 | 50 | N(m)-N(m) | 1.09 |
| 33NNF50B | DC to 18 | 50 | N(m)-N(f) | 1.09 |
| 33NFNF50B | DC to 18 | 50 | N(f)-N(f) | 1.09 |
| 33SS50 | DC to 26.5 | 50 | WSMA(m)-WSMA(m) | 1.08 to 18 GHz<br>1.12 to 26.5 GHz |
| 33SSF50 | DC to 26.5 | 50 | WSMA(m)-WSMA(f) | 1.08 to 18 GHz<br>1.12 to 26.5 GHz |
| 33SFSF50 | DC to 26.5 | 50 | WSMA(f)-WSMA(f) | 1.08 to 18 GHz<br>1.12 to 26.5 GHz |
| 33KK50B | DC to 40 | 50 | K(m)-K(m) | 1.1 |
| 33KKF50B | DC to 40 | 50 | K(m)-K(f) | 1.1 |
| 33KFKF50B | DC to 40 | 50 | K(f)-K(f) | 1.1 |
| 33VV50B | DC to 65 | 50 | V(m)-V(m) | 1.22 |
| 33VVF50B | DC to 65 | 50 | V(m)-V(f) | 1.33 |
| 33VFVF50B | DC to 65 | 50 | V(f)-V(f) | 1.33 |
| 33WW50 | DC to 110 | 50 | W1(m)-W1(m) | 1.17 to 40 GHz<br>1.29 to 65 GHz<br>1.38 to 110 GHz |
| 33WWF50 | DC to 110 | 50 | W1(m)-W1(f) | 1.17 to 40 GHz<br>1.29 to 65 GHz<br>1.38 to 110 GHz |
| 33WFWF50 | DC to 110 | 50 | W1(f)-W1(f) | 1.17 to 40 GHz<br>1.29 to 65 GHz<br>1.38 to 110 GHz |

**Temperature range:** –55°C to +125°C

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Calibration grade adapter** |
| 33NN50B | DC to 18 GHz, 50 Ω, N(m)-N(m) |
| 33NNF50B | DC to 18 GHz, 50 Ω, N(m)-N(f) |
| 33NFNF50B | DC to 18 GHz, 50 Ω, N(f)-N(f) |
| 33SS50 | DC to 26.5 GHz, 50 Ω, WSMA(m)-WSMA(m) |
| 33SSF50 | DC to 26.5 GHz, 50 Ω, WSMA(m)-WSMA(f) |
| 33SFSF50 | DC to 26.5 GHz, 50 Ω, WSMA(f)-WSMA(f) |
| 33KFKF50B | DC to 40 GHz, 50 Ω, K(f)-K(f) |
| 33KK50B | DC to 40 GHz, 50 Ω, K(m)-K(m) |
| 33KKF50B | DC to 40 GHz, 50 Ω, K(m)-K(f) |
| 33VFVF50B | DC to 65 GHz, 50 Ω, V(f)-V(f) |
| 33VV50B | DC to 65 GHz, 50 Ω, V(m)-V(m) |
| 33VVF50B | DC to 65 GHz, 50 Ω, V(m)-V(f) |
| 33WW50 | DC to 110 GHz, 50 Ω, W1(m)-W1(m) |
| 33WWF50 | DC to 110 GHz, 50 Ω, W1(m)-W1(f) |
| 33WFWF50 | DC to 110 GHz, 50 Ω, W1(f)-W1(f) |

# INSTRUMENTATION GRADE ADAPTERS

34 Series DC to 60 GHz


*34ASF50*


*34NN50A*


*34RKRK50*


*34RSN50*

The 34 Series of precision adapters enable accurate measurements with GPC-7, Type N, or WSMA interfaces. Every adapter is fully specified and 100% tested to ensure low reflections and optimum phase performance over a broad frequency range.

## Precision adapter features

- *Low SWR and insertion loss*
- *GPC-7, Type N, and WSMA connectors*
- *Convenient transition with minimal effect on signal*
- *50 Ω or 75 Ω impedance*

## Specifications

| Model | Frequency range (GHz) | Impedance (Ω) | Connectors | SWR | Dimensions L(cm) x dia(cm) |
|---|---|---|---|---|---|
| 34NN75B<br>34NFNF75B | DC to 3 | 75 | N(m) to N(m)<br>N(f) to N(f) | 1.1 | 6.0 x 2.2<br>4.7 x 1.6 |
| 34AN50<br>34ANF50 | DC to 18 | 50 | GPC-7 to N(m)<br>GPC-7 to N(f) | 1.02 | 4.2 x 2.2<br>4.2 x 2.2 |
| 34AS50<br>34ASF50 | DC to 18 | 50 | GPC-7 to WSMA(m)<br>GPC-7 to WSMA(f) | 1.033 | 3.8 x 2.2<br>3.8 x 2.2 |
| 34NN50A<br>34NFNF50 | DC to 18 | 50 | N(m) to N(m)<br>N(f) to N(f) | 1.1 | 6.0 x 2.2<br>4.7 x 1.6 |
| 34NK50<br>34NKF50<br>34NFK50<br>34NFKF50 | DC to 18 | 50 | N(m) to K(m)<br>N(m) to K(f)<br>N(f) to K(m)<br>N(f) to K(f) | 1.12 | 3.8 x 2.2<br>3.8 x 2.2<br>3.8 x 1.6<br>3.8 x 1.6 |
| 34SFSF50 | DC to 26.5 | 50 | WSMA(f) to WSMA(f) | 1.11 to 18.5 GHz<br>1.18 to 26.5 GHz | 1.6 x 0.8 |

## Specifications

| Model | Frequency range (GHz) | Connectors | SWR | Dimensions L(cm) x dia(cm) |
|---|---|---|---|---|
| 34RSN50 | DC to 18 | RS(m) to N(m) | 1.40 | 5.1 x 2.2 |
| 34RKNF50 | DC to 18 | RK(m) to N(f) | 1.40 | 5.1 x 1.7 |
| 34RVNF50 | DC to 18 | RV(m) to N(f) | 1.40 | 5.1 x 1.7 |
| 34RKRK50 | DC to 40 | RK(m) to RK(m) | 2.00 | 5.8 x 1.7 |
| 34RVRK50 | DC to 40 | RV(m) to RK(m) | 2.00 | 5.8 x 1.7 |
| 34RVRV50 | DC to 60 | RV(m) to RV(m) | 2.30 | 5.8 x 1.7 |

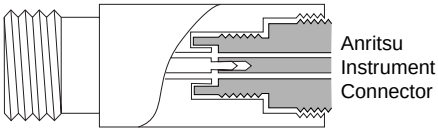
**Impedance:** 50 Ω
**Temperature range:** 0°C to +75°C

The 34R Series precision adapters provide a rugged, rigid connection between Anritsu instruments with WSMA, K Connector®, or V Connector® outputs and Anritsu SWR Autotesters and SWR Bridges or other instruments.

The adapters have an outside diameter equal to that of a Type N connector, adding mechanical strength to the test setup and making installation convenient and fast.

## Ruggedized adapter features

- *Enhance reliability of microwave test setup*
- *Easy-to-grasp Type N outside diameter*
- *Rigid test connections for improved test data repeatability*




*34R Series Adapter*

## Ordering information

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

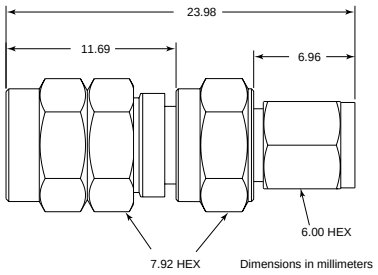
| Model/Order No. | Name |
|---|---|
| | **Precision adapter** |
| 34NN75B | DC to 3 GHz, 75 Ω, N(m)-N(m) |
| 34NFNF75B | DC to 3 GHz, 75 Ω, N(f)-N(f) |
| 34AN50 | DC to 18 GHz, 50 Ω, GPC-7-N(m) |
| 34ANF50 | DC to 18 GHz, 50 Ω, GPC-7-N(f) |
| 34AS50 | DC to 18 GHz, 50 Ω, GPC-7-WSMA(m) |
| 34ASF50 | DC to 18 GHz, 50 Ω, GPC-7-WSMA(f) |
| 34NN50A | DC to 18 GHz, 50 Ω, N(m)-N(m) |
| 34NFNF50 | DC to 18 GHz, 50 Ω, N (f)-N(f) |
| 34NK50 | DC to 18 GHz, 50 Ω, N (m)-K(m) |
| 34NKF50 | DC to 18 GHz, 50 Ω, N(m)-K(f) |
| 34NFK50 | DC to 18 GHz, 50 Ω, N (f)-K(m) |
| 34NFKF50 | DC to 18 GHz, 50 Ω, N(f)-K(f) |
| 34SFSF50 | DC to 26.5 GHz, 50 Ω, WSMA(f)-WSMA(f) |
| 34RSN50 | DC to 18 GHz, 50 Ω, RS(m) to N(m) |
| 34RKNF50 | DC to 18 GHz, 50 Ω, RK(m) to N(f) |
| 34RVNF50 | DC to 18 GHz, 50 Ω, RV(m) to N(f) |
| 34RKRK50 | DC to 40 GHz, 50 Ω, RK(m) to RK(m) |
| 34RVRK50 | DC to 40 GHz, 50 Ω, RV(m) to RK(m) |
| 34RVRV50 | DC to 60 GHz, 50 Ω, RV(m) to RV(m) |

# INSTRUMENTATION GRADE ADAPTERS

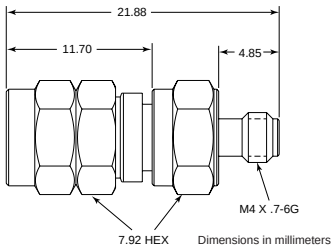
34 Series W to V  DC to 65 GHz

*34WVF50*

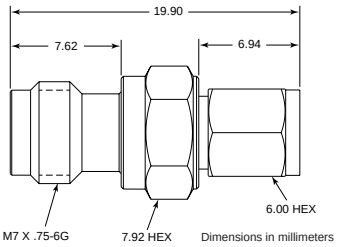
*34WFVF50*



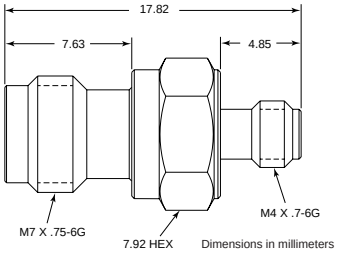

*34WV50 outline*




*34WFV50 outline*




*34WVF50 outline*




*34WFVF50 outline*

These 34 Series of precision adapter enable accurate measurement with W1 Connector® and V Connector® interfaces.

## Precision adapter features

- *Low SWR and insertion loss*
- *W1 and V Connectors®*
- *50 Ω Impedance*

## Specifications

| Model | Frequency Range (GHz) | Impedance | Connectors | Insertion Loss | SWR |
|---|---|---|---|---|---|
| 34WV50 | DC to 65 GHz | 50 | W1(m) to V(m) | 0.5 dB | 1.22 |
| 34WFV50 | DC to 65 GHz | 50 | W1(f) to V(m) | 0.5 dB | 1.22 |
| 34WVF50 | DC to 65 GHz | 50 | W1(m) to V(f) | 0.5 dB | 1.22 |
| 34WFVF50 | DC to 65 GHz | 50 | W1(f) to V(f) | 0.5 dB | 1.22 |

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Precision adapter** |
| 34WV50 | DC to 65 GHz, 50 Ω, W1(m) to V(m) |
| 34WFV50 | DC to 65 GHz, 50 Ω, W1(f) to V(m) |
| 34WVF50 | DC to 65 GHz, 50 Ω, W1(m) to V(f) |
| 34WFVF50 | DC to 65 GHz, 50 Ω, W1(f) to V(f) |

# INSTRUMENTATION GRADE WAVEGUIDE ADAPTERS

35WR Series 18 to 110 GHz

*35WR42K*

*35WR19K*

*35WR10W*

*35WR22V*

*35WR19V*

*35WR10WF*

The 35 Series precision adapters transform standard or double-ridge waveguide to coaxial K Connector® and V Connector®, and W1 Connector®, interfaces, thus enabling convenient millimeter wave coaxial measurements.

## Features

- *18 to 65 GHz frequency coverage*
- *K Connector® compatibility with SMA and 3.5 mm*
- *V Connector® compatibility with 2.4 mm*
- *W1 Connector® compatibility with 1.0 mm*
- *Standard and double-ridge designs*

## Specifications

| Model | Frequency range (GHz) | Connectors | W/G flange | SWR |
|---|---|---|---|---|
| 35WRD180K<br>35WRD180KF | 18 to 40 | WRD180 to K(m)<br>WRD180 to K(f) | N/A | 1.25 |
| 35WR42K<br>35WR42KF | 18 to 26.5 | WR42 to K(m)<br>WR42 to K(f) | 595 | 1.25 |
| 35WR28K<br>35WR28KF | 26.5 to 40 | WR28 to K(m)<br>WR28 to K(f) | 599 | 1.25 |
| 35WR22K<br>35WR22KF | 33 to 50 | WR22 to K(m)<br>WR22 to K(f) | 383 | 1.30 |
| 35WR22V<br>35WR22VF | 33 to 50 | WR22 to V(m)<br>WR22 to V(f) | 383 | 1.30 |
| 35WR19K<br>35WR19KF | 40 to 50<br>Usable to 54 | WR19 to K(m)<br>WR19 to K(f) | 383 | 1.30 |
| 35WR19V<br>35WR19VF | 40 to 60 | WR19 to V(m)<br>WR19 to V(f) | 383 | 1.30 |
| 35WR15V<br>35WR15VF | 50 to 65 | WR15 to V(m)<br>WR15 to V(f) | 385 | 1.30 |
| 35WR10W<br>35WR10WF | 75 to 110 | WR10 to W(m)<br>WR10 to W(f) | 387 | 1.38 |

**Impedance:** 50 Ω
**Temperature range:** –55°C to +125°C

## Ordering information

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

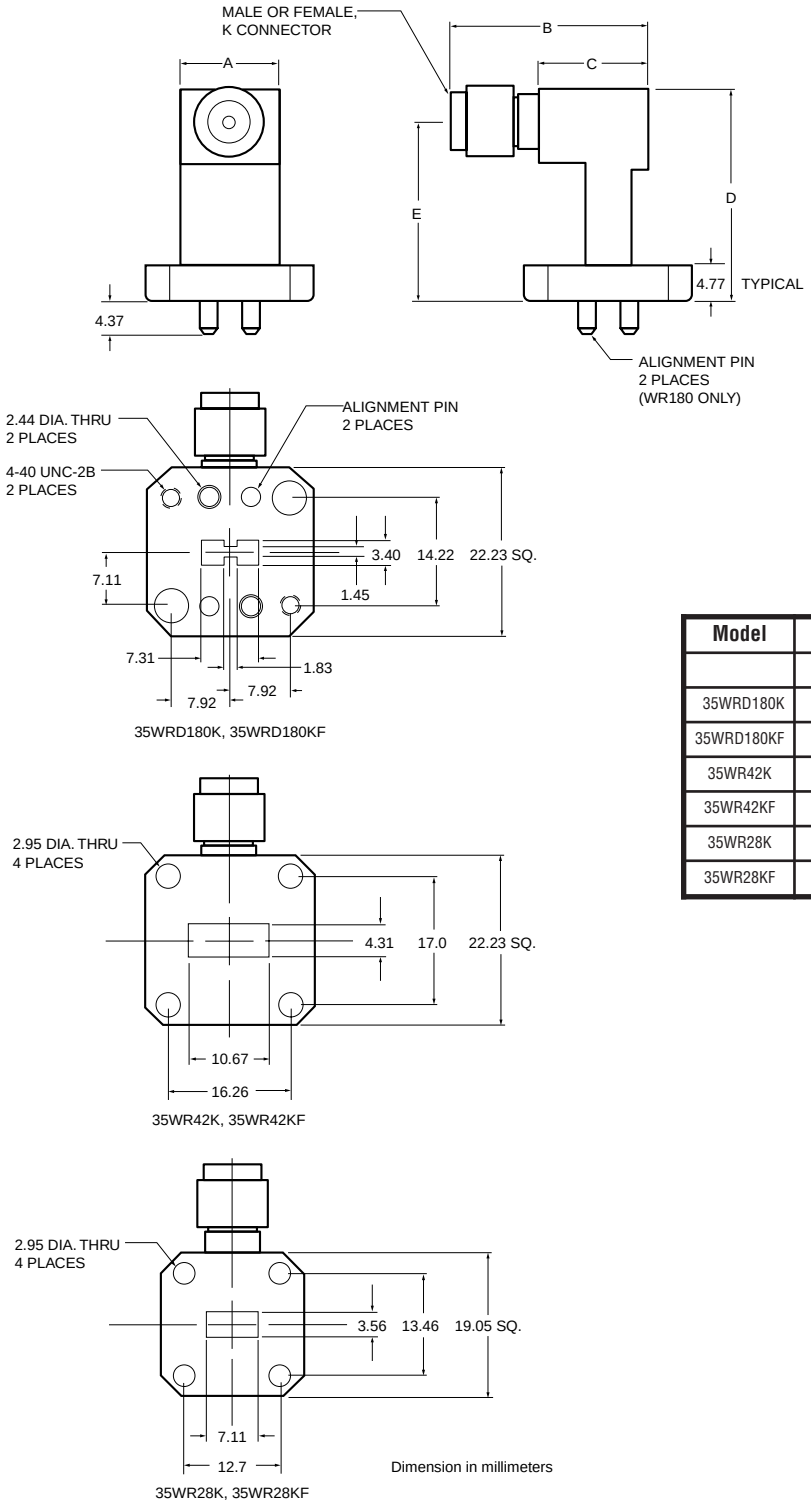
| Model/Order No. | Name |
|---|---|
| | **Precision waveguide to coax adapter** |
| 35WRD180K | 18 to 40 GHz, WRD180 (double ridge waveguide) to K(m) |
| 35WRD180KF | 18 to 40 GHz, WRD180 (double ridge waveguide) to K(f) |
| 35WR42K | 18 to 26.5 GHz, WR42-K(m) |
| 35WR42KF | 18 to 26.5 GHz, WR42-K(f) |
| 35WR28K | 26.5 to 40 GHz, WR28-K(m) |
| 35WR28KF | 26.5 to 40 GHz, WR28-K(f) |
| 35WR22K | 33 to 50 GHz, WR22-K(m) |
| 35WR22KF | 33 to 50 GHz, WR22-K(f) |
| 35WR22V | 33 to 50 GHz, WR22-V(m) |
| 35WR22VF | 33 to 50 GHz, WR22-V(f) |
| 35WR19K | 40 to 50 GHz (usable to 54 GHz), WR19-K(m) |
| 35WR19KF | 40 to 50 GHz (usable to 54 GHz), WR19-K(f) |
| 35WR19V | 40 to 60 GHz, WR19-V(m) |
| 35WR19VF | 40 to 60 GHz, WR19-V(f) |
| 35WR15V | 50 to 65 GHz (usable to 67 GHz), WR15-V(m) |
| 35WR15VF | 50 to 65 GHz (usable to 67 GHz), WR15-V(f) |
| 35WR10W | 75 to 110, WR10 to W(m) |
| 35WR10WF | 75 to 110, WR10 to W(f) |

Outline drawings for the 35 Series Waveguide-to-Coaxial Adapters, 18 to 110 GHz, are shown on the following three pages.

# INSTRUMENTATION GRADE WAVEGUIDE ADAPTERS

35WR Series 18 to 110 GHz

## Outline Drawings



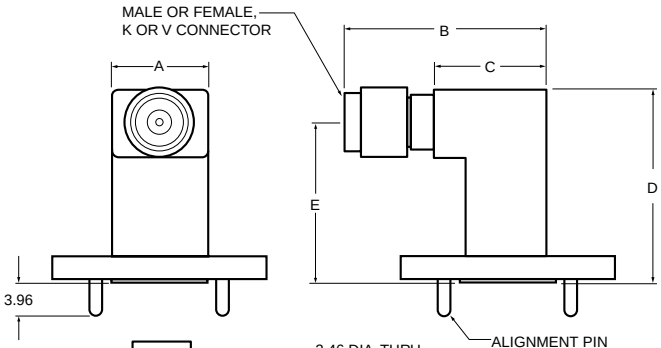

| Model | Dimensions (mm) | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 35WRD180K | 13.20 | 27.9 | 14.43 | 28.40 | 23.80 |
| 35WRD180KF | 13.20 | 22.9 | 14.43 | 28.40 | 23.80 |
| 35WR42K | 13.20 | 27.9 | 14.43 | 28.14 | 23.93 |
| 35WR42KF | 13.20 | 22.9 | 14.43 | 28.14 | 23.93 |
| 35WR28K | 10.67 | 27.9 | 14.86 | 28.78 | 23.93 |
| 35WR28KF | 10.67 | 22.9 | 14.86 | 28.78 | 23.88 |

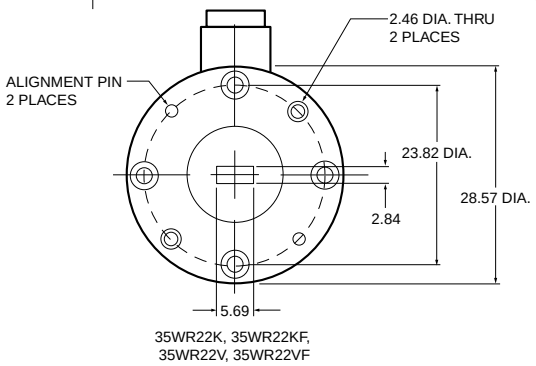
*35WRD180K, 35WRD180KF, 35WR42K, 35WR42KF, 35WR28K, 35WR28KF outlines*

# INSTRUMENTATION GRADE WAVEGUIDE ADAPTERS

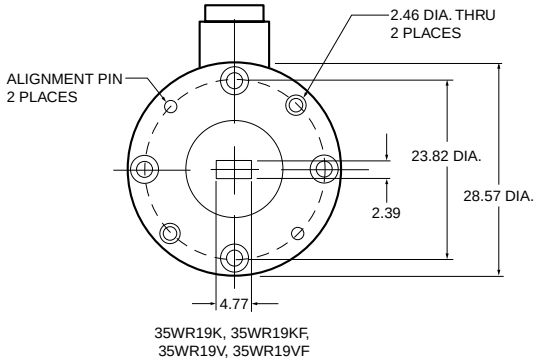
35WR Series 18 to 110 GHz

## Outline Drawings

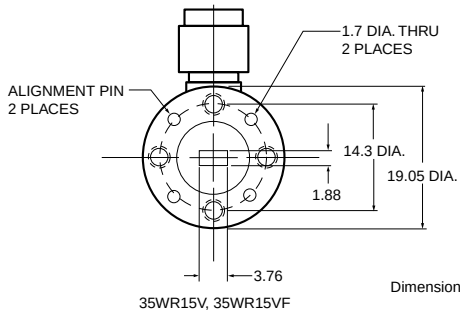



35WR22K, 35WR22KF,
35WR22V, 35WR22VF




35WR19K, 35WR19KF,
35WR19V, 35WR19VF




35WR15V, 35WR15VF

Dimension in millimeters

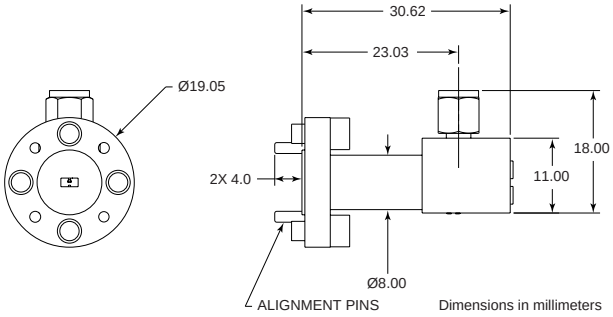
| Model | Dimensions (mm) | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 35WR22K | 12.70 | 26.9 | 14.73 | 25.76 | 21.44 |
| 35WR22KF | 12.70 | 21.6 | 14.73 | 25.76 | 21.44 |
| 35WR22V | 12.70 | 26.9 | 14.73 | 25.76 | 21.44 |
| 35WR22VF | 12.70 | 21.6 | 14.73 | 25.76 | 21.44 |
| 35WR19K | 12.70 | 26.9 | 14.73 | 25.76 | 21.44 |
| 35WR19KF | 12.70 | 21.6 | 14.73 | 25.76 | 21.44 |
| 35WR19V | 12.70 | 27.9 | 14.73 | 25.76 | 21.44 |
| 35WR19VF | 12.70 | 22.6 | 14.73 | 25.76 | 21.44 |
| 35WR15V | 12.70 | 24.4 | 12.19 | 26.97 | 21.62 |
| 35WR15VF | 12.70 | 20.3 | 12.19 | 26.97 | 21.62 |

*35WR22K, 35WR22KF, 35WR22V, 35WR22VF, 35WR19K, 35WR19KF, 35WR19V, 35WR19VF, 35WR15V, and 35WR15VF outlines*

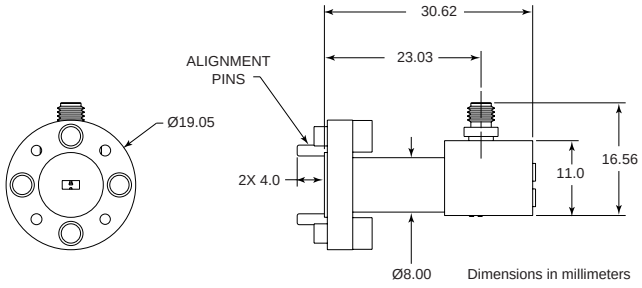
# INSTRUMENTATION GRADE WAVEGUIDE ADAPTERS

35WR Series 18 to 110 GHz

## Outline Drawings




*35WR10W outline*



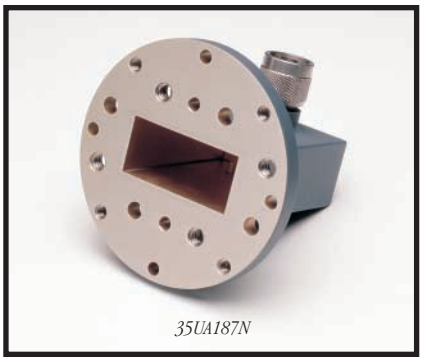

*35WR10WF outline*

# INSTRUMENTATION GRADE WAVEGUIDE ADAPTERS

35U, 35C Series 3.3 to 26.5 GHz

*35UM40N*

*35UM84N*



*35UA187N*

*35UA42K*

The 35U and 35C Series precision adapters transform standard waveguide to coaxial Type N and K Connector® interfaces, thus enabling convenient microwave coaxial measurements.

## Features

- *3.3 to 26.5 GHz frequency coverage*
- *Type N connector compatibility*
- *K Connector® compatibility with SMA and 3.5 mm*

## Specifications

| Model | Frequency range (GHz) | Connectors | W/G flange | SWR |
|---|---|---|---|---|
| 35UM40N | 3.3 to 4.9 | WR229 to N(m)<br>WG11A to N(m) | PDR40 | 1.08 |
| 35UM48N | 3.9 to 5.8 | WR187 to N(m)<br>WG12 to N(m) | CAR48, PAR48,<br>UAR48, PDR48 | 1.08 |
| 35UM58N | 4.9 to 7.0 | WR159 to N(m)<br>WG13 to N(m) | CAR58, PAR58,<br>UAR58, PDR58 | 1.08 |
| 35UM70N | 5.8 to 8.2 | WR137 to N(m)<br>WG14 to N(m) | CAR70, PAR70,<br>UAR70, PDR70 | 1.08 |
| 35UM84N | 7.0 to 10 | WR112 to N(m)<br>WG15 to N(m) | CBR84, UBR84,<br>PBR84, PDR84 | 1.08 |
| 35UM100N | 8.2 to 12.4 | WR90 to N(m)<br>WG16 to N(m) | CBR100, UBR100,<br>PBR100, PDR100 | 1.08 |
| 35UM120N | 10 to 15 | WR75 to N(m)<br>WG17 to N(m) | CBR120, UBR120,<br>PBR120, PDR120 | 1.08 |
| 35UM140N | 12.4 to 18 | WR62 to N(m)<br>WG18 to N(m) | CBR140, UBR140,<br>PBR140, PDR140 | 1.08 |
| 35UM220K | 17 to 26.5 | WR42 to K(m)<br>WG20 to K(m) | CBR220, UBR220,<br>PBR220, PDR220 | 1.20 |
| 35UA229N | 3.3 to 4.9 | WR229 to N(m)<br>WG11A to N(m) | CPR229F, CPR229G,<br>UG-1350/U, UG-1351/U,<br>UG-1726/U, UG-1727/U | 1.08 |
| 35UA187N | 3.9 to 5.8 | WR187 to N(m)<br>WG12 to N(m) | CPR187F, CPR187G,<br>UG-1352/U, UG-1353/U,<br>UG-1728/U, UG-1729/U,<br>UG-148/U, UG-149A/U | 1.08 |
| 35UA159N | 4.9 to 7.0 | WR159 to N(m)<br>WG13 to N(m) | CPR159F, CPR159G,<br>UG-1354/U, UG-1355/U,<br>UG-1730/U, UG-1731/U | 1.08 |
| 35UA137N | 5.8 to 8.2 | WR137 to N(m)<br>WG14 to N(m) | CPR137F, CPR137G,<br>UG-1356/U, UG-1357/U,<br>UG-1732/U, UG-1733/U,<br>UG-343B/U, UG-344/U,<br>UG-440B/U, UG-441/U | 1.08 |

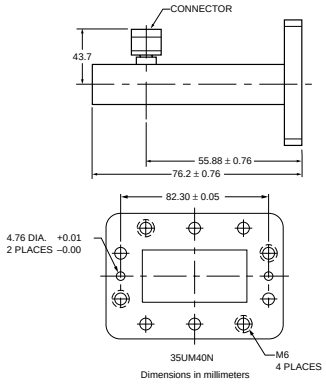
## Specifications

| Model | Frequency range (GHz) | Connectors | W/G flange | SWR |
|---|---|---|---|---|
| 35UA112N | 7.0 to 10 | WR112 to N(m)<br>WG15 to N(m) | CPR112F, CPR112G,<br>UG-1358/U, UG-1359/U,<br>UG-1734/U, UG-1735/U,<br>UG-52B/U, UG-51/U,<br>UG-137B/U, UG-138/U | 1.08 |
| 35UA90N | 8.2 to 12.4 | WR90 to N(m)<br>WG16 to N(m) | CPR90F, CPR90G,<br>UG-1360/U, UG-1361/U,<br>UG-1736/U, UG-1737/U,<br>UG-40B/U, UG-39/U,<br>UG-135B/U, UG-136/U | 1.08 |
| 35UA75N | 10 to 15 | WR75 to N(m)<br>WG17 to N(m) | WR75 | 1.08 |
| 35UA62N | 12.4 to 18 | WR62 to N(m)<br>WG18 to N(m) | UG-541A/U, UG-419A/U<br>UG-1665/U, UG-1666/U | 1.08 |
| 35UA42K | 17 to 26.5 | WR42 to K(m)<br>WG20 to K(m) | UG-596A/U, UG-595/U,<br>UG-597/U, UG-598A/U | 1.08 |
| 35CMR229N | 3.3 to 4.9 | WR229 to N(m) | CMR229 | 1.08 |
| 35CMR187N | 3.9 to 5.8 | WR187 to N(m)<br>WG12 to N(m) | CMR187, UG-1475/U,<br>UG-148/U | 1.08 |
| 35CMR159N | 4.9 to 7.0 | WR159 to N(m)<br>WG13 to N(m) | CMR159 | 1.08 |
| 35CMR137N | 5.8 to 8.2 | WR137 to N(m)<br>WG14 to N(m) | CMR137, UG-1476/U<br>1UG-1481/U | 1.08 |
| 35CMR112N | 7.0 to 10 | WR112 to N(m)<br>WG15 to N(m) | CMR112, UG-1477/U<br>UG-1482/U | 1.08 |
| 35CMR90N | 8.2 to 12.4 | WR90 to N(m)<br>WG16 to N(m) | CMR90, UG-1478/U<br>UG-1483/U | 1.08 |
| 35UER40N | 3.3 to 4.9 | WR229 to N(m)<br>WG11A to N(m) | UER40 | 1.08 |
| 35UER48N | 3.9 to 5.8 | WR187 to N(m)<br>WG12 to N(m) | UER48 | 1.08 |
| 35UER58N | 4.9 to 7.0 | WR159 to N(m)<br>WG13 to N(m) | UER58 | 1.08 |
| 35UER70N | 5.8 to 8.2 | WR137 to N(m)<br>WG14 to N(m) | UER70 | 1.08 |
| 35UER84N | 7 to 10 | WR112 to N(m)<br>WG15 to N(m) | UER84 | 1.08 |
| 35UER100N | 8.2 to 12.4 | WR90 to N(m)<br>WG16 to N(m) | UER100 | 1.08 |

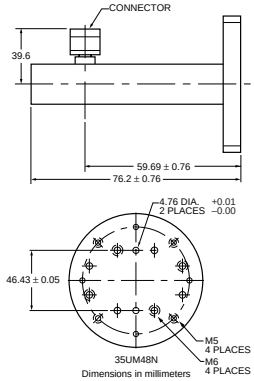
# INSTRUMENTATION GRADE WAVEGUIDE ADAPTERS

35U, 35C Series 3.3 to 26.5 GHz

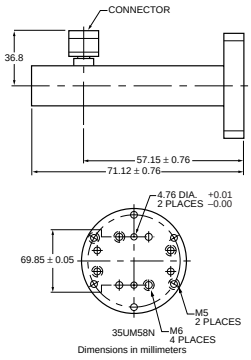
## Outline Drawings



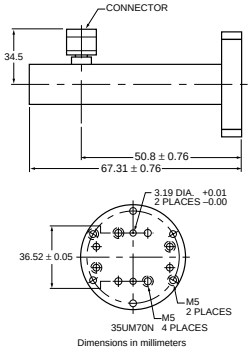

*35UM40N outline*



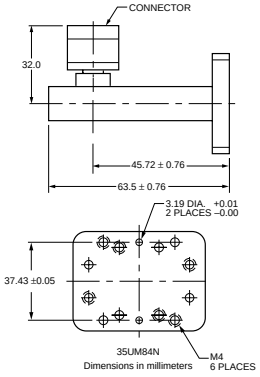

*35UM48N outline*



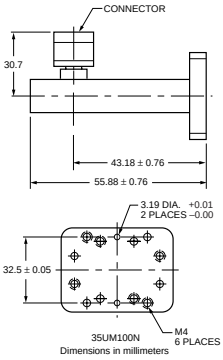

*35UM58N outline*



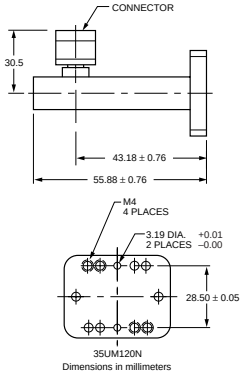

*35UM70N outline*



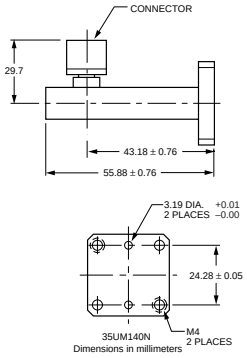

*35UM84N outline*



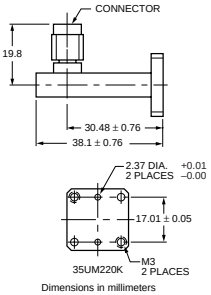

*35UM100N outline*



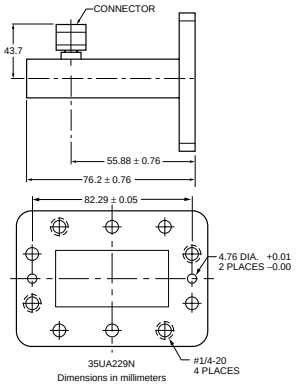

*35UM120N outline*



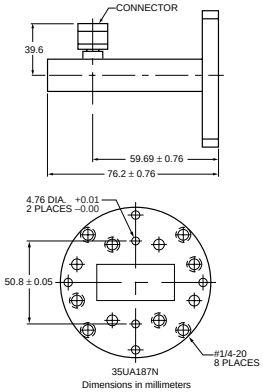

*35UM140N outline*



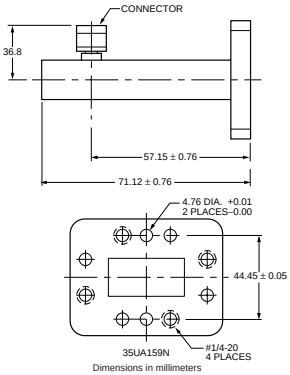

*35UM220K outline*




*35UA229N outline*




*35UA187N outline*

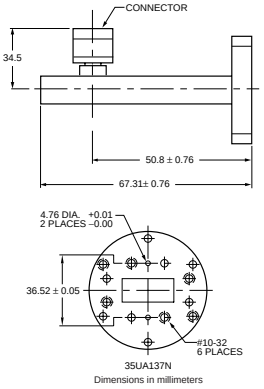



*35UA159N outline*

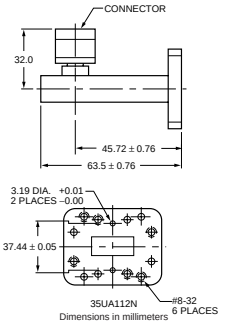
# INSTRUMENTATION GRADE WAVEGUIDE ADAPTERS

35U, 35C Series 3.3 to 26.5 GHz

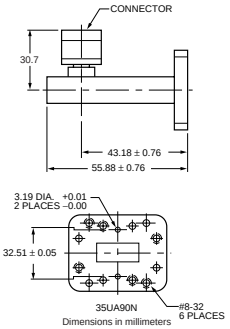
## Outline Drawings



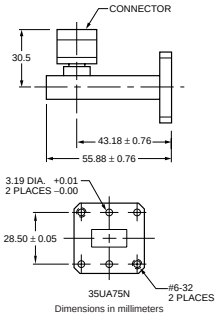

*35UA137N outline*



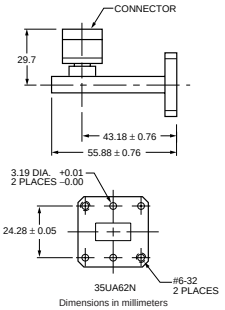

*35UA112N outline*



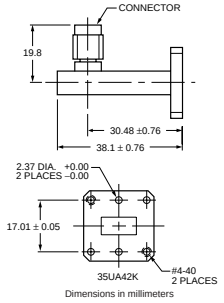

*35UA90N outline*



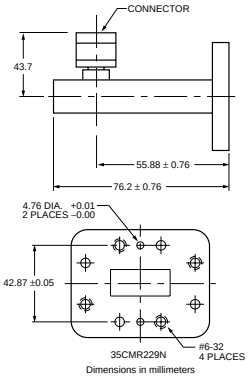

*35UA75N outline*



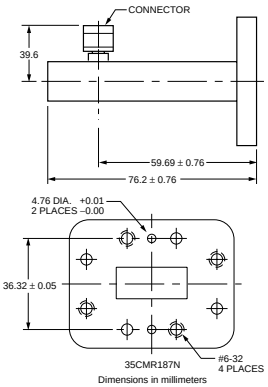

*35UA62N outline*



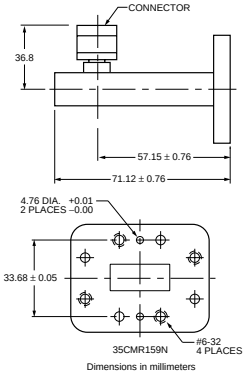

*35UA42K outline*



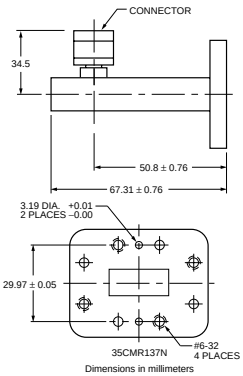

*35CMR229N outline*



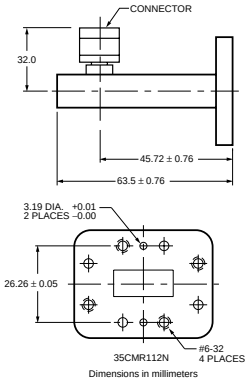

*35CMR187N outline*



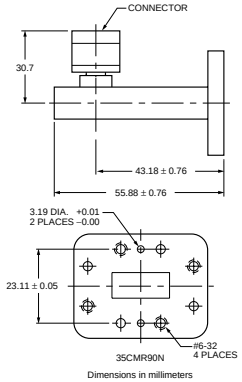

*35CMR159N outline*




*35CMR137N outline*




*35CMR112N outline*

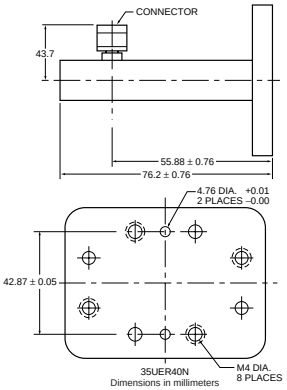



*35CMR90N outline*

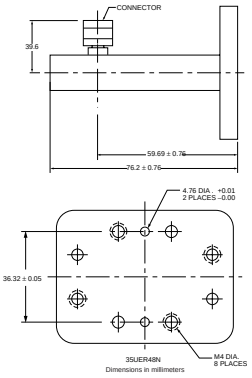
# INSTRUMENTATION GRADE WAVEGUIDE ADAPTERS

35U, 35C Series 3.3 to 26.5 GHz

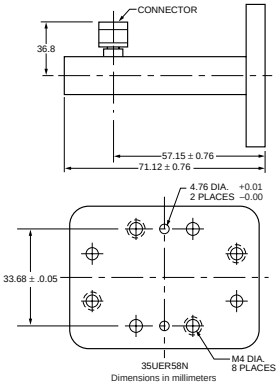
## Outline Drawings



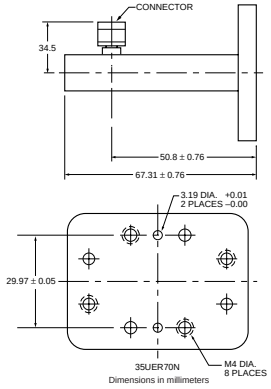

*35UER40N outline*



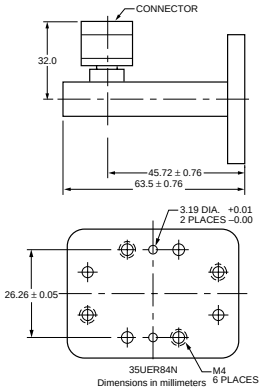

*35UER48N outline*



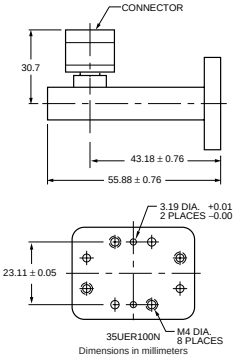

*35UER58N outline*




*35UER70N outline*




*35UER84N outline*




*35UER100N outline*

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Coaxial adapter** |
| 35UM40N | N(m), metric, 3.30 to 4.90 GHz |
| 35UM48N | N(m), metric, 3.95 to 5.85 GHz |
| 35UM58N | N(m), metric, 4.90 to 7.05 GHz |
| 35UM70N | N(m), metric, 5.85 to 8.20 GHz |
| 35UM84N | N(m), metric, 7.05 to 10.00 GHz |
| 35UM100N | N(m), metric, 8.20 to 12.40 GHz |
| 35UM120N | N(m), metric, 10.00 to 15.00 GHz |
| 35UM140N | N(m), metric, 12.40 to 18.0 GHz |
| 35UM220K | K(m), metric, 17.00 to 26.5 GHz |
| 35UA229N | N(m), US, 3.30 to 4.90 GHz |
| 35UA187N | N(m), US, 3.95 to 5.85 GHz |
| 35UA159N | N(m), US, 4.90 to 7.05 GHz |
| 35UA137N | N(m), US, 5.85 to 8.20 GHz |
| 35UA112N | N(m), US, 7.05 to 10.00 GHz |
| 35UA90N | N(m), US, 8.20 to 12.40 GHz |
| 35UA75N | N(m), US, 10.00 to 15.00 GHz |
| 35UA62N | N(m), US, 12.40 to 18.0 GHz |
| 35UA42K | K(m), US, 17.00 to 26.5 GHz |

| Model/Order No. | Name |
|---|---|
| | **Coaxial adapter** |
| 35CMR229N | N(m), CMR, 3.30 to 4.90 GHz |
| 35CMR187N | N(m), CMR, 3.95 to 5.85 GHz |
| 35CMR159N | N(m), CMR, 4.90 to 7.05 GHz |
| 35CMR137N | N(m), CMR, 5.85 to 8.20 GHz |
| 35CMR112N | N(m), CMR, 7.05 to 10.00 GHz |
| 35CMR90N | N(m), CMR, 8.20 to 12.40 GHz |
| 35UER40N | N(m), UER, 3.30 to 4.90 GHz |
| 35UER48N | N(m), UER, 3.95 to 5.85 GHz |
| 35UER58N | N(m), UER, 4.90 to 7.05 GHz |
| 35UER70N | N(m), UER, 5.85 to 8.20 GHz |
| 35UER84N | N(m), UER, 7.05 to 10.00 GHz |
| 35UER100N | N(m), UER, 8.20 to 12.40 GHz |

# COAXIAL TERMINATIONS

28, 29 Series DC to 110 GHz


*28K50*


*28KF50*


*28V50B*


*29A50-20*


*28W50*


*28N50-2*

These precision, metrology-grade terminations are used in measurement systems that need to achieve the smallest possible reflections. Their excellent match makes them ideal as a reference for fault location measurements on scalar network analyzers.

## Precision termination features

- *Accurate reference for SWR measurements*
- *Precise termination for test instrument or device under test*

## Precision termination specifications

| Model | Frequency range (GHz) | Test port connector | Input impedance (Ω) | SWR (F in GHz) | Dimensions L(cm) x dia(cm) |
|---|---|---|---|---|---|
| 28A50-1 | DC to 18 | GPC-7 | 50 | 1.02 Max. | 5.2 x 2.2 |
| 28N50-2<br>28NF50-2 | DC to 18 | N(m)<br>N(f) | 50 | 1.02 Max. | 5.2 x 2.2<br>4.8 x 1.6 |
| 28N50-3<br>28NF50-3 | DC to 8 | N(m)<br>N(f) | 50 | 1.03 Max. | 5.2 x 2.2<br>4.8 x 1.6 |
| 28S50-1<br>28SF50-1 | DC to 26.5 | WSMA(m)<br>WSMA(f) | 50 | 1.020 to 18.5 GHz<br>1.153 to 26.5 GHz | 3.7 x 1.2<br>3.7 x 1.2 |
| 28K50<br>28KF50 | DC to 40 | K(m)<br>K(f) | 50 | 1.040 to 18.5 GHz<br>1.070 to 26.5 GHz<br>1.135 to 40 GHz | 3.7 x 1.2<br>3.7 x 1.2 |
| 28V50B<br>28VF50B | DC to 67 | V(m)<br>V(f) | 50 | 1.018 to 6 GHz<br>1.058 to 26.5 GHz<br>1.074 to 40 GHz<br>1.12 to 60 GHz<br>1.25 to 67 GHz | 3.7 x 1.2<br>3.7 x 1.2 |
| 28W50 | DC to 110 | W1(m) | 50 | 1.0458 to 20 GHz<br>1.058 to 65 GHz<br>1.33 to 110 GHz | 2.5 x 0.8 |
| 28WF50 | DC to 110 | W1(f) | 50 | 1.0515 to 20 GHz<br>1.0653 to 65 GHz<br>1.50 to 110 GHz | 2.5 x 0.8 |

**Maximum Input Power:** 0.5 W

When used with Anritsu airlines, the 29 Series Offset Terminations permit measurements down to 1.006 SWR to 18 GHz, 1.01 SWR to 26.5 GHz, and 1.02 SWR to 40 GHz.

## Offset termination features

- *50 Ω Offset Terminations for precise measurement of low SWR or high directivity*
- *Measurements down to 1.006 SWR to 18 GHz, 1.01 SWR to 26.5 GHz, and 1.02 SWR to 40 GHz*

## Offset termination specifications

| Model | Frequency range (GHz) | Test port connector | Return loss (dB) | Dimensions L(cm) x dia(cm) |
|---|---|---|---|---|
| 29A50-20 | DC to 18 | GPC-7 | 20 ±0.5 to 1 GHz<br>20 ±1.0 to 4 GHz<br>20 ±1.5 to 18 GHz | 5.2 x 2.2 |
| 29S50-20 | DC to 26.5 | WSMA(m) | 20 ±1.5 to 18.5 GHz<br>20 ±2.5 to 26.5 GHz | 3.7 x 1.2 |
| 29SF50-20 | DC to 26.5 | WSMA(f) | 20 ±1.5 to 18.5 GHz<br>20 ±2.5 to 26.5 GHz | 3.7 x 1.2 |
| 29K50-15 | DC to 40 | K(m) | 15 ±1.5 to 18.5 GHz<br>15 ±2.5 to 26.5 GHz<br>15 ±3.5 to 40 GHz | 3.7 x 1.2 |
| 29KF50-15 | DC to 40 | K(f) | 15 ±1.5 to 18.5 GHz<br>15 ±2.5 to 26.5 GHz<br>15 ±3.5 to 40 GHz | 3.7 x 1.2 |

**Temperature range:** +25°C ±5°C

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Precision termination** |
| 28A50-1 | DC to 18 GHz, 50 Ω, GPC-7, Max. SWR=1.02 |
| 28N50-2 | DC to 18 GHz, 40 dB, 50 Ω, N(m) |
| 28NF50-2 | DC to 18 GHz, 40 dB, 50 Ω, N(f) |
| 28N50-3 | DC to 8.6 GHz, 50 Ω, N(m) |
| 28NF50-3 | DC to 8.6 GHz, 50 Ω, N(f) |
| 28S50-1 | DC to 26.5 GHz, 50 Ω, WSMA(m) (selected for higher accuracy) |
| 28SF50-1 | DC to 26.5 GHz, 50 Ω, WSMA(f) (selected for higher accuracy) |
| 28K50 | DC to 40 GHz, 50 Ω, K(m) |
| 28KF50 | DC to 40 GHz, 50 Ω, K(f) |
| 28V50B | DC to 65 GHz, V(m) |
| 28VF50B | DC to 65 GHz, V(f) |
| 28W50 | DC to 110 GHz, 50 Ω, W1(m) |
| 28WF50 | DC to 110 GHz, 50 Ω, W1(f) |
| | **Offset termination** |
| 29A50-20 | DC to 18 GHz, 50 Ω, GPC-7, 20 dB return loss |
| 29S50-20 | DC to 26.5 GHz, 50 Ω, WSMA(m), 20 dB return loss |
| 29SF50-20 | DC to 26.5 GHz, 50 Ω, WSMA(f), 20 dB return loss |
| 29K50-15 | DC to 40 GHz, 50 Ω, K(m), 15 dB return loss |
| 29KF50-15 | DC to 40 GHz, 50 Ω, K(f), 15 dB return loss |

# COAXIAL TERMINATIONS

K210, V210  DC to 65 GHz


*K210*


*V210*

## Specifications

| Model | Frequency Range (GHz) | Test Port Connector | Input Impedance (Ω) | SWR |
|---|---|---|---|---|
| K210 | DC to 40 | K(m) | 50 | 1.106 to 18 GHz<br>1.253 to 40 GHz |
| V210 | DC to 65 | V(m) | 50 | 1.12 to 18 GHz<br>1.22 to 18-26.5 GHz<br>1.29 to 26.5-40 GHz<br>1.38 to 40-65 GHz |

**Maximum Input Power:** 0.5W

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| K210 | Coaxial Termination, DC to 40 GHz, K(m) |
| V210 | Coaxial Termination, DC to 65 GHz, V(m) |

## Coaxial Termination features

- *Accurate reference for SWR measurements*
- *Precise termination for test instrument or device under test*

# FIXED ATTENUATORS

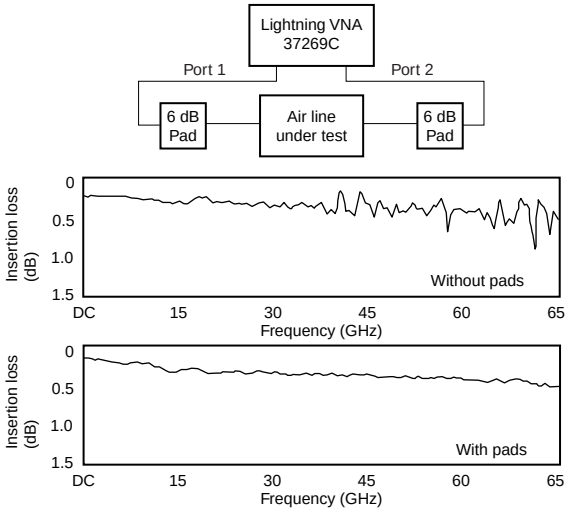
41, 43 Series DC to 65 GHz

*41V-10*

*43KC-10*

*41V-20*

*43KC-20*




*Improved Measured Accuracy*

Anritsu offers two series of fixed attenuators:

- *The Gold Line (Series 41) for precision measurement applications covering DC to 65 GHz*
- *The Silver Line (Series 43) for use in systems and OEM equipment covering DC to 40 GHz*

Both series offer fixed attenuation values of 3, 6, 10, or 20 dB with models that span frequency range of DC to 26.5 GHz, 40 GHz, or 65 GHz

## Features

- *3, 6, 10, or 20 dB Attenuation up to 65 GHz*
- *Low SWR, 1.28 Up to 40 GHz*
- *SMA, 3.5 mm, and 2.4 mm compatibility*
- *Rugged and reliable K Connector® and V Connector®*

## Advanced performance and reliability

Anritsu attenuators define the standard for fixed attenuator performance and reliability. Performance, however, is not their only distinguishing feature. Attenuators that use the K Connector® offer a vast improvement in reliability, compared to attenuators with SMA connectors. Attenuators that use the V Connector® can be connected directly to 2.4 mm devices.

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

The reliability of the attenuator connectors is affected by insertion force, outer conductor mating area, and mating alignment. The K Connector® is used because it has excellent performance in all of these areas. For example, a typical female SMA, 3.5 mm center conductor requires up to 27N* of insertion force compared to 2.2N* for the K Connector®. In addition, the K Connector® outer conductor is four times thicker than SMA, resulting in a conservative order-of-magnitude improvement in the number of reliable connections.

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

## Gold Line - improved measurement accuracy

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

## Silver Line - improved system reliability

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

The Series 43 (Silver Line) attenuator's small size, 8 mm dia. x 28.8 mm length, and light weight, 8g make them an attractive choice for miniaturized, lightweight systems.

* Force is measured in Newtons (N).

# FIXED ATTENUATORS

41, 43 Series DC to 65 GHz

## Common specifications

| | | |
|---|---|---|
| **Impedance** | | 50 Ω |
| **Power rating (average)** | | 2W at 20°C; 1W at 85°C |
| **Temperature coefficient** | | 0.001 dB/dB/°C |
| **Connectors** | **V Connector®** | Male and female compatible with 2.4 mm |
| | **K Connector®** | Male and female, compatible with SMA and 3.5 mm |
| **Material** | | Passivated stainless steel housing |
| **Size** | **Length** | 28.8 mm ±0.5 mm |
| | **Diameter** | 8 mm |
| **Weight** | | 8g |
| **Temperature range** | **Operating** | –55°C to +85°C |
| | **Nonoperating** | –55°C to +125°C |

## Specifications

| | Model① | Attenuation (dB) | Attenuation Accuracy | | | | SWR | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DC-18 GHz | 18-26.5 GHz | 26.5-40 GHz | 40-65 GHz | DC-12 GHz | 12-18 GHz | 18-26.5 GHz | 26.5-40 GHz | 40-65 GHz |
| Gold Line | **DC to 60 GHz** | | | | | | | | | | |
| | 41V-3 | 3 | ±0.5 | ±0.6 | ±0.9 | ±1.50 | 1.15 | 1.20 | 1.30 | 1.50 | 1.90 |
| | 41V-6 | 6 | ±0.5 | ±0.6 | ±0.9 | ±1.50 | 1.15 | 1.20 | 1.25 | 1.40 | 1.90 |
| | 41V-10 | 10 | ±0.5 | ±0.6 | ±0.9 | ±1.50 | 1.15 | 1.20 | 1.25 | 1.40 | 1.90 |
| | 41V-20 | 20 | ±0.5 | ±0.6 | ±0.9 | ±1.50 | 1.15 | 1.20 | 1.25 | 1.40 | 1.90 |
| | **DC to 40 GHz** | | | | | | | | | | |
| | 41KC-3 | 3 | ±0.4 | ±0.5 | ±0.8 | - | 1.10 | 1.15 | 1.23 | 1.42 | - |
| | 41KC-6 | 6 | ±0.4 | ±0.5 | ±0.8 | - | 1.10 | 1.15 | 1.18 | 1.28 | - |
| | 41KC-10 | 10 | ±0.4 | ±0.5 | ±0.8 | - | 1.10 | 1.15 | 1.18 | 1.28 | - |
| | 41KC-20 | 20 | ±0.4 | ±0.5 | ±0.8 | - | 1.10 | 1.15 | 1.18 | 1.28 | - |
| | **DC to 26.5 GHz** | | | | | | | | | | |
| | 41KB-3 | 3 | ±0.4 | ±0.5 | - | - | 1.10 | 1.15 | 1.23 | - | - |
| | 41KB-6 | 6 | ±0.4 | ±0.5 | - | - | 1.10 | 1.15 | 1.18 | - | - |
| | 41KB-10 | 10 | ±0.4 | ±0.5 | - | - | 1.10 | 1.15 | 1.18 | - | - |
| | 41KB-20 | 20 | ±0.4 | ±0.5 | - | - | 1.10 | 1.15 | 1.18 | - | - |

| | Model | Attenuation② (dB) | Attenuation Accuracy | | | | SWR | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DC-18 GHz | 18-26.5 GHz | 26.5-40 GHz | 40-60 GHz | DC-12 GHz | 12-18 GHz | 18-26.5 GHz | 26.5-40 GHz | 40-60 GHz |
| Silver Line | **DC to 40 GHz** | | | | | | | | | | |
| | 43KC-3 | 3 | ±0.5 | ±0.6 | ±0.9 | - | 1.15 | 1.20 | 1.30 | 1.50 | - |
| | 43KC-6 | 6 | ±0.5 | ±0.6 | ±0.9 | - | 1.15 | 1.20 | 1.30 | 1.40 | - |
| | 43KC-10 | 10 | ±0.5 | ±0.6 | ±0.9 | - | 1.15 | 1.20 | 1.30 | 1.40 | - |
| | 43KC-20 | 20 | ±0.5 | ±0.6 | ±0.9 | - | 1.15 | 1.20 | 1.30 | 1.40 | - |
| | **DC to 26.5 GHz** | | | | | | | | | | |
| | 43KB-3 | 3 | ±0.5 | ±0.6 | - | - | 1.15 | 1.20 | 1.30 | - | - |
| | 43KB-6 | 6 | ±0.5 | ±0.6 | - | - | 1.15 | 1.20 | 1.30 | - | - |
| | 43KB-10 | 10 | ±0.5 | ±0.6 | - | - | 1.15 | 1.20 | 1.30 | - | - |
| | 43KB-20 | 20 | ±0.5 | ±0.6 | - | - | 1.15 | 1.20 | 1.30 | - | - |

① For traceability, all Gold Line attenuators are serialized.
② ±1 dB from DC to 26.5 GHz; ±1.3 dB from >26.5 to 40 GHz, including frequency response and DC offset.

## Environmental information

Tests are performed per MIL-STD-202F.

| | |
|---|---|
| **Operating Temperature Range** | –55°C to +85° |
| **Temperature Shock** | –55°C to +150° |
| **Humidity** | 95% at 40°C, 96 hours, Test 103B, Condition B |
| **Shock** | 100 G peak sawtooth, method 213, Condition B |
| **Vibration** | Sinewave: 10 Hz to 2000 Hz, 0.06" DA, method 204, test condition D<br>Random: 50 Hz to 2000 Hz, 11.6 Grms, Power Spectral Density 0.1 Grms 2 Hz, Method 214, Test Condition 1, Letter D |
| **Salt Spray** | 5% concentration for 48 hours, Method 101D, Condition B |
| **Voltage withstanding** | 500 Vac RMS, 60 seconds, method 301 |

## Ordering information

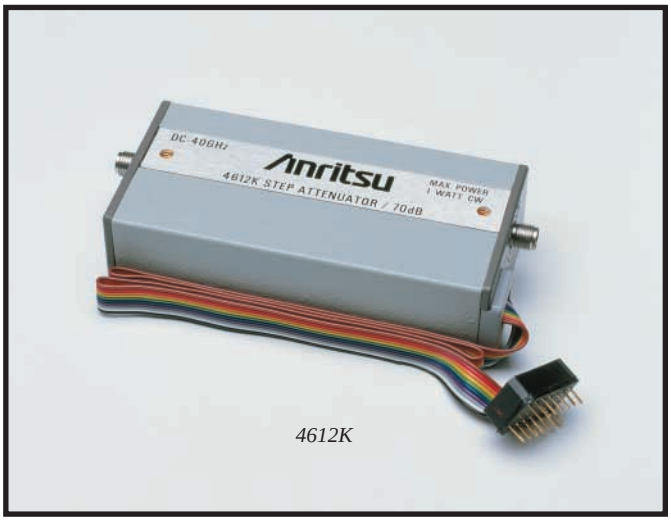
Please specify model/order number, name, and quantity when ordering. Single fixed attenuators may be ordered from the table above.

| Model/Order No. | Name |
|---|---|
| | **Precision Fixed Attenuator** |
| 41KB-3, 6, 10, or 20 | 3 dB, 6 dB, 10 dB, 20 dB, DC to 26.5 GHz, 50 Ω, K(m)-K(f) |
| 41KC-3, 6, 10, or 20 | 3 dB, 6 dB, 10 dB, 20 dB, DC to 40 GHz, 50 Ω, K(m)-K(f) |
| 41V-3, 6, 10, or 20 | 3 dB, 6 dB, 10 dB, 20 dB, DC to 65 GHz, 50 Ω, V(m)-V(f) |
| | **Precision Fixed Attenuator Set** |
| 41KB-S* | 41KB Series |
| 41KC-S* | 41KC Series |
| 41V-S* | 41V Series |
| | **Fixed Attenuator** |
| 43KB-3, 6, 10, or 20 | 3 dB, 6 dB, 10 dB, 20 dB, DC to 26.5 GHz, 50 Ω, K(m)-K(f) |
| 43KC-3, 6, 10, or 20 | 3 dB, 6 dB, 10 dB, 20 dB, DC to 40 GHz, 50 Ω, K(m)-K(f) |
| | **Option** |
| Option C** | Calibration Data |

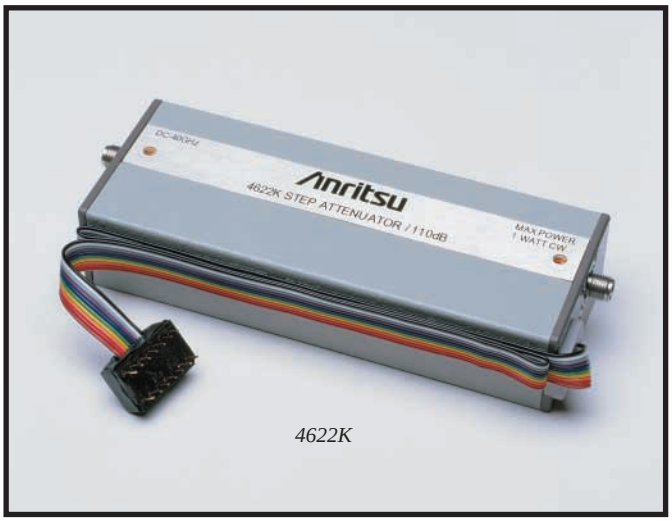
* A set of 3, 6, 10, and 20 dB Gold line (Series 41). Attenuators are supplied in a handsome hardwood case. Calibration data are included for each unit.
** Attenuation and SWR test data are provided for input and output ports at 500 MHz frequency intervals.

# STEP ATTENUATORS

4400, 4500, 4600 Series DC to 40 GHz




*4612K*




*4622K*

Anritsu programmable step attenuators bring a substantial increase in the frequency and attenuation range available in one small package. Using the latest technology, these units offer superior performance, reliability, and ease of use to 40 GHz. All are plug-compatible with competitive units.

## Features

- *DC-20 GHz, DC-26.5 GHz, DC-40 GHz*
- *70 dB and 110 dB attenuation ranges*
- *Lowest insertion loss*
- *Precise repeatability*
- *Life of 5 million operations*
- *Small, rugged, light weight*

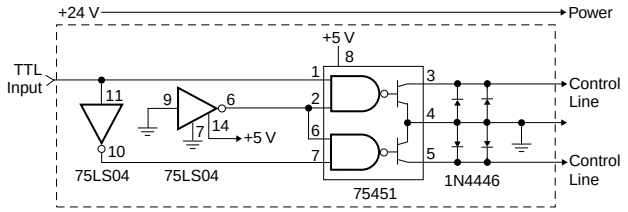
## Advanced technology-advanced performance

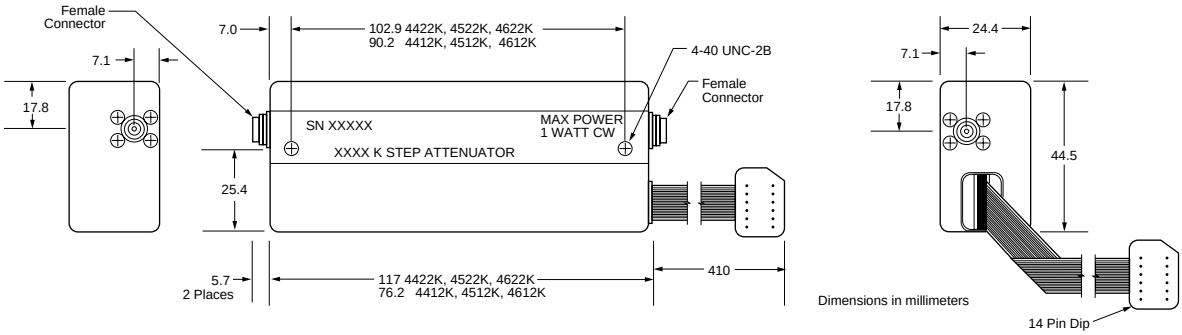
Anritsu has lowered throughline loss by designing the first 40 dB attenuator sections to operate above 18 GHz. Compared with designs that use 30 dB sections, these attenuators have a shorter thru path and fewer switching contacts. As a result, insertion loss is as much as 1.7 dB less than that of units made by other companies. RF input power requirements for systems that use these attenuators can be reduced, saving money, space, and weight.

## Integrated switching structure

The push rods that switch in the attenuator modules and thrulines are driven by a solenoid actuator. By designing the solenoid as an integral part of the attenuator assembly, switching speeds of 20 ms (including settling time) are achieved. Upon completion of the switching operation, the solenoid is magnetically latched to withstand severe shock and vibration. At the same time, the solenoid current is automatically turned off to save power and to minimize temperature rise.

Also integrated in the design is solid state dc switching circuitry that avoids the relatively high failure rate of mechanical DC switches. Each attenuator section is controlled by its own driver circuit, which requires 24V, 125 mA. A typical external driver circuit for one section is shown in the figure below.




*4400, 4500, and 4600 series outline*

# STEP ATTENUATORS

4400, 4500, 4600 Series DC to 40 GHz

## Accuracy enhancing calibration data

Attenuation accuracy can be improved by using optional calibration data taken on an Anritsu vector network analyzer. The calibration data can be used to normalize the effect of frequency response and reflections. The calibration data is traceable to NIST.

## Specifications

Frequency and attenuation ranges

| Model | Frequency range | Attenuation range in 10 dB steps | Connectors |
|---|---|---|---|
| 4412K<br>4422K | DC to 20 GHz | 0 to 70 dB<br>0 to 110 dB | K(f) |
| 4512K<br>4522K | DC to 26.5 GHz | 0 to 70 dB<br>0 to 110 dB | K(f) |
| 4612K<br>4622K | DC to 40 GHz | 0 to 70 dB<br>0 to 110 dB | K(f) |

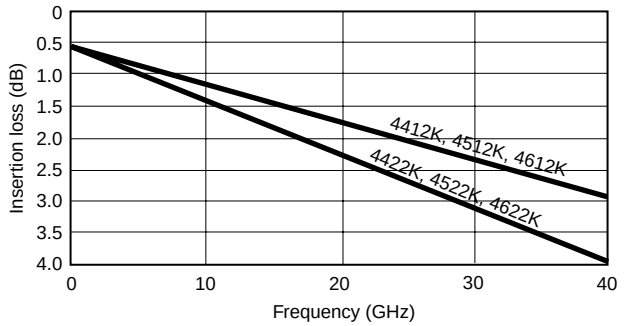
## Attenuator accuracy (± dB)

| Frequency (GHz) | Attenuation (dB) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80-110 |
| DC to 8 | 0.3 | 0.5 | 0.6 | 0.7 | 0.8 | 1.0 | 1.1 | 1.4 |
| >8 to 12 | 0.4 | 0.5 | 0.7 | 0.9 | 1.0 | 1.3 | 1.5 | 2.0 |
| >12 to 20 | 0.5 | 0.6 | 0.8 | 1.1 | 1.2 | 1.4 | 1.7 | 2.2 |
| >20 to 26.5 | 0.7 | 0.8 | 1.0 | 1.5 | 1.6 | 1.9 | 2.3 | 2.8 |
| >26.5 to 40 | 0.9 | 1.0 | 1.2 | 1.7 | 1.9 | 2.3 | 2.6 | 3.2 |

## Electrical

| | |
|---|---|
| **Switching speed (maximum)** | 20 ms |
| **Operating voltage** | 20 to 30 Volts |
| **Switching control current** | 125 mA at 24V nominal per section<br>3 sections in 4412K, 4512K, 4612K<br>4 sections in 4422K, 4522K, 4622K |
| **Solenoid coil impedance** | 190 Ω |
| **Solenoid coil inductance** | 65 mH |
| **RF input power (maximum)** | 1W average, 100W peak for 10 µs |
| **RF power sensitivity** | 0.001 dB/W |
| **Life (minimum operations per section)** | 5 million |
| **Repeatability (typical after 1 million operations)** | ±0.03 dB to 18 GHz<br>±0.05 dB to 26.5 GHz<br>±0.08 dB to 40 GHz |

## Insertion loss (maximum)




## Impedance match

| Frequency (GHz) | Return loss (dB) | SWR |
|---|---|---|
| DC to 8 | 19 | 1.25 |
| >8 to 12 | 14 | 1.5 |
| >12 to 20 | 12.7 | 1.6 |
| >20 to 26.5 | 11 | 1.8 |
| >26.5 to 40 | 9 | 2.1 |

## Mechanical

| | |
|---|---|
| **Weight** | 4412K, 4512K, 4612K: 170g<br>4422K, 4522K, 4622K: 213g |
| **Mounting position** | Any |
| **RF connectors** | K Connectors, female, in-line |
| **Programming connector** | 14 pin DIP |
| **Programming cable length** | 406 mm |

## Environment

| | | |
|---|---|---|
| **Temperature** | Operating: | 0C to +70C |
| | Non-operating: | -55C to +85C |
| **Altitude** | Operating: | 4.6 km (440 mm Hg) |
| | Non-operating: | 15 km |
| **Shock** | Operating: | 10g, 6 ms, on 6 sides, 3 blows |
| | Non-operating: | 500g, 1.8 ms, in 6 directions |
| **Humidity** | | 0 to 95% relative humidity |
| **EMC** | | Mil-Std-461, Method RE02, VDE 0871, CISPR#2 |

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| 4412K | Step Attenuator, DC to 20 GHz, 70 dB |
| 4512K | Step Attenuator, DC to 26.5 GHz, 70 dB |
| 4612K | Step Attenuator, DC to 40 GHz, 70 dB |
| 4422K | Step Attenuator, DC to 20 GHz, 110 dB |
| 4522K | Step Attenuator, DC to 26.5 GHz, 110 dB |
| 4622K | Step Attenuator, DC to 40 GHz, 110 dB |
| | **Options** |
| Option C* | Calibration Data (4412K, 4512K, 4612K) |

*Calibration data is taken every 100 MHz from DC to 900 MHz and every 500 MHz from 1 GHz to 40 GHz.

# SWR BRIDGES

87 Series 2 to 18 GHz

*87A50*

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

## Features

- *Broadband 2 to 18 GHz frequency range*
- *High 38 dB directivity*
- *Precise GPC-7 test port connector*
- *Built-in reference termination*

## Specifications

| Model | Directivity (dB) | Accuracy① | | |
|---|---|---|---|---|
| | | 2 to 3 GHz | 3 to 4 GHz | 4 to 18 GHz |
| 87A50 | 35 | $0.018 + 0.32\rho^2$ | $0.018 + 0.23\rho^2$ | $0.018 + 0.015\rho^2$ |
| 87A50-1 | 38 | $0.013 + 0.32\rho^2$ | $0.013 + 0.23\rho^2$ | $0.013 + 0.015\rho^2$ |

| | |
|---|---|
| **Frequency range** | 2 to 18 GHz |
| **Insertion loss** | 6.5 dB nominal② |
| **Maximum input power** | 0.5W |
| **Test port connector** | GPC-7 |
| **Input and output connector** | Type N(f) |
| **Dimensions** | 7.3 x 5.2 x 2.9 cm plus connectors |
| **Weight** | 340g |

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

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| 87A50 | SWR Bridge, 2 to 18 GHz, GPC-7, 35 dB directivity |
| 87A50-1 | SWR Bridge, 2 to 18 GHz, GPC-7, 38 dB directivity |

**Temperature range:** +25°C ±5°C

# SWR AUTOTESTERS

97 Series and 560-97, 560-98 Series 10 MHz to 50 GHz




The Series 97, 560-97 and 560-98 SWR Autotesters integrate a high directivity bridge, a detector, a low reflection test port, and a precision reference termination. The 560-97 and -98 Series units are broadband microwave measurement components that are used with the Model 56100A Scalar Network Analyzer and with Series 54100A Scalar Measurement System for making fixed-frequency and swept-frequency return loss (SWR) measurements. Return loss measurements are used over a wide range of radio and microwave frequencies to check the performance of systems, subsystems, and microwave components such as amplifiers, directional couplers, attenuators, filters, splitters, and terminations.

## 560-97, 98 Series SWR autotester features

- *Up to 40 dB directivity*
- *10 MHz to 50 GHz range*
- *Test port connectors to fit most measurement applications; avoids use of adapters*

## 97 Series SWR autotester features

- *High 40 dB directivity*
- *Low test port reflections*
- *Broadband 10 MHz to 18 GHz frequency range*
- *Small package including bridges, termination, and detector*
- *Selection of GPC-7, WSMA, or Type N test port connectors*

## Specifications

| Models | Directivity (dB) | Accuracy① | | Frequency Sensitivity (dB) | Test Port Connection | Physical |
|---|---|---|---|---|---|---|
| 97 Series SWR Autotesters, 10 MHz to 18 GHz② | | | | | | |
| | | 10 MHz-8 GHz | 8-18 GHz | | | |
| 97A50 | 36 | 0.016 ±0.06ρ² | 0.016 ±0.10ρ² | ±1.5 max. | GPC-7 | |
| 560-97 Series SWR Autotesters, 10 MHz to 18 GHz② | | | | | | |
| | | 0.01-8 GHz | 8-18 GHz | | | |
| 560-97A50 | 36 | 0.013 ±0.08ρ² | 0.016 ±0.10ρ² | ±1.2 | GPC-7 | Dimensions③ 7.6 x 5 x 2.8 cm plus connectors Weight: 340 g |
| 560-97A50-1 | 40 | 0.010 ±0.06ρ² | 0.010 ±0.10ρ² | ±1.2 | GPC-7 | |
| 560-97N50<br>560-97NF50 | 35 | 0.018 ±0.08ρ² | 0.018 ±0.12ρ² | ±1.5 | Type N (m)<br>Type N (f) | |
| 560-97N50-1<br>560-97NF50-1 | 38 | 0.013 ±0.08ρ² | 0.013 ±0.12ρ² | ±1.5 | Type N (m)<br>Type N (f) | |

① Where ρ is the reflection coefficient being measured. Accuracy includes the effects of test port reflections and directivity.
② Input Connector: Type N Female
③ Plus connectors and cable

**Temperature range:** +25°C ±5°C

Continued on next page

# SWR AUTOTESTERS

97 Series and 560-97, 560-98 Series 10 MHz to 50 GHz

| Models | Directivity (dB) | Accuracy① | | | | Freq. Sensitivity (dB) | Test Port Connection | Physical |
|---|---|---|---|---|---|---|---|---|
| 560-98 Series SWR Autotesters, 10 MHz to 40 GHz② | | | | | | | | |
| | | 0.01-8 GHz | 8-18 GHz | 18-26.5 GHz | 26.5-40 GHz | | | |
| 560-98S50<br>560-98SF50 | 37<br>36 | | 0.014 ±0.01ρ² | 0.016 ±0.13ρ² | | ±2.0 | WSMA (m)<br>WSMA (f) | Dimensions④:<br>1.9 x 3.8 x 2.9 cm<br>Weight: 198 g |
| 560-98S50-1<br>560-98SF50-1 | 40<br>38 | 0.010 ±0.07ρ² | 0.010 ±0.01ρ² | 0.013 ±0.13ρ² | | ±2.0 | WSMA (m)<br>WSMA (f) | |
| 560-98K50<br>560-98KF50 | 35<br>32<br>30 | 0.018 ±0.07ρ² | 0.018 ±0.07ρ² | 0.026 ±0.15ρ² | 0.032 ±0.18ρ² | ±3.0 | Type K (m)<br>Type K (f) | |
| 560-98 Series SWR Autotesters, 10 MHz to 50 GHz③ | | | | | | | | |
| | | 0.01-50 GHz | | | | | | |
| 560-98VA50<br>560-98VFA50 | 30 | 0.032 ±0.11ρ² | | | | ±4.0 | Type V (m)<br>Type V (f) | Dimensions④:<br>2.2 x 6.6 x 5.3 cm<br>Weight: 198 g |
| 560-97, 560-98 Offset SWR autotesters, 10 Mhz to 40 GHz | | | | | | | | |
| | | 500 MHz-18 GHz⑤ | | | | ±2.5 | | Dimensions④:<br>7.6 x 5.1 x 2.8 cm<br>Weight: 340 g |
| 560-97A50-20 | 20 | 0.0015 | | | | | GPC-7 | |
| | | 800 MHz-40 GHz⑥ | | | | | | Dimensions④:<br>2.2 x 6.6 x 5.3 cm<br>Weight: 198 g |
| 560-98KF50-15 | 15 | 0.0100 | | | | ±4.0 | Type K (m) | |

**All Models:**

Input Port Impedance: 50Ω
Insertion Loss (from input to test port): 6.5 dB nominal
Detector Output Polarity: Negative
Output Time Constant: 2 ms
Maximum Power Input: 0.5 watts (+27 dBm) (560-98C50A: +24 dBm)
Cable Length: 122 cm (4 ft.)

① Where ρ is the reflection coefficient being measured. Accuracy includes the effects of test port reflections and directivity.
② Input Connector: Ruggedized Type K Female
③ Input Connector: Ruggedized Type V Female
④ Plus connectors and cable
⑤ When used with 18A50 Airline
⑥ When used with 19K50 Airline

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **SWR Autotester** |
| 97A50 | 10 MHz to 18 GHz, GPC-7, 36 dB directivity |
| 560-97A50 | 10 MHz to 18 GHz, GPC-7, 50 Ω, 36 dB directivity |
| 560-97A50-1 | 10 MHz to 18 GHz, GPC-7, 50 Ω, 40 dB directivity |
| 560-97N50 | 10 MHz to 18 GHz, N(m), 50 Ω, 35 dB directivity |
| 560-97N50-1 | 10 MHz to 18 GHz, N(m), 50 Ω, 38 dB directivity |
| 560-97NF50 | 10 MHz to 18 GHz, N(f), 50 Ω, 35 dB directivity |
| 560-97NF50-1 | 10 MHz to 18 GHz, N(f), 50 Ω, 38 dB directivity |

| Model/Order No. | Name |
|---|---|
| | **SWR Autotester** |
| 560-98S50 | 10 MHz-26.5 GHz, WSMA(m), 50 Ω, directivity = 37 dB (<18 GHz), 36 dB (18 GHz) |
| 560-98S50-1 | 10 MHz-26.5 GHz, WSMA(m), 50 Ω, directivity = 40 dB (<18 GHz), 38 dB (18 GHz) |
| 560-98SF50 | 10 MHz-26.5 GHz, WSMA(f), 50 Ω, directivity = 37 dB (< 18 GHz), 36 dB (18 GHz) |
| 560-98SF50-1 | 10 MHz-26.5 GHz, WSMA(f), 50 Ω, directivity = 40 dB (< 18 GHz), 38 dB (18 GHz) |
| 560-98K50 | 10 MHz-40 GHz, K(m), 50 Ω, directivity = 35 dB (<18 GHz), 32 dB (18 to 26.5 GHz), 30 dB (26.5 GHz) |
| 560-98KF50 | 10 MHz-40 GHz, K(f), 50 Ω, directivity = 35 dB (<18 GHz), 32 dB (18 to 26.5 GHz), 30 dB (26.5 GHz) |
| 560-98VA50 | 10 MHz-50 GHz, V(m), 50 Ω, directivity = 36 dB (<20 GHz), 30 dB (20 GHz) |
| 560-98VFA50 | 10 MHz-50 GHz, V(m), 50 Ω, directivity = 36 dB (<20 GHz), 30 dB (20 GHz) |
| | **Offset SWR Autotester** |
| 560-97A50-20 | 10 MHz to 18 GHz, GPC-7, 20 dB offset reference in bridge |
| 560-98KF50-15 | 10 MHz to 40 GHz, K(f), 15 dB offset reference in bridge |

# SWR AUTOTESTERS

5400-6 Series 1 MHz to 3000 MHz

*5400-6N50*

*5400-6NF50*

The 5400-6 Series SWR Autotesters integrate a high directivity bridge, a detector, a low reflection test port, a precision reference termination, and a connecting cable. They are used with the Model 56100A Scalar Network Analyzers and with Series 54100A Scalar Measurement Systems for making fixed-frequency and swept-frequency return loss (SWR) measurements. Return loss measurements are used over a wide range of radio and microwave frequencies to check the performance of systems, subsystems, and microwave components such as amplifiers, directional couplers, attenuators, filters, splitters, and terminations.

## Features

- *40 dB directivity.*
- *1 MHz to 3000 MHz range*
- *F, N, or BNC type test port connectors*

## Specifications

| Models | Directivity (dB) | Accuracy① | | | Test Port Connection | Physical |
|---|---|---|---|---|---|---|
| 5400-67FF75②⑤ | 40 | 10-1000 MHz<br>0.010 ±0.01ρ² | | | F (f) | |
| 5400-6B50B③<br>5400-6BF50B③ | 40 | 1-1500 MHz<br>0.010 ±0.01ρ² | | | BNC (m)<br>BNC (f) | Dimensions④:<br>2.5 x 5.1 x 7.0 cm<br>Weight: 255 g |
| 5400-6B75B③⑤<br>5400-6BF75B③⑤ | 40 | 0.010 ±0.10ρ² | | | BNC (m)<br>BNC (f) | |
| 5400-6N50③<br>5400-6NF50③ | 40 | 1-1000 MHz<br>0.010 ±0.05ρ² | 1000-3000 MHz<br>0.010 ±0.05ρ² | 2000-3000 MHz<br>0.010 ±0.05ρ² | Type N (m)<br>Type N (f) | |
| 5400-6N75③⑤<br>5400-6NF75③⑤ | 40 | 0.010 ±0.05ρ² | 0.010 ±0.05ρ² | 0.010 ±0.05ρ² | Type N (m)<br>Type N (f) | |

**All Models:**

Input Port Impedance: 50Ω (Except as Noted)
Insertion Loss (from input to test port): 6.5 dB nominal
Detector Output Polarity: Negative
Output Time Constant: 2 ms
Maximum Power Input: 0.5 watts (+27 dBm)
Cable Length: 122 cm (4 ft.)

① Where ρ is the reflection coefficient being measured. Accuracy includes the effects of test port reflections and directivity.
② Input Connector: BNC Female
③ Input Connector: Type N Female
④ Plus connectors and cable
⑤ Impedance 75Ω

**Temperature range:** +25°C ±5°C

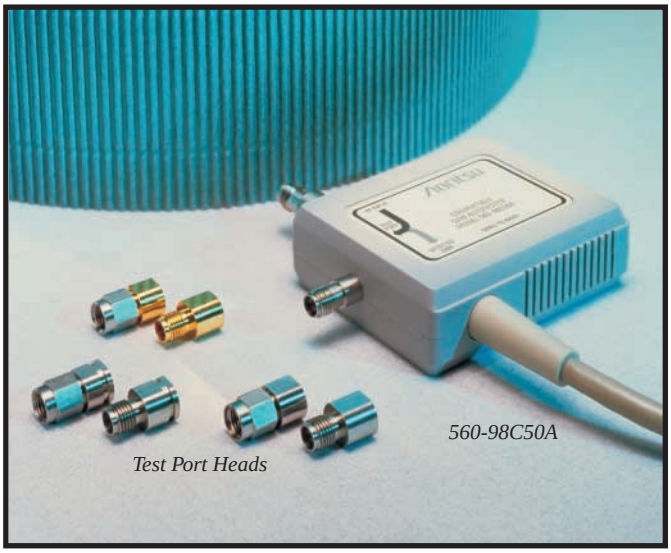
## Ordering information

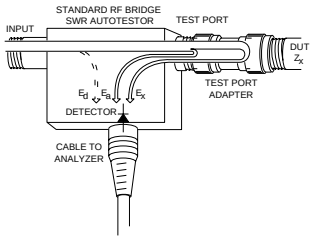
Please specify model/order number, name, and quantity when ordering.

| Model/Order No. | Name |
|---|---|
| | **SWR Autotester** |
| 5400-6N50 | 1 to 3000 MHz, Type N(m), 50 Ω 40 dB Directivity |
| 5400-6N75 | 1 to 3000 MHz, Type N(m), 75 Ω |
| 5400-6NF50 | 1 to 3000 MHz, Type N(f), 50 Ω |
| 5400-6NF75 | 1 to 3000 MHz, Type N(f), 75 Ω |

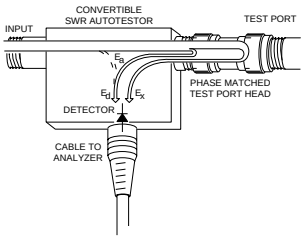
# CONVERTIBLE SWR AUTOTESTER

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.

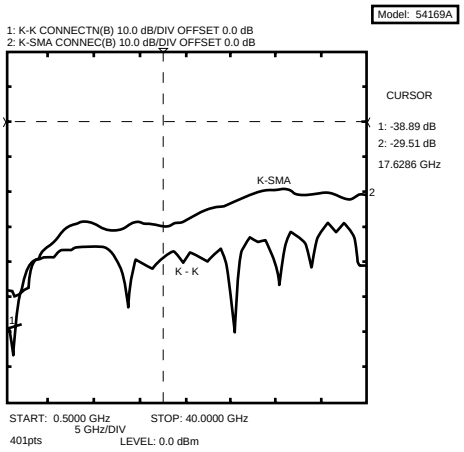
## Adapter errors

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*

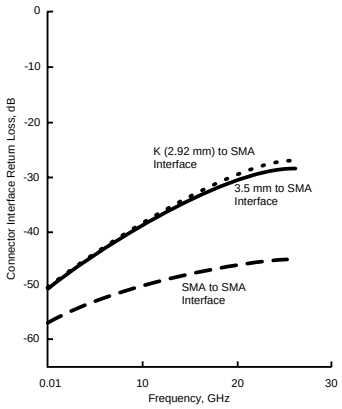
The above graph illustrates the degradation to directivity when a K Connector® test port is used to measure a precision SMA device. A 3.5 mm interface causes similar errors. The directivity was measured using the precision return loss mode on a 54100A Series Network Analyzer.

# CONVERTIBLE SWR AUTOTESTER

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

## 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<br>> 32 dB 20.0 to 26.5 GHz<br>> 29 dB 26.5 to 40.0 GHz |
| **Test Port Match** | > 21 dB 0.01 to 20.0 GHz<br>> 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<br>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.

# AIRLINES

18, 19 Series 2 to 40 GHz

*18N50*

*18A50*

*19S50*

The 18 and 19 Series Precision Airlines are the most accurate impedance standards available today, and they are the recognized traceability path for impedance at high frequencies. Anritsu airlines are a critical component when measuring accurate impedances, enabling measurements down to 1.006 SWR to 18 GHz,1.01 SWR to 26.5 GHz, and 1.02 SWR to 40 GHz.

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

## Features

- *Plating is gold over nickel*
- *Provide impedance traceability to NIST*
- *Enable measurements down to 1.006 SWR to 18 GHz, 1.01 SWR to 26.5 GHz, and 1.02 SWR to 40 GHz*

## Specifications

| Model | Frequency range (GHz) | Test port connector | Beaded port connector | SWR (test port) | Dimensions L(cm) x dia(cm) |
|---|---|---|---|---|---|
| 18A50 | 0.5 to 18 | GPC-7 | GPC-7 | 1.003 | 30 x 0.7 |
| 18N50<br>18NF50 | 0.5 to 18 | N(m)<br>N(f) | GPC-7 | 1.006 | 30 x 0.7 |
| 19S50<br>19SF50 | 0.8 to 26.5 | WSMA(m)<br>WSMA(f) | WSMA(m) | 1.006 to 18 GHz<br>1.010 to 26.5 GHz | 25 x 0.35 |
| 19K50<br>19KF50 | 0.8 to 40 | K(m)<br>K(f) | K(m) | 1.020 | 15 x 0.29 |

**Temperature range:** +25°C ±5°C

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Precision Air Line** |
| 18A50 | 0.5 to 18 GHz, 50 Ω, GPC-7 |
| 18N50 | 0.5 to 18 GHz, 50 Ω, N (m) |
| 18NF50 | 0.5 to 18 GHz, 50 Ω, N (f) |
| 19K50 | 0.8 to 40 GHz, 50 Ω, K(m) |
| 19KF50 | 0.8 to 40 GHz, 50 Ω, K(f) |
| 19S50 | 0.8 to 26.5 GHz, 50 Ω |
| 19SF50 | 0.8 to 26.5 GHz, 50 Ω |

# OPEN/SHORTS

22 Series DC to 50 GHz

*22K50*

*22KF50*

The 22 Series Open/Shorts are used on the test port of an SWR Autotester or SWR bridge to establish a full reflection reference for accurate SWR measurements. When used with scalar network analyzers, the open and short reflections over a swept frequency range can be automatically averaged to enhance measurement accuracy. All models consist of an open on one end and a short on the other.

## Features

- *Single Gold Plated Component providing full open and short reflections for accurate SWR measurements*
- *DC to 50 GHz frequency coverage*
- *GPC-7, Type N, WSMA, K Connectors® and V Connectors®*
- *50 Ω or 75 Ω impedance*

## Specifications

| Model | Frequency range (GHz) | Test port connector | Characteristic impedance (Ω) | Dimensions L(cm) x dia(cm) |
|---|---|---|---|---|
| 22N75<br>22NF75 | DC to 2 | N(m)<br>N(f) | 75 | 6.3 x 1.8<br>4.9 x 1.6 |
| 22N50<br>22NF50 | DC to 18 | N(m)<br>N(f) | 50 | 6.3 x 1.8<br>4.9 x 1.6 |
| 22A50 | DC to 18 | GPC-7 | 50 | 3.8 x 1.6 |
| 22S50<br>22SF50 | DC to 26.5 | WSMA(m)<br>WSMA(f) | 50 | 4.2 x 0.8<br>3.5 x 0.8 |
| 22K50<br>22KF50 | DC to 40 | K(m)<br>K(f) | 50 | 4.2 x 0.8<br>3.5 x 0.8 |
| 22V50<br>22VF50 | DC to 50 | V(m)<br>V(f) | 50 | 3.6 x 0.8<br>2.8 x 0.8 |

**Temperature range:** +25°C ±5°C

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Open/Short** |
| 22N50 | DC to 18 GHz, N(m), 50 Ω |
| 22NF50 | DC to 18 GHz, N(f), 50 Ω |
| 22N75 | DC to 3 GHz, N(m), 75 Ω |
| 22NF75 | DC to 3 GHz, N(f), 75 Ω |
| 22A50 | DC to 18 GHz, GPC-7 connector, 50 Ω |
| 22K50 | DC to 40 GHz, K(m), 50 Ω |
| 22KF50 | DC to 40 GHz, K(f), 50 Ω |
| 22S50 | DC to 26.5 GHz, WSMA(m), 50 Ω |
| 22SF50 | DC to 26.5 GHz, WSMA(f), 50 Ω |
| 22V50 | DC to 50 GHz, V(m), 50 Ω |
| 22VF50 | DC to 50 GHz, V(f), 50 Ω |

# OPEN/SHORTS/LOADS

OSL Series DC to 4 GHz


*OSLN50LF*

The OSL series open/short/load are used on the test port of the Site Master™ Series of handheld instruments to establish a reference for accurate measurement. When used with a Site Master, the open/short and load reflection over a swept frequency range can be automatically averaged to enhance measurement accuracy. OSL series Open/short/load comes in both N(Male) and N (Female) connector configuration and consist open on one end, short on other and Load on the tee section.

## Features

- *Single Nickel Plated Component providing full open, short and load reflections for accurate measurements.*
- *DC to 4 GHz frequency coverage*
- *Type N(Male) and N(Female) connector configuration*
- *50 Ω Impedence*

## Specifications

| Model | Frequency range (GHz) | Test port connector | Characteristic impedance (Ω) |
|---|---|---|---|
| OSLN50LF | DC to 4 | N(m) | 50 |
| OSLNF50LF | DC to 4 | N(f) | 50 |

**Temperature range:** +25°C ±5°C

## Ordering information

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

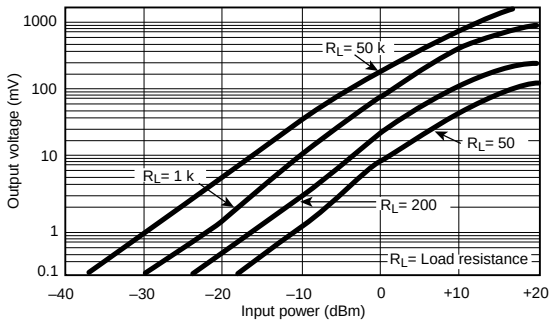
| Model/Order No. | Name |
|---|---|
| | **Open/Short/Load** |
| OSLN50LF | DC to 4 GHz, N(m), 50 Ω |
| OSLNF50LF | DC to 4 GHz, N(f), 50 Ω |

# MICROWAVE DETECTORS

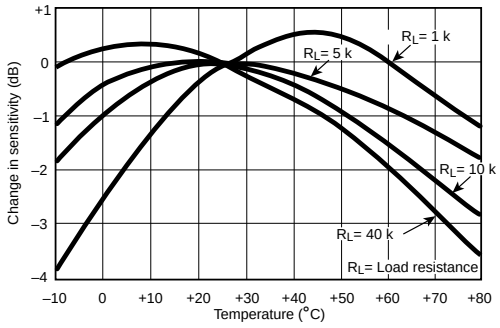
70, 75 Series 100 kHz to 50 GHz

*70KA50*

*75N50B*




*Typical sensitivity*




*Typical sensitivity change*

Within the 70 or 75 Series product lines, you will find a model that matches your needs for instrumentation, system, or OEM applications. By using the latest design and microelectronics production technologies, Anritsu low-barrier Schottky-diode detectors outperform others and offer significant cost savings. Input connector types include Type N, and K Connector® (compatible with SMA and 3.5 mm), and V Connector® (compatible with 2.4 mm). In addition to frequency coverage and price, these detectors are distinguished by their low SWR, flat frequency response, and close output-voltage tracking over a wide dynamic range.

## Features

- *Broadband coverage, 10 MHz to 50 GHz with a Single Detector*
- *K Connector® compatible with SMA and 3.5 mm*
- *V Connector® compatible with 2.4 mm*
- *Lowest SWR: 1.33 to 20 GHz, 1.5 to 40 GHz*
- *Flat Response: ±0.5 dB to 20 GHz ±1.5 dB to 40 GHz*
- *Best Value for Instrumentation, system, and OEM applications*
- *Low price and availability from stock*

# MICROWAVE DETECTORS

70, 75 Series 100 kHz to 50 GHz

## Specifications

| Model | Frequency range | Flatness (dB) | Connectors | | Impedance (Ω) | SWR (Maximum) | Low level sensitivity at –30 dBm (mV/μW) | High level sensitivity at +13 dBm (Volts, Min.) | Input maximum (mW) | Output capacitance (pF) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | In | Out | | | | | | |
| 70KA50 | 0.01 to 20 GHz | ±0.6 | K(m) | SMC(f) | 50 | 1.33 | 0.6 | 1 | 100 | 30 |
| 70KC50 | 0.01 to 40 GHz | ±0.5 to 20 GHz<br>±1.0 to 26.5 GHz<br>±1.5 to 40 GHz | K(m) | SMC(f) | 50 | 1.33 to 20 GHz<br>1.50 to 26.5 GHz<br>1.90 to 40 GHz | 0.4 | 1 | 100 | 30 |
| 75N50B | 0.01 to 18 GHz | ±0.3 to 12.4 GHz<br>±0.6 to 18 GHz | N(m) | BNC(f) | 50 | 1.15 to 4.5 GHz<br>1.30 to 15 GHz<br>1.39 to 18 GHz | 0.35 | 1 | 100 | 30 |
| 75KC50 | 0.01 to 40 GHz | ±0.5 to 20 GHz<br>±1.0 to 26.5 GHz<br>±1.5 to 40 GHz | K(m) | BNC(f) | 50 | 1.33 to 20 GHz<br>1.50 to 26.5 GHz<br>1.90 to 40 GHz | 0.4 | 1 | 100 | 30 |
| 75VA50 | 0.01 to 50 GHz | ±0.5 to 20 GHz<br>±1.0 to 26.5 GHz<br>±1.5 to 40 GHz<br>±3 to 50 GHz | V(m) | BNC(f) | 50 | 1.33 to 20 GHz<br>1.50 to 26.5 GHz<br>1.90 to 40 GHz<br>2.1 to 50 GHz | 0.4 | 1 | 100 | 30 |

## Dimensions

| Model | Dimensions L(cm) x dia(cm) |
|---|---|
| 70KA50 | 4.6 x 1.0 |
| 70KC50 | 4.6 x 1.0 |
| 75N50B | 6.4 x 1.8 |
| 75KC50 | 4.6 x 1.0 |
| 75VA50 | 4.6 x 1.0 |

## Ordering information

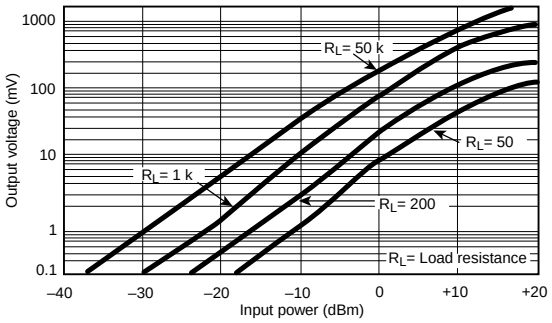
Please specify model/order number, name, and quantity when ordering.

| Model/Order No. | Name |
|---|---|
| | **Microwave Detector** |
| 70KA50 | 10 MHz to 20 GHz, K(m) input, SMC(f) output, 50 Ω |
| 70KC50 | 10 MHz to 40 GHz, K(m) input, SMC(f) output, 50 Ω |
| 75KC50 | 10 MHz to 40 GHz, K(m) input, BNC(f) output, 50 Ω |
| 75N50B | 10 MHz to 18 GHz, N(m) input, BNC(f) output, 50 Ω |
| 75VA50 | 10 MHz to 50 GHz, V(m) input, BNC(f) output, 50 Ω |
| | **Options** |
| Option 2 (75KC50) | Matching frequency response of two detectors |
| Option 3 (75KC50) | Matching frequency response of three detectors |

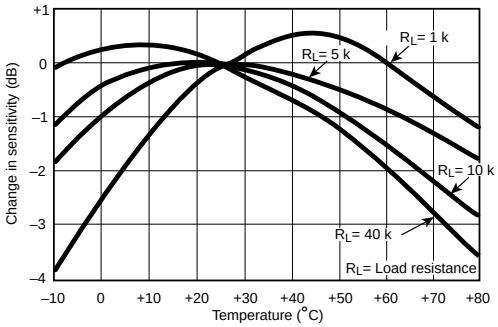
* Upper frequency limit (GHz): ≤8, ≤12.4, ≤18, ≤26.5, ≤40

** Frequency response tracking (dB): ±0.2, ±0.3, ±0.6, ±0.8, ±1.2

# FIELD REPLACEMENT DIODE MODULE


*Typical sensitivity*




*Typical sensitivity change*

Field replaceable diode modules provide field replacements for damaged diodes, virtually eliminating down time. To avoid all degradation in performance when a diode is replaced in the field, all replacement modules include the thin-film matching circuit. Performance after replacement cannot be distinguished from that of a new detector.

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Diode module** |
| 10-108 | 71 & 73 Series |
| 10-75 | 75A50 |
| A16176 | 70K Series (>=20 GHz) and 75K Series (>=20 GHz) |
| A16177 | 70K Series (<=20 GHz) and 75K Series (<=20 GHz) |
| A18735 | 74N50B |
| B16132 | 75N50B |

# MICROWAVE DETECTORS

5400-71, 560-7 Series 1 MHz to 50 GHz


*5400-71N50*

The Anritsu 560-7 and 5400-71 Series RF Detectors are used with the Model 56100A Scalar Network Analyzer and with Series 54100A Scalar Measurement System for making coaxial transmission loss or gain and power measurements. They are also used with the Site Master® and Cable Mate® Series Personal SWR/RL and Fault Location Testers for making power measurements.

## Features

- *Zero-biased Schottky diodes*
- *–55 dBm to +16 dBm range*

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Microwave Detector** |
| 5400-71N50 | 1 to 3000 MHz, N(m), 50 Ω |
| 5400-71N75 | 1 MHz to 3 GHz, N(m), 75 Ω |
| 5400-71N75L | 0.005 to 1.2 GHz, N(m), 75 Ω |
| 560-7A50 | 10 MHz to 18 GHz, GPC-7, 50 Ω |
| 560-7K50 | 10 MHz to 40 GHz, K(m), 50 Ω |
| 560-7N50B | 10 MHz to 20 GHz, N(m), 50 Ω |
| 560-7S50-2 | 10 MHz to 26.5 GHz, WSMA(m), 50 Ω |
| 560-7S50B | 10 MHz to 20 GHz, WSMA(m), 50 Ω |
| 560-7VA50 | 10 MHz to 50 GHz, V(m), 50 Ω |

**Temperature range:** 0°C to +70°C

## Specifications*

| 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<br>±0.3 dB, <3 GHz |
| 5400-71N75 | 0.001 to 3 GHz | 75 Ω | 26 dB, <2 GHz<br>20 dB, <3 GHz | N(m) | ±0.2 dB, <1 GHz<br>±0.5 dB, <3 GHz |
| 5400-71N75L** | 0.005 to 1.2 GHz | 75 Ω | 24 dB | N(m) | ±0.2 dB, <1 GHz<br>±0.5 dB, <1.2 GHz |
| 560-7A50 | 0.01 to 18 GHz | 50 Ω | 15 dB, <0.04 GHz<br>22 dB, <8 GHz<br>17 dB, <18 GHz | GPC-7 | ±0.5 dB, 18 GHz |
| 560-7N50B | 0.01 to 20 GHz | 50 Ω | 15 dB, <0.04 GHz<br>22 dB, <8 GHz<br>17 dB, <18 GHz<br>14 dB, <20 GHz | N(m) | ±0.5 dB, <18 GHz<br>±1.25 dB, <20 GHz |
| 560-7S50B | 0.01 to 20 GHz | 50 Ω | 15 dB, <0.04 GHz<br>22 dB, <8 GHz<br>17 dB, <18 GHz<br>14 dB, <20 GHz | WSMA(m) | ±0.5 dB, <18 GHz<br>±1.25 dB, <20 GHz |
| 560-7S50-2 | 0.01 to 26.5 GHz | 50 Ω | 15 dB, <0.04 GHz<br>22 dB, <8 GHz<br>17 dB, <18 GHz<br>14 dB, <26.5 GHz | WSMA(m) | ±0.5 dB, <18 GHz<br>±1.25 dB, <26.5 GHz |
| 560-7K50 | 0.01 to 40 GHz | 50 Ω | 12 dB, <0.04 GHz<br>22 dB, <8 GHz<br>17 dB, <18 GHz<br>15 dB, <26.5 GHz<br>14 dB, <32 GHz<br>13 dB, <40 GHz | K(m) | ±0.5 dB, <18 GHz<br>±1.25 dB, <26.5 GHz<br>±2.2 dB, <32 GHz<br>±2.5 dB, <40 GHz |
| 560-7VA50 | 0.01 to 50 GHz | 50 Ω | 12 dB, <0.04 GHz<br>19 dB, <20 GHz<br>15 dB, <40 GHz<br>10 dB, <50 GHz | V(m) | ±0.8 dB, <20 GHz<br>±2.5 dB, <40 GHz<br>±3.0 dB, <50 GHz |

*The maximum input power is + 20 dBm for all microwave detectors with the exception of 5400-71N75L.

**The input of the 5400-71N75L is designed to extend the damage level to 1W (+30 dBm). Compression begins at 10 dBm <0.05 GHz, 15 dBm <1 GHz, or 20 dBm <1.2 GHz.

# POWER SENSORS

MA2400A/D Series 10 MHz to 50 GHz


The MA24XXA/D Series Power Sensors consist of MA247XD Series Power Sensors, MA246XD Series Power Sensors, MA248XD Series Universal Power Sensors, MA242XD Series Thermal Power Sensors, MA244XD Series High Accuracy Power Sensors, MA249XA Series Wideband Power Sensors, and MA2411A Pulse Power Sensor. These units are broadband microwave measurement components. All models except the MA246XD Series, MA249XA Series, and MA2411A Power Sensors, are used with the ML2430A Series Power Meters. The MA246XD Series Power Sensors are used with the ML2400A Series Power Meters only. The MA249XA and MA2411A Power Sensors are used with the ML2480A Series Power Meters only.

## Features

- *10 MHz to 50 GHz range*
- *N, K, and V type RF connectors*
- *90 dB dynamic range provides stable power readings to –70 dBm*
- *MA244XD Series High Accuracy Power Sensors contain an additional matching circuit to improve return loss performance.*
- *MA242XD Series Thermal Power Sensors provide measuring speeds to 4 ms rise and fall times in addition to exceptional return loss performance*
- *MA246XD power sensors have fast 1 milli second rise and fall times needed for CDMA measurements*
- *MA248XD Universal sensors measure average power of modulated signals such as W-CDMA, multitone, etc.*
- *All MA2481D Series Power Sensors contain internal EEPROMs for storage of calibration data as a function of frequency, power, and temperature. This allows the power meter to interpolate and correct readings automatically*
- *MA2411A Pulse Power Sensor has a rise time of <18ns needed for pulse radar measurements*
- *MA249XA Series Wideband Power Sensors have a video bandwidth of 20 MHz for accurate Peak Measurement on Radar and WLAN. These are also is ideal for Multi Pulse Radar or GPRS measurements.*

## Fast thermal sensors

Anritsu's thermal sensors provide excellent power measurement accuracy over 50 dB of dynamic range with more speed than any other thermal sensor available (see fig. 1). Thermal sensors use Seebeck elements where the combined effect of a thermal gradient and charge migration between dissimilar metals gives a true reading of average power on any incident waveform. Anritsu thermal sensors have class-leading SWR and built in EEPROM with calibration factor and linearity correction data. This results in assured accuracy when measuring any signal. Anritsu's fast thermal power sensors improve sensor rise time and fall time to less than 4.0ms– an order of magnitude faster than previous thermal sensors. Settled power measurements are now 10 times faster; that means reduced test time.

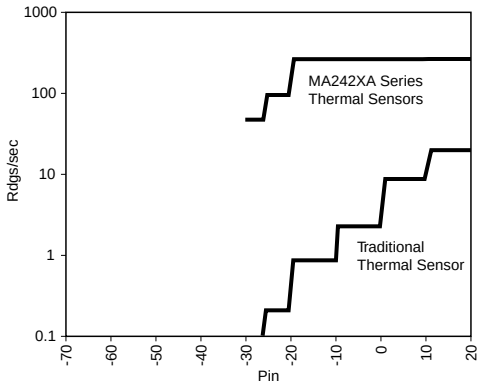



*Fig. 1 Fast Thermal Sensors*

## Standard diode sensors

Diode sensors have greater speed, sensitivity and dynamic range than thermal sensors (see fig. 2). All Anritsu diode sensors use a dual diode architecture that gives improved sensitivity and dynamic range over single diode architectures. The MA2470D Series Power Sensors 90 dB dynamic range is both fast and accurate. Linearity is better than 1.8%, typically < 1.0% through 18 GHz.

MA2470D power sensors offer an ideal combination of speed and dynamic range for general purpose power measurements. A single sensor replaces the two sensors that were previously required with sensors limited to 50 dB dynamic range.

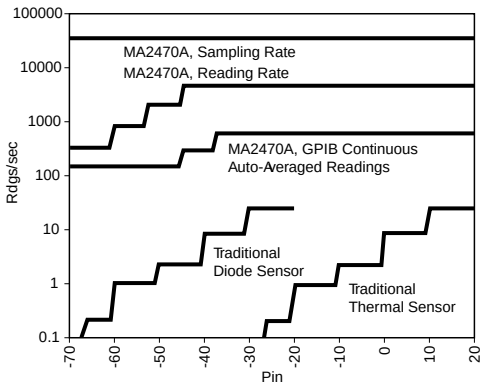



*Fig. 2 Standard Diode Sensors*

# POWER SENSORS

MA2400A/D Series 10 MHz to 50 GHz

## High accuracy diode sensors

The Anritsu MA2440D series high-accuracy diode sensors have a built in 3 dB attenuator to minimize input SWR. They are used where the best measurement accuracy is required over a large dynamic range, for example when measuring amplifiers. High accuracy diode sensors have a dynamic range of 87 dB compared to the 90 dB of standard diode sensors.

## Fast diode sensors

The MA2460D fast diode sensors from Anritsu have a rise time of 0.6 µs. This, together with a sensor video bandwidth of 1.25 MHz, makes them the ideal solution for power measurements on N-CDMA (IS-95) signals. The MA2460 sensors must be used with the ML2407/08A power meter. This combination of meter and sensor provides fast signal processing and sampling speeds. Average power, peak power and crest factor on N-CDMA signals can be measured and displayed. The MA2460 are dual diode sensors that deliver a greater-than 80 dB dynamic range, which makes them suitable for both open- and closed-loop power-control testing. The sensors internal AC detection circuitry gives a guaranteed noise floor of –60 dBm with typical performance to –70 dBm, even when measuring CDMA signals.

Pulses down to 1 µs can also be captured and displayed, thanks to the sensor rise time of 0.6 µs. In profile mode the ML2407A meter can be used to measure average power across narrow pulses, an increasingly common test method for amplifiers in digitally modulated systems.

## Universal power sensors

The new MA2480D series Universal Power Sensors will measure any modulated or multi-tone signal, thanks to a patented sensor architecture with three diode pairs (see fig. 3). Universal power sensors deliver over 80 dB of dynamic range with speed and accuracy. Average power measurements on WCDMA signals can now be made without the need for special power meters. Universal sensors are also ideal for power measurements on other digitally modulated carriers such as HDTV, DAB or QAM modulated radio links.

Universal power sensors are also ideal for applications where multiple signals are present, such as intermodulation measurements and satellite multi carrier power loading measurements.

A unique additional capability of the Anritsu Universal power sensor is the ability to use it as a standard diode sensor for CW measurements. In this mode the fast response of diode sensors is maintained across the full dynamic range of the sensor, meaning that for the majority of users it is the only sensor that they will ever need – a truly Universal Power Sensor.

## Wideband sensors

The new MA2490A and MA2491A sensors from Anritsu have rise time of 18 ns and are ideal for Radar, WLAN, Edge, and WCDMA applications. MA2490A and MA2491A are 8 GHz and 18 GHz sensors with 20 MHz video bandwidth. The sensor is equipped with a chopper circuit that allows it to measure CW/average power as low as -60 dBm. Both the sensors must be used with ML2487/88A Power Meters, specially designed to handle high-speed sampling rates up to 64MS/s.

## Pulse sensor

The wideband sensor MA2411 is a 40 GHz diode sensor with 50 MHz video bandwidth. This sensor is not fitted with chopper circuit, and therefore mainly is a pulse-profiling sensor. A rise time of 7 nS along with 50 MHz video bandwidth, makes this sensor ideal for Radar applications. MA2411A Power Sensor can be used with ML2480 series Power Meters. However, the bandwidth of the sensor is limited only to 20 MHz, when using with ML2480 series power meter.

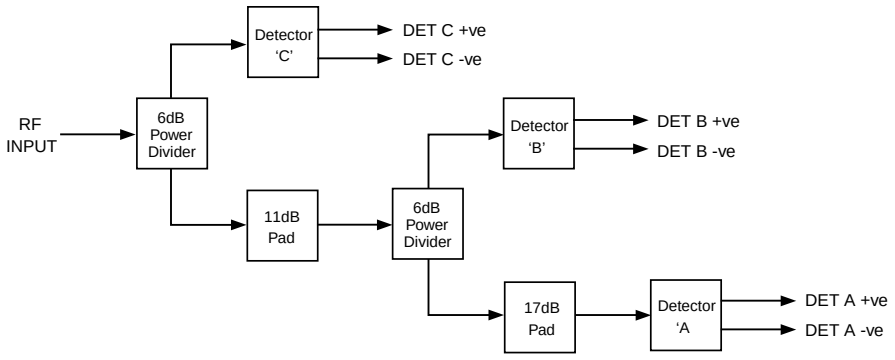



*Fig. 3 Universal Power Sensor*

# POWER SENSORS

MA2400A/D Series 10 MHz to 50 GHz

## Specifications

| Model | Frequency range | Dynamic range (dBm) | SWR | Rise time① | Sensor linearity | RF connector② |
|---|---|---|---|---|---|---|
| **Standard diode sensors** | | | | | | |
| MA2472D | 10 MHz - 18 GHz | –70 to +20 | <1.90; 10 - 50 MHz<br><1.17; 50 - 150 MHz<br><1.12; 0.15 - 2 GHz<br><1.22; 2 - 12.4 GHz<br><1.25; 12.4 - 18 GHz<br><1.35; 18 - 32 GHz<br><1.50; 32 - 40 GHz<br><1.63; 40 - 50 GHz | <0.004 ms | 1.8%, <18 GHz<br>2.5%, <40 GHz<br>3.5%, <50 GHz | N (m) |
| MA2473D | 10 MHz - 32 GHz | | | | | K (m) |
| MA2474D | 10 MHz - 40 GHz | | | | | K (m) |
| MA2475D | 10 MHz - 50 GHz | | | | | V (m) |
| **Fast thermal sensors** | | | | | | |
| MA2421D | 0.1 MHz - 18 GHz | –30 to +20 | <1.10; 0.1 MHz - 2 GHz<br><1.15; 2 - 12.4 GHz<br><1.20; 12.4 - 18 GHz | <4.0 ms | 1.3%, <18 GHz<br>1.5%, <40 GHz<br>1.8%, <50 GHz | N (m) |
| MA2422D | 10 MHz - 18 GHz | | <1.90; 10 - 50 MHz<br><1.17; 50 - 150 MHz<br><1.10; 0.15 - 2 GHz<br><1.15; 2 - 12.4 GHz<br><1.20; 12.4 - 18 GHz<br><1.25; 18 - 32 GHz<br><1.30; 32 - 40 GHz<br><1.40; 40 - 50 GHz | | | N (m) |
| MA2423D | 10 MHz - 32 GHz | | | | | K (m) |
| MA2424D | 10 MHz - 40 GHz | | | | | K (m) |
| MA2425D | 10 MHz - 50 GHz | | | | | V (m) |
| **High accuracy diode sensors** | | | | | | |
| MA2442D | 10 MHz - 18 GHz | –67 to +20 | <1.90; 10 - 50 MHz<br><1.17; 50 - 150 MHz<br><1.08; 0.15 - 2 GHz<br><1.16; 2 - 12.4 GHz<br><1.21; 12.4 - 18 GHz<br><1.29; 18 - 32 GHz<br><1.44; 32 - 40 GHz<br><1.50; 40 - 50 GHz | <0.004 ms | 1.8%, <18 GHz<br>2.5%, <40 GHz<br>3.5%, <50 GHz | N (m) |
| MA2444D | 10 MHz - 40 GHz | | | | | K (m) |
| MA2445D | 10 MHz - 50 GHz | | | | | V (m) |
| **Fast diode sensors** | | | | | | |
| MA2468D③ | 10 MHz - 6 GHz | –60 to +20 | <1.17; 10 - 150 MHz<br><1.12; 0.15 - 2 GHz<br><1.22; 2 - 12.4 GHz<br><1.25; 12.4 - 18 GHz | < 0.001 ms | 1.8% | N (m) |
| MA2469D③ | 10 MHz - 18 GHz | | | | | |
| **Universal power sensors** | | | | | | |
| MA2481D | 10 MHz - 6 GHz | –60 to +20 | < 1.17; 10 - 150 MHz<br>< 1.12; 0.15 - 2 GHz<br>< 1.22; 2 - 12.4 GHz<br>< 1.25; 12.4 - 18 GHz | <0.0004 ms<br>(with option 1 only) | 10 MHz to 6 GHz<br>3% –60 to +20 dBm<br>6 to 18 GHz<br>3% to 18 GHz<br>3.5% 0 to +20 GHz<br>3% (1.8% CW with option 1) | N (m) |
| MA2482D | 10 MHz - 18 GHz | | | | | |
| MA2480/01 | Adds fast CW mode to Universal Power Sensors for high speed measurements of CW signal plus TDMA and pulse measurements. | | | | | |
| **Wideband sensors** | | | | | | |
| MA2490A | 50 MHz - 8 GHz | –60 to +20 CW Mode<br>–20 to +20 Peak Pulse Mode | <1.17; 50 - 150 MHz<br><1.12; 0.15 - 2.5 GHz<br><1.22; 2.5 - 8 GHz | <18 ns | <7% 50 - 300 MHz<br><3.5% 0.3 - 8 GHz | N (m) |
| MA2491A | 50 MHz - 18 GHz | | <1.17; 50 - 150 MHz<br><1.12; 0.15 - 2.5 GHz<br><1.22; 2.5 - 12.4 GHz<br><1.25; 12.4 - 18 GHz | | <7% 50 - 300 MHz<br><3.5% 0.3 - 18 GHz | |
| **Pulse sensor** | | | | | | |
| MA2411A | 300 MHz - 40 GHz | –20 to +20 | <1.15; 0.3 - 2.5 GHz<br><1.35; 2.5 - 26 GHz<br><1.50; 26 - 40 GHz | <8 ns<br><18 ns when used with ML2487/8A | <4.5% 0.3 - 18 GHz<br><7% 18 - 40 GHz | K (m) |

① 0.0 dBm, room temperature.

② Each MA24XXA/D series sensor incorporates precision RF connectors with hexagon coupling nut for attachment by industry standard torque wrench.

③ MA2460D Fast Diode Sensors must be used with ML2407/08A Power Meters for NCDMA and Fast Pulse measurements.

**Temperature range:** +25°C ±5°C

# POWER SENSORS

MA2400A/D Series 10 MHz to 50 GHz

## Ordering information

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

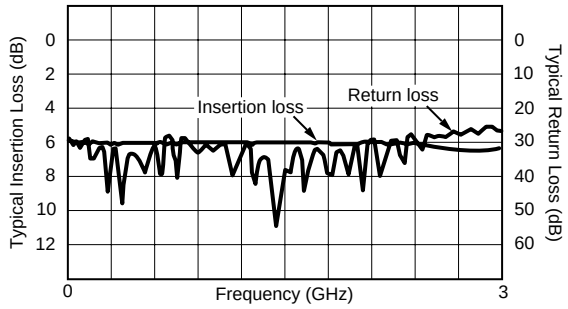
| Model/Order No. | Name |
|---|---|
| | **Thermal Sensor** |
| MA2421D | 0.1 MHz to 18 GHz |
| MA2422D | 10 MHz to 18 GHz |
| MA2423D | 10 MHz to 32 GHz |
| MA2424D | 10 MHz to 40 GHz |
| MA2425D | 10 MHz to 50 GHz |
| | **High Accuracy Sensor** |
| MA2442D | 10 MHz to 18 GHz |
| MA2444D | 10 MHz to 40 GHz |
| MA2445D | 10 MHz to 50 GHz |
| | **Fast Diode Sensor** |
| MA2468D | 10 MHz to 6 GHz |
| MA2469D | 10 MHz to 18 GHz |

| Model/Order No. | Name |
|---|---|
| | **Power Sensor** |
| MA2472D | 10 MHz to 18 GHz |
| MA2473D | 10 MHz to 32 GHz |
| MA2474D | 10 MHz to 40 GHz |
| MA2475D | 10 MHz to 50 GHz |
| MA2481D | Universal Power Sensor, 10 MHz to 6 GHz |
| MA2482D | Universal Power Sensor, 10 MHz to 18 GHz |
| MA2480/01 | Option 1, Universal Power Sensor CW Option |
| MA2400/98 | Z540/Guide 25 Calibration |
| MA2400/99 | Premium Calibration |
| MA2497A | Agilent (HP) Sensor adapter |
| MA2499B | Anritsu Sensor 10 to 12 pin Adapter |
| | **Wideband Sensor** |
| MA2490A | 50 MHz to 8 GHz |
| MA2491A | 50 MHz to 18 GHz |
| | **Pulse Sensor** |
| MA2411A | 300 MHz to 40 GHz |

# POWER DIVIDERS

11 Series DC to 3000 MHz

*11N50B*

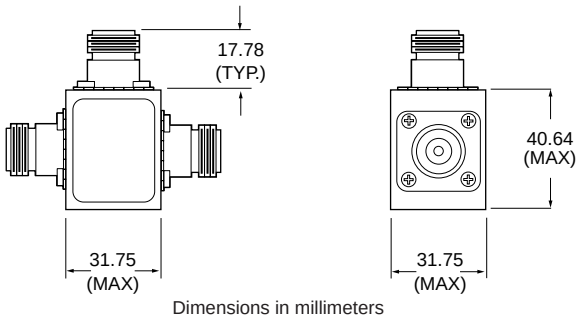



*Insertion loss (typical) /return loss (typical)*

These RF power dividers are symmetrical, three-resistor tee designs that can be used in applications where signals from DC to 3000 MHz must be accurately divided. They are available in 50 Ω and provide excellent amplitude and phase tracking.

## Features

- *DC to 3000 MHz frequency range*
- *Excellent amplitude and phase tracking*
- *50 Ω*




*11N50B outline*

## Specifications

| Model | Frequency range (MHz) | SWR | Insertion loss (dB, max.) | Impedance (Ω) | Connectors | |
|---|---|---|---|---|---|---|
| | | | | | Input | Output |
| 11N50B | DC to 3000 | <1.25 | 7 | 50 | N(f) | N(f) |

**Maximum Input Power:** 1 Watt
**Temperature range:** 0°C to +70°C

## Ordering information

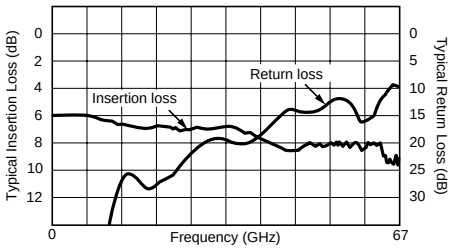
Please specify model/order number, name, and quantity when ordering.

| Model/Order No. | Name |
|---|---|
| 11N50B | Power Divider, 1 MHz to 3 GHz, 50 Ω |

# POWER DIVIDERS

K240, V240 Series DC to 65 GHz

*V240C*

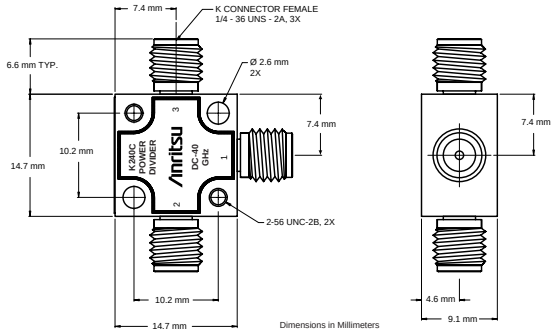



*Insertion loss (typical) /return loss (typical) for V240C*

These microwave power dividers are symmetrical, three-resistor tee designs that can be used in applications where signals from DC to 65 GHz must be accurately divided or combined. K Connector® is compatible with 3.5 mm and SMA; V Connector® is compatible with 2.4 mm. All models have exceptional amplitude and phase tracking characteristics.

## Features

- *DC to 65 GHz frequency range*
- *K Connector® compatibility with SMA/3.5 mm*
- *V Connector® compatibility with 2.4 mm*
- *Excellent amplitude and phase tracking*



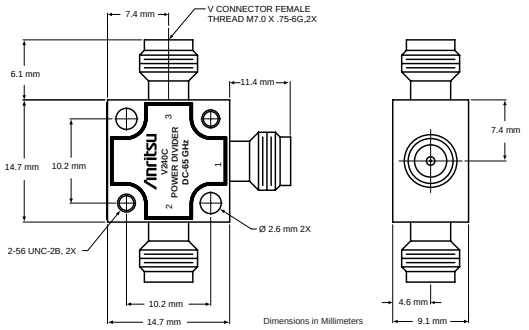

*K240B, K240C outline*

## Specifications

| Model | Frequency range (GHz) | Impedance (Ω) | Connectors |
|---|---|---|---|
| K240B | DC to 26.5 | 50 | K(f) |
| K240C | DC to 40 | 50 | K(f) |
| V240C | DC to 65 | 50 | V(f) |

| Frequency range (GHz) | Tracking of outputs | | Insertion loss (dB max.) | SWR |
|---|---|---|---|---|
| | Amplitude | Phase | | |
| DC to 6 | ±0.3 dB | ±2° | 7 | 1.22 |
| 6 to 18 | ±0.3 dB | ±3° | 7.5 | 1.44 |
| 18 to 26.5 | ±0.6 dB | ±4° | 8 | 1.58 |
| 26.5 to 40 | ±0.6 dB | ±6° | 8.5 | 1.79 |
| 40 to 65 | ±1.8 dB | ±18° | 10 | 3.11 |

**Maximum Input Power:** 1W
**Temperature range:** 0°C to +70°C
**Weight:** 43g




*V240C outline*

## Ordering information

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

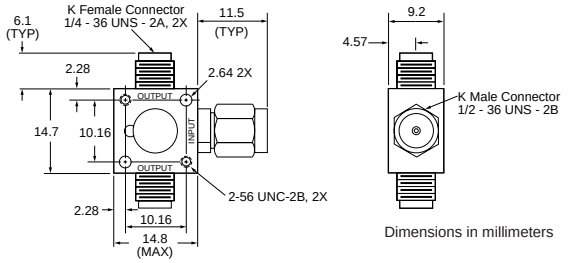
| Model/Order No. | Name |
|---|---|
| K240B | Precision Power Divider, DC to 26.5 GHz |
| K240C | Precision Power Divider, DC to 40 GHz |
| V240C | Precision Power Divider, DC to 65 GHz |

# POWER SPLITTERS

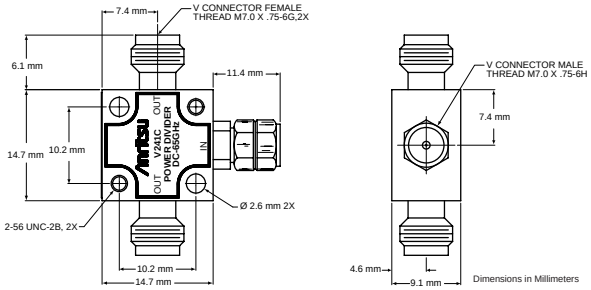
K241, V241 Series, DC to 65 GHz

*K241C*

*V241C*




*K241B, K241C outline*




*V241C outline*

These microwave power splitters are symmetrical, two-resistor designs that can be used in applications where signals from DC to 65 GHz must be accurately divided for ratio measurements. They provide excellent flatness and effective output SWR. K Connectors® are compatible with 3.5 mm and SMA; V Connectors® are compatible with 2.4 mm.

## Features

- *DC to 65 GHz frequency range*
- *K Connector® compatibility with SMA/3.5 mm*
- *V Connector® compatibility with 2.4 mm*
- *Excellent flatness and effective output SWR*

## Specifications

| Model | Frequency range (GHz) | Impedance (Ω) | Connectors | |
|---|---|---|---|---|
| | | | Input | Output |
| K241B | DC to 26.5 | 50 | K(m) | K(f) |
| K241C | DC to 40 | 50 | K(m) | K(f) |
| V241C | DC to 65 | 50 | V(m) | V(f) |

| Model | Frequency range (GHz) | Flatness (dB) | Input SWR | Effective output SWR | Insertion loss (dB) |
|---|---|---|---|---|---|
| K241B | DC to 26.5 | 2.0 | 1.45 | 1.45 | 7.5 |
| K241C | DC to 26.5 | 2.0 | 1.45 | 1.45 | 7.5 |
| | 26.5 to 40 | 2.0 | 1.93 | 1.70 | 8.5 |
| V241C | DC to 18 | 2.0 | 2.11 | 2.00 | 8.5 |
| | 18 to 40 | 2.0 | 2.33 | 2.30 | 9.5 |
| | 40 to 65 | 2.0 | 2.62 | 2.60 | 10.5 |

**Maximum Input Power:** 1W
**Temperature range:** 0°C to +70°C
**Weight:** 43g

## Ordering information

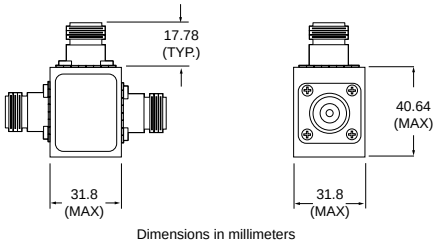
Please specify model/order number, name, and quantity when ordering.

| Model/Order No. | Name |
|---|---|
| K241B | Precision Power Splitter, DC to 26.5 GHz |
| K241C | Precision Power Splitter, DC to 40 GHz |
| V241C | Precision Power Splitter, DC to 65 GHz |

# POWER SPLITTERS

N241 Series, DC to 3000 MHz

*N241A50*




*N241A50 outline*

These RF power splitters are symmetrical, two resistor designs that can be used in applications where signals from DC to 3000 MHz must be accurately divided for ratio measurements. They are available in 50 Ω and provide excellent flatness and effective output SWR.

## Features

- *DC to 3000 MHz frequency range*
- *Excellent flatness and effective output SWR*
- *50 Ω Impedance*

## Specifications

| Model | Frequency range | Input SWR | Effective output SWR | Insertion loss | Flatness | Impedance | Connectors |
|---|---|---|---|---|---|---|---|
| N241A50 | DC to 3000 MHz | 1.3 | 1.3 | 7.5 dB | ±1.5 dB | 50 Ω | Input: N(f)<br>Output: N(f) |

**Maximum Input Power:** 1 W
**Temperature range:** 0°C to +70°C

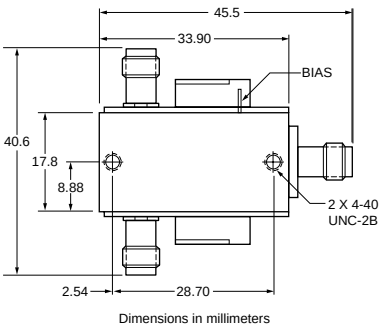
## Ordering information

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

| Model/Order No. | Name |
|---|---|
| N241A50 | Power Splitter, DC to 3000 MHz, 50 Ω |

# SPDT SWITCH

DC to 65 GHz




*SC4734, SC6135 outline*

Coaxial 65 GHz microwave SPDT switch
Short voltage pulse driven.

## Features

- *Switching Speed: 20 msec max*
- *Operating Voltage: 20 to 30V*
- *Duty Cycle: 20 msec min*

## Specifications*

| Model | Frequency range | Connectors | | Insertion loss (dB) | Return loss (dB) | Isolation (dB) |
|---|---|---|---|---|---|---|
| | | in | out | | | |
| SC4734 | DC to 60 GHz | V(f) | V(f), V(f) | 1.5 ≤40 GHz<br>3.0 >40 GHz | 10 ≤40 GHz<br>6 >40 GHz | 29 ≤40 GHz<br>26 >40 GHz |
| SC6135 | DC to 65 GHz | V(f) | V(f), V(f) | 1.5 ≤40 GHz<br>3.0 >40 GHz | 10 ≤40 GHz<br>6 >40 GHz | 29 ≤40 GHz<br>26 >40 GHz |

**Temperature range:** 0°C to +70°C

*Call 1-800-ANRITSU for detailed information

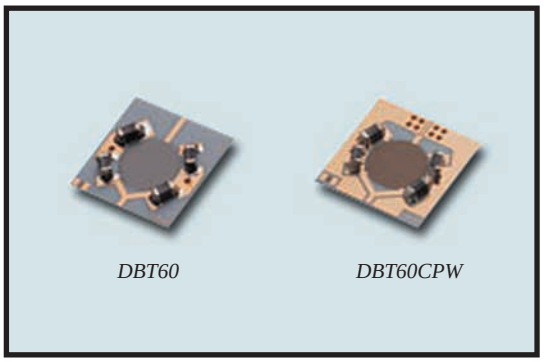
## Ordering information

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

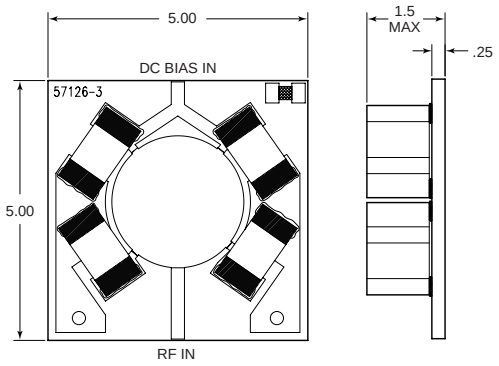
| Model/Order No. | Name |
|---|---|
| SC4734 | SPDT Switch, DC to 60 GHz |
| SC6135 | SPDT Switch, DC to 65 GHz |

# BIAS TERMINATION

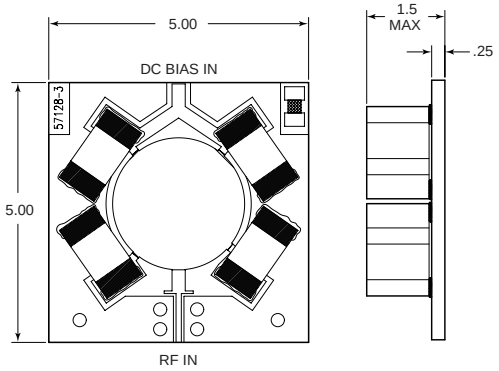
DBT60, DBTCPW 50 kHz to 65 GHz



*DBT60* *DBT60CPW*




*DBT60 outline*




*DBT60CPW outline*

The Bias Termination is designed to meet the stringent electrical performance requirements and small size of passive components in optical communication networks. A broad bandwidth of 50 kHz to 65 GHz, with very good return loss, makes it ideal to provide DC Bias in 40 Gbps optical modulators. In addition, the small size of the Bias terminations makes integration of the Biasing network easier.

The two different models available are DBT60 and DBT60CPW. Depending on the type of substrate configuration used within an Optical Modulator, one can use the DBT60 for 0.25 mm thick Microstrip or DBT60CPW for 0.25 mm thick CPW substrate. Bias Terminations can be customized to meet customer requirements for different substrate types, substrate thickness, frequency ranges etc.

## Features

- *Low SWR*
- *Broad Frequency Performance*
- *High Voltage Capacity*
- *Small Form Size*

## Specifications

| Model Number | Frequency Range | Return Loss | DC Voltage | DC Current | Operating Temperature |
|---|---|---|---|---|---|
| DBT60 | 50 kHz to 60 GHz | ≥18 dB typical | 16V | 200 mA | 0°C to 70°C |
| DBT60CPW | 50 kHz to 50 GHz<br>50 GHz to 60 GHz | ≥17 dB typical<br>≥14 dB typical | 16V | 200 mA | 0°C to 70°C |

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| DBT60 | Bias Termination, 0.25 mm Microstrip |
| DBT60CPW | Bias Termination, 0.25 mm CPW Substrate |

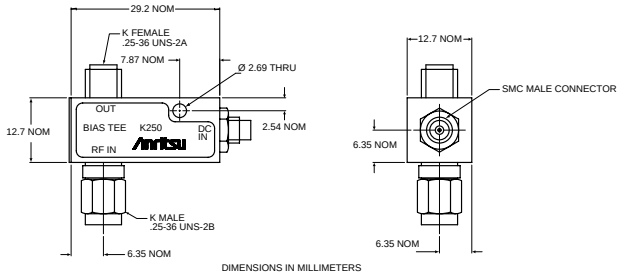
# BIAS TEE

K250 100 MHz to 40 GHz, V250 100 MHz to 60 GHz

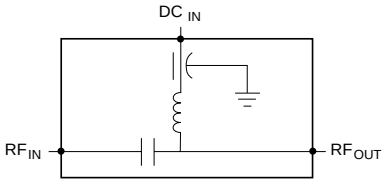

*K250*

## Specifications

| | |
|---|---|
| **Temperature** | 0 to 60°C |
| **Mounting position** | Any |
| **Weight** | 57g |




*Outline (K and V models)*




*Schematic diagram (K and V models)*

These bias tees are designed for applications where both DC and RF signals must be applied to a device under test. They are particularly suited for active device measurements. DC voltages of up to 30 volts at 0.5 amps may be applied to test devices with negligible effect on RF performance. Low RF throughline loss (<1 dB) and low return loss ensure negligible effect on measurements up to 60 GHz. An RF input DC block isolates the input port from the applied bias voltage.

## Features

- *Broadband, 0.1 to 60 GHz coverage*
- *Low SWR, low insertion loss*
- *K Connector® and V Connector® availability*

## Specifications

| Model | Frequency range | Insertion loss | Return loss | RF power | DC voltage | DC current | DC port isolation | RF connectors | DC connectors |
|---|---|---|---|---|---|---|---|---|---|
| K250 | 0.1 to 40 GHz① | 1.2 dB typ. | 15 dB min. to 20 GHz<br>10 dB min. to 40 GHz | 1W max. | 30V max. | 0.5A | 20 dB at 0.1 GHz<br>40 dB above 0.5 GHz | Input: K(m)<br>Output: K(f) | SMC(m) |
| V250 | 0.1 to 60 GHz① | 2.2 dB typ. | 13 dB min. to 20 GHz<br>9 dB min. to 40 GHz<br>8 dB min. to 60 GHz | 1W max. | 30V max. | 0.5A | 20 dB at 0.1 GHz<br>40 dB above 0.5 GHz | Input: V(m)<br>Output: V(f) | SMC(m) |

① Usable between 0.04 and 0.1 GHz with degraded performance.
**Temperature range:** 0°C to +70°C

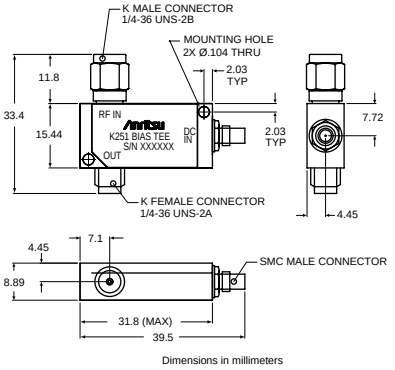
## Ordering information

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

| Model/Order No. | Name |
|---|---|
| K250 | Precision Bias Tee, 100 MHz to 40 GHz |
| V250 | Precision Bias Tee, 100 MHz to 60 GHz |

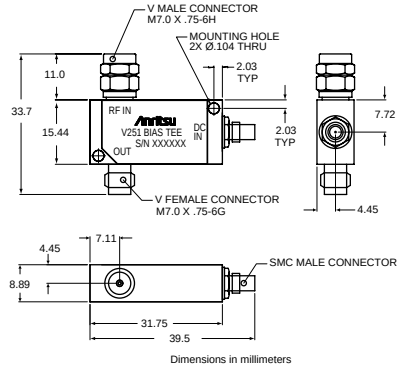
# ULTRA-WIDEBAND BIAS TEES

K251 50 kHz to 40 GHz, V251 100 kHz to 65 GHz


*K251 outline*

These ultra-wide bandwidth bias tees have been optimized for optical communications and other high-speed pulse, data or microwave applications. Designed to simultaneously apply both DC and RF drive signals to a device via a single input port, these bias tees feature fast rise times, excellent low frequency response, minimum insertion loss and flat group delay. Precision K Connector® and V Connector® interfaces assure excellent impedance match across the wide bandwidths available. A one year warranty is provided. Adapters are available to convert between K and V Connectors - See page 21 of this catalog for details.




*V251 outline*

## Features

- *Ideal for Optical Communications Applications*
- *Low Insertion Loss*
- *Risetime: <5 ps typical (V251), <7 ps typical (K251)*

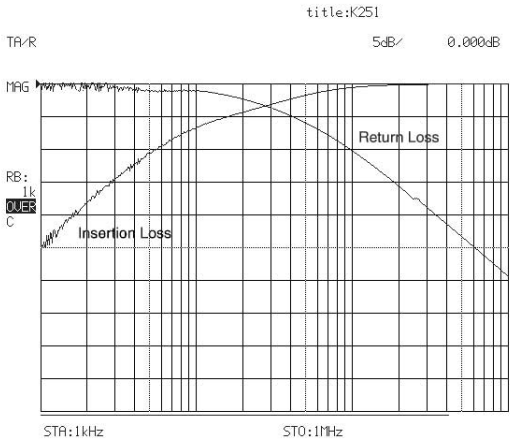
## Specifications

| Model | Frequency range 3dB BW | Insertion loss | Return loss | Rise time | Group delay | Max DC current | Max DC voltage | Max RF power | Connectors |
|---|---|---|---|---|---|---|---|---|---|
| K251 | 50 kHz to 40 GHz | <2 dB typical | See Plot | < 7 ps typical | 110 ± 2 ps typical | 100 mA | 16VDC | 1 W | RF In: K(m)<br>RF Out: K(f)<br>Bias: SMC(m) |
| V251 | 100 kHz to 65 GHz | < 2.5 dB typical | See Plot | < 5 ps typical | 113 ± 2 ps typical | 100 mA | 16VDC | 1 W | RF In: V(m)<br>RF Out: V(f)<br>Bias: SMC(m) |

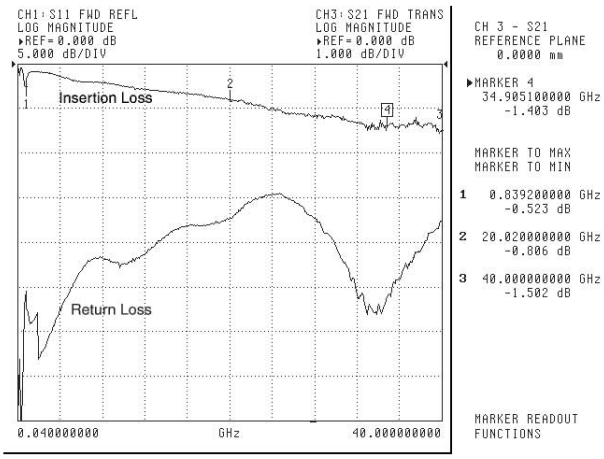
Specifications apply over the full DC Bias current range and over the temperature range of 0°C to +70°C.

# ULTRA-WIDEBAND BIAS TEES

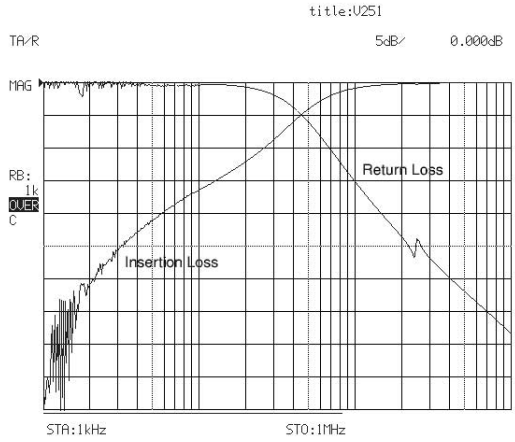
K251 50 kHz to 40 GHz, V251 100 kHz to 65 GHz



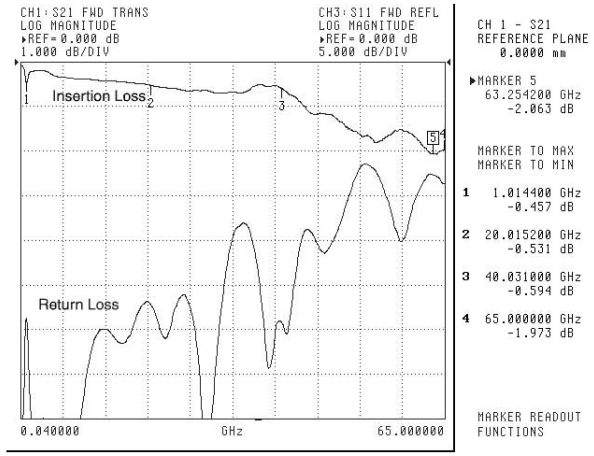

*Typical Low Frequency Insertion Loss and Return Loss measured on K251 over the range of 1kHz to 1 MHz.*



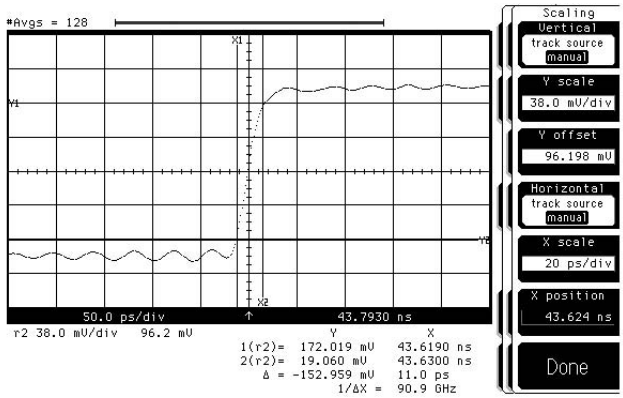

*Typical Frequency Insertion Loss and Return Loss measured on K251 over the range of 40 MHz to 40 GHz.*




*Typical Low Frequency Insertion Loss measured on V251 over the range of 1 kHz to 1 MHz.*




*Insertion Loss and Return Loss measured on V251 over the range of 40 MHz to 65 GHz.*




*Typical Uncorrected Pulse Response for V251. Absolute risetime for the Bias Tee is derived from this measured data by applying the RSS method to compensate for the risetime of the input pulse.*

$$\sqrt{T_{BT}^2 + T_{PG}^2} = T\ meas.$$

*T meas. = uncorrected risetime*
*$T_{BT}$ = absolute Bias Tee risetime*
*$T_{PG}$ = risetime of input pulse*

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| K251 | Precision Bias Tee, 50 kHz to 40 GHz |
| V251 | Precision Bias Tee, 100 kHz to 65 GHz |

# KELVIN CONNECTION BIAS TEE

K252, V252 DC to 65 GHz

*K252*

Kelvin Connection Bias Tee is designed for applications where both DC and RF signals are applied to the Device under Test (DUT) and precision DC measurements are required. A high resistance of the DC Coil results in a voltage drop that leads to a DC Biasing voltage error in the measurements. A Kelvin connection bias tee is used to eliminate DC Biasing errors as the sense coil allows accurate measurement of the DC Voltage applied across the DUT. Both 40 GHz and 65 GHz models are available with precision K connectors® and V Connectors® respectively. A male connector for the RF input and a female connector for the output is the standard interface for K252 and V252 Bias Tees. A SMC connector is standard for DC Bias and Sense connections. Other connector types with different connector configurations can be ordered through factory.

## Features

- *Broadband 0.1 to 65 GHz frequency coverage*
- *50 V and 500 mA Current capability*
- *Low Insertion and SWR performance*

| Model | Frequency Range 3dB BW | Insertion Loss | Return Loss | Max DC Current | Max DC Voltage | Max RF Power | Connectors | Inductance |
|---|---|---|---|---|---|---|---|---|
| K252 | 100 MHz to 40 GHz | <2.5 dB typical | 11 dB | 500 mA | 50 VDC | 1 W | RF In: K(m)<br>RF Out: K(f)<br>Bias: SMC(m)<br>Sense: SMC(m) | Bias: 6 mH<br>Sense: 8 mH |
| V252 | 100 MHz to 65 GHz | <3.7 dB typical | 10 dB to 60 GHz<br>8 dB to 65 GHz | 500 mA | 50 VDC | 1 W | RF In: V(m)<br>RF Out: V(f)<br>Bias: SMC(m)<br>Sense: SMC(m) | Bias: 6 mH<br>Sense: 8 mH |

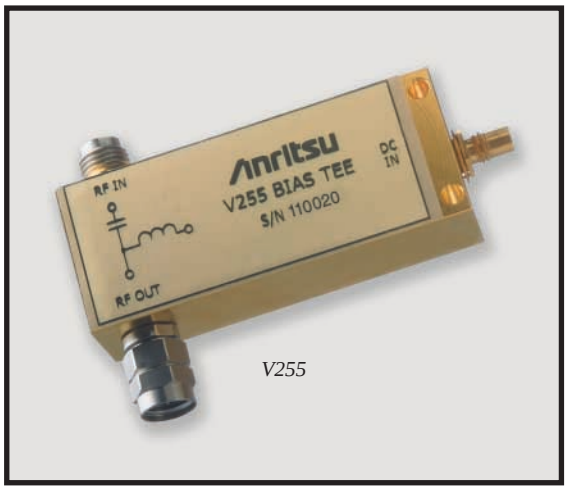
## Ordering information

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

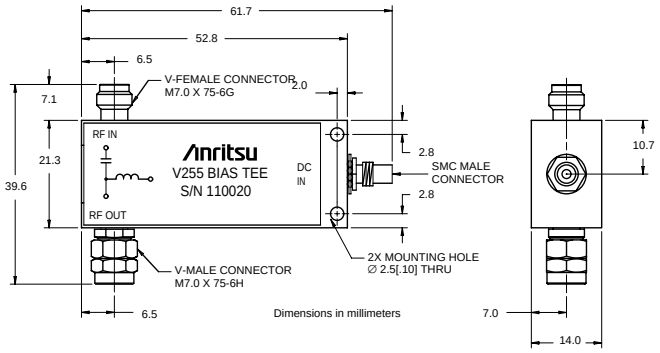
| Model/Order No. | Name |
|---|---|
| K252 | Kelvin Bias Tee, 0.1 to 40 GHz |
| V252 | Kelvin Bias Tee, 0.1 to 65 GHz |

# ULTRA-WIDEBAND BIAS TEES

V255 50 kHz to 65 GHz




*V255*




*V255 outline*

The V255 Gen II Ultra Wideband Bias Tee is designed to meet the high electrical performance requirement of passive components in optical communication networks. Given a broader bandwidth of 50 kHz to 65 GHz, with low insertion losses and very good return loss, makes it ideal to use in 40 Gbps systems to bias optical modulators and broad band data drivers. It's fast rise time and flat group delay performance allows extremely accurate measurements within a laboratory environment. The V255 Bias Tee comes with a standard V Connector® that assures excellent impedance match across the available wide bandwidth. The DC signal can be applied or extracted from the bias tee through an SMC connector at the third port. As with our other bias tees, the V255 also has a one-year warranty.

## Features

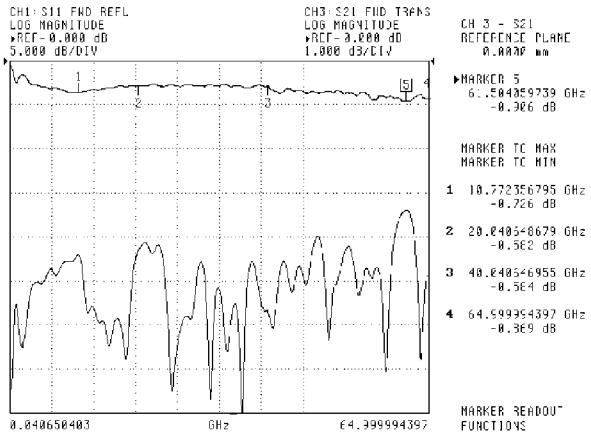
- *Ideal for Optical Communication applications.*
- *Very low Insertion Loss*
- *Rise Time 3 ps typical*
- *High Current Capacity*
- *High Isolation between Input Port and DC Port*

## Specifications

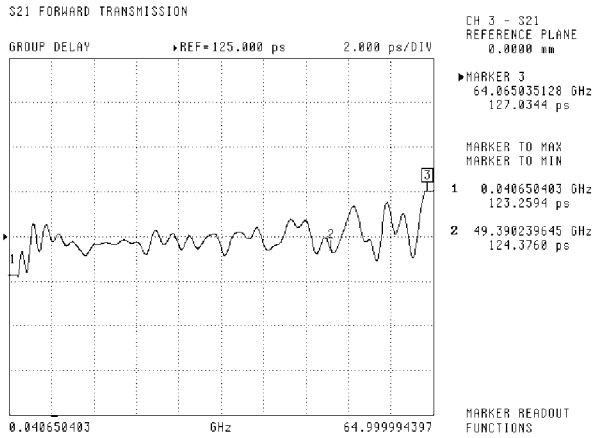
| Model | Frequency range | Insertion loss | Return loss | Rise time | Group delay | Max DC current | Max DC voltage | Min. Isolation | Operating temperature |
|---|---|---|---|---|---|---|---|---|---|
| V255 | 50 kHz to 65 GHz (30 kHz to 65 GHz typical) | 1.2 dB to 65 GHz typical | <–15 dB to 65 GHz typical | 3 ps typical | 125 ± 2 ps typical | 400 mA | 16 VDC | –50 dBm | 0˚C to 80˚C |

# ULTRA-WIDEBAND BIAS TEES

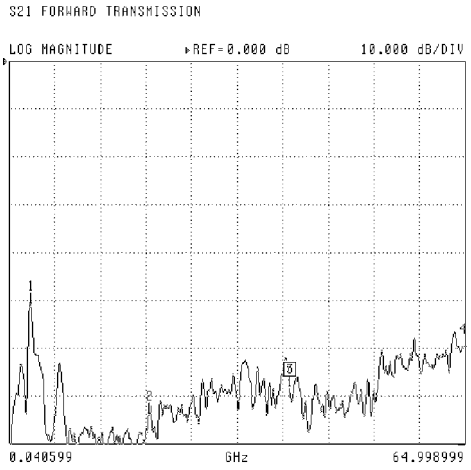
V255 50 kHz to 65 GHz



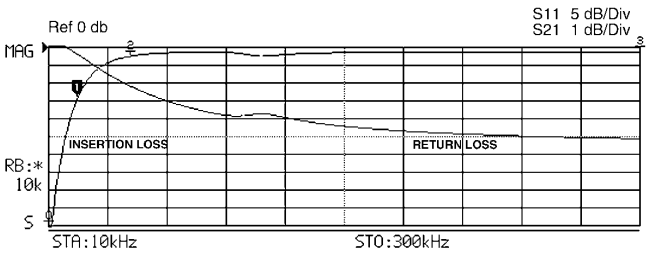

*Typical High Frequency Insertion Loss and Return Loss measured on V255 over the range of 40 MHz to 65 GHz using Anritsu 37397C VNA*



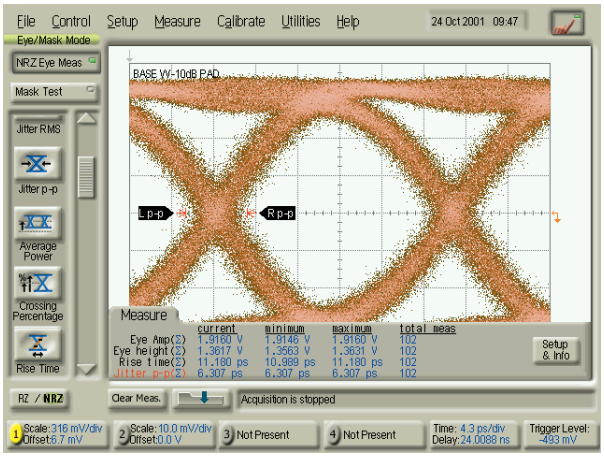

*Typical Group Delay Performance measured on V255 using Anritsu 37397C VNA*



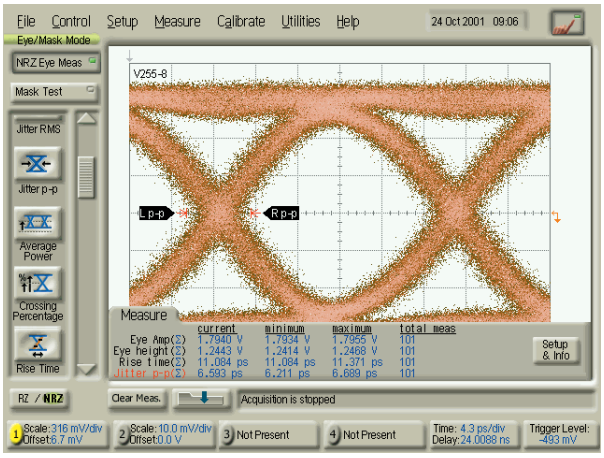

*Typical Isolation between Data I/P and DC Port using Anritsu 37397C VNA*




*Typical Low Frequency Insertion Loss and Return Loss measured on V255 Bias Tee over the range of 10 kHz to 300 kHz*




*Input Test Signal to V255 2.0 V NRZ Input Signal using Anritsu 43G ME7750A BERT*




*V255 Output Response to 2.0V NRZ Input Signal using Anritsu 43G ME7750A BERT*

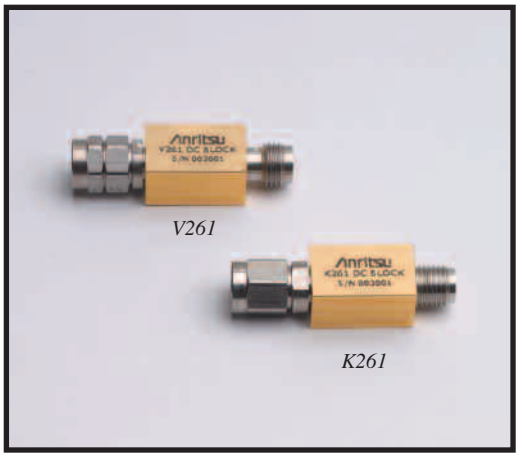
## Ordering information

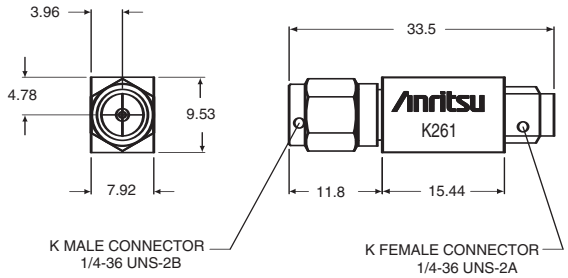
Please specify model/order number, name, and quantity when ordering.

| Model/Order No. | Name |
|---|---|
| V255 | Gen II Wideband Bias Tee, 50 kHz to 65 GHz |

# PRECISION DC BLOCKS

K261, 10 kHz to 40 GHz, V261 50 kHz to 65 GHz

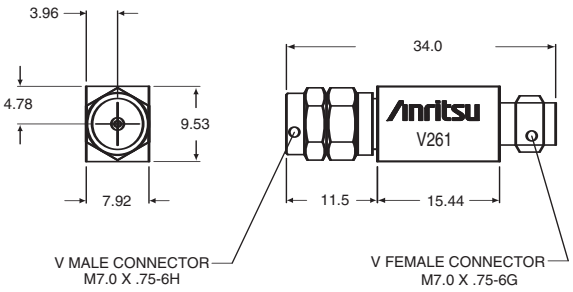



Dimensions in millimeters

*K261 outline*

These ultra-wide bandwidth DC Blocks have been optimized for optical communications and other high-speed pulse, data or microwave applications. Designed to apply AC drive signals to a device while eliminating any DC components, these DC Blocks feature wide bandwidth, excellent low frequency response, minimum insertion loss and flat group delay. Precision K Connector® and V Connector® interfaces assure excellent impedance match across the wide bandwidths available. A one year warranty is provided.




Dimensions in millimeters

*V261 outline*

## Features

- *Ideal for Optical Communications and high speed Pulse Applications*
- *<1.0 dB Insertion Loss (K261)*
- *Risetime: <5 ps (V261), <7 ps (K261)*

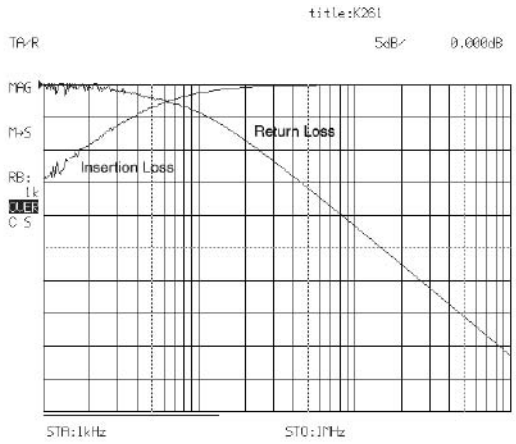
## Specifications

| Model | Frequency range 3 dB BW | Insertion loss | Return loss | Rise time | Group delay | Max DC voltage | Max RF power | Connectors |
|---|---|---|---|---|---|---|---|---|
| K261 | 10 kHz to 40 GHz | <1.0 dB typical | See Plot | < 7 ps typical | 110 ±1 ps typical | 16VDC | 1 W | RF In: K(m)<br>RF Out: K(f) |
| V261 | 50 kHz to 65 GHz | < 2.0 dB typical | See Plot | < 5 ps typical | 113 ±1 ps typical | 16VDC | 1 W | RF In: V(m)<br>RF Out: V(f) |

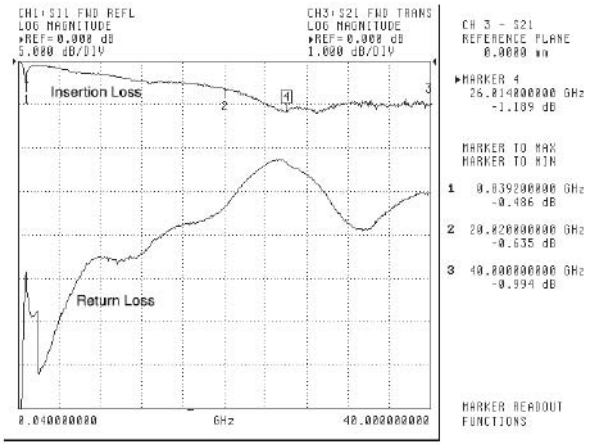
Specifications apply over the temperature range of 0°C to +70°C.

# PRECISION DC BLOCKS

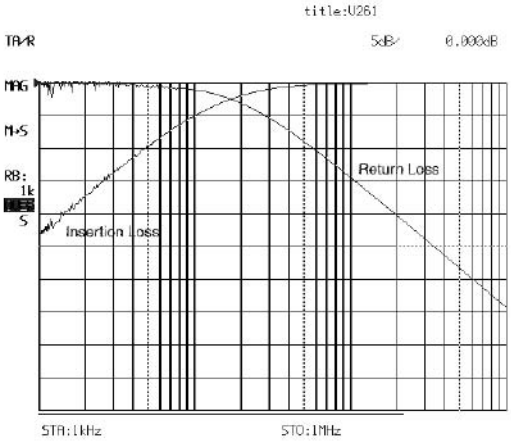
K261, 10 kHz to 40 GHz, V261 50 kHz to 65 GHz



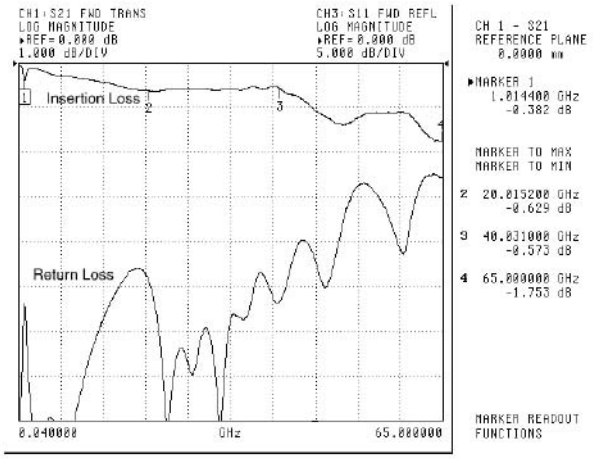

*Typical Low Frequency Insertion Loss measured on K261 over the range of 1 kHz to 1 MHz.*



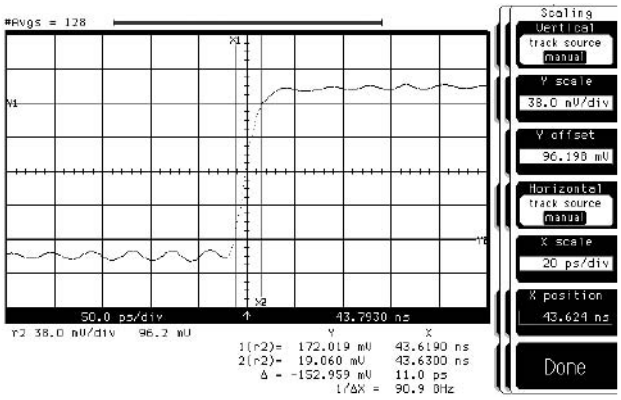

*Insertion Loss and Return Loss measured on K261 over the range of 40 MHz to 40 GHz.*




*Typical Low Frequency Insertion Loss measured on V261 over the range of 1 kHz to 1 MHz.*




*Insertion Loss and Return Loss measured on V261 over the range of 40 MHz to 65 GHz.*




*Typical Uncorrected Pulse Response for V261. Absolute risetime for the DC Blocks is derived from this measured data by applying the RSS method to compensate for the risetime of the input pulse.*

$$\sqrt{T_{BT}^2 + T_{PG}^2} = T \text{ meas.}$$

*T meas. = uncorrected risetime*
*$T_{BT}$ = absolute Bias Tee risetime*
*$T_{PG}$ = risetime of input pulse*

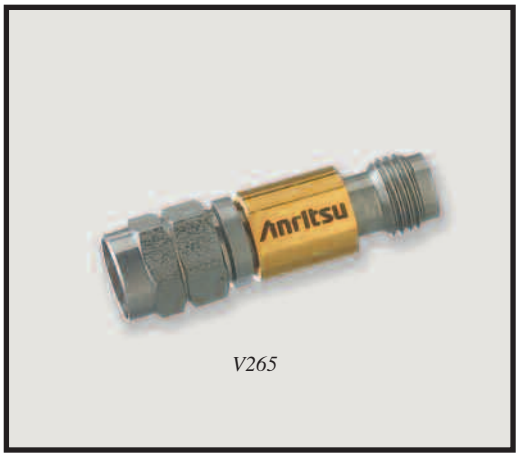
## Ordering information

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

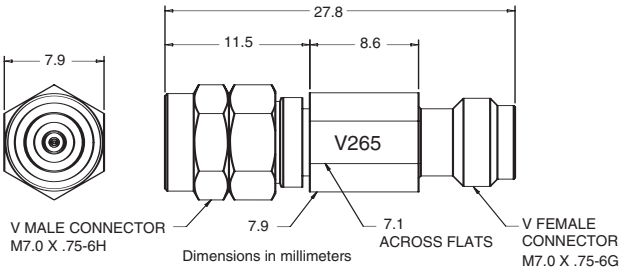
| Model/Order No. | Name |
|---|---|
| K261 | Precision DC Block, 50 kHz to 40 GHz |
| V261 | Precision DC Block, 100 kHz to 65 GHz |

# DC BLOCKS

V265, 50 kHz to 65 GHz




*V265*




*V265 outline*

The V265 DC Block has been designed and optimized for optical communications and other high speed pulse, data or microwave applications. Based on the coaxial resilient connection – which is the same as on our V255 Gen II Bias Tee – it provides excellent low frequency response with very low losses and flat group delay over the temperature of operation. Designed to apply AC drive signals to a device while eliminating any DC voltage or current components, the V265 DC Block can be used in isolating DC leakage between two electrical components. The DC block comes with a standard V Connector® and assures excellent impedance match across the wide bandwidth available. A one-year warranty is provided.

## Features

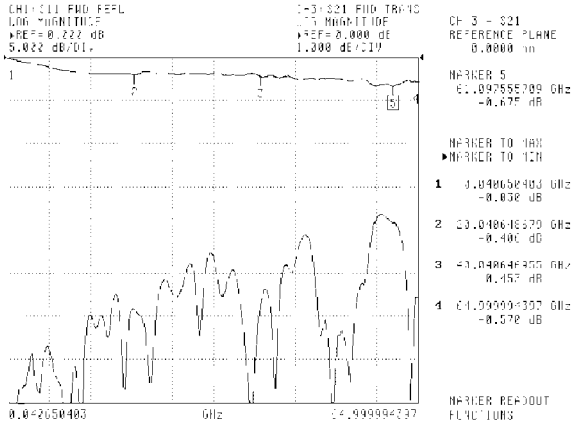
- *Ideal for Optical Communication applications.*
- *Low Insertion Loss*
- *Rise Time 3 ps typical*

## Specifications

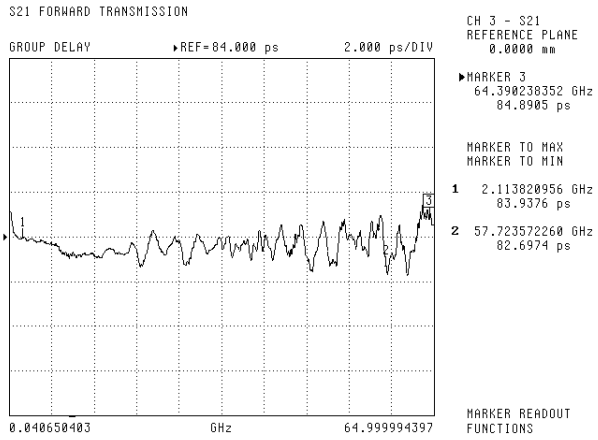
| Model | Frequency range | Insertion loss | Return loss | Rise time | Group delay | Max DC voltage | Max RF power | Connectors | Operating temperature |
|---|---|---|---|---|---|---|---|---|---|
| V265 | 50 kHz to 65 GHz<br>30 kHz to 65 GHz typical | <0.7 dB to 65 GHz typical | –15 dB to 65 GHz typical | 3 ps typical | 84 ±2 ps typical | 16 VDC | 1 W | RF In: V(f)<br>RF Out: V(m) | 0°C to 80°C |

# PRECISION DC BLOCKS

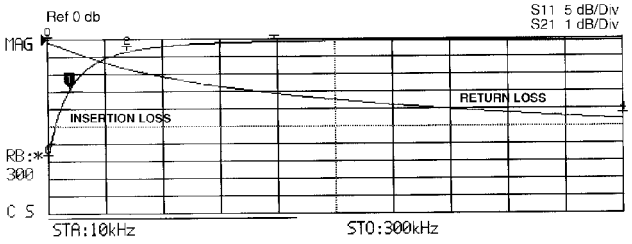
V265, 50 kHz to 65 GHz



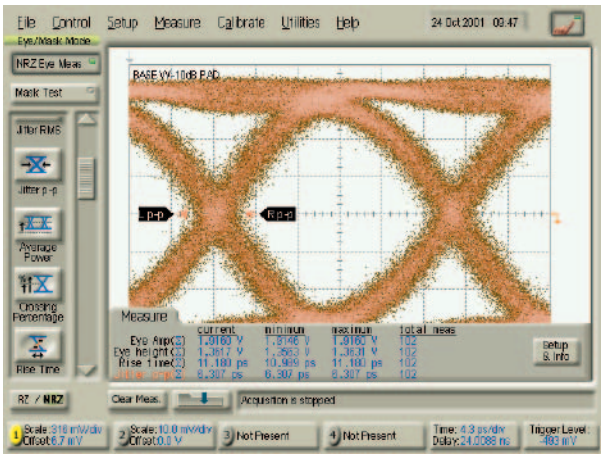

*Typical High Frequency Insertion Loss and Return Loss measured on V265 over the range of 40 MHz to 65GHz using Anritsu 37397C VNA*



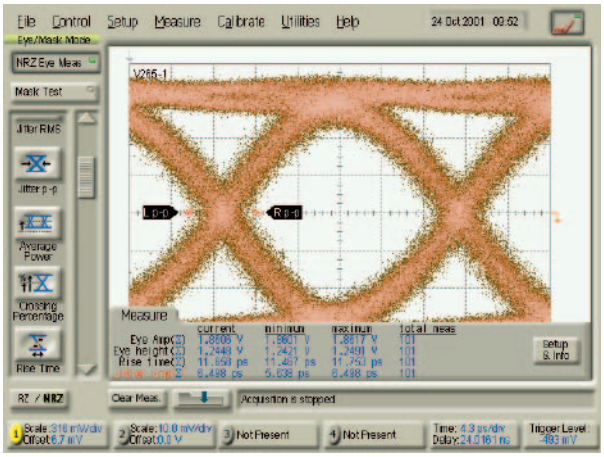

*Typical Group Delay Performance measured on V265 using Anritsu 37397C VNA*




*Typical Low Frequency Insertion Loss and Return Loss measured on V265 Bias Tee over the range of 10 kHz to 300 kHz using Anritsu MS4630B Network Analyzer*




*Input Test Signal to V265 2.0 V NRZ Input Signal using Anritsu 43G ME7750A BERT*




*V265 Output Response to 2.0V NRZ Input Signal using Anritsu 43G ME7750A BERT*

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| V265 | DC Block, 50 kHz to 65 GHz |

# UNIVERSAL TEST FIXTURES

3680 Series DC to 60 GHz


The 3680 series provide an accurate, repeatable solution for measuring microstrip and Coplanar substrate devices. Input and output connections are made to the substrate device by two spring-loaded jaws that include coax-to-microstrip/Coplanar launchers. The jaws accommodate substrates from 0.13 to 1.9 mm in thickness. No center section is required. One jaw is movable in two dimensions to accommodate substrates up to 50 mm long (100 mm for 3680-20) and substrates with line offsets of up to 12.7 mm (25 mm for 3680-20). The 3680 series includes three models: the 3680-20 covers DC to 20 GHz with APC-3.5™ connectors, the 3680K covers DC to 40 GHz with Anritsu's K Connector®, and the 3680V covers DC to 60 GHz with Anritsu's V Connector®.

## Features

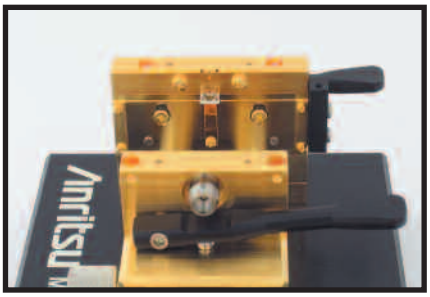
- *DC to 60 GHz coverage*
- *Microstrip and coplanar measurement capability*
- *Accommodates offset and right-angle test devices*
- *Calibration/verification kits (optional)*
- *Substrate measurement capability*

## Substrate Measurement Capability

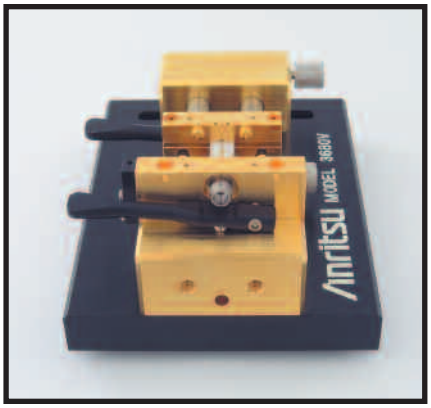
Providing substrate measurement capability for your microstrip or coplanar waveguide designs, the 3680 Series Universal Test Fixtures allow accurate, repeatable transitions from coax to microstrip or coax to coplanar waveguide (CPW). Complete substrate measurement systems comprised of a Universal Test Fixture, a vector or scalar network analyzer, and a "substrate" Calibration Kit can fulfill your microstrip or CPW test needs. Anritsu provides the complete measurement solution, the test fixtures, the calibration kits, and the test equipment for measurements on substrate devices. Our total system responsibility ensures compatible system components, designed to work together properly. Guaranteed system specs provide assurance that your test results are accurate and verifiable.

## Universal Test Fixtures

The most critical part of any substrate measurement system is the launching fixture. It must be simple yet flexible, easy to use, and most of all provide accurate, repeatable measurements. Our Universal Test Fixtures are designed to meet these requirements. Three versions of the Universal Test Fixture are available: the 3680-20, DC to 20 GHz; the 3680K, DC to 40 GHz; and the 3680V, DC to 60 GHz. The fixture consists of a fixed connector and a movable connector that can be positioned for substrates up to 2 inches long. No center section is required. The substrate is held in place between springloaded jaws. This allows the fixture to accommodate different devices without requiring a custom center section for each different length. The unique jaw action ensures solid, repeatable electrical contact. The jaw tension is defined by the force of a spring, independent of human judgment errors. This means the tension will always be the same, providing more repeatable measurements. Dielectric rods behind the jaws accurately position the substrate away from the launch to reduce fringing capacitance and contribute to the fixture's excellent repeatability. With a Universal Test Fixture you can be sure your measurements are both accurate and repeatable.




## Microstrip or Coplanar Waveguide Measurements

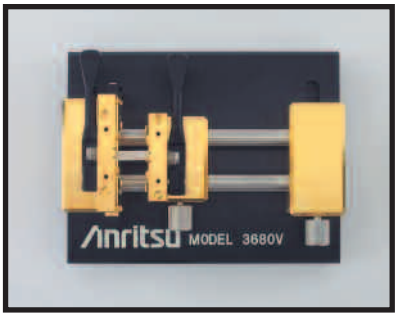



The unique design of the 3680 provides measurement capability for either microstrip or coplanar waveguide (CPW) designs. All that is required is a simple jaw change. The 3680 does the job of two fixtures, saving you time and money. A substrate measurement system with the 37xxx series VNA is the only measurement system capable of directly providing microstrip dispersion compensation. Microstrip is a dispersive media - phase shift is not linear with respect to frequency. Our Vector Network Analyzer's ability to compensate for this dispersion can dramatically improve vector measurement accuracy and provide you with the most accurate vector measurements possible.

# UNIVERSAL TEST FIXTURES

3680 Series DC to 60 GHz

## Offset Measurements




With a 3680-based substrate measurement system, there is no need to force your designs into a straight line or leave your designs untested. The 3680 has the ability to offset lines by as much as ±_ inch. Many designs, such as filters, require parallel traces that are offset. In the past, designers were forced to add extra line lengths, create one-of-a-kind custom fixtures, or worse, not test offset designs. With the flexibility of the 3680, you can test offset or in-line designs with one setup. Formerly-untestable designs can now be tested with ease.

## Right-Angle Measurements

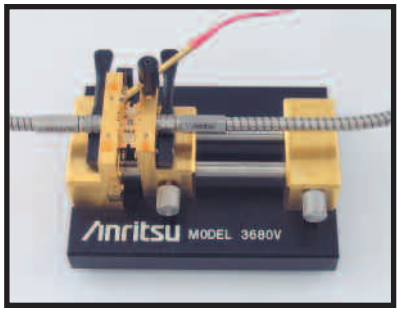
Testing designs with right-angle connections is made easy. The optional rightangle launcher adds a connection at 90° to the fixture. This lets you test devices with right-angle connections with precision and repeatability corresponding to an in-line measurement. The fixture is designed to fit your device; you don't have to design your device to fit the fixture. The right-angle launcher also provides another benefit - the ability to test multiport devices. With the addition of right-angle launchers, the 3680 can become a three port, or even four port launching fixture. A 37xxx series VNA-based microstrip measurement system with optional dual source control can interdependently control up to two sources and a receiver, for testing mixers or other frequency conversion devices. Now a microstrip or CPW mixer, converter, or other device can be tested, with the same convenience as a packaged device.

## 60 GHz Measurements

Anritsu was the first manufacturer to offer a coaxial VNA with continuous 0.04 GHz to 60 GHz measurement capability. With the 3680 Series Universal Test Fixtures, that measurement capability is extended onto the substrate. An Anritsu VNA-based substrate measurement system is capable of measurements from 0.04 GHz to 60 GHz in one setup. And the optional 60 GHz time domain capability provides time or distance measurements with unsurpassed resolution. Discontinuities as close as 1.2 mm on alumina can be resolved. You can measure devices whose performance could previously only be theorized. The 3680V, has excellent return loss and insertion loss from DC to 60 GHz. In a substrate measurement system, that translates to improved accuracy and repeatability, for more accurate characterization of your microstrip or CPW designs.

## Bias Capability

For active device measurements, the 3680 has bias capability either through the RF connection or through a bias probe. With optional multiple bias probes, you can inject bias into any point on your device under test. The bias probe provides infinite placement resolution and eliminates the need for external bias hardware. Alternately, if your active device is biased through an RF connection, bias tees can be used to combine bias and RF at any launch point. The 3680's flexible bias injection eliminates the need for multiple fixtures, saving you time and money. Up to four bias probes can be accommodated.




## MMIC Measurements

With the optional MMIC attachment, you can test MMIC's and very small components as conveniently as other devices. A MMIC attachment consists of a center carrier, with microstrip lines for launching, and cam-operated pressure rods. The MMIC component is placed on the center carrier between microstrip lines. (Machinable center carrier blocks are available for your custom designs.) Contact with the component is made with spring tabs, for reliability and damage protection. The unique design of the MMIC attachment assures solid, repeatable measurements on any small device. An Anritsu substrate measurement system can fulfill all your substrate measurement needs including, with a MMIC attachment, very small substrates and MMICs.

## Calibration/Verification Kits

A full complement of calibration kits for microstrip or coplanar waveguide are available. Standard Open Short Load (OSL) and Line Reflect Line (LRL) calibration components are included. The substrates for these cal kits are carefully selected for proper impedance and consistency, to provide the most accurate measurements possible. Included with every cal kit is a Beatty standard (standard mismatch) and a 20 dB offset termination. Now you can verify, in the fixture, the quality of your calibrations. This verification, available only from Anritsu, ensures the validity of your device measurements.

# UNIVERSAL TEST FIXTURES

3680 Series DC to 60 GHz

## Specifications

| | | |
|---|---|---|
| 3680 series Universal Test Fixture | Substrate types supported | Microstrip or coplanar waveguide |
| | Overall size | 10 x 12.7 x 6.4 cm |
| | Substrate length | 0.5 cm min.<br>5 cm max.<br>[10 cm with 3680-20] |
| | Maximum substrate width | No limit |
| | Substrate thickness | 0.012 cm min.<br>0.19 cm max. |
| | Maximum line offset | ±1.2 cm<br>[±2.5 cm with 3680-20] |
| | Input and output connectors | 3680-20: APC-3.5™ female<br>3680K: K Connector® female<br>3680V: V Connector® female |
| 36802 MMIC Attachment | Substrate thickness | 0.0 cm, 0.038 cm, 0.064 cm |
| | Minimum test substrate length | 1.5 mm |
| | Maximum test substrate length | 1.17 cm with standard block |
| | Maximum line offset | ±1.2 cm |
| 36801 Right Angle Launcher | Distance from in-line connector, axial | Minimum: 1 cm<br>Maximum: 4 cm |
| | Distance from in-line connector, offset | Minimum: 0.0 cm<br>Maximum: 2 cm |

## Electrical

| Model | Universal Test Fixture | | | Right-Angle Launcher | | MMIC Attachment |
|---|---|---|---|---|---|---|
| | 3680-20 | 3680K | 3680V | 36801K | 36801V | 36802 |
| Frequency range (GHz) | DC to 20 | DC to 40 | DC to 60 | DC to 30 | DC to 50 | DC to 60 |
| Return loss (dB)<br>DC to 20 GHz<br>20 to 40 GHz<br>40 to 60 GHz | >17 | >17<br>>14 | >17<br>>14<br>>8 | >16<br>>12 | >16<br>>12<br>>7 | >12<br>>8<br>>6 |
| Repeatability (dB)<br>DC to 20 GHz<br>20 to 40 GHz<br>40 to 60 GHz | <±0.10 | <±0.10<br><±0.20 | <±0.10<br><±0.20<br><±0.30 | <±0.15<br><±0.25 | <±0.15<br><±0.25<br><±0.40 | <±0.20<br><±0.40<br><±0.60 |

**Temperature range:** –20° to 70°C

## Ordering information

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

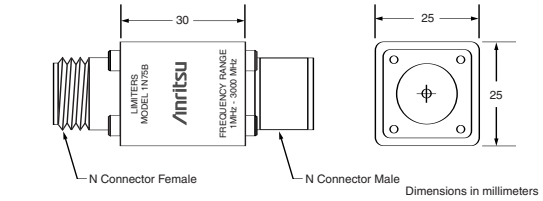
| Model/Order No. | Name |
|---|---|
| | **Main frame** |
| 3680-20 | Universal Test Fixture (20 GHz) |
| 3680K | Universal Test Fixture (40 GHz) |
| 3680V | Universal Test Fixture (60 GHz) |
| | **Accessories** |
| 36801K | Right-Angle Launcher (30 GHz) |
| 36801V | Right-Angle Launcher (50 GHz) |
| 36802 | MMIC Attachment |
| 36803 | Bias Probe |
| 36805-10M | 10 mil launchers① |
| 36805-15M | 15 mil launchers① |
| 36805-25M | 25 mil launchers① |
| | **Calibration/verification kits** |
| 36804B-10M | 10 mil microstrip cal/verif. kit, DC to 50 GHz |
| 36804B-15M | 15 mil microstrip cal/verif. kit, DC to 30 GHz |
| 36804B-25M | 25 mil microstrip cal/verif. kit, DC to 15 GHz |
| 36804B-25C | 25 mil coplanar waveguide cal/verif. kit, DC to 20 GHz |

① 36805 series includes (4) substrate launchers for the 36802 MMIC attachment

# LIMITERS

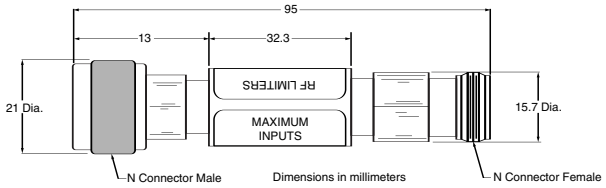
1 Series 1 MHz to 26.5 GHz


*1N50C*




*1N50B and 1N75B Limiters outline*

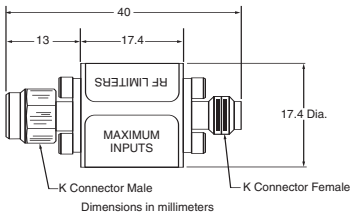

*1K50B*




*1N50C and 1N75C Limiters outline*

## Broadband microwave limiter features

- *High power protection: Up to 5 Watts*
- *Very fast turn-on time: 10 ns max.*
- *Broad frequency range: 0.001 to 26.5 GHz*
- *Low insertion loss: 2.7 dB to 20 GHz*
- *Excellent return loss: 11 dB at 20 GHz*
- *Single side limiting*




*1K50A and 1K50B Limiters outline*

## Specifications

| Model | Frequency range | Max. input power | Min. return loss (at 0 dBm input) | Max. insertion loss (at 0 dBm input) | Max. turn-on time | Input connector | Output connector | Input/output coupling |
|---|---|---|---|---|---|---|---|---|
| 1K50B | 0.01 to 26.5 GHz | 3 Watts | 10 dB | 3.9 dB | 10 ns | K(m) | K(f) | DC |
| 1K50A | 0.01 to 20 GHz | 5 Watts | 14 dB, ≤12 GHz<br>11 dB, >12 GHz | 2.7 dB | 10 ns | K(m) | K(f) | DC |
| 1N50C | 0.01 to 18 GHz | 5 Watts | 14 dB, ≤12 GHz<br>11 dB, >12 GHz | 2.9 dB | 10 ns | N(m) | N(f) | DC |
| 1N75C | 0.01 to 3 GHz | 5 Watts | 15 dB | 1.1 dB | 10 ns | 75 Ω N(m) | 75 Ω N(f) | DC |
| 1N50B | 0.001 to 3 GHz | 1.5 Watts | 19 dB | 1.3 dB | 10 ns | N(m) | N(f) | AC |
| 1N75B | 0.001 to 3 GHz | 1.5 Watts | 19 dB | 1.3 dB | 10 ns | 75 Ω N(m) | 75 Ω N(f) | AC |

**Limiting Level:** Limiter begins compressing at approximately +10 dBm. In compression, output level increases by 0.25 to 0.5 dB for each 1 dB increase at the input. Output power at 5W input at 500 MHz is 21 dBm max.
**Dimensions:** 1N50B and 1N75B 3.8 cm x 2.5 cm x 2.5 cm
**Temperature range:** 0°C to +70°C

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Limiter** |
| 1N50B | N(m) to N(f), 50 Ω, 1 MHz to 3 GHz |
| 1N75B | N(m) to N(f), 75 Ω, 1 MHz to 3 GHz |
| 1N50C | N(m) to N(f), 50 Ω, 10 MHz to 18 GHz |
| 1N75C | N(m) to N(f), 75 Ω, 10 MHz to 3 GHz |
| 1K50A | K(m) to K(f), 50 Ω, 10 MHz to 20 GHz |
| 1K50B | K(m) to K(f), 50 Ω, 10 MHz to 26.5 GHz |

# MATCHING PADS

12 Series DC to 3000 MHz


*12N50-75B*

## RF matching pad and impedance adapter features

- *DC to 3000 MHz frequency range*
- *Matching pad matches 50 Ω to 75 Ω or 75 Ω to 50 Ω circuits*
- *Impedance adapter converts 50 Ω to 75 Ω with <3 dB loss*

The 12N50-75B matching pad is a two-resistor design that matches 50 Ω to 75 Ω or 75 Ω to 50 Ω circuits.

The 12N75B impedance adapter is a one-resistor design that converts 50 Ω to 75 Ω with less than 3 dB loss.

## Specifications

| Model | Frequency range (MHz) | SWR | Insertion loss (dB) | Connectors |
|---|---|---|---|---|
| 12N50-75B | DC to 3000 | 1.25 | 7.5 max. | N(m) 50 Ω to N(f) 75 Ω |
| 12N75B | DC to 3000 | 1.25 | 3.0 max. | N(m) 50 Ω to N(m) 75 Ω |

**Temperature range:** 0°C to +70°C
**Dimensions:** 3.8 cm x 2.5 cm x 2.5 cm

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| 12N50-75B | Matching Pad, DC to 3000 MHz |
| 12N75B | Impedance Adapter, DC to 3000 MHz |

# VNA AND VNMS CALIBRATION KITS

*3753LF*


*3651, Option 1*

The Anritsu Calibration Kits contain all the precision components and tools required to calibrate your VNA or VNMS 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 kits support calibration with opens, shorts, and broadband loads. Option 1 adds sliding terminations and a pin depth gauge where required.

**The following kits are for use with 37XXX Lightning VNAs.**
**3650 SMA/3.5 mm Calibration Kit consisting of:**
- 34ASF50-2 Female Adapter (2)
- 33SFSF50 Female-Female Adapter (2)*
- 33SS50 Male-Male Adapter*
- 28S50-2 Broadband Male Termination (2)
- 28SF50-2 Broadband Female Termination (2)
- 33SSF50 Male-Female Adapter (2)*
- 24S50 Male Open
- 24SF50 Female Open
- 23S50 Male Short
- 23SF50 Female Short
- 34AS50-2 Male Adapter (2)
- Connector Thumb Wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-222 Pin Depth Gauge
- 01-223 Pin Depth Gauge
- Calibration coefficients diskette

## Option 1

**Adds the following:**
- 01-212 Female Flush Short
- 01-211 Male Flush Short
- 17SF50 Female Sliding Termination
- 17S50 Male Sliding Termination

**3651 GPC-7 Calibration Kit consisting of:**
- 28A50-2 Broadband Termination (2)
- 24A50 Open
- 23A50 Short
- 01-200 Torque Wrench
- 01-221 Collet Extractor Tool and 4 Collets
- Calibration coefficients diskette

## Option 1

**Adds the following:**
- 17A50 Sliding Termination
- 01-210 Reference Flat
- 01-220 Pin Depth Gauge

**3652 K Connector® Calibration Kit consisting of:**
- 34AKF50 Female Adapter (2)
- 33KFKF50B Female-Female Adapter (2)*
- 33KK50B Male-Male Adapter*
- 28K50 Broadband Male Termination (2)
- 28KF50 Broadband Female termination (2)
- 33KKF50B Male-Female Adapter (2)*
- 24K50 Male Open
- 24KF50 Female Open
- 23K50 Male Short
- 23KF50 Female Short
- 34AK50 Male Adapter (2)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-222 Pin Depth Gauge
- 01-223 Pin Depth Gauge
- Calibration coefficients diskette
- Connector thumb wheel (4)

## Option 1

Adds the following:
- 17KF50 Female Sliding Termination
- 17K50 Male Sliding Termination
- 01-212 Female Flush Short
- 01-211 Male Flush Short

**3653 Type N Calibration Kit consisting of:**
- 23NF50 Female Short
- 23N50 Male Short
- 24NF50 Female Open
- 24N50 Male Open
- 28N50-2 Broadband Male Termination (2)
- 28NF50-2 Broadband Female Termination (2)
- 34AN50-2 Male Adapter (2)
- 34ANF50-2 Female Adapter (2)
- 01-213 Reference Gauge
- 01-224 Pin Depth Gauge
- Calibration coefficients diskette

**3654B V Connector® Calibration Kit consisting of:**
- 23V50B-5.1 Male Short 5.1mm
- 23VF50B-5.1 Female Short 5.1mm
- 24V50B Male Open
- 24VF50B Female Open
- 28V50B Male Broadband Termination (2)
- 28VF50B Female Broadband Termination (2)
- 17VF50B Female Sliding Termination
- 17V50B Male Sliding Termination
- 33VV50B Male-Male Adapter*
- 33VFVF50B Female-Female Adapter (2)*
- 33VVF50B Male-Female Adapter (2)*
- Calibration coefficients diskette
- Connector thumb wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-322 Pin Depth Gauge
- 01-323 Female Adapter for pin gauge
- 01-204 Adapter Wrench
- 01-312 Male Flush Short
- 01-311 Female Flush Short

**3655 Series Waveguide Calibration Kit**

The 3655 Series Calibration Kit contains all of the precision components and tools required to calibrate your VNA 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 offset shorts and broadband loads. Option 1 adds a sliding termination.

**Consisting of:**
- Short, Flush (2)
- Offsets, 1/8 and 3/8 Wavelength
- Terminations, Fixed (2)
- Test Port Sections (2)

## Option 1

**Adds the following:**
- Sliding Termination

**3656 W1 Calibration Kit consisting of:**
- 23W50-1 Male Offset Short (2.02 mm)
- 23W50-2 Male Offset Short (2.65 mm)
- 23W50-3 Male Offset Short (3.180 mm)
- 24W50 Male Open (1.510 mm)
- 28W50 Male Broadband Termination
- 23WF50-1 Female Offset Short 1 (2.02 mm)
- 23WF50-2 Female Offset Short 2 (2.65 mm)
- 23WF50-3 Female Offset Short 3 (3.180 mm)
- 28WF50 Female Broadband Termination
- 24WF50 Female Open (1.930 mm)
- 33WSC50 Fixed Male SC Connector
- 33WFSC50 Fixed Female SC Connector
- Interchangeable Sliders, SC Connectors
- Locking Keys, SC Connectors
- 01-402 Interchange Adapter Fixed Male
- 33WWF50 Male-Female Adapter
- 33WW50 Male-Male Adapter
- 33WFWF50 Female-Female Adapter
- 01-504 6 mm Torque Wrench
- 01-505 6-7 mm End Wrench
- 18WWF50-1B Stepped Impedance Thruline (Verification Device)
- 18WWF50-1 50Ω Matched Thruline (Verification Device)
- Calibration coefficients diskette

* Phase Equal Adapters

**The following kits are for use with MS462XX Scorpion VNAs.**

**3750R SMA/3.5 mm 9 GHz Calibration Kit consisting of:**
- 23LF50 Female Short
- 23L50 Male Short
- 24LF50 Female Open
- 24L50 Male Open
- 28L50R Male Termination (2)
- 28LF50R Female Termination (2)
- 01-204 Adapter wrench
- Calibration coefficients diskette

**3751R GPC-7 9 GHz Calibration Kit consisting of:**
- 23A50 Short
- 24A50 Open
- 28A50R Termination (2)
- Calibration coefficients diskette

**3753R Type N 9 GHz Calibration Kit consisting of:**
- 23NF50 Female Short
- 24NF50 Female Open
- 24N50 Male Open
- 28NF50R Female Termination (2)
- 28N50R Male Termination (2)
- 23N50 Male Short
- Calibration coefficients diskette

**3753-75R 75 Ω Type N 3 GHz Calibration Kit consisting of:**
- 23N75-3 Male Short
- 23NF75-3 Female Short
- 24N75-3 Male Open
- 24NF75-3 Female Open
- 28N75-3 Male Termination (2)
- 28NF75-3 Female Termination (2)
- 34NN75-3 Male-Male Adapter
- 34NNF75-3 Male-Female Adapter
- 34NFNF75-3 Female-Female Adapter
- Calibration coefficients diskette

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Calibration kits** |
| 3650 | SMA/3.5 mm calibration kit |
| Option 1 | Adds sliding terminations |
| 3651 | GPC-7 calibration kit |
| Option 1 | Adds sliding terminations |
| 3652 | K Connector® calibration kit |
| Option 1 | Adds sliding terminations |
| 3653 | Type N calibration kit |
| Option 1 | Adds sliding terminations |
| 3654B | V Connector® calibration kit with sliding terminations |
| 3655E | WR12 Waveguide calibration kit |
| Option 1 | Adds sliding terminations |
| 3655F | WR08 Waveguide calibration kit |
| Option 1 | Adds sliding terminations |
| 3655V | WR15 Waveguide calibration kit |
| Option 1 | Adds sliding terminations |
| 3655W | WR10 Waveguide calibration kit |
| Option 1 | Adds sliding terminations |
| 3656 | W1 calibration kit |
| 3750R | SMA/3.5 mm 9 GHz calibration kit |
| 3751R | GPC-7 9 GHz calibration kit |
| 3753R | Type N 9 GHz calibration kit |
| 3753-75R | 75 Ω Type N 3 GHz calibration kit |

# VNA AND VNMS VERIFICATION KITS

*3669B*

The Anritsu 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 the system accuracy of your VNA. A disk containing factory measured test data for all components is supplied for comparison with customer-measured data.

The following kits are for use with 37XXX Lightning VNAs.

**3663 Type N Verification Kit consisting of:**
- 42N-50, 50 dB Attenuator
- 18N50-10, 10 cm Airline
- 42N20, 20 dB Attenuator
- 18N50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

**3665 Waveguide Verification Kit consisting of:**
- Straight section
- Pin set
- Mismatch section
- Ball driver
- 50 dB Attenuator
- 20 dB Attenuator
- Verification kit disks

**3666 SMA/3.5 mm Verification Kit consisting of:**
- 19S50-7, 7.5 cm Airline
- 19SF50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- 42S-50, 50 dB Attenuator
- 42S-20, 20 dB Attenuator
- Verification kit disks

**3667 GPC-7 Verification Kit consisting of:**
- 42A-50, 50 dB Attenuator
- 18A50-10, 10 cm Airline
- 42A-20, 20 dB Attenuator
- 18A50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

**3668 K Connector® Verification Kit consisting of:**
- 19K50-7, 7.5 cm Airline
- 42K-50, 50 dB Attenuator
- 42K-20, 20 dB Attenuator
- 18K50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

**3669B V Connector® Verification Kit consisting of:**
- 42V-40, 40 dB Attenuator
- 42V-20, 20 dB Attenuator
- 19V50-5, 5 cm Airline
- 18V50-5B, 5 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

**The following kits are for use with MS462XX Scorpion VNAs.**

**3663R Type N 9 GHz Verification Kit consisting of:**
- 42N-50, 50 dB Attenuator
- 42N20, 20 dB Attenuator
- 42NOP-20 N Mismatch attenuator
- Verification kit disks

**3666R SMA/3.5 mm 9 GHz Verification Kit consisting of:**
- 42L-50, 50 dB Attenuator
- 42L-20, 20 dB Attenuator
- 42LOP-20 SMA/3.5 mm Mismatch Attenuator
- Verification kit disks

**3667R GPC-7 9 GHz Verification Kit consisting of:**
- 42A-50, 50 dB Attenuator
- 42A-20, 20 dB Attenuator
- 42AOP-20 GPC-7 Mismatch Attenuator
- Verification kit disks

## Ordering information

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

| Model/Order No. | Name |
|---|---|
| | **Verification kits** |
| 3663 | Type N verification kit |
| 3665 | Waveguide verification kit |
| 3666 | SMA/3.5 mm verification kit |
| 3667 | GPC-7 verification kit |
| 3668 | K Connector® verification kit |
| 3669B | V Connector® verification kit |
| 3663R | Type N 9 GHz verification kit |
| 3666R | SMA/3.5 mm 9 GHz verification kit |
| 3667R | GPC-7 9 GHz verification kit |

# PART NUMBER INDEX

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# NOTES

# NOTES

# POWER CONVERSION TABLE

| Power (dBm) | P (mW) | Volts ms into 50 Ω | Volts Peak | Volts Peak to Peak |
|---|---|---|---|---|
| -60 | 0.00000100 | 0.000224 | 0.000316 | 0.00063 |
| -59 | 0.00000126 | 0.000251 | 0.000355 | 0.00071 |
| -58 | 0.00000158 | 0.000282 | 0.000398 | 0.00080 |
| -57 | 0.00000200 | 0.000316 | 0.000447 | 0.00089 |
| -56 | 0.00000251 | 0.000354 | 0.000501 | 0.00100 |
| -55 | 0.00000316 | 0.000398 | 0.000562 | 0.00112 |
| -54 | 0.00000398 | 0.000446 | 0.000631 | 0.00126 |
| -53 | 0.00000501 | 0.000501 | 0.000708 | 0.00142 |
| -52 | 0.00000631 | 0.000562 | 0.000794 | 0.00159 |
| -51 | 0.00000794 | 0.000630 | 0.000891 | 0.00178 |
| -50 | 0.00000100 | 0.000707 | 0.001000 | 0.00200 |
| -49 | 0.00000126 | 0.000793 | 0.001122 | 0.00224 |
| -48 | 0.00000158 | 0.000890 | 0.001259 | 0.00252 |
| -47 | 0.00000200 | 0.00100 | 0.001413 | 0.00283 |
| -46 | 0.00000251 | 0.00112 | 0.001585 | 0.00317 |
| -45 | 0.00000316 | 0.00126 | 0.001778 | 0.00356 |
| -44 | 0.00000398 | 0.00141 | 0.001995 | 0.00399 |
| -43 | 0.00000501 | 0.00158 | 0.002239 | 0.00448 |
| -42 | 0.00000631 | 0.00178 | 0.002512 | 0.00502 |
| -41 | 0.00000794 | 0.00199 | 0.002818 | 0.00564 |
| -40 | 0.00000100 | 0.00224 | 0.003162 | 0.00632 |
| -39 | 0.00000126 | 0.00251 | 0.003548 | 0.00710 |
| -38 | 0.00000158 | 0.00282 | 0.003981 | 0.00796 |
| -37 | 0.00000200 | 0.00316 | 0.004467 | 0.00893 |
| -36 | 0.00000251 | 0.00354 | 0.005012 | 0.0100 |
| -35 | 0.00000316 | 0.00398 | 0.005623 | 0.0112 |
| -34 | 0.00000398 | 0.00446 | 0.006310 | 0.0126 |
| -33 | 0.00000501 | 0.00501 | 0.007079 | 0.0142 |
| -32 | 0.00000631 | 0.00562 | 0.007943 | 0.0159 |
| -31 | 0.00000794 | 0.00630 | 0.008913 | 0.0178 |
| -30 | 0.0010 | 0.00707 | 0.010000 | 0.0200 |
| -29 | 0.0013 | 0.00793 | 0.011220 | 0.0224 |
| -28 | 0.0016 | 0.00890 | 0.012589 | 0.0252 |
| 27 | 0.0020 | 0.00999 | 0.014125 | 0.0283 |
| -26 | 0.0025 | 0.01121 | 0.015849 | 0.0317 |
| -25 | 0.0032 | 0.01257 | 0.017783 | 0.0356 |
| -24 | 0.0040 | 0.01411 | 0.019953 | 0.0399 |
| -23 | 0.0050 | 0.01583 | 0.022387 | 0.0448 |
| -22 | 0.0063 | 0.01776 | 0.025119 | 0.0502 |
| -21 | 0.0079 | 0.01993 | 0.028184 | 0.0564 |
| -20 | 0.0100 | 0.02236 | 0.031623 | 0.0632 |
| -19 | 0.0126 | 0.02509 | 0.035481 | 0.0710 |
| -18 | 0.0158 | 0.02815 | 0.039811 | 0.0796 |
| -17 | 0.0200 | 0.03159 | 0.044668 | 0.0893 |
| -16 | 0.0251 | 0.03544 | 0.050119 | 0.1002 |
| -15 | 0.0316 | 0.03976 | 0.056234 | 0.1125 |
| -14 | 0.0398 | 0.04462 | 0.063096 | 0.1262 |
| -13 | 0.0501 | 0.05006 | 0.070795 | 0.1416 |
| -12 | 0.0631 | 0.05617 | 0.079433 | 0.1589 |
| -11 | 0.0794 | 0.06302 | 0.089125 | 0.1783 |
| -10 | 0.1000 | 0.07071 | 0.100000 | 0.2000 |

| Power (dBm) | P (mW) | Volts ms into 50 Ω | Volts Peak | Volts Peak to Peak |
|---|---|---|---|---|
| –9 | 0.1259 | 0.07934 | 0.112 | 0.2244 |
| -8 | 0.1585 | 0.08902 | 0.126 | 0.2518 |
| -7 | 0.1995 | 0.09988 | 0.141 | 0.2825 |
| -6 | 0.2512 | 0.11207 | 0.158 | 0.3170 |
| -5 | 0.3162 | 0.12574 | 0.178 | 0.3557 |
| -4 | 0.3981 | 0.14109 | 0.200 | 0.3991 |
| -3 | 0.5012 | 0.15830 | 0.224 | 0.4477 |
| -2 | 0.6310 | 0.17762 | 0.251 | 0.5024 |
| -1 | 0.7943 | 0.19929 | 0.282 | 0.5637 |
| 0 | 1.0000 | 0.22361 | 0.316 | 0.6325 |
| 1 | 1.259 | 0.25089 | 0.355 | 0.7096 |
| 2 | 1.585 | 0.28150 | 0.398 | 0.7962 |
| 3 | 1.995 | 0.31585 | 0.447 | 0.8934 |
| 4 | 2.512 | 0.35439 | 0.501 | 1.0024 |
| 5 | 3.162 | 0.39764 | 0.562 | 1.1247 |
| 6 | 3.981 | 0.44615 | 0.631 | 1.2619 |
| 7 | 5.012 | 0.50059 | 0.708 | 1.4159 |
| 8 | 6.310 | 0.56167 | 0.794 | 1.5887 |
| 9 | 7.943 | 0.63021 | 0.891 | 1.7825 |
| 10 | 10.000 | 0.70711 | 1.000 | 2.0000 |
| 11 | 12.589 | 0.79339 | 1.122 | 2.2440 |
| 12 | 15.849 | 0.89019 | 1.259 | 2.5179 |
| 13 | 19.953 | 0.99881 | 1.413 | 2.8251 |
| 14 | 25.119 | 1.12069 | 1.585 | 3.1698 |
| 15 | 31.623 | 1.25743 | 1.778 | 3.5566 |
| 16 | 39.811 | 1.41086 | 1.995 | 3.9905 |
| 17 | 50.119 | 1.58301 | 2.239 | 4.4774 |
| 18 | 63.096 | 1.77617 | 2.512 | 5.0238 |
| 19 | 79.433 | 1.99290 | 2.818 | 5.6368 |
| 20 | 100.000 | 2.23607 | 3.162 | 6.3246 |
| 21 | 125.893 | 2.50891 | 3.548 | 7.0963 |
| 22 | 158.489 | 2.81504 | 3.981 | 7.9621 |
| 23 | 199.526 | 3.15853 | 4.467 | 8.9337 |
| 24 | 251.189 | 3.54393 | 5.012 | 10.0237 |
| 25 | 316.228 | 3.97635 | 5.623 | 11.2468 |
| 26 | 398.107 | 4.46154 | 6.310 | 12.6191 |
| 27 | 501.187 | 5.00593 | 7.079 | 14.1589 |
| 28 | 630.957 | 5.61675 | 7.943 | 15.8866 |
| 29 | 794.328 | 6.30210 | 8.913 | 17.8250 |
| 30 | 1000.000 | 7.07107 | 10.000 | 20.0000 |
| 31 | 1258.925 | 7.93387 | 11.220 | 22.4404 |
| 32 | 1584.893 | 8.90195 | 12.589 | 25.1785 |
| 33 | 1995.262 | 9.98815 | 14.125 | 28.2508 |
| 34 | 2511.886 | 11.20689 | 15.849 | 31.6979 |
| 35 | 3162.278 | 12.57433 | 17.783 | 35.5656 |
| 36 | 3981.072 | 14.10864 | 19.953 | 39.9052 |
| 37 | 5011.872 | 15.83015 | 22.387 | 44.7744 |
| 38 | 6309.573 | 17.76172 | 25.119 | 50.2377 |
| 39 | 7943.282 | 19.92898 | 28.184 | 56.3677 |
| 40 | 10000.000 | 22.36068 | 31.623 | 63.2456 |
| 41 | 12589.254 | 25.08910 | 35.481 | 70.9627 |

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