Keysight Technologies
RF and Microwave Test Accessories

Catalog

Switches
Attenuators
Amplifiers
Attenuator/Switch Drivers
Adapters & Connectors
Mixers
Directional Couplers
Power Dividers & Splitters
Power Limiters
DC Blocks
PXI Switches
PXI Attenuators

Keysight Technologies
RF and Microwave Test Accessories

Catalog

The Keysight Technologies, Inc. RF and Microwave Test Accessories Catalog allows you to quickly and conveniently research the highest quality RF and microwave test accessories in the industry. Our test accessories are the result of decades of innovation in creating the building blocks used in our test and measurement products and solutions. We've evolved these key technologies into a broad line of RF and microwave test accessories for use in your test and measurement solutions.

In addition to this catalog, our Web Site (**www.keysight.com/find/mta**) provides the latest news, product and support information. We encourage you to visit the site, where you can obtain updated technical information and download technical literature on Keysight's high-performance RF and microwave test accessories.

KEYSIGHT TECHNOLOGIES

Choose High-Quality for Every Connection

...Keysight's Test Accessories Eliminate the Weak Links in Your Measurement System

Keysight Assures Confidence – Proven Technology, Trusted Measurements

Keysight Technologies is the world's premier measurement company with over 60 years of industry-leading measurement experience.

Our test and measurement business provides standard and customized solutions that are used in design, development, manufacture, installation, deployment and operation of electronics equipment and communications networks and services.

Keysight's Test and Measurement Organization

Keysight's RF and microwave test solutions help engineers create designs, generate waveforms, measure and analyze signals, and build systems more accurately. Today, Keysight's high-performance RF and microwave test solutions such as spectrum analyzers, signal generators, network analyzers, power meters, signal source analyzers and more are used all over the world.

Keysight's industry-leading RF and microwave test accessories complete our test solutions by simplifying test setups and maximizing the equipment's full potential to ensure the best possible measurement results.

Keysight's RF and Microwave Test Accessories

Product innovation

Keysight provides a complete series of coaxial and waveguide RF and microwave test accessories – everything from adapters, power limiters, DC blocks, attenuators, and couplers to switches and system amplifiers.

Together with the engineers in Keysight Labs, our application consultants throughout the world will recommend a suitable solution for you. Take advantage of Keysight's expertise in precision measurement technology.

Quality innovation

Quality innovation is not only a passion for the Keysight engineers who design and manufacture our RF and microwave test accessories – it is a way of life. We give exceptional precision through our integrated approach to manufacturing, such as advanced fabrication facilities with state-of-the-art milling equipment and sophisticated metallurgical and planting processes. This way of life ensures you receive exceptional reliability, accuracy and repeatability in every Keysight test accessory.

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Trademark Information

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2 New Products

Low PIM Coaxial Switches

N1810T/10U/11T/12U Low PIM Coaxial Switch, SPDT/Bypass, DC to 26.5 GHz

87104P/Q/R Low PIM Coaxial Switch, SP4T/6T, DC to 26.5 GHz

87222R Low PIM Coaxial Switch, Transfer, DC to 26.5 GHz

87406/606Q Low PIM Coaxial Switch, Matrix, DC to 20 GHz

- Low PIM performance of -160 dBc to keep your system PIM level low
- 0.03 dB IL repeatability, ensures accuracy and reduces calibration cycles
- 3 million cycles per section of operating life, reduces cost of test and ensures reliability of the test system life expectancy
- Excellent isolation minimizes cross-talk between channels to ensure signal integrity

Keysight low PIM coaxial switches provide ultra-low passive intermodulation (PIM) performance for applications where two or more transmitted signals share a common antenna or whenever the transmitter signal is too high or the receiver is sensitive to high intermodulation. These low PIM switches can help to keep the system PIM level low. 0.03 dB insertion loss repeatability and 3 million cycles of operating life ensures signal integrity, improves testing efficiency, and ultimately maximizes test throughput.

Web Link

www.keysight.com/find/lowpim

U1816A/C USB Coaxial Switch, Dual SP6T, DC to 8/26.5 GHz

- Allows switching of multiple signals without physically changing the connections, shorten test time and increase throughput
- 5 million cycles operating life (typical 10 million cycles), reduces cost-of-test and ensures reliability of the test system
- Excellent isolation minimizes cross-talk between channels to ensure signal integrity

The Keysight U1816A/C is a USB-controlled switch matrix that consists of two single-pole-six-throw (SP6T) switches. It allows switching of multiple signal paths without physically changing the connections. This allows multiple tests to be performed with the same setup, eliminating the need for frequent connects and disconnects. An entire testing process can be automated, increasing the throughput in high-volume production environments.

	U1816A	**U1816C**
Frequency range:	DC to 8 GHz	DC to 26.5 GHz
SWR:	DC to 4 GHz: < 1.20 4 to 8 GHz: < 1.35	DC to 4 GHz: < 1.20 4 to 12.4 GHz: < 1.35 12.4 to 18 GHz: < 1.45 18 to 26.5 GHz: < 1.70
Insertion loss (dB, max):	0.3 + 0.015 f, where f is specified in GHz	
Isolation (dB, min):	DC to 8 GHz: 100	DC to 12 GHz: 100 15 to 20 GHz: 70 20 to 26.5 GHz: 65
Life	5 million cycles (typical 10 million cycles)	

Web Link

www.keysight.com/find/USBswitch

U1810B USB Coaxial Switch with E5071C ENA Series network analyzer

U1810B USB Coaxial Switch SPDT, DC to 18 GHz

- USB plug-and-play eliminates the need for additional power adapters or drivers, simplifies complex test setup
- 0.03 dB insertion loss repeatability, ensures measurement accuracy
- 5 million cycles operating life (typical 10 million cycles), reduces cost-of-test and ensures reliability of the test system
- Excellent isolation (> 70 dB at 18 GHz), minimizes cross-talk between channels to ensure signal integrity
- Instant switch toggling via a push-button on the casing facilitates in quick test setup validation

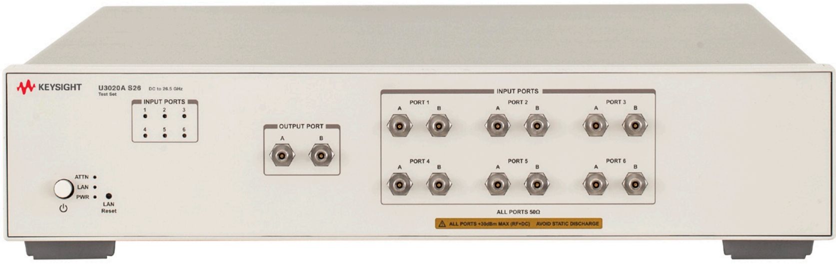
The Keysight U1810B is a USB-powered SPDT coaxial switch, operating from DC to 18 GHz, and supports the standard plug-and-play functionality of typical USB devices. The unique combination of excellent RF performance with the convenience of USB connectivity presents an invaluable alternative for users to increase the efficiency of their test systems. No additional power supply is required and the Type-N common input connector provides a rugged and robust connection with the instrument ports. A push-button on the switch casing allows for direct toggling of the two output ports without the need for any software interface. In addition, the bundled soft front panel provides an alternative virtual interface to control the U1810B. Users also have the option to control the switch through commonly used software programming platforms such as C#, C++, LabVIEW, VEE, etc.

Inheriting Keysight's unique switch technology, the U1810B is designed to operate for more than 10 million cycles. The exceptional 0.03 dB insertion loss repeatability is warranted for 5 million cycles. This excellent RF characteristic significantly reduces downtime for recalibration, improves testing efficiency and ultimately maximizes test throughput.

Frequency range:	DC to 18 GHz
SWR:	DC to 4 GHz: < 1.15 4 to 12.4 GHz: < 1.25 12.4 to 18 GHz: < 1.40
Insertion loss (dB, max):	0.3 + (0.6/18)f, where f is specified in GHz
Isolation (dB, min):	90 – (30/26.5)f, where f is specified in GHz
Life:	5 million cycles (typical 10 million cycles)

Web Link

www.keysight.com/find/USBswitch



U3020AS26 Switching Test Set, DC to 26.5 GHz

- Allows switching of multiple signals without physically changing the connections, reduce test time and increase throughput
- Supported by the Keysight Infiniium Series compliance application framework where switch support is enabled
- 5 million cycles operating life (typical 10 million cycles), reduces cost-of-test and ensures reliability of the test system

The Keysight U3020AS26 is a switch matrix that consists of two single-pole-six-throw (SP6T) switches. It allows switching of multiple signal paths without physically changing the connections. This allows multiple tests to be performed with the same setup, eliminating the need for frequent connects and disconnects. An entire testing process can be automated, increasing the throughput in high-volume production environments.

The U3020AS26 can be recognized by the switch matrix software option for Infiniium compliance applications which then automates test for each lane on a multi-lane bus. Accessories are available for coaxial SMA and SMP connection test interfaces as well as for direct probing using the Keysight InfiniiMax Series probes. In addition, Keysight's N2809A PrecisionProbe oscilloscope probe and cable correction software can be used to remove the loss and skew introduced when the switch paths are added to the measurement setup.

Frequency range:	DC to 26.5 GHz
Insertion loss (dB, max):	2.5 up to 20 GHz
Phase tracking (Skew):	8 ps up to 20 GHz
Life:	5 million cycles (typical 10 million cycles)

Web Link

www.keysight.com/find/switching

PXI M9155/6/7C switch modules DC to 26.5 GHz

M9155/6/7C and M9155/6/7CH40 PXI Microwave Switch Modules

- 0.03 dB insertion loss repeatability throughout the operating life, typical operating life up to 10 million cycles
- Unmatched isolation of 60 dB at 26.5 GHz
- Soft front panel is available for each switch module

Keysight designs and manufactures a comprehensive range of RF and microwave switches to meet your switching requirements. Other than connectorized switches, Keysight also offers switch modules that operate across a broad frequency range and come in a variety of configurations. Designed with high accuracy and repeatability for automated test and measurement, signal monitoring and routing applications, Keysight switches have a proven track record for high performance, quality and reliability.

The new Keysight PXI switch module series operates from a frequency range of DC to 26.5/40 GHz. It is being used in applications such as Automatic Test Equipment (ATE), RF communications measurement and RF parametric measurements where a rugged switching module is needed in high density switching systems.

The PXI switch module comes in a selection of 6 models; the integration of Keysight dual SPDT switches, dual transfer switches and a single SP6T configurations of DC to 26.5 GHz or 40 GHz. These PXI modules provide an exceptional 0.03 dB insertion loss repeatability, high isolation, low SWR with a long operating life of up to 10 million cycles.

Web Link

www.keysight.com/find/PXIswitch

M9168C/E PXI Programmable Step Attenuator Module

- 0 to 101 dB attenuation, 1 dB steps
- 0.03 dB insertion loss repeatability per section for the entire 5 million cycles
- Excellent attenuation accuracy across a wide operating temperature range ensures precise measurement

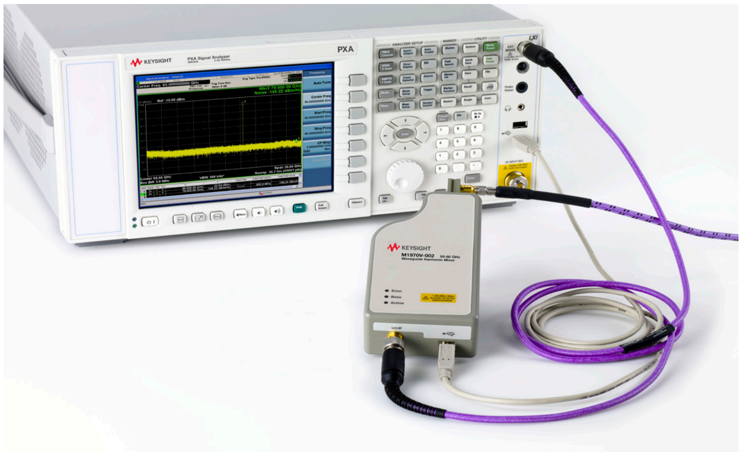
M9168C/E is a programmable step attenuator module based on PXI platform, operating from DC to 26.5/50 GHz. It is a signal conditioning module that enhances the measurement accuracy and flexibility of PXI based RF and microwave test systems.

M9170A PXI Switch/Attenuator Driver Module

- Drive up to 12 external SPDT switches, or 4 external SP4T/6T switches, or 12 transfer switches, or 2 external attenuators

Web Link

www.keysight.com/find/PXIattenuator



M1970E/V/W with N9030A PXA signal analyzer

M1970E/V/W Waveguide Harmonic Mixers 60 to 90 GHz, 50 to 75/80 GHz and 75 to 110 GHz

- Automatic amplitude correction and transfer of conversion loss data through USB plug and play features
- Automatic LO amplitude adjustment to compensate the cable loss (up to 3 m or 10 dB loss)
- Automatically detect mixer model/serial number when used with N9040B UXA, N9030A PXA, N9020A MXA and N9010A EXA signal analyzers
  - Automatic setting of the default frequency range and LO harmonic numbers
  - Automatic LO alignment at start up
  - Automatically run calibration when time and temperature change
- Improved overall system DANL and TOI with excellent conversion loss of 25 dB maximum and excellent amplitude accuracy

The Keysight M1970E/V/W waveguide harmonic mixers are un-preselected mixers designed to extend the frequency range of the high-performance Keysight N9040B UXA, N9030A PXA, N9020A MXA and N9010A EXA signal analyzers for high frequency wireless and millimeter-wave applications.

It provides the most efficient test setup and test performance through its smart features when combined with Keysight N9040B UXA, N9030A PXA, N9020A MXA and N9010A EXA signal analyzers. The waveguide harmonic mixers will automatically transfer the conversion loss data, auto detect the mixer model and serial number to setup default frequency range, automatic LO alignment at start up and run calibration when time and temperature change.

Automatically perform LO amplitude adjustments to improve the overall DANL and TOI of your test system with excellent conversion loss and calibration accuracy. Go smart with your harmonic mixing using the combined solution of M1970E/V/W waveguide harmonic mixers and N9040B UXA, N9030A PXA, N9020A MXA and N9010A EXA signal analyzers.

Web Link

www.keysight.com/find/smartmixers

U7227A/C/F with N9030A PXA signal analyzer

U7227A/C/F USB Preamplifiers

- Automatic gain correction value with temperature compensation and transfer of calibration data (noise figure and S-parameters) through USB plug and play features for improved noise figure measurements when used with Keysight X-Series signal analyzers
- Excellent noise figure and optimized gain with the X-Series signal analyzers improves measurement accuracy and minimizes uncertainty
- Provides broadband operating frequency from 10 MHz up to 50 GHz for various applications
- Rugged and portable design for bench top measurements or remote front end field applications

The U7227A/C/F USB preamplifiers are designed to bring reliable gain and low noise figure to measurement systems improving the overall system performance and reduce systematic errors; a total solution with the X-Series signal analyzers to perform noise figure measurements up to 50 GHz.

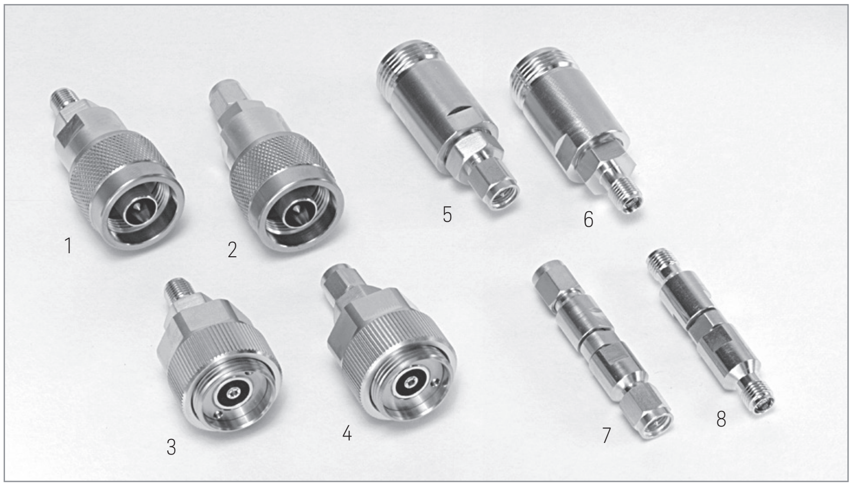
When connected to the X-Series signal analyzers, the USB preamplifiers can automatically configure the analyzers to detect the specific preamplifier connected and download the embedded calibration data such as gain, noise figure and S-parameters. The calibration data provides accurate correction data and repeatable results for each actual measurement made.

Web Link
www.keysight.com/find/amplifiers

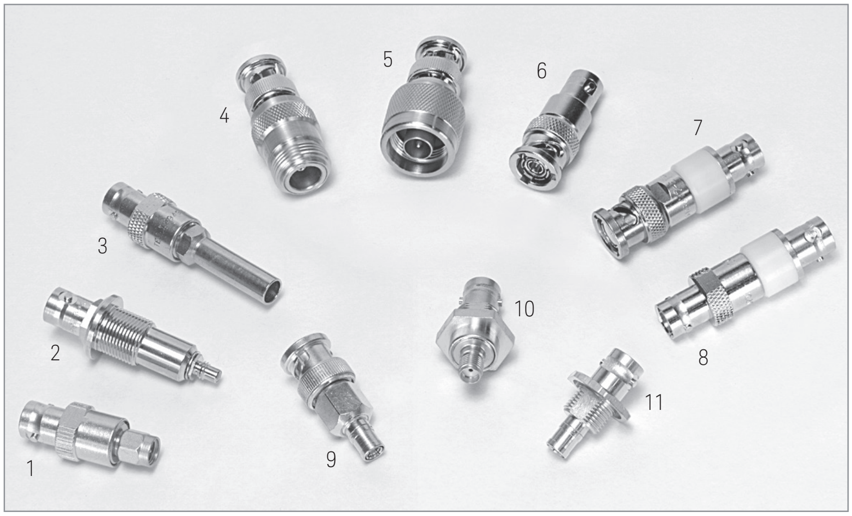
3

Adapters and Connectors

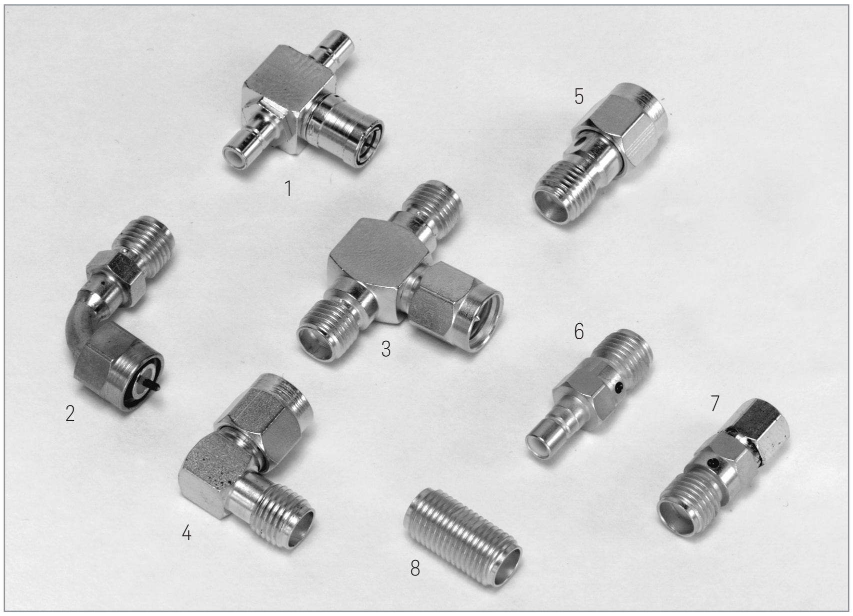
Selected Instrument Grade Adapters



1 1250-1744 adapter, 3.5 mm (f) to type-N (m), DC to 18 GHz
2 1250-1743 adapter, 3.5 mm (m) to type-N (m), DC to 18 GHz
3 1250-1747 SMA (f) to APC-7 adapter
4 1250-1746 SMA (m) to APC-7 adapter
5 1250-1750 3.5 mm (m) to type-N (f)
6 1250-1745 3.5 mm (f) to type-N (f)
7 1250-1748 3.5 mm (m) to 3.5 mm (m) instrument-grade adapter
8 1250-1749 3.5 mm (f) to 3.5 mm (f)



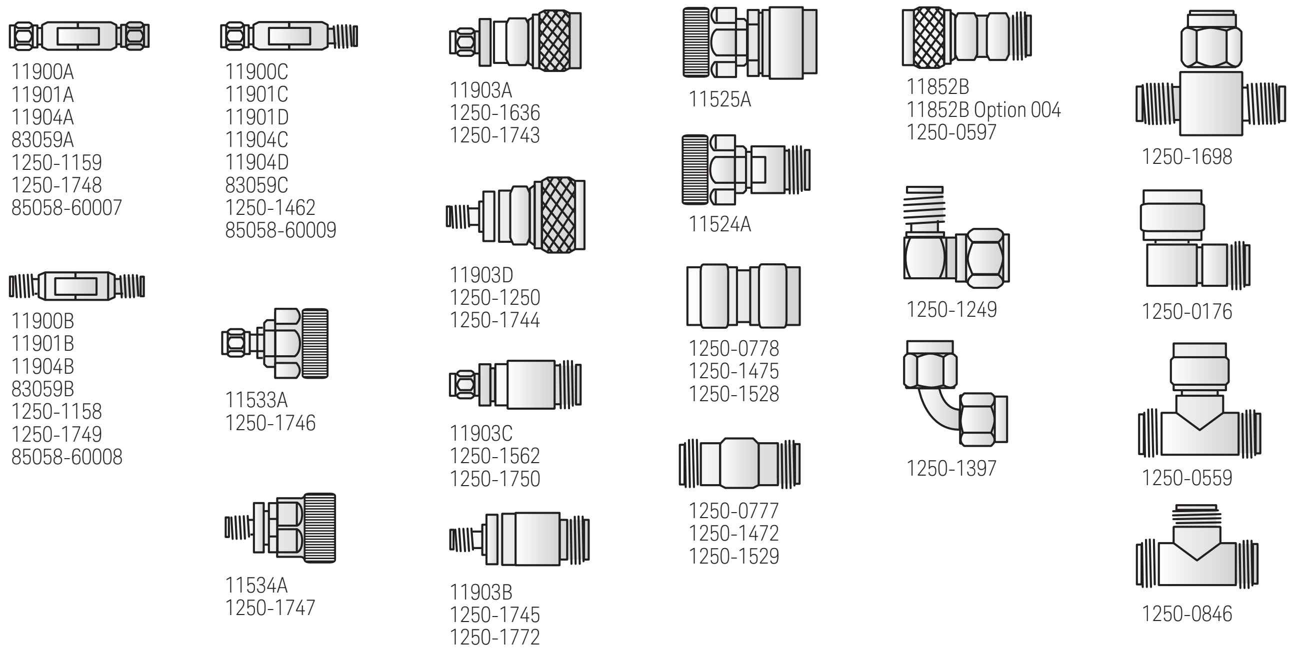
1 1250-1200 adapter, BNC (f) to SMA (m)
2 1250-1899 adapter, BNC (f) to SMB (m)
3 1250-0556 adapter, BNC (f) to WECO video (m)
4 1250-1477 standard, N (f) to BNC (m), precision 50 Ω
5 1250-1473 standard, N (m) to BNC (m), precision 50 Ω adapter
6 1250-0595 adapter, BNC (f) to BNC triaxial (m)
7 1250-1930 adapter, BNC (m) to BNC triaxial (f)
8 1250-1830 adapter, BNC (f) to BNC triaxial (f)
9 1250-1857 adapter, SMB (f) to BNC (m)
10 1250-0562 adapter, BNC (f) to SMA (f)
11 1250-1236 adapter, SMB (f) to BNC (f)



1 1250-1391 adapter, SMB tee (f) (m) (m)
2 1250-1741 SMA (f) to SMA (m) right angle adapter
3 1250-1698 adapter, SMA tee (m) (f) (f)
4 1250-1249 adapter, SMA right angle (m) (f)
5 1250-1462 adapter, SMA (m) to SMA (f)
6 1250-0674 adapter, SMB (m) to SMA (f)
7 1250-1694 SMA (f) and SMC (f) adapter
8 1250-1158 SMA (f) to SMA (f) adapter

1 1250-0597 adapter, type-N (m) 50 Ω to type-N (f) 75 Ω
2 1250-1778 standard N (m) to standard N (m) adapter, 50 Ω
3 1250-1529 standard N (f) to standard N (f) adapter, 75 Ω
4 1250-1152 adapter, SMC (f) to type-N (m)
5 1250-1404 adapter, SMA (f) to type-N (f)
6 1250-1023 adapter, SMC (m) to type-N (m)
7 1250-1535 adapter, N (m) to BNC (f) adapter, 75 Ω
8 1250-1533 standard N (m) to BNC (m) adapter, 75 Ω
9 1250-1250 adapter, type-N (m) to SMA (f), 50 Ω
10 1250-0846 tee adapter, standard N (f) (f) (f)
11 1250-1636 adapter, type-N (m) to SMA (m) 50 Ω
12 1250-0559 tee adapter, standard N (m) (f) (f)
13 1250-0176 right angle standard N (m) to standard N (f)

Typical Configuration



Overview

Many coaxial connector types are available in the RF and microwave industry, each designed for a specific purpose and application. For measurement applications, it is important to consider the number of connects/disconnects, which impact the connector's useful life.

The frequency range of any connector is limited by the excitation of the first circular waveguide propagation mode in the coaxial structure. Decreasing the diameter of the outer conductor increases the highest usable frequency; filling the air space with dielectric lowers the highest usable frequency and increases system loss.

Performance of all connectors is affected by the quality of the interface for the mated pair. If the diameters of the inner and outer conductors vary from the nominal design, if plating quality is poor, or if contact separation at the junction is excessive, then the reflection coefficient and resistive loss at the interface will be degraded.

A few connectors, such as the APC-7, are designed to be sexless. Most are female connectors that have slotted fingers, which introduce a small inductance at the interface. The fingers accommodate tolerance variations but reduce repeatability and may ultimately break after 1000 connections. Keysight offers slotless versions of connectors in certain measuring products, which decrease inductance and increase repeatability.

The following is a brief review of common connectors used in test and measurement applications:

APC-7 (7 mm) Connector

The APC-7 (Amphenol Precision Connector-7 mm) offers the lowest reflection coefficient and most repeatable measurement of all 18 GHz connectors. Development of the connector was a joint effort between HP and Amphenol, which began in the 1960s. This is a sexless design and is the preferred connector for the most demanding applications, notably metrology and calibration.

Type-N Connector

The type-N (Navy) 50-ohm connector was designed in the 1940s for military systems operating below 4 GHz. In the 1960s, improvements pushed performance to 12 GHz and later with an operating frequency up to 18 GHz. Keysight offers products with slotless type-N center conductors for improved performance to 18 GHz. Keysight type-N connectors are completely compatible with MIL-C-39012. Certain 75-ohm products use a type-N design with smaller center conductor diameters, and thus are not compatible with 50-ohm connectors.

SMA Connector

The SMA (Subminiature A) connector was designed by Bendix Scintilla Corporation and is one of the most commonly used RF/microwave connectors. It is intended for use on semirigid cables and in components that are connected infrequently. Most SMA connectors have higher reflection coefficients than other connectors available for use to 24 GHz because of the difficulty to anchor the dielectric support.

3.5 mm Connector

The 3.5 mm connector was primarily developed at Hewlett Packard – now Keysight Technologies, with early manufacturing at Amphenol. Its design strategy focused on highly-rugged physical interfaces that would mate with popular SMA dimensions, allowing thousands of repeatable connections. It has an operating frequency up to 33 GHz.

1.0 mm Launch

The launch adapter has a 1.0 mm female connector on one end and a glass to metal seal interface on the other end. This is for transition of ultra-high frequency (up to 110 GHz) signals from coax into a microstrip package or onto a circuit board.

2.92 mm Connector

The 2.92 mm connector mates with SMA and 3.5 mm connectors and has an operating frequency up to 40 GHz.

2.4 mm Connector

The 2.4 mm connector was developed by HP, Amphenol, and M/A-COM with an operating frequency up to 50 GHz. This design eliminates the fragility of the SMA and 2.92 mm connectors by increasing the outer wall thickness and strengthening the female fingers. It can mate with SMA, 3.5 mm and 2.92 mm with the use of precision adapters. The 2.4 mm product is offered in three quality grades; general purpose, instrument, and metrology. General purpose grade is intended for economy use on components, cables, and microstrip, where limited connections and low repeatability is acceptable. Instrument grade is best suited for measurement applications where repeatability and long life are primary considerations. Metrology grade is best suited for calibration applications where the highest performance and repeatability are required.

1.85 mm Connector

The 1.85 mm connector was developed in the mid-1980s by Hewlett Packard – now Keysight Technologies – with an operating frequency up to 65 GHz. HP offered their design as public domain in 1988 to encourage standardization of connector types; a few devices are available from various manufacturers for research work. The 1.85 mm connector mates with the 2.4 mm connector and has the same ruggedness. In recent years, the 1.85 mm connector has been optimized to operate mode-free to 67 GHz. Many experts have considered this connector to be the smallest possible coaxial connector for common usage up to 67 GHz.

1.0 mm Connector

Designed to support transmission with an operating frequency up to 110 GHz, this 1.0 mm connector is a significant achievement in precision manufacturing resulting in a reliable and flexible interconnect.

BNC Connector

The BNC (Bayonet Navy Connector) was designed for military use and has gained wide acceptance in video and RF applications to 2 GHz. Above 4 GHz, the slots may radiate signals. Both 50 Ω and 75 Ω versions are available. A threaded version (TNC) helps resolve leakage for common applications up to 12 GHz. An 18 GHz version is also available.

SMC Connector

The SMC (Subminiature C) is much smaller than an SMA connector, making it suitable for some applications with size constraints. It is often used up to 7 GHz where low leakage and few connections are required.

Connector Care and Signal Performance

While many Keysight RF/microwave connectors have been designed for rugged mechanical interfaces, the user must be aware that cleanliness of the surfaces and care in applying torque to the connector nut are crucial to long life and full signal performance. The following table shows the recommended torque for various connector types.

Recommended torque values for connectors

Connector type	Torque lb-inch (N-cm)
Precision 7 mm and Type-N	12 (136)
Precision 3.5 mm	8 (90)
SMA	8 (90)
Precision 2.4 mm	8 (90)
Precision 1.85 mm	8 (90)
Precision 1.0 mm	4 (45)

Maximum mode free operation of precision connectors in air

APC-7 and Type-N	19.4 GHz
3.5 mm	38.8 GHz
2.92 mm	46 GHz
2.4 mm	56.5 GHz
1.85 mm	73.3 GHz
1.0 mm	135.7 GHz

1.0 mm Adapters

- Increased measurement versatility
- Ease-of-use for on-wafer and coaxial measurements

Increased measurement versatility

For microwave and RF engineers making coaxial measurements at 50, 67 or 110 GHz, the Keysight 11920/1/2 Series 1.0 mm adapters provide an easy way of measuring coaxial devices at high frequencies. The Keysight 11920 A/B/C 1.0 mm to 1.0 mm are designed for the measurement of components with 50 Ω 1.0 mm connectors. The Keysight 11921 A/B/C/D, 1.0 mm to 1.85 mm, and the Keysight 11922 A/B/C/D, 1.0 mm to 2.4 mm, are intended to be used as general purpose adapters that are versatile and interchangeable. These adapters increase the capability needed to use test systems, such as the Keysight N5250A.

Ease-of-use for on-wafer and coaxial measurements

Each connector has an air dielectric interface and a center conductor that is supported by a low-loss plastic bead. Available with male and female connectors, these Keysight 1.0 mm adapters provide ease-of-use for microwave engineers who need to connect their test systems. The Keysight 1.0 mm adapters allow engineers to make fewer connections directly to their test port while maintaining the accuracy of their test system.

1.0 mm Connector Launch

Flexible microcircuit packaging

The Keysight 11923A 1.0 mm female connector launch threads into a package or fixture housing to transition a microwave circuit from microstrip to coaxial connector. The 11923A connector launch is intended for use with the N5250A and other test systems up to 110 GHz. The 11923A 1.0 mm female connector has an air dielectric interface and center conductor that is supported by a low-loss plastic bead on one end and a glass-to-metal seal interface on the other end. This interface consists of a 0.162 mm diameter pin that extends inside the package or fixture for connection onto a microwave circuit.

The 11923A is pre-assembled and supplied with a machining detail for mounting the launch and assembly instructions. The user is responsible for making the connection onto the circuit card, machining the package, and installing the connector. If a quasi-hermetic seal is desired, epoxy may be applied to threads of the launch prior to installation. The procedure describing the necessary dimensions for the package and installation is provided with the launch assembly.

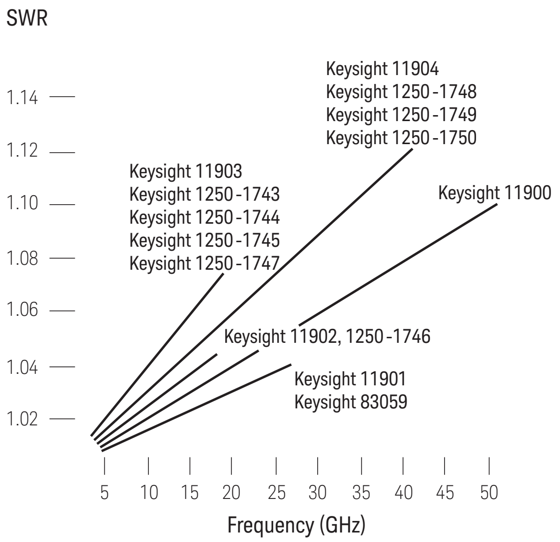
3

Metrology Grade Adapters [1]

Model	Type [2]	Frequency range	Return loss	Repeatability [3] (min)	Overall length (nom) mm (in)	Ref. plane to ref. plane length (nom) mm (in)	Diameter (nom) mm (in)
11900A	2.4 mm (m), 2.4 mm (m)	DC to 50 GHz	> 26 dB	44 dB	16.2 (0.64)	12.4 (0.49)	9 (0.35)
11900B	2.4 mm (f), 2.4 mm (f)	DC to 50 GHz	> 26 dB	44 dB	18.5 (0.73)	12.4 (0.49)	8 (0.31)
11900C	2.4 mm (m), 2.4 mm (f)	DC to 50 GHz	> 26 dB	44 dB	17.4 (0.69)	12.4 (0.49)	9 (0.35)
11901A	2.4 mm (m), 3.5 mm (m)	DC to 26.5 GHz	> 26 dB	54 dB	20.9 (0.82)	16.1 (0.63)	9 (0.35)
11901B	2.4 mm (f), 3.5 mm (f)	DC to 26.5 GHz	> 32 dB	54 dB	21.1 (0.83)	16.1 (0.63)	8 (0.31)
11901C	2.4 mm (m), 3.5 mm (f)	DC to 26.5 GHz	> 32 dB	54 dB	20.2 (0.80)	16.1 (0.63)	9 (0.35)
11901D	2.4 mm (f), 3.5 mm (m)	DC to 26.5 GHz	> 32 dB	54 dB	21.8 (0.86)	16.1 (0.63)	9 (0.35)
11903A	2.4 mm (m), Type-N (m)	DC to 18 GHz	> 28 dB	48 dB	49.1 (1.93)	46.1 (1.82)	22 (0.86)
11903B	2.4 mm (f), Type-N (f)	DC to 18 GHz	> 28 dB	48 dB	58.3 (2.30)	46.1 (1.82)	15.7 (0.62)
11903C	2.4 mm (m), Type-N (f)	DC to 18 GHz	> 28 dB	48 dB	57.4 (2.26)	46.1 (1.82)	15.7 (0.62)
11903D	2.4 mm (f), Type-N (m)	DC to 18 GHz	> 28 dB	48 dB	50.0 (1.97)	46.1 (1.82)	22 (0.86)
11904A	2.4 mm (m), 2.92 mm (m) [4]	DC to 40 GHz	> 24 dB	40 dB	16.4 (0.64)	11.3 (0.45)	9 (0.35)
11904B	2.4 mm (f), 2.92 mm (f)	DC to 40 GHz	> 24 dB	40 dB	16.3 (0.64)	11.3 (0.45)	8 (0.31)
11904C	2.4 mm (m), 2.92 mm (f)	DC to 40 GHz	> 24 dB	40 dB	13.3 (0.52)	11.3 (0.45)	9 (0.35)
11904D	2.4 mm (f), 2.92 mm (m)	DC to 40 GHz	> 24 dB	40 dB	17.0 (0.67)	11.3 (0.45)	9 (0.35)
11904S	2.4 mm to 2.92 mm matched set						

1 Keysight 1190x adapters are phase matched within each family
2 f = jack, m = plug
3 Repeatability = –20 Log | Δr | , where | Δr | = | r m1 – r m2 |
4 2.92 mm is compatible with 3.5 mm

Typical Precision Adapter Performance



Slotless Connectors

Precision slotless sockets (female connectors) were developed by Keysight to provide the most accurate traceable calibration possible. Connectors that use precision slotless sockets are metrology grade connectors. The outside diameter of the socket does not change when mated with pins of varying diameters, within the tolerance requirements of a metrology grade connector.

Conventional slotted sockets are flared by the inserted pin. Because physical dimensions determine connector impedance, electrical characteristics of the connector pair are dependent upon the mechanical dimensions of the pin. While connectors are used in pairs, their pin and socket halves are always specified separately as part of a standard, instrument, or device under test. Because the slotted socket's outer diameter changes with different pin diameters, it is very difficult to make precision measurements with the conventional slotted socket connector. The measurement of the device is a function of its connector.

Slotless sockets are used in the following calibration kits:

85052B standard mechanical calibration kit
85052C precision mechanical calibration kit
85052D economy mechanical calibration kit
85054B standard mechanical calibration kit
85054D economy mechanical calibration kit
85056A standard mechanical calibration kit
85056D economy mechanical calibration kit

Metrology/instrument Grade Adapter Selection Guide

Connector type	1.0 mm	1.85 mm	2.4 mm	2.92 mm	3.5 mm	7 mm	Type-N (50 Ω)	Type-N (75 Ω)
1.0 mm	11920A/B/C	11921E/F/G/H	11922A/B/C/D					
1.85 mm		85058-60007 85058-60008 85058-60009						
2.4 mm			11900A/B/C	11904A/B/C/D 11904S	11901A/B/C/D 1250-2277	11902A/B	11903A/B/C/D	
3.5 mm					83059A/B/C 1250-1748 1250-1749	1250-1746 1250-1747	1250-1743 1250-1744 1250-1745 1250-1750	
Type N (50 Ω)								11852B 11852B Option 004

Instrument Grade Adapters

Model	Type [1]	Frequency range	Return loss (typ)	Overall length (nom) mm (in)	Ref. plane to ref. plane length (nom) mm (in)	Diameter (nom) mm (in)
83059A	3.5 mm (m), 3.5 mm (m)	DC to 26.5 GHz	32 dB	28.4 (1.12)	23.1 (0.91)	10 (0.39)
83059B	3.5 mm (f), 3.5 mm (f)	DC to 26.5 GHz	32 dB	26.9 (1.06)	23.1 (0.91)	10 (0.39)
83059C	3.5 mm (m), 3.5 mm (f)	DC to 26.5 GHz	32 dB	25.7 (1.01)	23.1 (0.91)	10 (0.39)
83059K	Set of Keysight 83059A, B, C in wood case					
1250-1743	3.5 mm (m), type-N (m)	DC to 18 GHz	28 dB	44.2 (1.74)	40.8 (1.61)	20.8 (0.82)
1250-1744	3.5 mm (f), type-N (m)	DC to 18 GHz	28 dB	43.6 (1.72)	40.8 (1.61)	20.8 (0.82)
1250-1745	3.5 mm (f), type-N (f)	DC to 18 GHz	28 dB	42.7 (1.68)	31.6 (1.24)	15.8 (0.62)
1250-1746	3.5 mm (m), APC-7	DC to 18 GHz	34 dB	37.9 (1.49) [2]	33.1 (1.30)	22.0 (0.87)
1250-1747	3.5 mm (f), APC-7	DC to 18 GHz	28 dB	37.0 (1.46) [2]	33.1 (1.30)	22.0 (0.87)
1250-1748	3.5 mm (m), 3.5 mm (m)	DC to 26.5 GHz	25 dB	45.1 (1.78)	39.6 (1.56)	9.2 (0.36)
1250-1749	3.5 mm (f), 3.5 mm (f)	DC to 34 GHz	23 dB	43.5 (1.71)	39.6 (1.56)	9.2 (0.36)
1250-1750	3.5 mm (m), type-N (f)	DC to 18 GHz	24 dB	43.4 (1.71)	31.6 (1.24)	15.8 (0.62)
85058-60007	1.85 mm (m), 1.85 mm (m) [3]	DC to 65 GHz	22 dB	29.5 (1.16)	25.2 (0.99)	9.1 (0.36)
85058-60008	1.85 mm (f), 1.85 mm (f) [3]	DC to 65 GHz	22 dB	31.3 (1.23)	25.2 (0.99)	9.1 (0.36)
85058-60009	1.85 mm (m), 1.85 mm (f) [3]	DC to 65 GHz	22 dB	30.4 (1.20)	25.2 (0.99)	9.1 (0.36)
11852B [4]	50 Ω type-N (f), 75 Ω type-N (m)	DC to 3 GHz	30 dB	60.1 (2.37)	50.2 (1.98)	22 (0.87)
11852B Option 004 [4]	50 Ω type-N (m), 75 Ω type-N (f)	DC to 3 GHz	30 dB	60.1 (2.37)	50.2 (1.98)	22 (0.87)

1. f = jack, m = plug
2. Overall length with threaded coupling sleeve extended
3. 1.85 mm is compatible with 2.4 mm. To adapt 1.85 mm to other connector types, use Keysight 1190x Series adapters
4. Insertion loss is 5.7 dB typical

General Purpose Grade Adapter Selection Guide

Connector type	1.85 mm	SMA	SMA Tee	SMB	SMC	Type-N (50 Ω)	Type-N (75 Ω)	BNC (75 Ω)	Type-N Tee	BNC (50 Ω)
1.85 mm	N5520A/B/C									
SMA		1250-1158 1250-1159 1250-1462		1250-0674	1250-0675					1250-0562 1250-1200
Right Angle, SMA		1250-1249 1250-1397 1250-1741								
SMA Tee			1250-1698							
SMB		1250-0674		1250-0672 1250-1391		1250-0671				1250-1857
SMC		1250-0675 1250-1694			1250-0827 1250-0837 1250-0838 1250-1113	1250-1152				
7 mm		11533A 11534A 1250-1468				11524A 11525A				
BNC (50 Ω)		1250-1200 1250-0562		1250-1236 1250-1237 1250-1899	1250-0831 1250-0832					
Type-N (50 Ω)		1250-1250 1250-1404 1250-1636 1250-1772			1250-1152	1250-1529 1250-0777 1250-0778 1250-1472 1250-1475	1250-0597			1250-1473 1250-1474 1250-1476 1250-1477
Type-N (75 Ω)								1250-1533 1250-1534 1250-1535 1250-1536		
Right angle, Type-N (50 Ω)						1250-0176				
Type-N tee									1250-0559 1250-0846	
BNC (75 Ω)								1250-1286 1250-1287		
BNC Trixial										1250-0595 1250-1830 1250-1930

Adapter Kit Selection Guide

Connector type	3.5 mm	7 mm	Type-N (50 Ω)	Type-N (75 Ω)	BNC (75 Ω)	Type-F (75 Ω)	BNC (50 Ω)	7-16
3.5 mm	83059K		11878A					
Type-N (50 Ω)			11853A				11854A	
Type-N (75 Ω)				86213A		86211A		

1.0 mm Adapters

Model	11920A 11920B 11920C	11921E 11921F 11921G 11921H	11922A 11922B 11922C 11922D	11923A
Features	←	Excellent accuracy and measurement versatility		→
Frequency range	DC to 110 GHz	DC to 67 GHz	DC to 50 GHz	DC to 110 GHz
Frequency response Insertion loss Return loss	 0.5 dB 24 dB DC to 20 GHz 20 dB 20 to 50 GHz 18 dB 50 to 75 GHz 14 dB 75 to 110 GHz	 0.5 dB 20 dB	 0.7 dB 20 dB	 1.0 dB 16 dB
Input power Max CW power	 10 W	 10 W	 10 W	 6 W
Repeatability [1]	–35 dB	–35 dB 1.0 mm –40 dB 1.85 mm	–35 dB 1.0 mm –44 dB 2.4 mm	
RF connectors A, E B, F C, G D, H	 1 mm (m) to 1 mm (m) 1 mm (f) to 1 mm (f) 1 mm (m) to 1 mm (f)	 1 mm (m) to 1.85 mm (m) 1 mm (f) to 1.85 mm (f) 1 mm (m) to 1.85 mm (f) 1 mm (f) to 1.85 mm (m)	 1 mm (m) to 2.4 mm (m) 1 mm (f) to 2.4 mm (f) 1 mm (m) to 2.4 mm (f) 1 mm (f) to 2.4 mm (m)	 1 mm (f) to circuit card launch

[1] Measured at 25 °C

Specifications

Specifications describe the instrument's warranted performance over the temperature range 0 to 55° C (except where noted). Supplemental characteristics are intended to provide information for applying the instrument by giving typical but nonwarranted performance parameters. These are noted as "typical", "nominal", or "approximate".

1.0 mm (f) Connector Launch

Model	Coax connector type	Frequency (GHz)	Insertion loss
11923A	(f) to circuit card launch	DC to 110	better than: –1.0 dB

Supplemental Characteristics

Model	Return loss	Max CW power
11923A	–16 dB	better than: 6 W

Environmental Specifications

	Operating	Non-operating
Temperature	0° to 55 °C	–40° to 75 °C
Altitude	< 15.000 meters (< 50.000 feet)	< 15.000 meters (< 50.000 feet)

The operating temperature is a critical factor in the performance during measurements and between calibrations. Storage or operation within an environment other than that specified above may cause damage to the product and void the warranty.

Non-operating environmental specifications apply to storage and shipment. Products should be stored in a clean, dry environment. Operating environmental specifications apply when the product is in use. Products should not be operated in a condensing environment.

3

General Purpose Grade Adapters

Adapters APC-7 [1]	
11524A	APC-7 to type-N (f)
11525A	APC-7 to type-N (m)
11533A	APC-7 to SMA (m)
11534A	APC-7 to SMA (f)
Adapters type-N, standard 50 Ω	SWR <1.03 to 1.3 GHz
1250-1472	Type-N (f) to type-N (f)
1250-1473	Type-N (m) to BNC (m)
1250-1474	Type-N (f) to BNC (f)
1250-1475	Type-N (m) to type-N (m)
1250-1476	Type-N (m) to BNC (f)
1250-1477	Type-N (f) to BNC (m)
Adapters SMA	
1250-1158	SMA (f) to SMA (f)
1250-1159	SMA (m) to SMA (m)
1250-1249	SMA right angle (m) (f)
1250-1397	SMA right angle (m) (m)
1250-1462	SMA (m) to SMA (f)
1250-1698	SMA tee (m) (f) (f)
1250-1200	BNC (f) to SMA
E9633A	SMA (m) to BNC (m)
1250-1899	BNC (f) to SMB (m)
E9634A	SMA (f) to BNC (m)

Adapters type-N, standard 50 Ω	
1250-0077	Type-N (f) to BNC (m)
1250-0082	Type-N (m) to BNC (m)
1250-0176	Type-N (m) to type-N (f) right angle (use below 12 GHz)
1250-0559	Type-N tee, (m) (f) (f)
1250-0777	Type-N (f) to type-N (f)
1250-0778	Type-N (m) to type-N (m)
1250-0780	Type-N (m) to BNC (f)
1250-0846	Type-N tee (f) (f) (f)
1250-1250	Type-N (m) to SMA (f)
1250-1562	Type-N (f) to SMA (m)
1250-1636	Type-N (m) to SMA (m)
1250-1772	Type-N (f) to SMA (f)
Adapters type-N, standard 75 Ω [2]	
1250-0597	Type-N (m) (50 Ω) to type-N (f) (75 Ω)
1250-1528	Type-N (m) to type-N (m)
1250-1529	Type-N (f) to type-N (f)
1250-1533	Type-N (m) to BNC (m)
1250-1534	Type-N (f) to BNC (m)
1250-1535	Type-N (m) to BNC (f)
1250-1536	Type-N (f) to BNC (f)
Adapters type BNC, standard 50 Ω	
1250-0076	Right angle BNC (UG-306/D)
1250-0080	BNC (f) to BNC (f) (UG-914/U)
1250-0216	BNC (m) to BNC (m)
1250-0556	BNC (f) to WECO video (m)
1250-0595	BNC (f) to BNC triaxial (m)
1250-0781	BNC tee (m) (f) (f)
1250-1830	BNC (f) to BNC triaxial (f)
1250-1930	BNC (m) to BNC triaxial (f)
Adapters BNC, standard 75 Ω [3]	
1250-1286	Right angle BNC (m) (f)
E9628A	BNC (f) to BNC (f)
1250-1288	BNC (m) to BNC (m)
Adapters SMB, SMC [4]	
1250-0670	SMC tee (m) (m) (m)
1250-0671	SMB (m) to type-N (m)
1250-0672	SMB (f) to SMB (f)
1250-0674	SMB (m) to SMA (f)
1250-0675	SMC (m) to SMA (f)
1250-0827	SMC (m) to SMC (m)
1250-0831	SMC (m) to BNC (m)
1250-0832	SMC (f) to BNC (f)
1250-0837	SMC tee (m) (m) (m)
1250-0838	SMC tee (f) (m) (m)
1250-1023	SMC (m) to type-N (m)
1250-1113	SMC (f) to SMC (f)
1250-1152	SMC (f) to type-N (m)
1250-1236	SMB (f) to BNC (f)
1250-1237	SMB (m) to BNC (f)
1250-1391	SMB tee (f) (m) (m)
1250-1857	SMB (f) to BNC (m)

1. APC-7 is a registered trademark of the Bunker Ramo Corporation
2. Type-N outer conductor; center pin sized for 75 Ω characteristic
3. BNC outer conductor; center pin sized for 75 Ω characteristic
4. SMB and SMC are often used inside Keysight instruments for inter-module RF connections. SMB is snap-on configuration. SMC is screw-on configuration.

Related Literature

User's and service guide

11852B minimum loss pad, part number **11852-90009**
11904S 2.4 mm/2.92 mm adapter set, part number **11904-90009**
11920A/B/C, 11921E/F/G/H, 11922A/B/C/D, part number **11920-90001**
85029B 7 mm verification kit, part number **85029-90010**
85051B 7 mm verification kit, part number **85051-90031**
85053B 3.5 mm verification kit, part number **85053-90028**
85055A type-N 50 Ω verification kit, part number **85055-90014**
85057B 2.4 mm verification kit, part number **85057-90015**

Operating and service manual

11853A 50 Ω type-N accessory kit, part number **11853-90003**
11854A 50 Ω BNC accessory kit, part number **11854-90001**
11878A 50 Ω 3.5 mm adapter kit, part number **11878-90001**
11923A 1.0 mm connector launch assembly, part number **11923-90001**
11923A connectors product overview, part number **5968-4315E**
83059 precision 3.5 mm coaxial adapters (DC to 26.5 GHz) operating note, part number **83059-90001**
83059A/B/C/K precision 3.5 mm coaxial adapters DC to 26.5 GHz, part number **5952-2836E**
86211A 75 Ω type-F adapter kit, part number **86211-90001**
2.4 mm adapters and calibration accessories, part number **11900-90003**

Adapters, cables and connectors overview (**http://literature.cdn.keysight.com/litweb/pdf/5992-0118EN.pdf**)

Web Link

www.keysight.com/find/adapters

4 Amplifiers

83018A microwave system amplifier

83020A microwave system amplifier

87415A microwave system amplifier

83017A microwave system amplifier

83006A microwave system amplifier

87405C preamplifier

87405B preamplifier

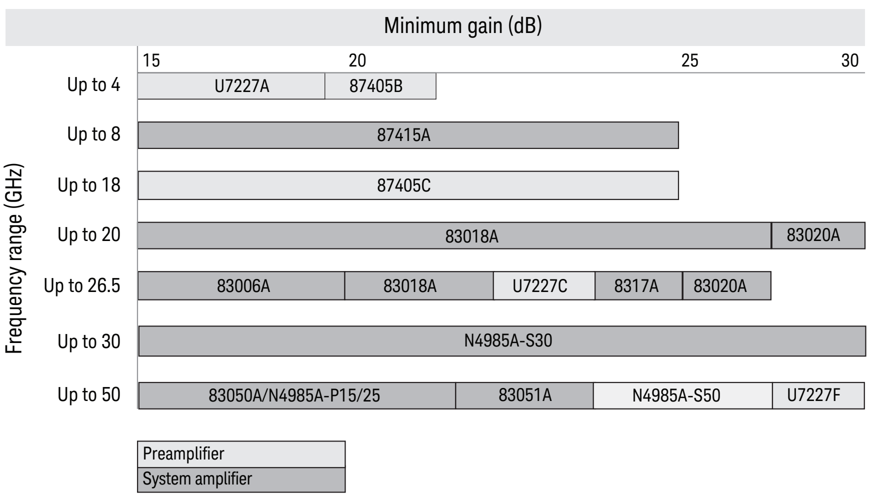
83050/51A microwave system amplifier

The Keysight Technologies, Inc. 83006/017/018/020/050/051A and N4985A test system amplifiers offer ultra broadband performance up to 50 GHz. With excellent noise figure relative to their broad bandwidth and high gain, these products can be used to significantly reduce test system noise figure. By replacing several amplifiers with a single broadband product, test setups can be greatly simplified. You can place this amplification power where you need it by using remotely-locatable Keysight power supplies. In addition, the Keysight 87415A provides octave band performance from 2 to 8 GHz.

The Keysight 87405B/C and N9485A-S30/S50 low noise amplifiers provide exceptional gain and flatness. The 87405B/C preamplifiers are very portable and come with a convenient probe-power bias connection which eliminates the need for an additional DC power supply, making them an ideal front-end preamplifier for a variety of Keysight instruments.

The N4985A-S30/S50 system amplifiers are a high-performance broadband amplifier featuring baseband RF (> 100 kHz) through millimeter wave (> 30 GHz) frequency coverage. These amplifiers are designed to be a multi-use laboratory RF amplifier as a gain block for frequency domain applications, or as a time domain pulse amplifier. Its small size and versatile performance make it an excellent choice for general purpose gain block with moderate power output in a single package, potentially replacing two or three narrower band amplifiers.

RF & Microwave Amplifiers Selection Guide



RF & Microwave Amplifiers Specification Table

Model	Frequency range (GHz)	Noise figure (dB) (typical)	Output power at P_{sat} (dBm)	Output power at P_{1dB} (dBm)	Gain (dB) (min)	VSWR	Isolation (dB)	Bias (nom)	RF connectors (input/ output)	Recommended power supply
Preamplifiers										
87405B	0.01 to 4 GHz	3.5 at 4 GHz	8 at 4 GHz	8 at 4 GHz	22	1.9	40	+15 V at 105 mA	Type N (m.f)	87422A
U7227A[4]	0.01 to 4 GHz	5.5 @ 100 MHz 5 @ 4 GHz	Refer data sheet	Refer data sheet	10 to 100 MHz: 16 100 MHz to 4 GHz: > 0.5F + 17	1.81	Refer datasheet	'USB + 5 Vdc at 360 mA	3.5 mm (m)	Do not require power supply. USB powered
87405C	0.1 to 18 GHz	3.5 at 4 GHz 3.8 at 18 GHz	17 at 18 GHz	15 at 4 GHz 14 at 18 GHz	25	1.92	50	+15 V at 140 mA –15 V at 3 mA	Type N (m.f)	87422A
U7227C[4]	0.1 to 26.5 GHz	6 @ 4 GHz 5 @ 6 GHz 4 @ 18 GHz 5 @ 26.5 GHz	Refer data sheet	Refer data sheet	100 MHz to 26.5 GHz: 16.1 + 0.26F	2.07	Refer datasheet	'USB + 5 Vdc at 400 mA	3.5 mm (m)	Do not require power supply. USB powered
N4985A -S30[1]	0.00001 to 30 GHz	5 at 2 to 30 GHz	22 at 26 GHz	N/A	30 at 26 GHz	1.92	N/A	AC power supply included	2.92 mm (f)	Included
U7227F[4]	2 to 50 GHz	510 @ 4 GHz 8 @ 40 GHz 9 @ 44 GHz 10 @ 50 GHz	Refer data sheet	Refer data sheet	2 to 50 GHz: 16.5 + 0.23F	2.27	Refer datasheet	'USB + 5 Vdc at 460 mA	2.4 mm (m)	Do not require power supply. USB powered
N4985A -S50[2]	0.00001 to 50 GHz	5 at 2 to 30 GHz 6 at 20 to 40 GHz	17 at 50 GHz	N/A	27 at 45 GHz	2.32	N/A	AC power supply included	2.92 mm (f)	Included
System amplifiers										
87415A	2 to 8 GHz	13 at 8 GHz	26 at 8 GHz	23 at 8 GHz	25	3	60	+12 V at 900 mA	SMA (f)	87421A
83006A	0.01 to 26.5 GHz	13 at 0.1 GHz 8 at 18 GHz 13 at 26.5 GHz	18 at 10 GHz 16 at 20 GHz 14 at 26.5 GHz	13 at 20 GHz 10 at 26.5 GHz	20	3.2	65	+12 V at 450 mA –12 V at 50 mA	3.5 mm (f)	87421A or 87422A
83017A[3]	0.5 to 26.5 GHz	8 at 20 GHz 13 at 26.5 GHz	20 at 20 GHz 15 at 26.5 GHz	18 at 20 GHz 13 at 26.5 GHz	25	2.6	65	+12 V at 700 mA –12 V at 50 mA	3.5 mm (f)	87421A or 87422A
83018A[3]	2 to 26.5 GHz	10 at 20 GHz 13 at 26.5 GHz	24 at 20 GHz 21 at 26.5 GHz	22 at 20 GHz 17 at 26.5 GHz	27 dB at 20 GHz 23 dB at 26.5 GHz	2.2	55	+12 V at 2 A –12 V at 50 mA	3.5 mm (f)	87421A or 87422A
83020A[3]	2 to 26.5 GHz	10 at 20 GHz 13 at 26.5 GHz	30 at 20 GHz 25 at 26.5 GHz	27 at 20 GHz 23 at 26.5 GHz	30 dB at 20 GHz 27 dB at 26.5 GHz	2.2	55	+15 V at 3.2 A –15 V at 50 mA	3.5 mm (f)	87422A
N4985A -P15	0.01 to 50 GHz	12 at 50 GHz	25 at 26.5 GHz 20 at 50 GHz	23 at 26.5 GHz 17 at 50 GHz	22 at 50 GHz	3.01	50	AC power supply included	2.4 mm (f)	Included
83050A	2 to 50 GHz	6 at 26.5 GHz 10 at 50 GHz	20 at 40 GHz 17 at 50 GHz	15 at 40 GHz 13 at 50 GHz	21	2.1	50	+12 V at 830 mA –12 V at 50 mA	2.4 mm (f)	87421A or 87422A
N4985A -P25	2 to 50 GHz	12 at 50 GHz	25 at 26.5 GHz 20 at 50 GHz	23 at 26.5 GHz 17 at 50 GHz	22 at 50 GHz	3.01	50	AC power supply included	2.4 mm (f)	Included
83051A	0.045 to 50 GHz	12 at 2 GHz 6 at 26.5 GHz 10 at 50 GHz	12 at 45 GHz 10 at 50 GHz	8 at 45 GHz 6 at 50 GHz	23	2.2	50	+12 V at 425 mA –12 V at 50 mA	2.4 mm (f)	87421A or 87422A

1. Option OA3 is available for optical application tuning.
2. Option OA5 is available for optical application tuning.
3. 83017A, 83018A and 83020A include internal directional detectors with BNC (f), DC connectors for external leveling applications.
4. U7227A/C/F designed to provide positive gain slope for gain compensation when used with CXA/EXA/MXA/PXA X-series Signal Analyzers.
   It provide automatic gain correction value with temperature compensation and transfer of calibration data (noise figure and S-parameters) through USB plug and play features for improved noise figure measurement.

Net Weights

Model	Net weight
83006A	0.64 kg (1.4 lbs)
83017A	0.64 kg (1.4 lbs)
83050A	0.64 kg (1.4 lbs)
83051A	0.64 kg (1.4 lbs)
83018A	1.8 kg (4 lbs)
83020A	3.9 kg (8.5 lbs)
87415A	0.64 kg (1.4 lbs)
87405B	0.23 kg (0.5 lbs)
87405C	0.22 kg (0.485 lbs)
N4985A-S30	0.26 kg (0.57 lbs)
N4985A-S50	0.26 kg (0.57 lbs)
N4985A-P15	1.03 kg (2.27 lbs)
N4985A-P25	1.03 kg (2.27 lbs)
U7227A	0.38 kg (0.84 lbs)
U7227C	0.38 kg (0.84 lbs)
U7227F	0.38 kg (0.84 lbs)

Power Supply Specifications

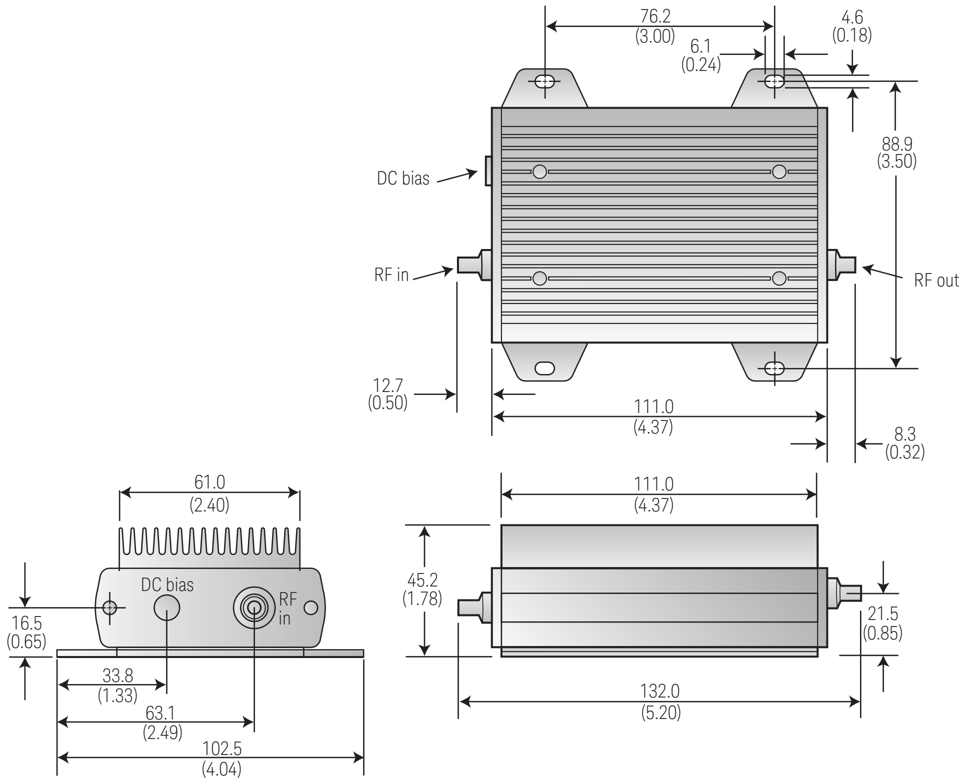
Model	AC Input voltage	DC output (nom)	Output power	Size (H, W, D)
87421A	100 to 240 VAC 50/60 Hz	+12 V at 2.0 A, –12 V at 200 mA	25 W max	57, 114, 176 mm 2.3, 4.5, 6.9 in
87422A[1]	100 to 240 VAC 50/60 Hz	+15 V at 3.3 A, –15 V at 50 mA +12 V at 2.0 A, –12 V at 200 mA	70 W max	86, 202, 276 mm 3.4, 8.0, 10.9 in

1 The ±15 V output is designed to power the Keysight 83020A; the ±12 V output can be used to power an additional amplifier.

4

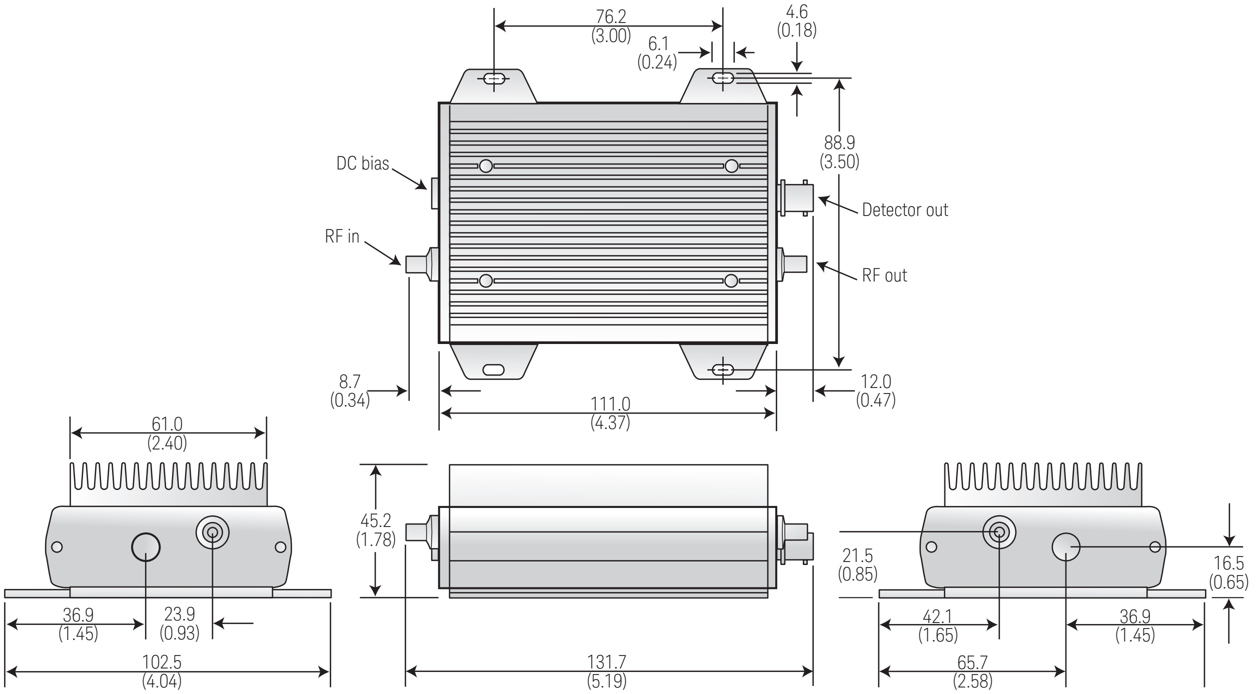
Mechanical Dimensions

83006A Microwave System Amplifier, 10 MHz to 26.5 GHz

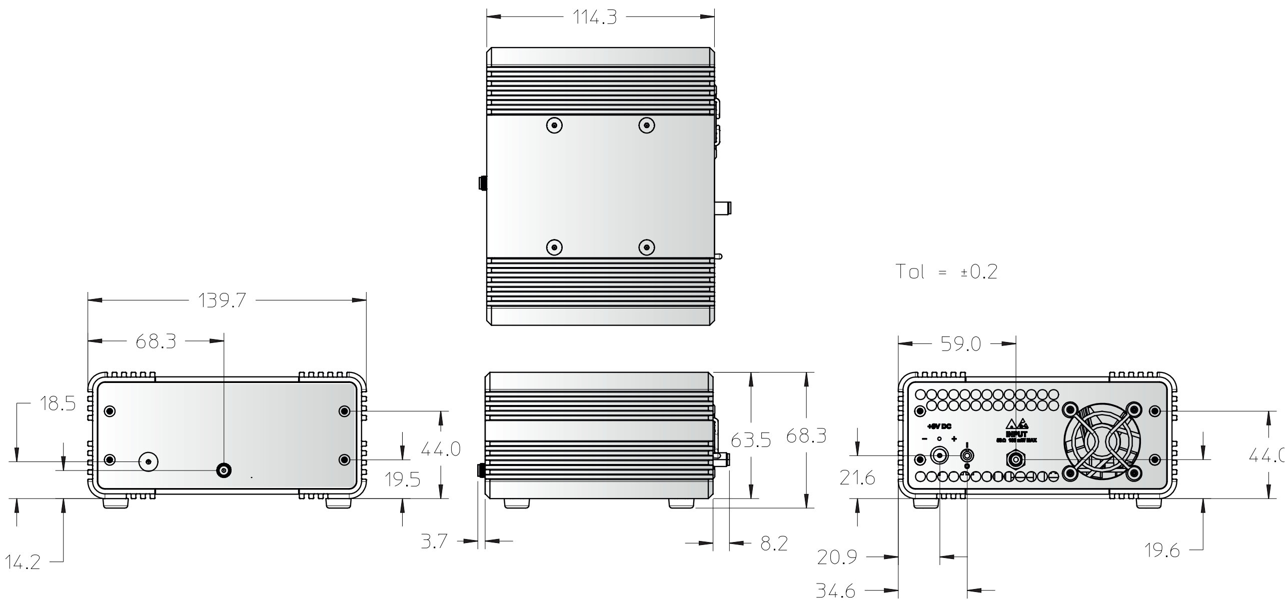


Dimensions are in mm (inches) nominal, unless otherwise specified.

83017A Microwave System Amplifier, 0.5 to 26.5 GHz

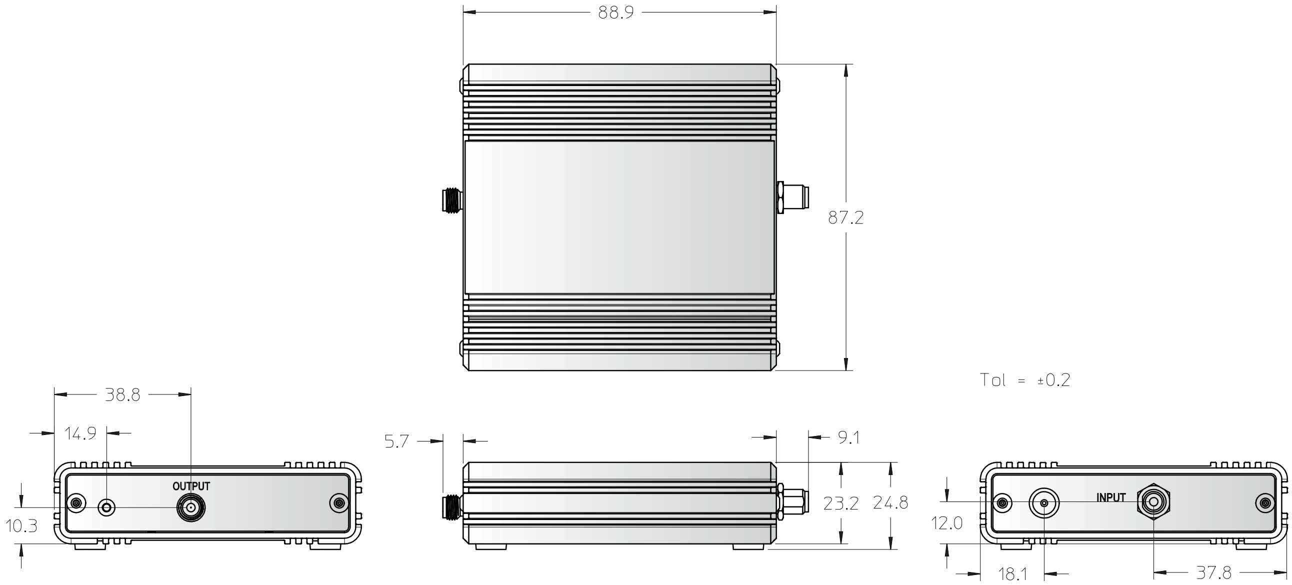


N4895A-P15/P25

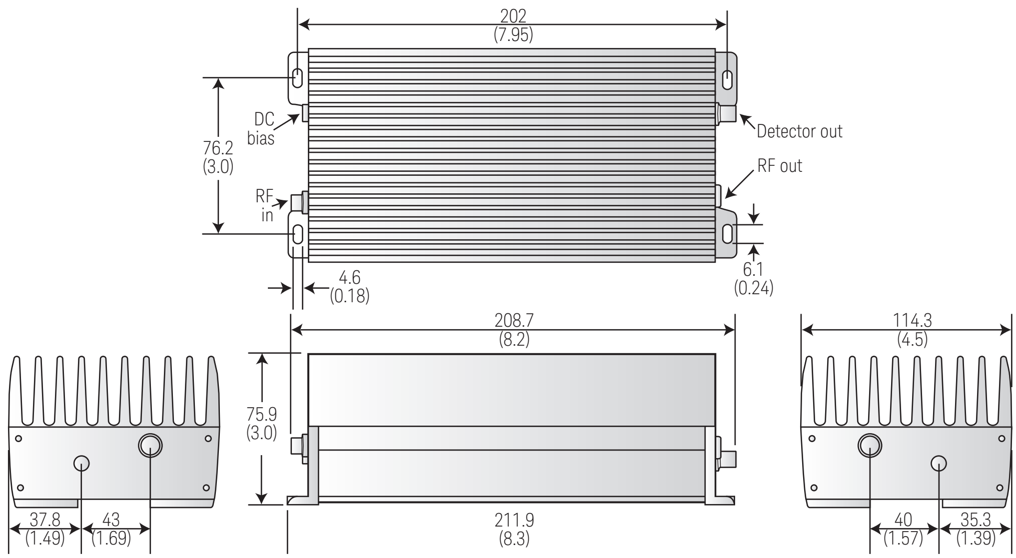


Dimensions are in mm (inches) nominal, unless otherwise specified.

N4985AS30/S50

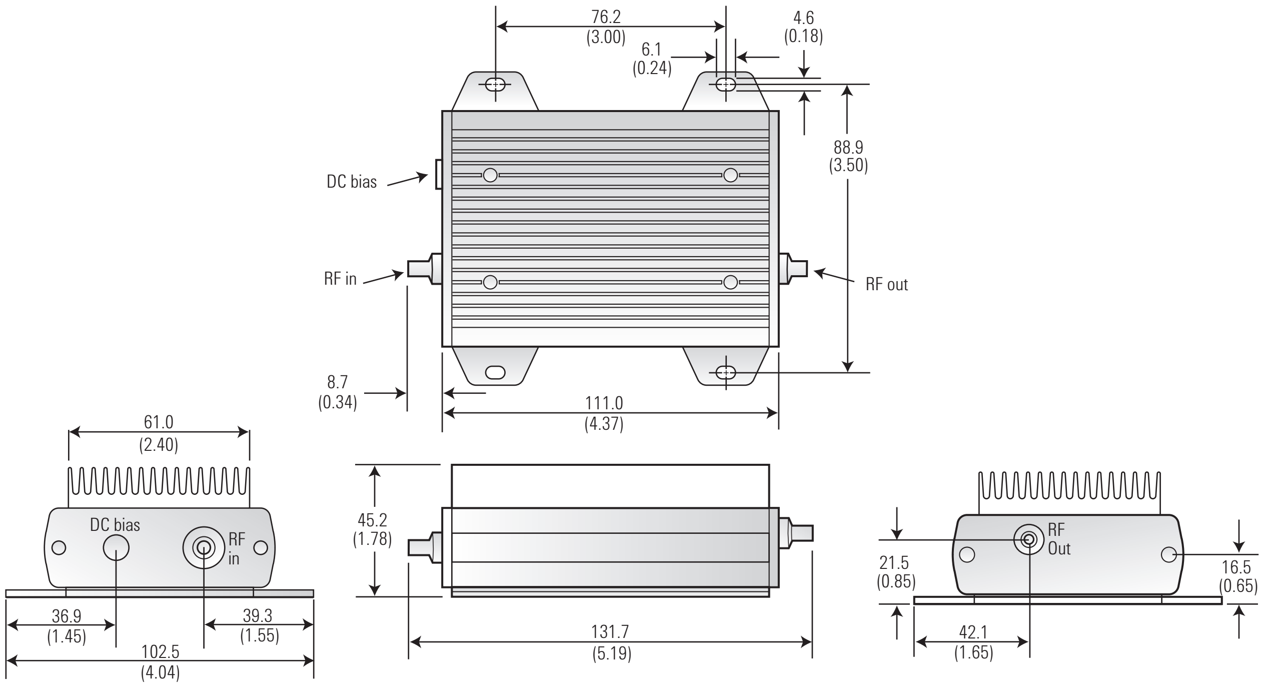


83018A Microwave System Amplifier, 2 to 26.5 GHz

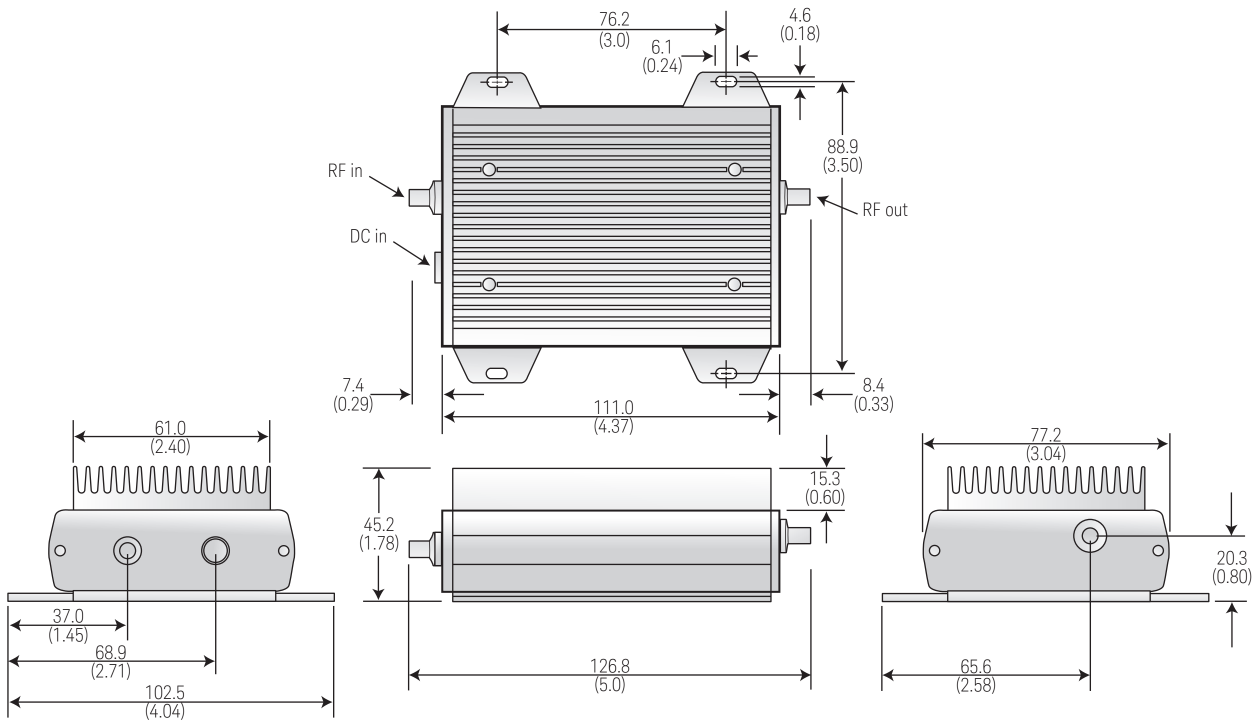


Dimensions are in mm (inches) nominal, unless otherwise specified.

83050A Microwave System Amplifier, 2 to 50 GHz
83051A Microwave System Amplifier, 45 MHz to 50 GHz

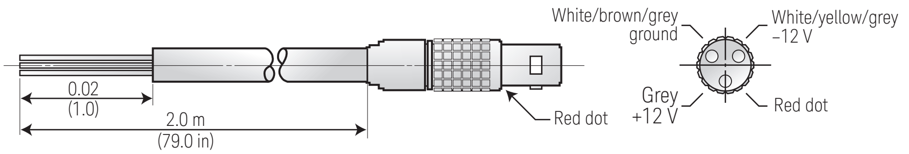


87415A Microwave System Amplifier, 2 to 8 GHz

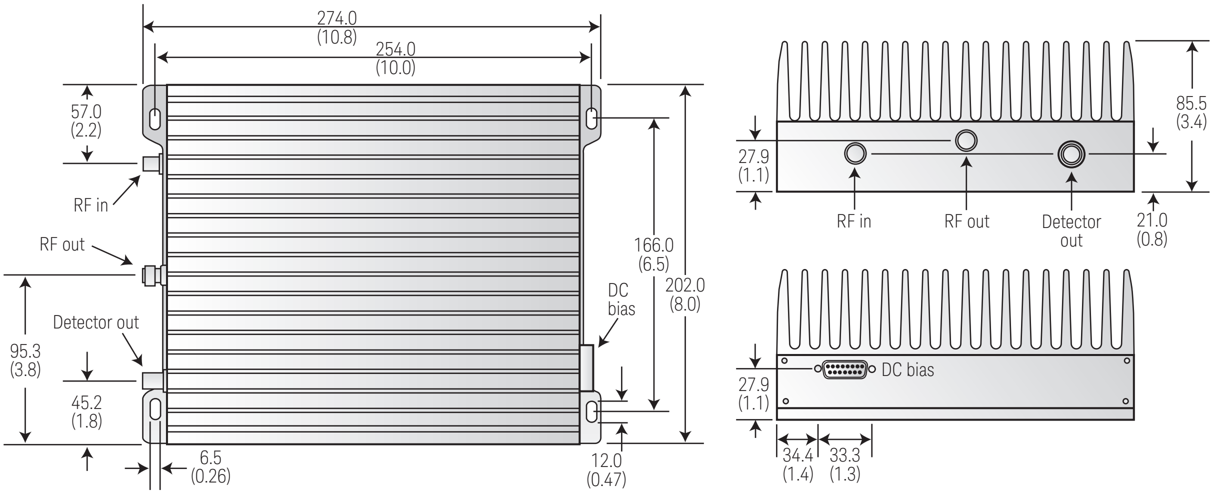


Dimensions are in mm (inches) nominal, unless otherwise specified.

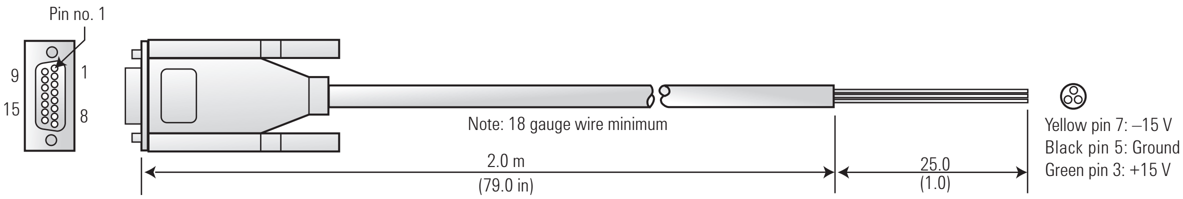
83006-60004 Cable (Shipped with 83006A, 83017A, 83018A, 83050A, 83051A, 87415A)



83020A Microwave System Amplifier, 2 to 26.5 GHz

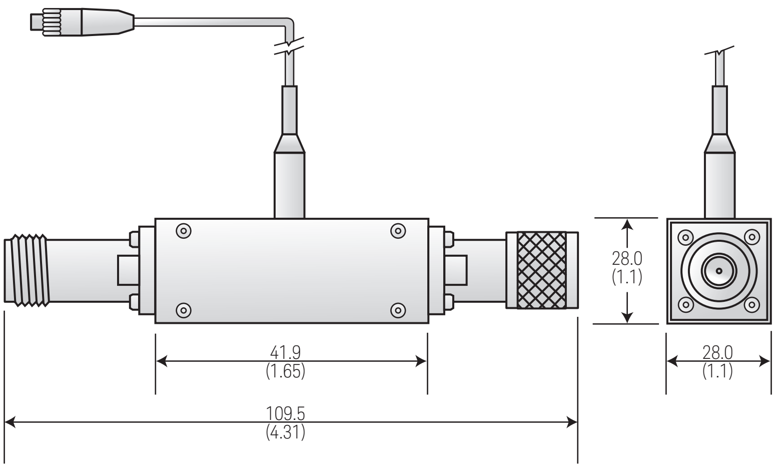


83020-60004 Cable (Shipped with 83020A)

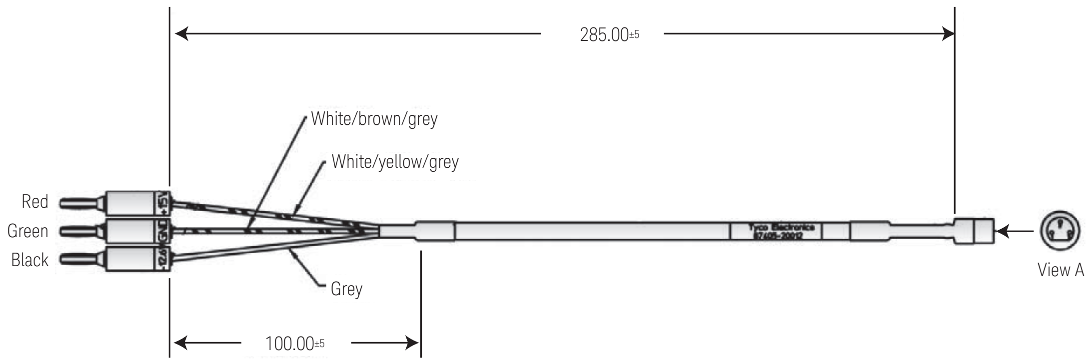


Dimensions are in mm (inches) nominal, unless otherwise specified.

87405B Preamplifier, 10 MHz to 4 GHz



87405B-001 Cable-Power Probe Connector to Banana Plugs



Dimensions are in mm (inches) nominal, unless otherwise specified.

87405C Preamplifier, 100 MHz to 18 GHz

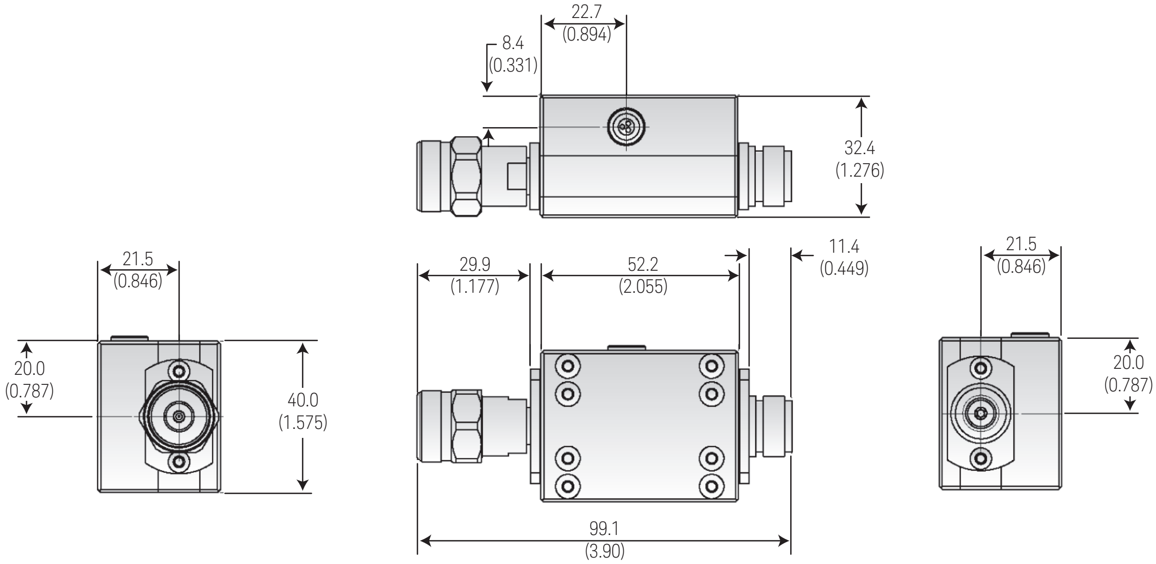


Figure 1. Mechanical dimension for the 87405C preamplifier

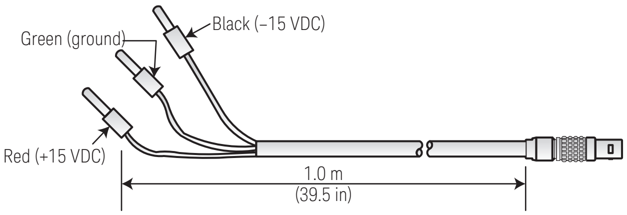


Figure 2a. Mechanical dimension for cable option with banana plugs (87405C-101)

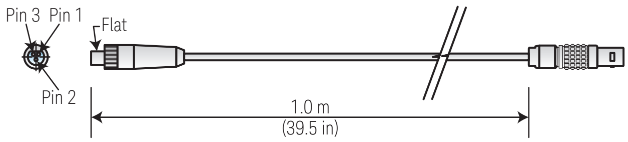


Figure 2b. Mechanical dimension for power probe bias cable (87405C-102)

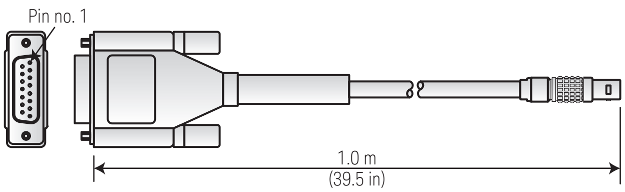


Figure 2c. Mechanical dimension for DSUB 15-pin cable (87405C-103)

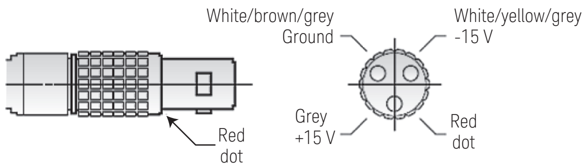
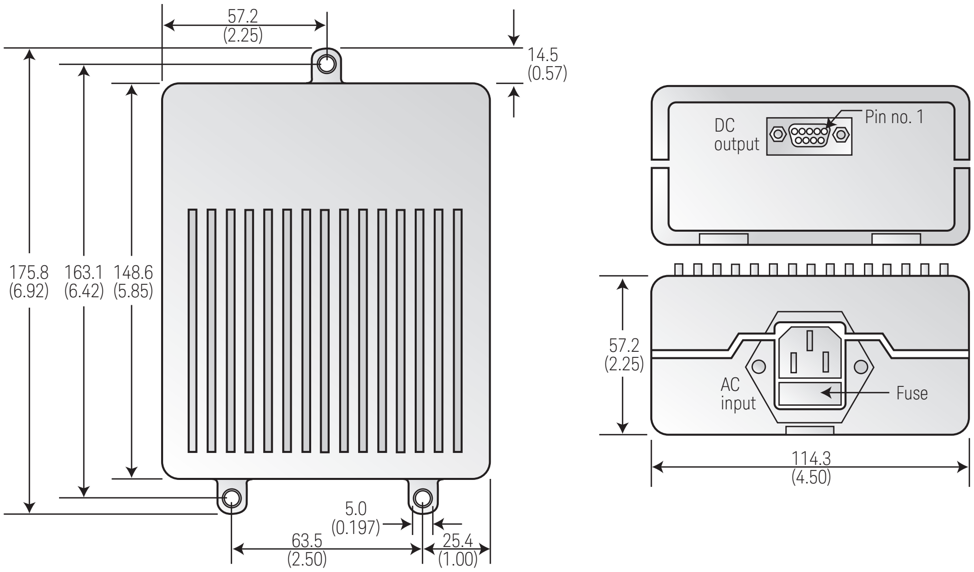


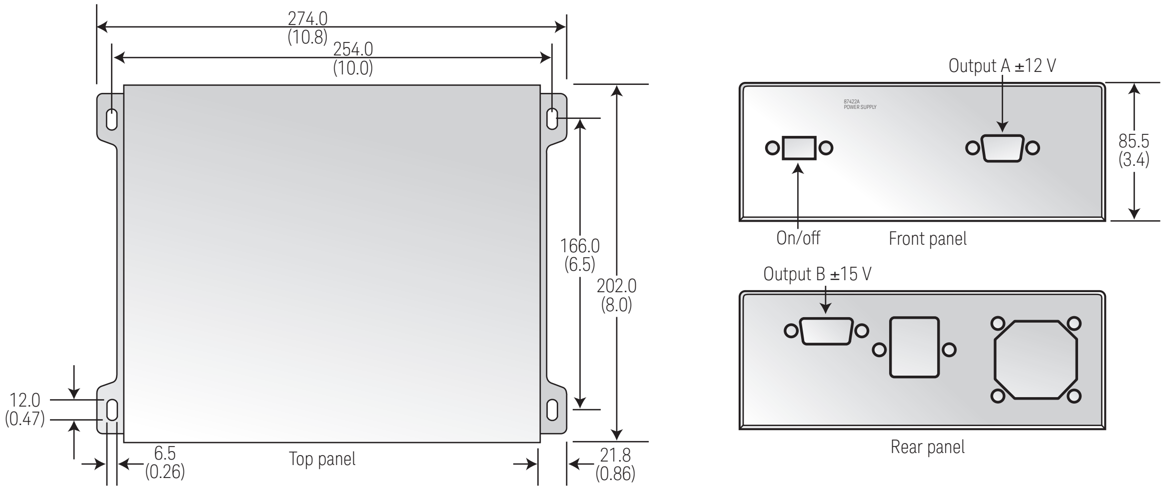
Figure 2d. Pin assignment of connector straight plug 3-pin circular

Dimensions are in mm (inches) nominal, unless otherwise specified.

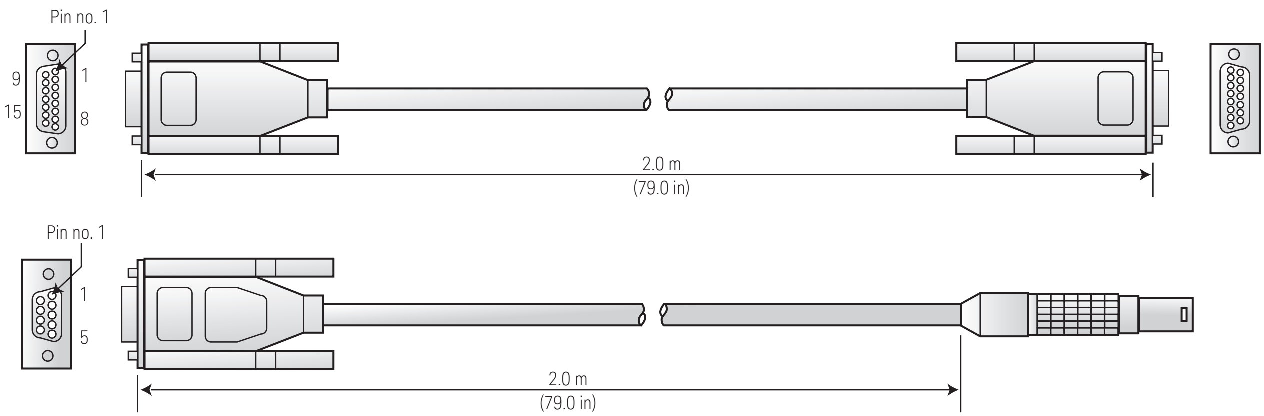
87421A Power Supply, 12 VDC, 15 VDC, 25 W



87422A Power Supply, 12 VDC, 15 VDC, 70 W

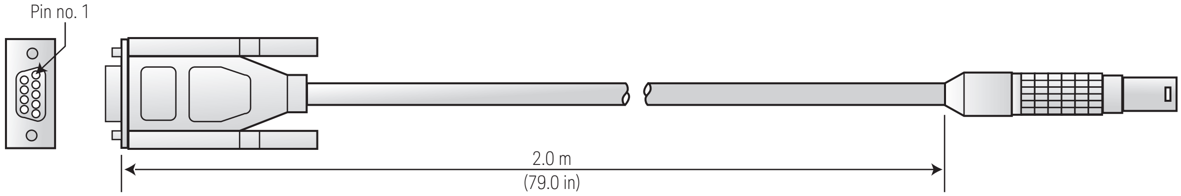


87422-60001 and 83006-60005 Cable (Shipped with 87422A)



Dimensions are in mm (inches) nominal, unless otherwise specified.

83006-60005 Cable (Shipped with 87421A)



Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

Model	Notes
87405B	Preamplifier, 0.01 to 4 GHz, 22 dB gain, type-N (m) output to type-N (f)
87405B-001	Power probe connector to banana plug
87405C	Preamplifier, 0.1 to 18 GHz, type N(M) output to type N(F)
87405C-101	Cable assembly – banana plug
87405C-102	Cable assembly – power probe cable
87405C-103	Cable assembly – 15 pin bias cable
87415A	2 to 8 GHz remote system amplifier
83006A	Amplifier, 0.01 to 26.5 GHz, 20 dB gain
83017A	Amplifier, 0.5 to 26.5 GHz; 25 dB gain
83018A	Microwave system amplifier, 2 to 26 GHz, 22 dBm
83020A	Power amplifier; 2 to 26.5 GHz, 27 dB gain
83050A	Amplifier; 2 to 50 GHz, 20 dBm at 40 GHz
83051A	Preamplifier; 0.045 to 50 GHz, 23 dB gain
N4985A	System amplifiers
N4985A-P15	10 MHz to 50 GHz
N4985A-P25	2 to 50 GHz
N4985A-S30	100 kHz to 30 GHz
N4985A-S50	100 kHz to 50 GHz
N4985A-OA3	Optical application tuning for Option S30
N4985A-OA5	Optical application tuning for Option S50
U7227A	10 MHz to 4 GHz USB Preamplifier
U7227C	100 MHz to 26.5 GHz USB Preamplifier
U7227F	2 to 50 GHz USB Preamplifier

Power Cable Cross Reference [1]

Model	Cable part number [2] (supplied with amplifier)	Power supply recommended	Cable part number [3] (supplied with power supply)
83006A	83006-60004	87421A	83006-60005
83017A	83006-60004	87421A	83006-60005
83018A	83006-60004	87421A	83006-60005
83050A	83006-60004	87421A	83006-60005
83051A	83006-60004	87421A	83006-60005
87415A	83006-60004	87421A	83006-60005
83020A	83020-60004	87422A[2]	87422-60001 83006-60005
87405B	Integral cable	Spectrum analyzer	
87405C [4]			
87405C-101	87405-20006	E3631A	No cable supplied
87405C-102	87405-20007	Spectrum analyzer	No cable supplied
87405C-103	87405-20010	87422A	87422-60001 83006-60005

1 See outline drawings for connector types
2 For use with available power supply
3 For use with power supply for direct connection
4 Must order one of cable options

Web Link

www.keysight.com/find/mta

5 Attenuators

ATTENUATORS – Fixed Attenuators

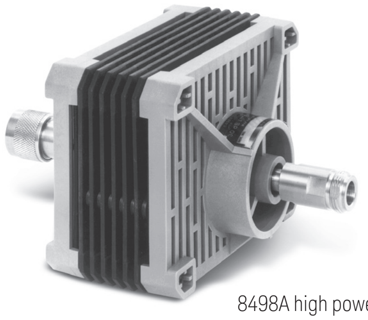
8491A coaxial fixed attenuator

8491B coaxial fixed attenuator

8493C coaxial fixed attenuator

8493A coaxial fixed attenuator

8493B coaxial fixed attenuator


8498A high power attenuator

8490D coaxial fixed attenuator

8490G coaxial fixed attenuator


11581A coaxial attenuators set


11582A coaxial attenuators set


11583C coaxial attenuators set

8491A/B, 8493A/B/C Coaxial Fixed Attenuator

Keysight coaxial fixed attenuators provide precise attenuation, flat frequency response, and low SWR over broad frequency ranges. Attenuators are available in nominal attenuations of 3 dB and 6 dB, as well as 10 dB increments from 10 dB to 60 dB. These attenuators are swept-frequency tested to ensure specification compliance at all frequencies. Calibration points are provided on a nameplate chart attached to each unit.

8498A High-Power Attenuator

The Keysight 8498A is designed to meet the needs of high-power attenuation applications in the RF and microwave frequency range. It is a 25 watt average, 30 dB fixed attenuator with a frequency range of DC to 18 GHz. The maximum peak power specification is 500 watts (DC to 5.8 GHz) and 125 watts (5.8 to 18 GHz). Available only in a 30 dB version, the unit offers a 1.3 SWR and ±1 dB accuracy at 18 GHz. Large heat-dissipating fans keep the unit cool even under continuous maximum input power conditions.

8490D Coaxial Fixed Attenuator

Keysight coaxial fixed attenuators have been the standard for accurate flat response and low SWR. The 8490D offers exceptional performance to 50 GHz using the 2.4 mm connector. Attenuation values available are 3, 6, 10, 20, 30, and 40 dB. Ideally suited for extending the range of sensitive power meters or for use as calibration standards, these broadband attenuators are manufactured with the same meticulous care as their lower frequency counterparts.

11581A, 11582A, 11583C Attenuator Sets

Provides a set of four attenuators (3, 6, 10, and 20 dB) furnished in a walnut accessory case. The 11581A set consists of 8491A attenuators; the 11582A set, 8491B attenuators; and the 11583C set, 8493C attenuators. These sets are ideal for calibration labs or where precise knowledge of attenuation and SWR is desired.

86213A Attenuator Set

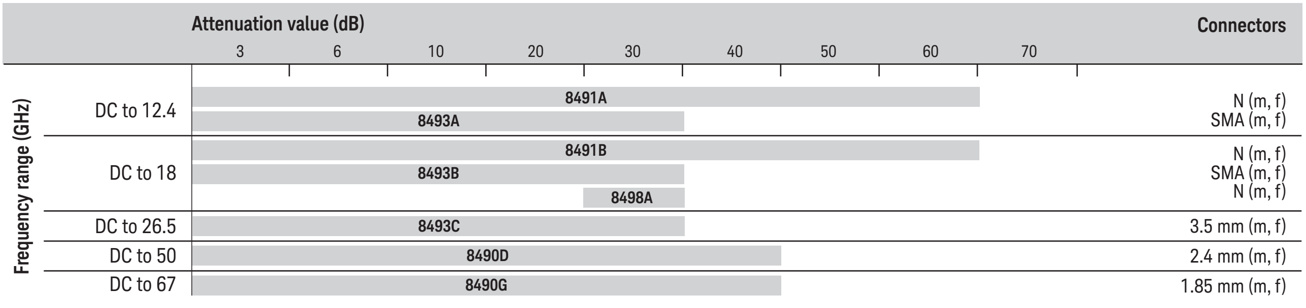
Provides a set of four 75 Ω type-N attenuators (3, 6, 10 and 20 dB) in a walnut accessory case (Keysight 0955-0765, 0955-0766, 0955-0767, and 0955-0768), respectively. Used for reducing power and improving match. SWR is 1.12 to 1.3 GHz and 1.3 to 3 GHz. Attenuation accuracy is ±0.5 dB.

8490G Fixed Attenuator

The Keysight 8490G family is a line of precision fixed coaxial attenuators with performance specified up to 67 GHz. These attenuators use the 1.85 mm coaxial connector, and exhibit excellent SWR and accuracy performance from DC to 67 GHz. The 8490G family has attenuation values of 3, 6, 10, 20, 30 and 40 dB.

The 8490G family of 1.85 mm fixed coaxial connectors are assembled and tested with the same meticulous care as their lower frequency counterparts: the Keysight 8490D, 8491 and 8493 families. These attenuators are tested on Keysight precision network analyzers to assure full specifications over their entire frequency range.

Coaxial Fixed Attenuator Selection Guide



Coaxial Fixed Attenuator Specifications

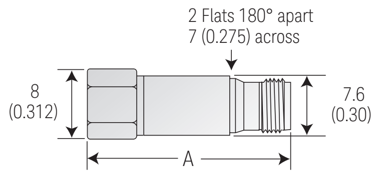
		Attenuation accuracy											
Model	**Frequency**	**3 dB**	**6 dB**	**10 dB**	**20 dB**	**30 dB**	**40 dB**	**50 dB**	**60 dB**	**Maximum SWR**	**Maximum input average power**	**Maximum input peak power**	**RF connectors**
8491A	DC to 12.4 GHz	0.3	0.3	0.5	0.5	1.0	1.5	1.5	2.0	1.30	2 W	100 W	N (m, f)
8493A	DC to 12.4 GHz	0.3	0.3	0.5	0.5	1.0	–	–	–	1.30	2 W	100 W	SMA (m, f)
8491B	DC to 18 GHz	0.3	0.4	0.6	1.0	1.0	1.5	1.5	2.0	1.50	2 W	100 W	N (m, f)
8493B	DC to 18 GHz	0.3	0.4	0.6	1.0	1.0	–	–	–	1.50	2 W	100 W	SMA (m, f)
8498A	DC to 18 GHz	–	–	–	–	1.0	–	–	–	1.30	25 W	125 W	N (m, f)
8493C	DC to 26.5 GHz	1.0	0.6	0.5	0.6	1.0	1.3	–	–	1.25	2 W	100 W	3.5 mm (m, f)
8490D	DC to 50 GHz	4.8	7.8	11.3	21.7	31.7	42.5	–	–	1.45	1 W	100 W	2.4 mm (m, f)
8490G	DC to 67 GHz	4.8	7.8	11.3	21.5	31.7	42.5	–	–	1.45	1 W	100 W	1.85 mm (m, f)

Coaxial Fixed Attenuator Option

Models	Option	Option description [2]
8490D, 8490G, 8491A, 8491B, 8493A, 8493B, 8493C, 8498A	003	3 dB attenuation
	006	6 dB attenuation
	010	10 dB attenuation
	020	20 dB attenuation
	030	30 dB attenuation
	040	40 dB attenuation [1]
	050	50 dB attenuation [1]
	060	60 dB attenuation [1]
	UK6	Commercial calibration test data with certifications

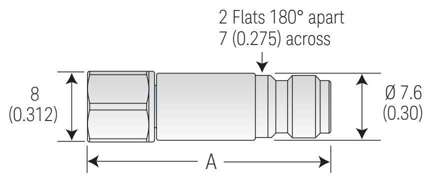
[1] Not available on all models, see specification table
[2] Each order must specify an attenuation option

8490D Coaxial Fixed Attenuator



Dimension A
3, 6, 10, 20 dB: 27 (1.06)
30, 40 dB: 29 (1.14)

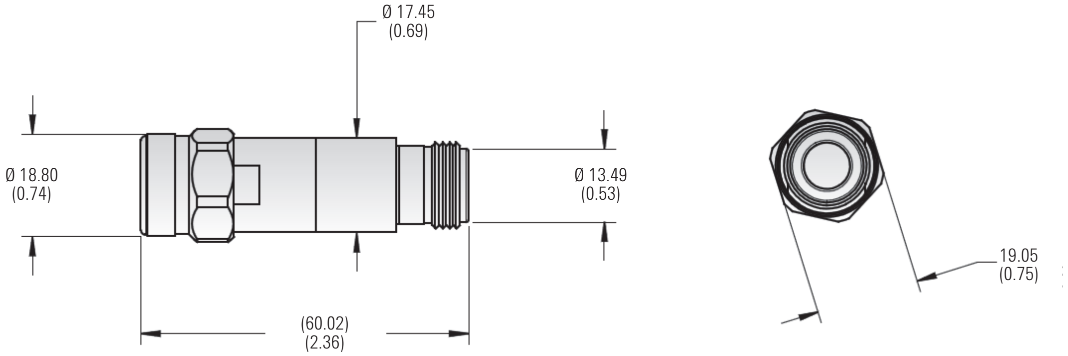
8490G Coaxial Fixed Attenuator



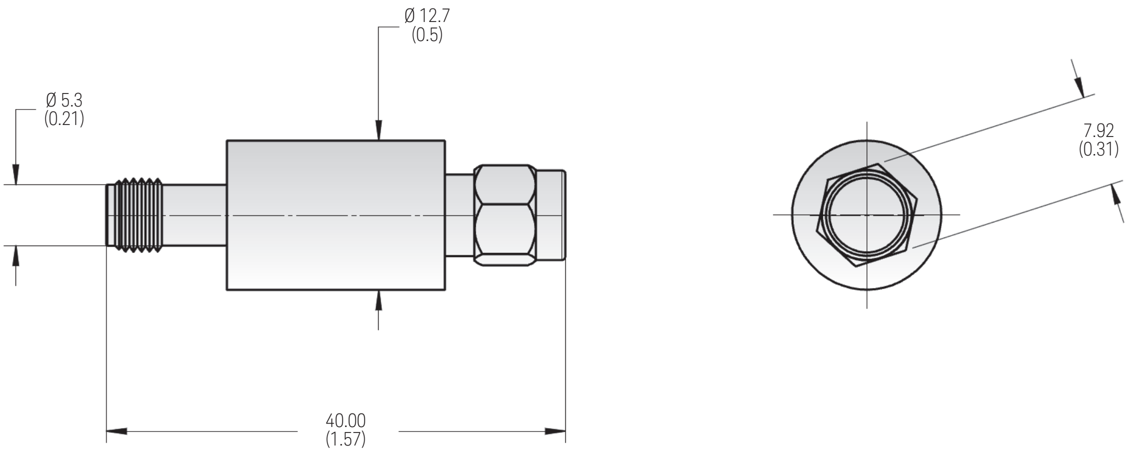
Dimension A
3, 6, 10, 20 dB: 27 (1.06)
30, 40 dB: 28 (1.10)

5

8491A/B Coaxial Fixed Attenuator

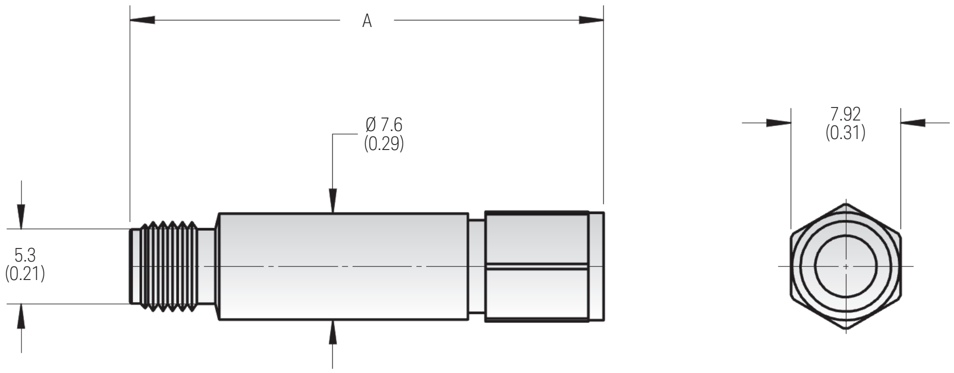


8493A/B Coaxial Fixed Attenuator



Dimensions are in mm (inches) nominal, unless otherwise specified.

8493C Coaxial Fixed Attenuator



Dimensions are in mm (inches) nominal, unless otherwise specified.

Fixed Attenuator Ordering Information

8490/91/93/98 Series ordering example [1]

Keysight 849 3 C | **Option 010** | **Option UK6**

Frequency range	Attenuation	Calibration documentation
0D: DC to 50 GHz	003: 3 dB	UK6: Commercial calibration test data with certificate
0G: DC to 67 GHz	006: 6 dB	
1A: DC to 12.4 GHz	010: 10 dB	
1B: DC to 18 GHz	020: 20 dB	
3A: DC to 12.4 GHz	030: 30 dB	
3B: DC to 18 GHz	040: 40 dB [2]	
3C: DC to 26.5 GHz	050: 50 dB [2]	
8A: DC to 18 GHz	060: 60 dB [2]	

1 Each order must specify an attenuation option
2 Not available on all models. See specification table

Related Literature

8490D coaxial attenuators technical overview, part number **5963-9931E**
8490G coaxial attenuators technical overview, part number **5989-4032EN**
8491A/B, 8493A/B/C, 11581A, 11582A and 11583C coaxial attenuators technical overview, part number **5953-6475**
8491B coaxial fixed attenuator datasheet, part number **5990-3453EN**
8493A coaxial fixed attenuator datasheet, part number **5990-5150EN**
8498A fixed attenuator operating and service manual, part number **08498-90008**
RF and microwave test accessories selection guide, part number **5990-5499EN**

Web Link

www.keysight.com/find/mta

Manual Step Attenuators

This family of manual step attenuators offers fast, precise signal-level control in three frequency ranges, DC to 4 GHz, DC to 18 GHz, and DC to 26.5 GHz. They feature exceptional repeatability and reliability in a wide range of frequency, attenuation, and connector options.

Attenuation repeatability is specified to be less than 0.03 dB (0.05 dB, 18 to 26.5 GHz) for 5 million cycles per section. This assures low-measurement uncertainty when designed into automatic test systems. Electromechanical step attenuators offer low SWR, low-insertion loss, and high-accuracy required by high-performance test and measurement equipment.

Precision-plated, leaf-spring contacts insert/remove attenuator sections (miniature tantalum nitride thin-film T-pads on sapphire and alumina substrates) from the signal path. Unique process controls and material selection ensure unmatched life and contact repeatability.

8494/95/96A/B/D manual attenuator

Manual Step Attenuator Selection Guide

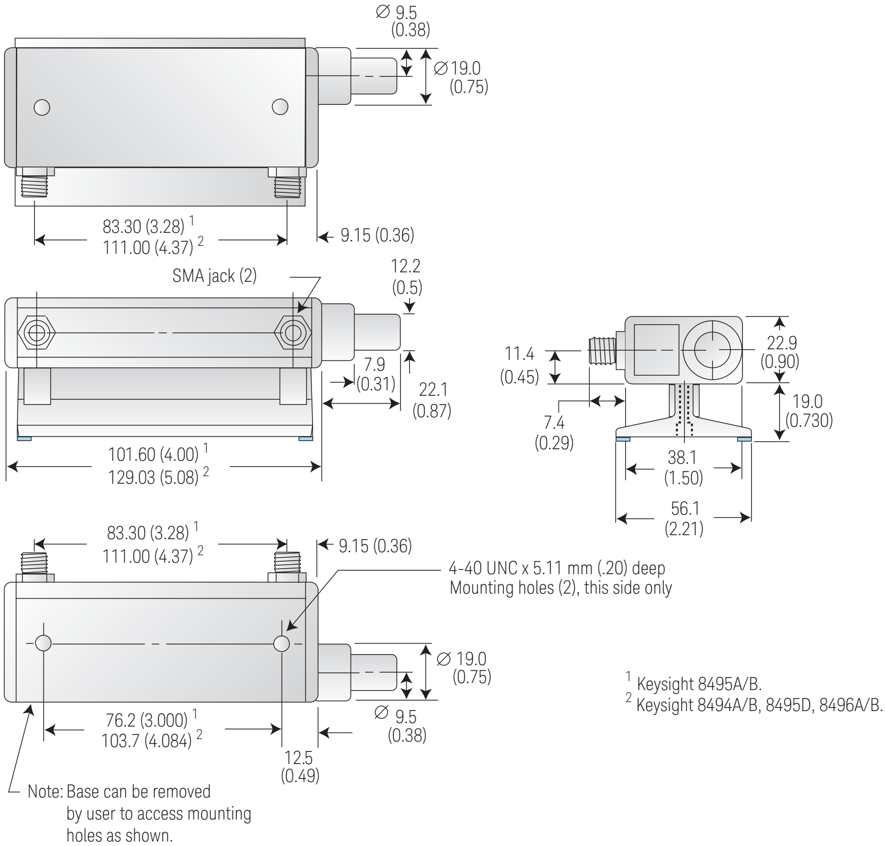
		Frequency range		
Step size	**Attenuation range**	**DC to 4 GHz**	**DC to 18 GHz**	**DC to 26.5 GHz**
1 dB	0 to 11 dB	8494A	8494B	
10 dB	0 to 70 dB 0 to 110 dB	8495A 8496A	8495B 8496B	8495D

Specifications

Model (switching model)	Frequency range (GHz)	Attenuation range	Insertion loss at 0 dB	Maximum SWR	Repeatability life [1]	Maximum RF input power	Shipping weight
8494A	DC to 4	0 to 11 dB 1 dB steps	0.96	1.5	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 µs max.)	0.9 kg (2 lb)
8494B	DC to 18	0 to 11 dB 1 dB steps	2.22	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 µs max.)	0.9 kg (2 lb)
8495A	DC to 4	0 to 70 dB 10 dB steps	0.68	1.35	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 µs max.)	0.9 kg (2 lb)
8495B	DC to 18	0 to 70 dB 10 dB steps	1.66	1.35 to 8 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 µs max.)	0.9 kg (2 lb)
8495D	DC to 26.5	0 to 70 dB 10 dB steps	3.95	1.25 to 6 GHz 1.45 to 12.4 GHz 1.9 to 18 GHz 2.2 to 26.5 GHz	±0.03 dB max to 18 GHz, ±0.05 dB max to 26.5 GHz 5 million cycles per section	1 W avg. 100 W peak [2] (10 µs max.)	0.9 kg (2 lb)
8496A	DC to 4	0 to 110 dB 10 dB steps	0.96	1.5	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 µs max.)	0.9 kg (2 lb)
8496B	DC to 18	0 to 110 dB 10 dB steps	2.22	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 µs max.)	0.9 kg (2 lb)

[1] Measured at 25 °C
[2] Not to exceed average power

8494/95/96 Series – Manual Attenuator



Dimensions are in mm (inches) nominal, unless otherwise specified.

Step Attenuator Ordering Information

8494/95/96 Series ordering example

Keysight 849 4 A **Option 001** **Option UK6**

Attenuation range	Type/frequency range	RF connector [1]	Calibration documentation
4: 11 dB max, 1 dB steps 5: 70 dB max, 10 dB steps 6: 110 dB max, 10 dB steps	A: Manual, DC to 4 GHz B: Manual, DC to 18 GHz D: Manual, DC to 26.5 GHz [2]	**A, B, G, H models:** 001: N (f) 002: SMA (f) **D models:** 004: 3.5 mm (f) [2]	UK6: Commercial calibration test data with certificate

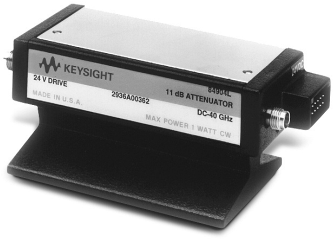
[1] Each order must include RF connector option
[2] Available with Keysight 8495 only

Related Literature

8494/95/96A/B attenuators operating and service manual, part number **08494-90008**
8495D/K attenuators operating and service manual, part number **08495-90027**

Web Link
www.keysight.com/find/mta

5

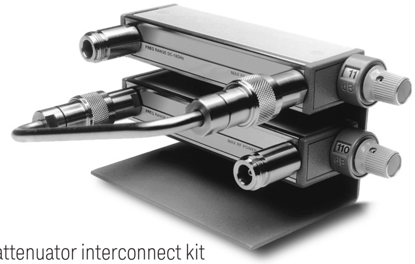


84904L programmable attenuator

84904M programmable step attenuator


11713B/C attenuator/switch driver

8494/95/96G/H/K programmable attenuator


11716A attenuator interconnect kit

5

84904/906/907 Series Programmable Step Attenuator

This family of programmable step attenuators offers unmatched attenuation performance to 50 GHz. The K models bring superior accuracy and reliability to 26.5 GHz, and the L and M models offer unparalleled performance to 40 and 50 GHz respectively.

Keysight step attenuators consist of 3 or 4 cascaded sections of specific attenuation values; e.g., 1, 2, 4, or 10, 20, 30, or 40 dB. Both families offer the selection, performance, accuracy, and reliability expected from Keysight: attenuation ranges from 11, 70, or 90 dB, 1 dB, and 10 dB step sizes, 5 million cycles per section and better than 0.03 dB repeatability.

Keysight programmable step attenuators feature electromechanical designs that achieve 20 milliseconds switching time, including settling time. The permanent magnet latching allows automatic interruption of the DC drive voltage to cut power consumption and simplify circuit design. They are equipped with 10-pin DIP sockets (m) and have optional interconnect cables available.

Programmable Driver Instruments

Programmable drive options for step attenuators include the Keysight 11713B/C attenuator/switch driver, which permits users to easily integrate the attenuator into GPIB/USB/LAN compatible automatic test systems.

Interconnect cable selections include various connector and ribbon cable configurations to match user applications.

11716 Series Attenuator Interconnect Kits

To achieve 1 dB step resolution up to 81 dB, 101 dB or 121 dB, combine the Keysight 8494 with 8495/96/97 using the Keysight 11716A/B/C interconnect kits to cascade attenuators in series.

The rigid interconnect cable is available in type-N and SMA connectors as described below.

11716A attenuator interconnect kit (type-N)

11716C attenuator interconnect kit (SMA)

Programmable Step Attenuator Selection Guide

		Frequency range				
Step size	**Attenuation range**	**DC to 4 GHz**	**DC to 18 GHz**	**DC to 26.5 GHz**	**DC to 40 GHz**	**DC to 50 GHz**
1 dB	0 to 11 dB	8494G	8494H	84904K	84904L	84904M
5 dB	0 to 65 dB					84908M
10 dB	0 to 60 dB					84905M
	0 to 70 dB	8495G	8495H	8495K		
				84907K	84907L	
	0 to 90 dB			8497K		
				84906K	84906L	
	0 to 110 dB	8496G	8496H			

Specifications

Model (switching model)	Frequency range (GHz)	Attenuation range	Insertion loss at 0 dB	Maximum SWR	Repeatability life [1]	Maximum RF input power	Shipping weight
8494G	DC to 4	0 to 11 dB 1 dB steps	0.96	1.5	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)
8494H	DC to 18	0 to 11 dB 1 dB steps	2.22	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)
8495G	DC to 4	0 to 70 dB 10 dB steps	0.68	1.35	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)
8495H	DC to 18	0 to 70 dB 10 dB steps	1.66	1.35 to 8 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)
8495K	DC to 26.5	0 to 70 dB 10 dB steps	2.20	1.25 to 6 GHz 1.45 to 12.4 GHz 1.9 to 18 GHz 2.2 to 26.5 GHz	±0.03 dB max to 18 GHz, ±0.05 dB max to 26.5 GHz 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)
8496G	DC to 4	0 to 110 dB 10 dB steps	0.96	1.5	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)
8496H	DC to 18	0 to 110 dB 10 dB steps	2.22	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)
8497K	DC to 26.5	0 to 90 dB 10 dB steps	2.79	1.25 to 6 GHz 1.45 to 12.4 GHz 1.6 to 18 GHz 1.8 to 26.5 GHz	±0.03 dB max to 18 GHz, ±0.05 dB max to 26.5 GHz 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)

1 Measured at 25 °C
2 Not to exceed average power

8494/95/96/97 Series Options

	Option 024	Option 011	
Supply voltage Supply voltage range Supply voltage (nom)	 20 to 30 VDC 24 VDC	 4.5 to 7 VDC 5 VDC	
Current drawn	125 mA	300 mA	
RF connectors G, H models K models	 **Option 001**: N (f) **Option 004** [1]: 3.5 mm (f)	 **Option 002**: SMA (f)	 **Option 003**: APC-7
DC connectors G, H, K models	 **Option 060**: 12-pin Viking connector **Option 016**: 16-inch ribbon cable with 14-pin DIP plug		
Calibration documentation	See ordering information		

1 Available with Keysight 8495/97 only

ATTENUATORS – Programmable Step Attenuators (continued)

Specifications

Model (switching mode)	Frequency range (GHz)	Attenuation range	Insertion loss at 0 dB	Maximum SWR Option 101 (Option 106)	Repeatability life [1]	Maximum RF input power	Shipping weight
84904K (programmable)	DC to 26.5	0 to 11 dB 1 dB steps	1.86	1.3 (1.5) to 12.4 GHz 1.7 (1.9) to 26.5 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.29 kg (10.32 oz)
84904L (programmable)	DC to 40	0 to 11 dB 1 dB steps	2.40	1.3 (1.5) to 12.4 GHz 1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.29 kg (10.32 oz)
84906K (programmable)	DC to 26.5	0 to 90 dB 10 dB steps	1.86	1.3 (1.5) to 12.4 GHz 1.7 (1.9) to 26.5 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.29 kg (10.32 oz)
84906L (programmable)	DC to 40	0 to 90 dB 10 dB steps	2.40	1.3 (1.5) to 12.4 GHz 1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.29 kg (10.32 oz)
84907K (programmable)	DC to 26.5	0 to 70 dB 10 dB steps	1.40	1.25 (1.4) to 12.4 GHz 1.5 (1.7) to 26.5 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.23 kg (8.1 oz)
84907L (programmable)	DC to 40	0 to 70 dB 10 dB steps	1.80	1.25 (1.4) to 12.4 GHz 1.5 (1.7) to 34 GHz 1.7 (1.9) to 40 GHz	±0.03 dB max 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.23 kg (8.1 oz)

[1] Measured at 25 °C
[2] Not to exceed average power

5

84904/906/907 Series Options

	Option 024	Option 011	Option 015	
Supply voltage Supply voltage range Supply voltage (nom)	 20 to 30 VDC 24 VDC	 4.5 to 7 VDC 5 VDC	 13 to 22 VDC 15 VDC	
Current drawn	125 mA	322 mA	187 mA	
RF connectors K models	 Option 004: 3.5 mm (f)	 Option 104: 3.5 mm (f) [1] 3.5 mm (m) [2]		
L models	Option 101: 2.4 mm (f)	Option 006: 2.92 mm (f)	Option 100: 2.4 mm (f) [1] 2.4 mm (m) [2]	Option 106: 2.92 mm (f) [1] 2.92 mm (m) [2]
Calibration documentation	See ordering information			

[1] Drive cable end
[2] End opposite to drive cable

Specifications

Model (switching model)	Frequency range (GHz)	Attenuation range	Insertion loss at 0 dB	Maximum SWR	Repeatability life [1]	Maximum RF input power	Shipping weight
84904M (programmable)	DC to 50	0 to 11 dB 1 dB steps	3.00	1.3 to 12.4 GHz 1.7 to 34 GHz 1.8 to 40 GHz 3 to 50 GHz	±0.03 dB max to 40 GHz, ±0.03 dB typical to 50 GHz 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.291 kg (10.3 oz)
84905M (programmable)	DC to 50	0 to 60 dB 10 dB steps	2.60	1.25 to 12.4 GHz 1.5 to 34 GHz 1.7 to 40 GHz 2.6 to 50 GHz	±0.03 dB max to 40 GHz, ±0.03 dB typical to 50 GHz 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.229 kg (8.1 oz)
84908M (programmable)	DC to 50	0 to 65 dB 5 dB steps	3.00	1.3 to 12.4 GHz 1.7 to 34 GHz 1.8 to 40 GHz 3 to 50 GHz	±0.03 dB max to 40 GHz, ±0.03 dB typical to 50 GHz 5 million cycles per section	1 W avg. 50 W peak [2] (10 µs max)	0.291 kg (10.3 oz)

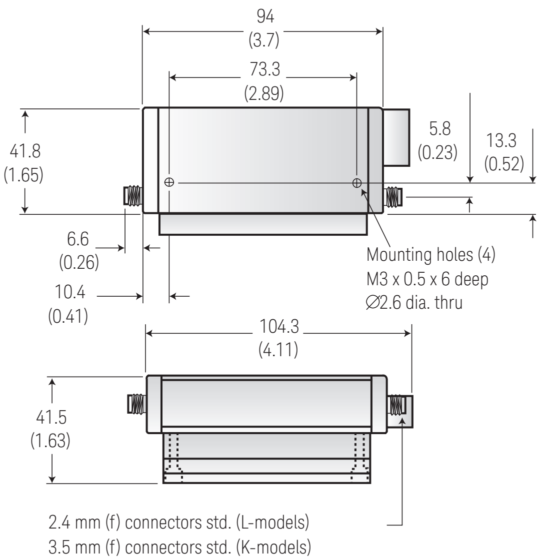
1 Measured at 25 °C
2 Not to exceed average power

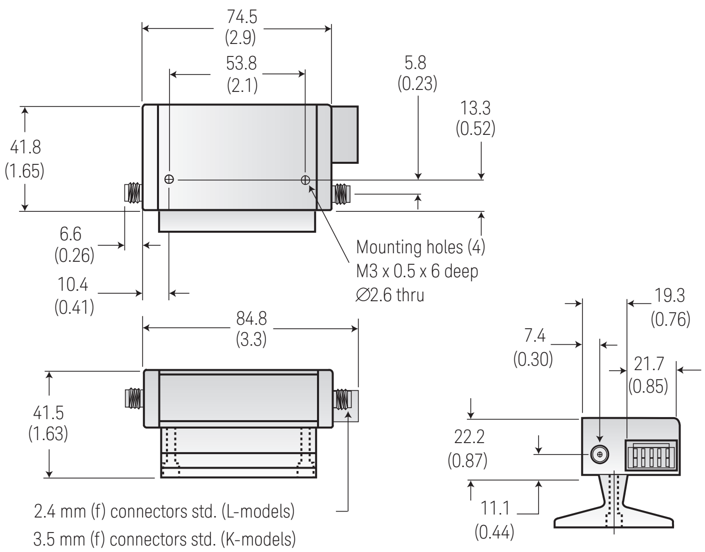
84904/905/908M Series Options

	Option 024	Option 011	Option 015
Supply voltage Supply voltage range Supply voltage (nom)	 20 to 30 VDC 24 VDC	 4.5 to 7 VDC 5 VDC	 13 to 22 VDC 15 VDC
Current drawn	125 mA	325 mA	188 mA
RF connectors	Option 100: 2.4 mm (f) [1]	Option 101: 2.4 mm (f)	
	2.4 mm (m) [2]	2.4 mm (f)	
Calibration documentation	See ordering information		

1 Drive cable end
2 End opposite to drive cable

84904/906/907 Series – Programmable Step Attenuator

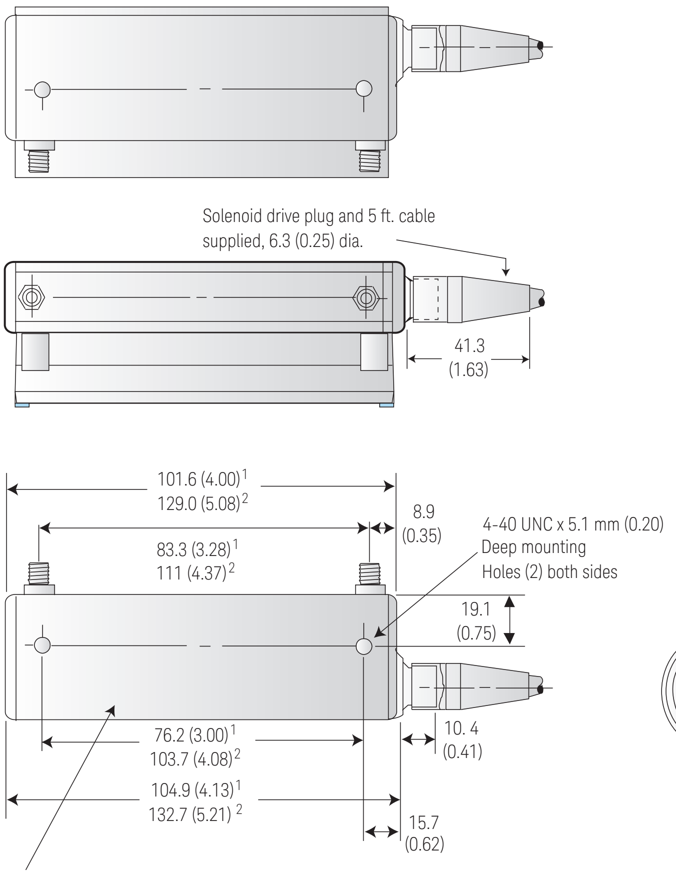


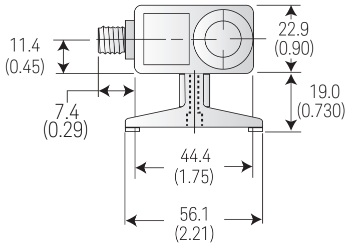


Dimensions are in mm (inches) nominal, unless otherwise specified.

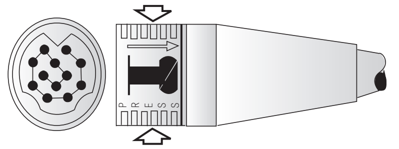
ATTENUATORS – Programmable Step Attenuators (continued)

8494/95/96/97 Series – Programmable Attenuator





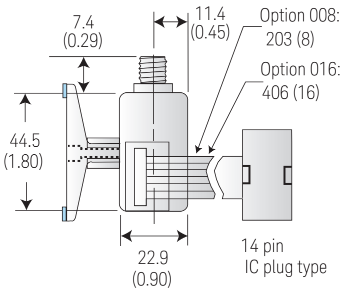
Solenoid drive plug detail

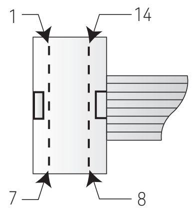


To remove: Press at arrows with thumb and finger; pull to detach.
Caution: Do not twist.

Note: Base can be removed by user to access mounting holes as shown above

[1] Keysight 8495G/H
[2] Keysight 8494G/H, 8495K, 8496G/H, 8497K





Plug top view (pins on other side)

Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

8494/95/96/97 Series ordering example

Keysight 849 **4** **A** Option **001** Option **011** Option **008** Option **UK6**

Attenuation range	Type/frequency range	RF connector [1]	Supply voltage	DC connector	Calibration documentation [5]
4: 11 dB max, 1 dB steps 5: 70 dB max, 10 dB steps 6: 110 dB max, 10 dB steps 7: 90 dB max, 10 dB steps	G: Programmable, DC to 4 GHz H: Programmable, DC to 18 GHz K: Programmable, DC to 26.5 GHz [2]	G, H models: 001: N (f) 002: SMA (f) 003: APC-7 [3] K models: 004: 3.5 mm (f) [2]	024: 24 VDC 011: 5 VDC	060: 12-pin Viking connector 016: 16-inch ribbon cable with 14-pin DIP plug	UK6: Commercial calibration test data with certificate

84904/905/906/907/908 Series ordering example [4]

Keysight 8490 **4** **K** Option **011** Option **006** Option **UK6**

Attenuation range	Frequency range	Supply voltage	RF connector	Calibration documentation [5]
4: 11 dB max, 1 dB steps 5: 60 dB max, 10 dB steps 6: 90 dB max, 10 dB steps 7: 70 dB max, 10 dB steps 8: 65 dB max, 5 dB steps	K: DC to 26.5 GHz [6] L: DC to 40 GHz [6] M: DC to 50 GHz [7]	024: 24 VDC 011: 5 VDC 015: 15 VDC	K models 104: 3.5 mm (f) drive cable end 3.5 mm (m) opposite end 004: 3.5 mm (f) both ends L models 006: 2.92 mm (f) both ends 100: 2.4 mm (f) drive cable end, 2.4 mm (m) opposite end 106: 2.92 mm (f) drive cable end, 2.92 mm (m) opposite end 101: 2.4 mm (f) both ends M models 100: 2.4 mm (f) drive cable end, 2.4 mm (m) opposite end 101: 2.92 mm (f) drive cable end, 2.92 mm (m) opposite end	UK6: Commercial calibration test data with certificate

1 Each order must include RF connector option
2 Available with Keysight 8495/97 only
3 Available with Keysight 8494/96/G/H and 8495H only
4 Drive cable not included
5 Option UK6 not available with Option 106
6 Available with 84904/906/907 only
7 Available with 84904/905/908 only

Related Literature

11713B/C attenuator/switch driver configuration guide, part number **5989-7277EN**
84904/6/7K/L programmable step attenuators datasheet, part number **5963-6944E**
84904/5/8M programmable step attenuators for microwave and RF manufacturing test systems product overview, part number **5988-2475EN**
8494/95/96G/H attenuators operating and service manual, part number **08495-90025**
8495D/K attenuators operating and service manual, part number **08495-90027**

Web Link

www.keysight.com/find/mta

J7211A/B/C attenuation control units

The J7211A/B/C attenuation control units are standalone portable instruments that offer a user-defined attenuation sweep function. This feature allows setting of desired attenuation range, step size, number of cycles, and attenuation configuration based on user application's requirements.

J7211A/B/C are designed in a way which make them suitable for benchtop and ATE testing for applications such as base station transceivers (BTS) test, WLAN, WIMAX™, MIMO and WCDMA. Exceptional insertion loss repeatability and excellent attenuation accuracy and flatness over 5 million cycles operating life ensure precise measurements and reduce calibration intervals reducing cost of test.

The features and functions of attenuation control units are easily accessible via front panel using soft keys and the rotary knob. J7211A/B/C are LXI Class C compliant instruments which provides GPIB, USB and LAN connectivity for easy remote control and triggering through a full-featured graphical web interface. These attenuation control units also allow relative attenuation to any values by selecting relative attenuation step function. Calibration data is stored in the instrument's memory for fast, simple and easy retrieval.

Key features of J7211A/B/C
Attenuation sweep function
Excellent insertion loss repeatability < 0.1dB typical throughout 5 million cycles operating life
GPIB, USB, LAN (LXI Class C)
Relative attenuation step function
Keypads and rotary knob
Calibration data storage

Specifications

Model	J7211A	J7211B	J7211C
Frequency range	DC to 6 GHz	DC to 18 GHz	DC to 26.5 GHz
Attenuation range	0 to 121 dB	0 to 121 dB	0 to 101 dB
Attenuation step size	1, 5 and 10 dB	1, 5 and 10 dB	1, 5 and 10 dB
Insertion loss (at 0 dB)	2.5 dB	DC to 6 GHz: 2.5 dB 6 to 18 GHz: 5.0 dB	DC to GHz: 2.5 dB 6 to 18 GHz: 4.0 dB 18 to 26.5 GHz: 5.0 dB
Return loss (VSWR)	14 dB (1.50)	DC to 6 GHz: 14 dB (1.50) 6 to 18 GHz: 10 dB (1.90)	DC to 6 GHz: 16 dB (1.35) 6 to 18 GHz: 11 dB (1.78) 18 to 26.5 GHz: 7 dB (2.61)
RF repeatability per section	0.03 dB	0.03 dB	0.05 dB
Maximum power input	1 W (+30 dBm)	1 W (+30 dBm)	1 W (+30 dBm)
Switching speed	20 ms	20 ms	20 ms
Operating life	5 million cycles	5 million cycles	5 million cycles
Connectivity	GPIB, USB, LAN (LXI Class C)	GPIB, USB, LAN (LXI Class C)	GPIB, USB, LAN (LXI Class C)
Connector type	SMA/type-N	SMA/type-N	3.5 mm

J7211A/B/C Supplemental Specifications and Characteristics

Supplemental characteristics are intended to provide useful information. They are typical but non-warranted performance parameters.

J7211A/B/C attenuation control units	
Power	100 to 240 VAC, automatic selection, 50/60 Hz
	50 VA maximum
	Main supply voltage fluctuations do not exceed 10 percent of the nominal supply voltage

Connector type	**Pin depth specifications**		**Specifications**
	(mm)	(inches)	
Type-N 50 Ω female	4.750 to 5.258	0.187 to 0.207	MIL-C-39012
SMA female	0.000 to – 0.254	0.000 to – 0.010	MIL-C-39012
3.5 mm female	0.000 to – 0.076	0.000 to – 0.003	IEEE STD 287 GPC

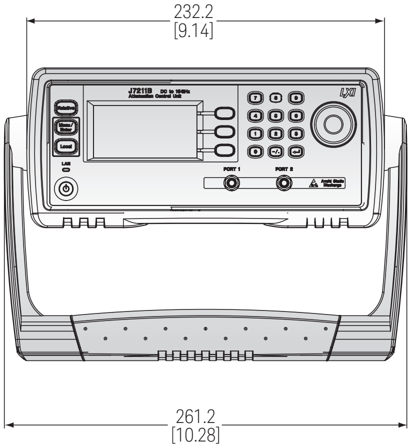
Attenuation Accuracy

(± dB; referenced from 0 dB setting)

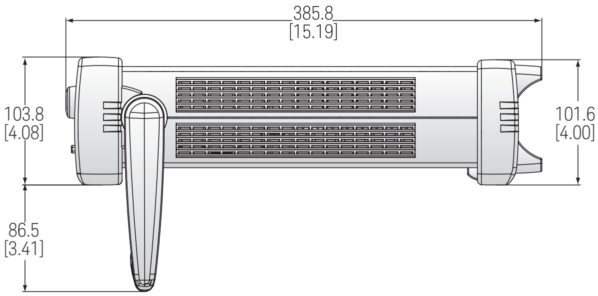
J7211A/B		
Attenuation setting for step ranges (dB)	**DC to 6 GHz**	**6 to 18 GHz**
1 to 2	0.3	0.7
3 to 4	0.4	0.7
5 to 6	0.5	0.8
7 to 10	0.6	0.8
11 to 20	0.7	1.4
21 to 40	1.2	2
41 to 60	1.8	2.8
61 to 80	2.4	3.6
81 to 100	3	4.4
101 to 121	3.3	5.3

J7211C		
Attenuation setting for step ranges (dB)	**DC to 6 GHz**	**6 to 18 GHz**
1 to 2	0.35	0.4
3 to 6	0.55	0.7
7 to 10	0.7	0.8
11 to 20	1.2	1.4
21 to 40	1.4	1.6
41 to 60	1.9	2.5
61 to 80	2.5	2.7
81 to 101	3.7	4.0

J7211A/B/C Attenuation Control Units



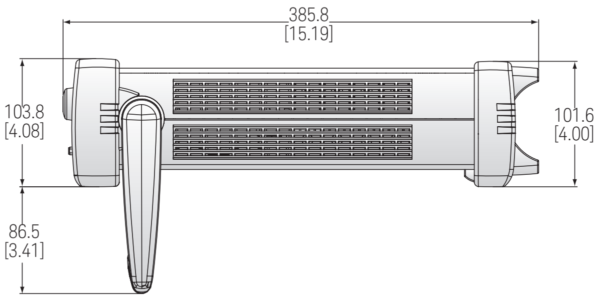
J7211A/B (SMA (f) Connectors) and J7211C (3.5 mm (f) Connector)



Product dimensions for J7211A/B (SMA connectors)

J7211A/B product dimensions (SMA (f) connectors [1])	
Net weight	3.8 kg (8.4 lbs)
Dimension (H x W x D) with handle and rubber bumper	103.8 mm x 232.2 mm x 385.7 mm (4.1 inches x 9.1 inches x 15.2 inches)
Dimension (H x W x D) without handle and rubber bumper	88.3 mm x 212.7 mm x 362.0 mm (3.5 inches x 8.4 inches x 14.2 inches)

[1] Only available for J7211A/B



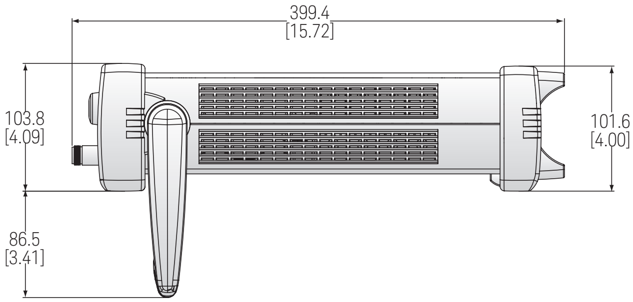
Product dimension for J7211C (3.5 mm connector)

J7211C product dimensions (3.5 mm (f) connector [2])	
Net weight	3.8 kg (8.4 lbs)
Dimension (H x W x D) with handle and rubber bumper	103.8 mm x 232.2 mm x 385.7 mm (4.1 inches x 9.1 inches x 15.2 inches)
Dimension (H x W x D) without handle and rubber bumper	88.3 mm x 212.7 mm x 362.0 mm (3.5 inches x 8.4 inches x 14.2 inches)

[2] Only available for J7211C

Dimensions are in mm (inches) nominal, unless otherwise specified.

J7211A/B (Type-N (f) Connectors)



Product dimensions for J7211A/B (Type-N connectors)

J7211A/B product dimensions (type-N (f) connectors [1])	
Net weight	3.8 kg (8.4 lbs)
Dimension (H x W x D) with handle and rubber bumper	103.8 mm x 232.2 mm x 398.4 mm (4.1 inches x 9.1 inches x 15.7 inches)
Dimension (H x W x D) without handle and rubber bumper	88.3 mm x 212.7 mm x 374.7 mm (3.5 inches x 8.4 inches x 14.6 inches)

[1] Only available for J7211A/B

Ordering Information

J7211A attenuation control unit, DC to 6 GHz, 0 to 121 dB
  J7211A-001 type-N (f) connector
  J7211A-002 SMA (f) connector
  J7211A-UK6 commercial calibration certificate with test data
J7211B attenuation control unit, DC to 6 GHz, 0 to 121 dB
  J7211B-001 type-N (f) connector
  J7211B-002 SMA (f) connector
  J7211B-UK6 commercial calibration certificate with test data
J7211C[1] attenuation control unit, DC to 26.5 GHz, 0 to 101 dB
  J7211C-UK6 commercial calibration certificate with test data

[1] 3.5 mm (f) connectors only

Related Literature

J7211A/B/C attenuation control units technical overview,
part number **5989-8323EN**
J7211A/B/C attenuation control unit operating and service manual,
part number **J7211-90001**

Web Link

www.keysight.com/find/mta

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Dimensions are in mm (inches) nominal, unless otherwise specified.

Keysight 11713B/C attenuator/switch driver

The 11713B attenuator/switch driver is a GPIB compatible instrument that concurrently drives up to two four-section programmable step attenuators and two microwave coaxial switches, or up to 10 SPDT switches. The 11713B is fully backward compatible with 11713A in terms of functionality and fit. Connectivity using USB and LAN are optional.

The 11713C attenuator/switch driver is a GPIB/USB/LAN compatible instrument that concurrently drives up to four four-section programmable step attenuators and four microwave coaxial switches, or up to 20 SPDT switches. The 11713C comes with tri-voltage selection of +5 V, +15 V and +24 V and also permits user-defined voltage supply capability.

The 11713B/C attenuator/switch drivers output continuous current and do not support pulse drive. Please ensure your switching devices can withstand continuous current or have a built-in current interrupt feature.

11713B/C Comparison Chart

Model	11713B	11713C
Drives up to	Two programmable attenuators and two electromechanical/solid state switches	Four programmable attenuators and four electromechanical/solid state switches
Drives up to	10 SPDT switches [1]	20 SPDT switches [1]
Voltage	24 V	5, 15, and 24 V
Voltage drive	1	2 independent banks of outputs
Attenuators types	Any, e.g.: Keysight 8494/5/6/7, Keysight 84904/6/7K/L/M	Any attenuator or switch [2]
Switch types	Any, e.g.: Keysight 8761, 8762, 8765 Series, or U9397A/C	Any attenuator or switch [2]
Connectivity	GPIB with options for USB, LAN (LXI Class C)	GPIB, USB, LAN (LXI Class C)
Backwards compatibility with 11713A	Yes	Yes

1 The amount of switches and attenuators that can be driven will depend on the type of switch configurations and the attenuator sections. The 11713C is capable of driving twice as many devices as the 11713B; however, the total load current that can be consumed is still 1.7A.
2 Accepts most attenuators and switches available today

11713B/C Supplemental Specifications and Characteristics

Supplemental characteristics are intended to provide useful information. They are typical but non-warranted performance parameters

Line power	100 to 240 VAC, automatic selection, 50/60 Hz 100 VA maximum
Response time	100 µs maximum for contact pairs 1 through 8 20 ms maximum for contact pairs 9 and 0
Driver life	> 2,000,000 switchings at 0.7 A for contact pairs 9 and 0
Maximum load inductance	500 mH
Maximum load capacitance	< 0.01 µF for contact pairs 9 and 0

Compatible Keysight Switches

Model	Description*
8761A/B, 8765A/B/C/D/F (33314A/B/D), N1810UL	SPDT, unterminated
8762A/B/C/F (33311A/B/C), N1810TL	SPDT, terminated
8763A/B/C (33312A/B/C), N1811TL	Bypass, 4-port, terminated
8764A/B/C (33313A/B/C), N1812UL	Bypass, 5-port, unterminated
8766K (33366K)	SP3T, unterminated
8767K (33367K), 8767M, L7204A/B/C	SP4T, unterminated
87104A/B/C/D, 87204A/B/C, L7104A/B/C	SP4T, terminated
8768K (33368K), 8768M	SP5T, unterminated
8769K (33369K), 8769M, L7206A/B/C	SP6T, unterminated
87106A/B/C/D, 87206A/B/C, L7106A/B/C	SP6T, terminated
87222C/D/E, L7222C	DPDT (transfer), unterminated
87406B	Matrix, 4-port, terminated
87606B	Matrix, 6-port, terminated
U9397A/C	SPDT, terminated, solid state

* Electromechanical switches unless specified

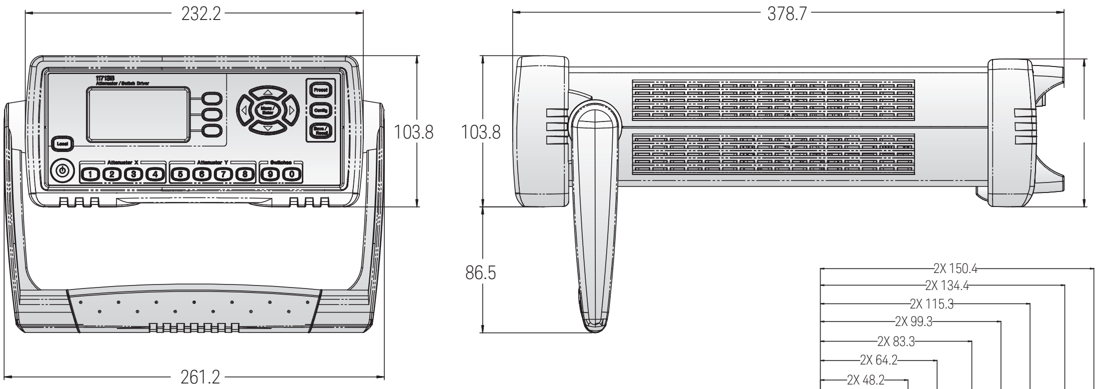
Compatible Keysight Attenuators

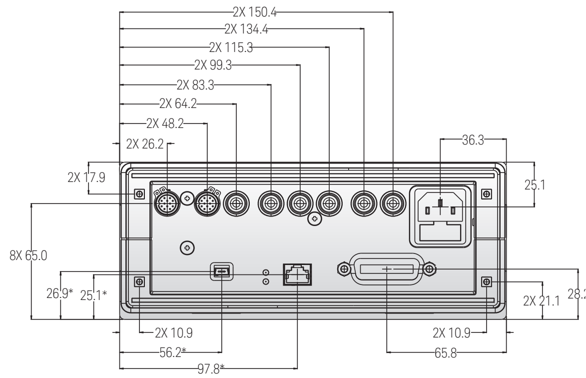
Model	Description
8494G/H (33320G/H), 84904K/L/M (33324K/L)	11 dB, 1 dB steps
8495G/H/K (33321 G/H/K), 84907K/L (33327K/L)	70 dB, 10 dB steps
8496G/H (33322G/H)	110 dB, 10 dB steps
8497K (33323K), 84906K/L (33326K/L)	90 dB, 10 dB steps
84905M	60 dB, 10 dB steps
84908M	65 dB, 5 dB steps

Physical Specifications

Net weight 3.2 kg (7.1 lbs)	
Dimensions (H x W x D)	103.8 mm x 232.2 mm x 378.7 mm
with handle and rubber bumper	(4.1 inches x 9.1 inches x 14.9 inches)
Dimensions (H x W x D)	88.3 mm x 212.7 mm x 364.0 mm
without handle and rubber bumper	(3.5 inches x 8.4 inches x 14.3 inches)

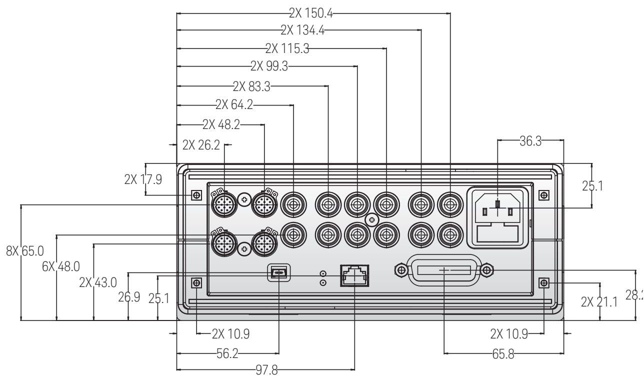
11713B/C (with handle and rubber bumper)





* For LXI model only

11713B product outline (with handle and rubber bumper)



11713C product outline (with handle and rubber bumper)

Dimensions are in mm (inches) nominal, unless otherwise specified.

Product Configuration and Ordering Information

11713B

Connectivity options

11713B-STD standard configuration, full compatibility to 11713A
11713B-LXI LXI Class-C configuration, additional USB/LAN connectivity

Cable options

11713B-001 viking connector to 10-pin DIP connector
11713B-101 viking connector to viking connector
11713B-201 viking connector to 12-pin conductor cable, bare wire
11713B-301 viking connector to (4) ribbon cables
11713B-401 dual-viking connector to 16-pin DIP connector
11713B-501 viking connector to (4) 9-pin Dsub connectors
11713B-601 viking connector to 16-pin DIP connector
11713B-701 viking connector to 14-pin DIP connector
11713B-801 viking connector to (4) 10-pin DIP connectors

Rack mount kit options (optional)

11713B-908 rack mount kit for one instrument
11713B-909 rack mount kit for two instruments

11713C

Cable options

11713C-001 viking connector to 10-pin DIP connector
11713C-101 viking connector to viking connector
11713C-201 viking connector to 12-pin conductor cable, bare wire
11713C-301 viking connector to (4) ribbon cables
11713C-401 dual-viking connector to 16-pin DIP connector
11713C-501 viking connector to (4) 9-pin Dsub connectors
11713C-601 viking connector to 16-pin DIP connector
11713C-701 viking connector to 14-pin DIP connector
11713C-801 viking connector to (4) 10-pin DIP connectors

Rack mount kit options (optional)

11713C-908 rack mount kit for one instrument
11713C-909 rack mount kit for two instruments

Note: The cable options are also orderable as standalone products. The maximum quantity orderable for each cable option is 9.

Related Literature

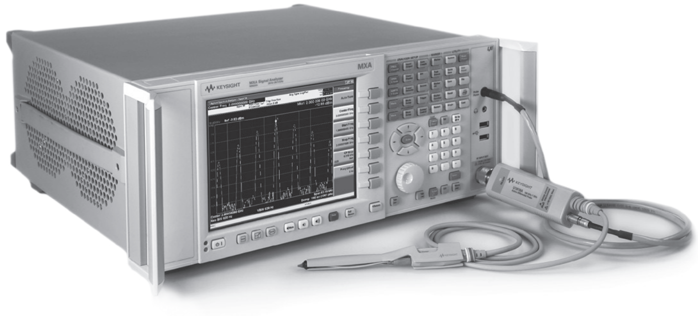
11713B/C attenuator/switch driver configuration guide,
part number **5989-7277EN**
11713B/C attenuator/switch driver technical overview,
part number **5989-6696EN**
11713B/C attenuator/switch driver operating and service manual,
part number **11713-90024**
RF and microwave switch selection guide,
part number **5989-6031EN**

Web Link

www.keysight.com/find/mta

6 Active Differential Probes

U1818A/B Active differential probes



U1818A/B Active differential probes with MXA signal analyzer

The Keysight U1818A/B active differential probes make it easy to perform high frequency in-circuit measurements using network, spectrum, and signal source analyzers. Designed to be directly compatible with Keysight's RF analyzers, they provide a high-frequency probing solution for R&D and quality assurance engineers performing RF/Microwave and high-speed digital design and validation in the wireline, wireless communications and aerospace/defense industries. With flat frequency response, low noise floor and direct power from instrument connection, the U1818A/B active differential probes allow measurements to be made while taking full advantage of Keysight's RF analyzers dynamic range.

The active differential probes are used with signal and spectrum analyzers providing a probing solution in measuring frequency, power, harmonics and modulation with a large dynamic range. In addition, it is used with signal source analyzers for probing jitter using phase noise measurement technique down to femto seconds of resolution. Lastly, probing gain and filter response can be done using the U1818A/B active differential probes with network analyzers.

Specifications

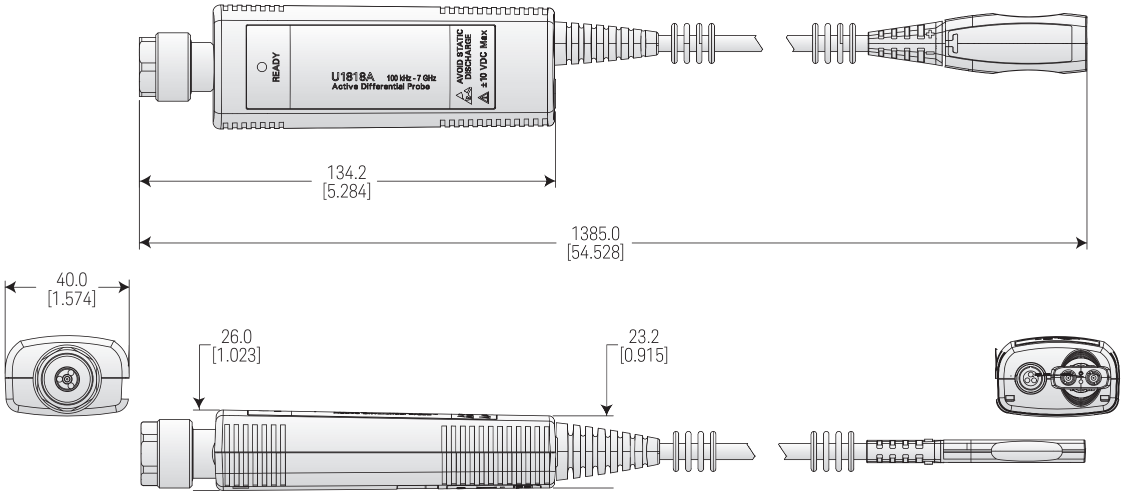
	U1818A/B with N5381A	U1818A/B with N5382A	U1818A/B with N5425A or N5426A	U1818A/B with N5380A
Bandwidth [1]	100 kHz – 7 or 12 GHz	100 kHz – 7 or 12 GHz	100 kHz – 7 or 12 GHz	100 kHz – 7 or 12 GHz

Supplementary/Typical Performances

	U1818A/B with N5381A	U1818A/B with N5382A	U1818A/B with N5425A or N5426A	U1818A/B with N5380A
Maximum CW input power	16 dBm	16 dBm	16 dBm	14 dBm
Output impedance	50 Ω nominal	50 Ω nominal	50 Ω nominal	50 Ω nominal
DC biasing charateristic	+15 V at 142 mA and –12.6 V at 12 mA	+15 V at 142 mA and –12.6 V at 12 mA	+15 V at 142 mA and –12.6 V at 12 mA	+15 V at 142 mA and –12.6 V at 12 mA
Maximum DC input voltage	±10 V	±10 V	±10 V	±10 V
Single ended mode input impedance at 1 MHz	25 kΩ	25 kΩ	25 kΩ	N/A
Differential mode input impedance at 1 MHz	50 kΩ	50 kΩ	50 kΩ	N/A
Model capacitance between tips Cm	0.09 pF	0.09 pF	0.13 pF	N/A
Model capacitance between tip and ground Cg	0.26 pF	0.26 pF	0.4 pF	N/A
Differential mode capacitance Cdiff (Cm + Cg/2)	0.21 pF	0.33 pF	0.33 pF	N/A
Single ended mode capacitance Cse (Cm+Cg)	0.35 pF	0.53 pF	0.53 pF	N/A
Norminal probe attenuation	–10 dB	–10 dB	–10 dB	–6.9 dB
Output return loss	100 kHz – 7 GHz : = < –13 dB 7 GHz – 12 GHz : = < – 8 dB			
Common mode rejection	< 2 GHz : 35 dB 2 to 12 GHz : < 30 dB	< 2 GHz : 35 dB 2 to 12 GHz : < 30 dB	< 2 GHz : 35 dB 2 to 12 GHz : < 30 dB	< 2 GHz : 25 dB 2 to 12 GHz : < 15 dB
Noise spectral density [2]	100 kHz to 10 MHz : < -120 dBm/Hz 10 MHz to 1 GHz : < –130 dBm/Hz 1 GHz to 12 GHz: < –145 dBm/Hz			
Noise figure [3]	100 kHz to 10 MHz : < 54 dB 10 MHz to 1 GHz : < 44 dB 1 GHz to 12 GHz: < 29 dB			
Spurious [4]	< 2 MHz : -80 dBm	< 2 MHz : -80 dBm	< 2 MHz : -80 dBm	< 2 MHz : -80 dBm
Harmonic distortion (dBc) [5]	< –40 dBc at +10 dBm input power for frequency < 5 GHz	< –40 dBc at +10 dBm input power for frequency < 5 GHz	< –40 dBc at +10 dBm input power for frequency < 5 GHz	< –35 dBc at +10 dBm input power for frequency at 2 GHz < –35 dBc at +4 dBm input power for frequency at 4 GHz < –35 dBc at +2 dBm input power for frequency at 5 GHz
P1dB compression	Input power >10 dBm at frequency < 7 GHz	Input power >10 dBm at frequency < 7 GHz	Input power >10 dBm at frequency < 7 GHz	Input power >10 dBm at <=2 GHz
Phase noise at +5 dBm input power [5]	Fc = 2 GHz at 1 MHz offset < –140 dBc/Hz			
Phase noise at +10 dBm input power [5]	Fc = 100 MHz at 1 MHz offset < –135 dBc/Hz	Fc = 100 MHz at 1 MHz offset < –135 dBc/Hz	Fc = 100 MHz at 1 MHz offset < –135 dBc/Hz	Fc =100 MHz at 1 MHz offset < –140 dBc/Hz
Calculated jitter: Fc = 2 GHz at+5 dBm input power [6]	5 kHz to 20 MHz : 31 fs	5 kHz to 20 MHz : 31 fs	5 kHz to 20 MHz : 31 fs	5 kHz to 20 MHz : 25 fs
Calculated jitter: Fc = 100 MHz at+10 dBm input power [6]	5 kHz to 20 MHz : 1100 fs	5 kHz to 20 MHz : 1100 fs	5 kHz to 20 MHz : 1100 fs	5 kHz to 20 MHz : 601 fs
ESD	> 8 kV	> 8 kV	> 8 kV	> 8 kV

Notes:
[1] Normalized 3 dB BW to 100 kHz
[2] Measured using "Noise Marker function" of PSA E4440A Option 110 with pre-amp on
[3] Noise figure reading is derived from noise spectral density
[4] No spurious signal detected > 2 MHz
[5] The signal source used is PSG
[6] The jitter value depends on the PSG and the U1818A/B probe. At close-in offset frequency, the residual noise of the probe is better. The PSG calculated jitter is 23 fs

U1818A/B Active Differential Probes



Mechanical dimension	
Connector type	N-Type (m)
Weight	0.170 kg (0.236 lb)
Shipping weight	1.135 kg (2.502 lb)

6

Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

U1818A 100 kHz to 7 GHz active differential probe
U1818B 100 kHz to 12 GHz active differential probe
U1818B-001 cable assembly – power probe cable
U1818B-002 cable assembly – banana plug

Probe Heads

E2668A single-ended kit (include E2676A, E2679A and E2678A)
E2669A differential kit (includes E2675A, E2677A and E2678A)
E2675A differential browser – wide span
E2676A single-ended browser
E2677A differential solder-in (high loading, high frequency response variation)
E2678A differential socket (high loading)
E2679A single-ended solder-in
E2695A differential SMA probe head for InfiniiMax probe
N5380A InfiniiMax II 12 GHz differential SMA adapter
N5381A 12 GHz InfiniiMax differential solder-in probe head
N5382A InfiniiMax II 12 GHz differential browser
N5425A 12 GHz InfiniiMax ZIF-solder-in probe head
N5426A 12 GHz InfiniiMax ZIF Tip – kit of 10
N5451A high bandwidth differential replaceable ZIF long solder-in

Related Accessories

11852B minimum loss attenuator pad
N2784A 1-arm probe positioner
N2785A 2-arm probe positioner
N2787A 3D probe positioner
N2880A in-line attenuator kit
N2881A DC blocking capacitor
N5450A InfiniiMax extreme temperature cable extension

Recommended Keysight RF Analyzer

Signal Source Analyzer

E5052B SSA signal source analyzer, 10 MHz to 7/26.5 GHz

Signal/Spectrum Analyzer

N9020A MXA signal analyzer, 20 Hz to 3.6/8.4/13.6/26.5 GHz
N9030A PXA signal analyzer, 3 Hz to 3.6/8.4/13.6/26.5 GHz

Network Analyzer

E5061A ENA-L RF network analyzer, 300 kHz to 1.5 GHz
E5061B ENA Series network analyzer, 5 Hz to 3 GHz
E5071C ENA network analyzer, 9 kHz to 4.5/6.5/8.5 GHz, 100 kHz to 4.5/6.5/8.5 GHz and 300 KHz to 14/20 GHz

Related Literature

U1818A/B technical overview, part number **5990-4148EN**
High frequency probing solutions for time and frequency domain application note, part number **5990-4387EN**

Web Link
www.keysight.com/find/RFprobes

7 DC Blocks


87106B
SP6T COAXIAL SWITCH
MADE IN U.S.A.
8762B
COAXIAL SWITCH

DC BLOCKS

N9398C DC block

N9399C DC block

N9398G DC block

N9398F DC block

N9399F DC block

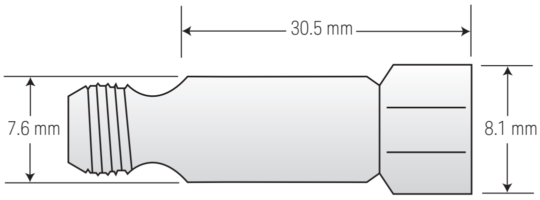
The Keysight DC blocks offer a new level of DC blocking with performance specified from 50 kHz all the way up to 67 GHz. Precision coaxial connector interfaces ensure an excellent impedance match across wide bandwidths and come in a variety of RF connectors to fit your application needs. Two choices of DC Voltage ratings make these suitable for a wide range of applications.

11742A blocking capacitor

Specifications

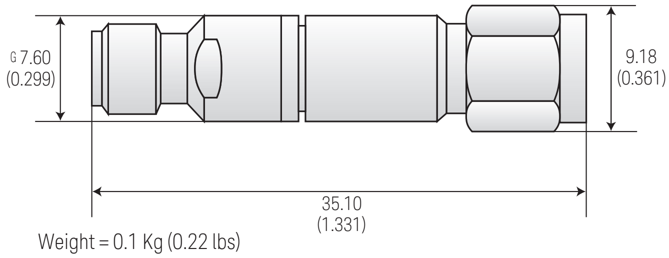
Model	Frequency range	Insertion loss	Return loss	Rise time	Group delay	Max DC working voltage	Connector type
N9398C	50 kHz to 26.5 GHz	0.9 dB	10 dB (50 to 300 kHz) 17 dB (300 kHz to 26.5 GHz)	3 ps (typical)	118 ps (typical)	16 V	3.5 mm (m-f)
N9399C	700 kHz to 26.5 GHz	1.2 dB	10 dB (700 kHz to 2 MHz) 17 dB (2 MHz to 26.5 GHz)	3 ps (typical)	118 ps (typical)	50 V	3.5 mm (m-f)
N9398F	50 kHz to 50 GHz	0.9 dB (50 kHz to 26.5 GHz) 1.0 dB (26.5 to 50 GHz)	10 dB (50 to 300 kHz) 15 dB (300 kHz to 50 GHz)	2 ps (typical)	78 ps (typical)	16 V	2.4 mm (m-f)
N9399F	700 kHz to 50 GHz	1.2 dB	10 dB (700 kHz to 2 MHz) 15 dB (2 MHz to 50 GHz)	2 ps (typical)	78 ps (typical)	50 V	2.4 mm (m-f)
N9398G	700 kHz to 67 GHz	0.9 dB (50 kHz to 26.5 GHz) 10 dB (26.5 to 67 GHz)	10 dB (700 kHz to 2 MHz) 15 dB (2 MHz to 67 GHz)	2 ps (typical)	76 ps (typical)	16 V	1.85 mm (m-f)
11742A	45 MHz to 26.5 GHz	0.35 dB (45 MHz to 12.4 GHz) 0.70 dB (12.4 to 26.5 GHz)	26 dB (45 MHz to 8 GHz) 24 dB (8 GHz to 12.4 GHz) 19 dB (12.4 GHz to 26.5 GHz)	–	–	50 V	3.5 mm (m-f)

11742A Blocking Capacitor



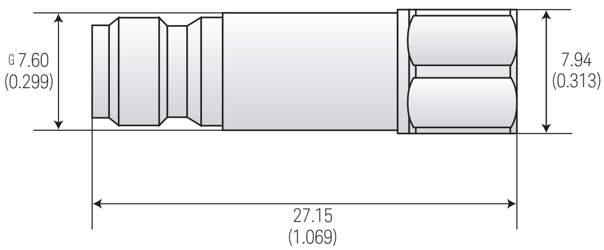
Weight = 0.1 Kg (0.22 lbs)

N9398C and N9399C DC Block



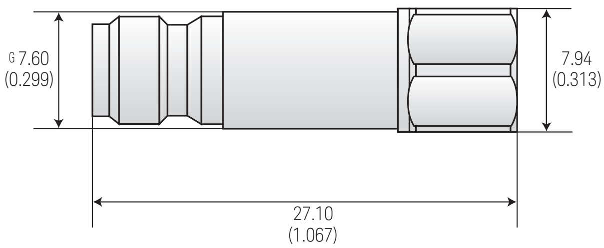
Weight = 0.1 Kg (0.22 lbs)

N9398F and N9399F DC Block



Weight = 0.1 Kg (0.22 lbs)

N9398G DC Block



Weight = 0.1 Kg (0.22 lbs)

Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

11742A 3.5 mm, 50 V 45 MHz to 26.5 GHz, DC block
N9398C 3.5 mm, 16 V 50 kHz to 26.5 GHz, DC block
N9399C 3.5 mm, 50 V 700 kHz to 26.5 GHz, DC block
N9398F 2.4 mm, 16 V 50 kHz to 50 GHz, DC block
N9399F 2.4 mm, 50 V 700 kHz to 50 GHz, DC block
N9398G 1.85 mm, 16 V 700 kHz to 67 GHz, DC block

Related Literature

11742A blocking capacitor datasheet, part number **5965-5725E**
N9398C/F/G and N9399C/F DC blocks brochure,
part number **5989-5519EN**
N9398C/F/G and N9399C/F DC blocks technical overview,
part number **5989-4544EN**
RF & microwave test accessories 2010 selection guide,
part number **5990-5499EN**

Web Link

www.keysight.com/find/mta

8 Detectors

87106B DC TO 20 GHz
SP6T COAXIAL SWITCH
MADE IN U.S.A.
8762B
COAXIAL SWITCH

Overview

Applications

Keysight Technologies broadband detectors[1] span frequencies from 100 kHz to 50 GHz. These detectors are widely used on the design and production test bench, as well as for internal components of test system signal interface units. They find use in a variety of test and measurement applications.

- Power monitoring
- Source leveling
- Video detection
- Swept transmission and reflection measurements

Technology

Keysight detectors are available in two families – Silicon Low Barrier Schottky Diode (LBSD) and Gallium Arsenide Planar Doped Barrier Diode (GaAs PDBD) detectors. The Gallium Arsenide detector technology produces diodes with extremely flat frequency response to 50 GHz. Also, the GaAs PDBD detector has a wider operating temperature range (–65 °C to +100 °C), and is less sensitive to temperature changes.

Key Specifications

- Frequency range
- Frequency response
- Open circuit voltage sensitivity
- Tangential sensitivity
- Output voltage versus temperature
- Rise time
- SWR
- Square-law response
- Input power

Frequency Range

Frequency range can be one of the most important factors to consider when specifying detectors. In the past, broadband frequency coverage was equated with high performance. It is important to note that though broadband coverage may be desirable in multi-octave applications, a good octave range detector may be your best solution for non-swept applications. Broadband coverage saves you from the inconvenience of having to switch between detectors when making measurements, but you may be sacrificing SWR and frequency response flatness.

Frequency Response

Frequency response is the variation in output voltage versus frequency, with a constant input power. Frequency response is referenced to the lowest frequency of the band specified. Keysight typically uses –30 dBm to measure frequency response. Keysight uses precision thin-film input circuitry to provide good, broadband input matching. Exceptionally flat frequency response is provided by the very low internal capacitance of the PDB diode. Also, excellent control of the video resistance of the PDB diode is obtained by the precision growth of molecular beam epitaxy (MBE) layers during diode fabrication.

Figure 1 displays frequency response characteristics comparing Keysight LBSD and PDBD detectors. The figure indicates typical performance of each device and the published specifications. Frequency response specifications include the mismatch effects of the detector input SWR specifications. Note that the Keysight 8474E, representative of PDBD detectors, is exceptionally flat beyond 26.5 GHz.

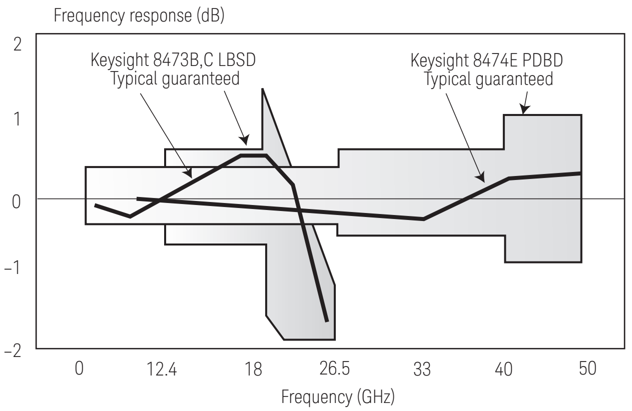


Figure 1. Detector frequency response characteristics

Open Circuit Voltage Sensitivity

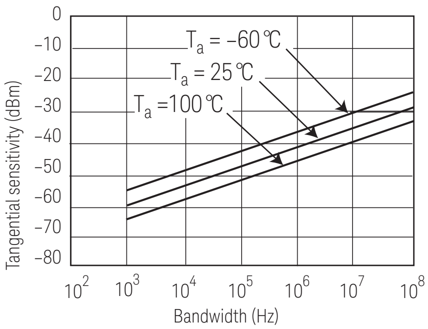
The open circuit voltage sensitivity (K) describes the slope of the transfer function of the detectors. This represents the conversion of RF/microwave power to a voltage at the output connector, typically specified in mV/uW. The value is an indication of the efficiency of the diode in converting the input power to a useful voltage.

Sensitivity is measured with the detector terminated in a high impedance. When used in video pulse applications, the sensitivity will appear to be much lower when terminated in 50 or 75 Ω for connection to an oscilloscope. Another factor, called the Figure of Merit, gives an indication of low-level sensitivity without consideration of a load circuit. It is useful for comparing detectors with different values of K and Rv. Figure of Merit equals $K/\sqrt{Rv}$, where Rv = internal video resistance.

[1] See Waveguide chapter for additional products.

Tangential Sensitivity

Tangential sensitivity is the lowest input signal power level for which the detector will have an 8 dB signal-to-noise ratio at the output of a test video amplifier. Test amplifier gain is not relevant because it applies to both signal and noise. Keysight detectors are designed for optimal flatness and SWR. Figure 2 shows typical tangential sensitivity.



$$P_{tss\,(watts)} = \frac{3.23 \times 10^{-10}\sqrt{BFR_V}}{K} \quad @\ 300\ °K$$

Where: B = Video amplifier bandwidth (Hz)
F = Video amplifier noise factor = $10^{(\text{Noise figure}/10)}$
R_V = Video resistance (Ω)
K = Open circuit voltage Sensitivity (mV/uW)

Figure 2. Typical tangential sensitivity performance

Output Voltage Versus Temperature

For applications such as power monitoring and leveling that require stable output voltage versus input power, the designer can choose a resistive termination that will optimize the transfer function over a wide temperature range. Figure 3 shows how sensitivity changes over temperature with different load resistances. In this case, a value between 1 kΩ and 10 kΩ will be optimum for 0 to 50 °C.

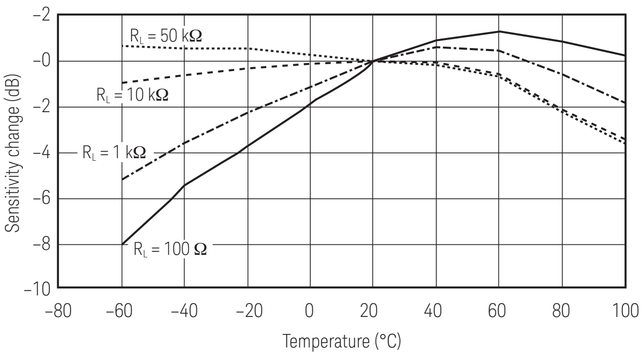


Figure 3: Typical output response with temperature (Pin <-20 dBm) (Planar-Doped Barrier Diode)

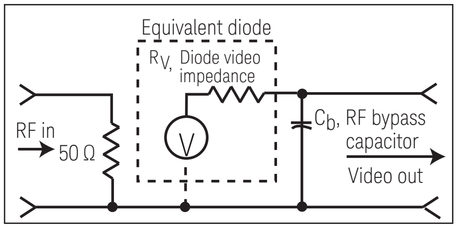
Rise Time

In applications where the frequency response of another microwave device is being measured, or where a fast rise time response is required for accurate measurements, the rise time of the detector becomes very important. It is critical to note that the rise time is dependent upon the characteristics of the detector AND the test equipment.

Figure 4 shows the typical equivalent circuit of a test detector, and can help in devising the external terminations and cables to connect to an oscilloscope or other instrument. The following equation gives the approximate rise time for different conditions of load resistance and capacitance. Note that rise time can be improved (lowered) with a termination of less than 50 Ω. This rise time improvement comes at the expense of lower pulse output voltage. The lower voltage can be overcome with the gain of a high performance oscilloscope.

$$T_r\ (10\%\ \text{to}\ 90\%) = \frac{2.2 * R_L * R_V * (C_L + C_b)}{R_L + R_V} = \frac{0.35}{BW}$$

Where
R_L = Load impedance
R_V = Video impedance
C_L = Load capacitance
C_b = Bypass capacitance



Typical values:
R_V (diode video impedance) = 1.5 kΩ[1]
C_b (RF bypass capacitor) = 27 pF nom.

[1] @ 25 °C and P_{in} <–20 dBm.
Extremely sensitive to power and temperature

Figure 4. Detector model

8

Broadband Match (SWR)

In many applications, the match (SWR) of the detector is of prime importance in minimizing the uncertainty of power measurements. If the input of the detector is not well matched to the source, simple and multiple mismatch errors will result, reducing the accuracy of the measurement.

Figure 5 represents the mismatch error introduced by multiple reflections caused by a mismatch between the detector and the source. For a detector SWR of 2.0 and source SWR of 2.0, the uncertainty is ±1.0 dB. For the LBSD and PDBD models, the integration of the diode with the 50 Ω matching resistor results in an excellent broadband match. Both LBSD and PDBD detectors utilize thin-film technology which yields a precision matching circuit that minimizes stray reactance and yields very good performance. Figure 6 displays typical SWR for the Keysight 8473B,C LBSD detector and the Keysight 8473D PDBD detector.

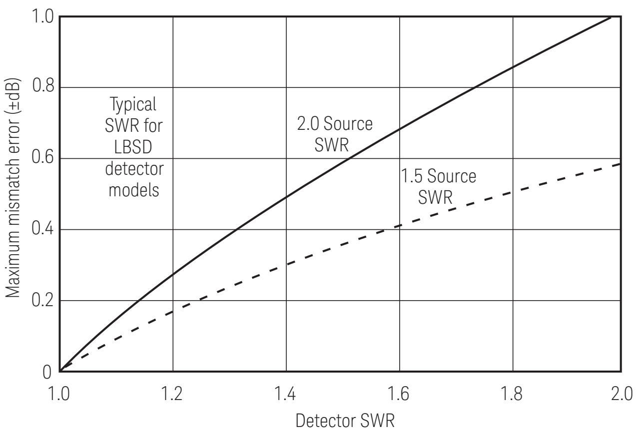


Figure 5. Measurement uncertainty due to detector source mismatch

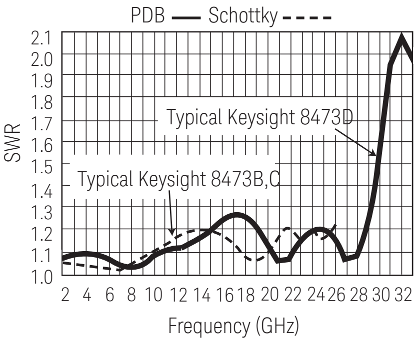


Figure 6. Typical SWR of detectors

Square Law Performance

When detectors are used in reflectometer and insertion loss setups, the measurement uncertainty depends on the output voltage being proportional to input power. The term square law comes from the output voltage being proportional to the input power (input voltage squared). Most microwave detectors are inherently square law from the P_{tss} level up to about –15 dBm. Figure 7 shows this characteristic.

Figure 8 shows detector output in dB relative to P_{in} = –20 dBm. As P_{in} exceeds –20 dBm, the detector response deviates from square law. The user can select a load resistor that will extend the upper limit of the square law range beyond ±15 dBm. By choosing the square law load option, the deviation from ideal square law response will be ±0.5 dB (although the sensitivity specification is decreased by a factor of 4).

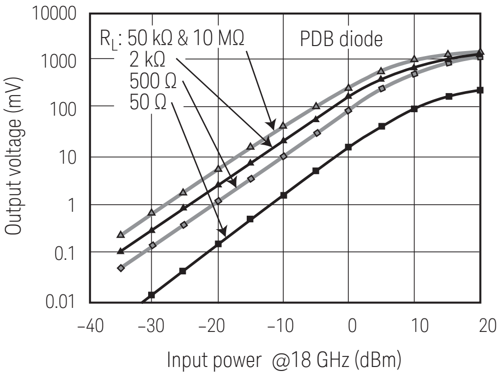


Figure 7. Typical detector square law response (mV)

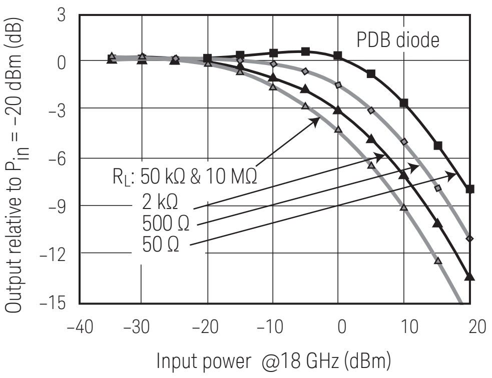


Figure 8. Typical detector square law response (dB)

8

8471D planar-doped barrier detector

8471E planar-doped barrier detector

8473D planar-doped barrier detector

8474 family of planar-doped barrier detector

Planar-Doped Barrier Detectors

Keysight 8471D and 8471E detectors are planar-doped barrier detectors offering excellent performance to 2 and 12 GHz. The 8471D covers 100 kHz to 2 GHz with a BNC (m) input connector and the 8471E covers 10 MHz to 12 GHz with a SMA (m) input connector. Both detectors come standard with negative polarity output, a positive polarity output is available with option 103.

High Performance Planar-Doped Barrier Detectors

8474B/C/E detectors are the newest additions to the Keysight family of high performance detectors. Utilizing a gallium arsenide, planar-doped barrier detecting diode, these detectors offer superior performance when compared to Schottky diodes. They feature extremely flat frequency response (typically better than ±1 dB to 50 GHz) and very stable frequency response versus temperature.

These detectors are available with type-N, 3.5-mm, or 2.4-mm connectors. They are also offered with an option for positive output polarity (Option 103). Additionally, some detectors have an optimal square law load available (Option 102).

For applications requiring an octave band or less, 8474B/C/E detectors are available with frequency band options that feature lower SWR and flatter frequency response.

Specifications

Model	8471D	8471E	8473D	8474B	8474C	8474E
Frequency range (GHz)	0.0001 to 2	0.01 to 12	0.01 to 33	0.01 to 18	0.01 to 33	0.01 to 50
Frequency response (dB)	±0.2 to 1 GHz ±0.4 to 2 GHz	±0.23 to 4 GHz ±0.6 to 8 GHz ±0.85 to 12 GHz	±0.25 to 14 GHz ±0.4 to 26.5 GHz ±1.25 to 33 GHz (±2.0 dB typical to 40 GHz)	±0.35 to 18 GHz	±0.45 to 26.5 GHz ±0.7 to 33 GHz	±0.4 to 26.5 GHz ±0.6 to 40 GHz ±1.0 to 50 GHz
Maximum SWR	1.23 to 1 GHz 1.46 to 2 GHz	1.2 to 4 GHz 1.7 to 8 GHz 2.4 to 12 GHz	1.2 to 14 GHz 1.4 to 26.5 GHz 3.0 to 33 GHz (3.0 typical to 40 GHz)	1.3 to 18 GHz	1.4 to 26.5 GHz 2.2 to 33 GHz	1.2 to 26.5 GHz 1.6 to 40 GHz 2.8 to 50 GHz
Low-level sensitivity (mV/µW)	> 0.5	> 0.4	> 0.4	> 0.4	> 0.4 > 0.34 to 50 GHz	> 0.4 to 40 GHz
Maximum operating input power	100 mW	200 mW	200 mW	200 mW	200 mW	200 mW
Typical short term maximum input power (<1 minute)	0.7 W	0.75 W	1 W	0.75 W	0.75 W	0.75 W
Video impedance (nom)	1.5 kΩ	1.5 kΩ	1.5 kΩ	1.5 kΩ	1.5 kΩ	1.5 kΩ
RF bypass capacitance (nom)	6800 pF	30 pF	30 pF	27 pF	27 pF	27 pF
Output polarity	Negative	Negative	Negative	Negative	Negative	Negative
Input connector	BNC (m)	SMA (m)	3.5 mm (m)	Type-N (m)	3.5 mm (m)	2.4 mm (m)
Output connector	BNC (f)	SMC (m)	BNC (f)	BNC (f)	SMC (m)	SMC (m)

DETECTORS – Planar-Doped Barrier Diode Detector (continued)

Options

Model	8471D	8471E	8473D	8474B	8474C	8474E
Optimal square law load [1]	Option 102	N/A	N/A	Option 102	N/A	N/A
Positive polarity output	Option 103	Option 103	Option 003	Option 103	Option 103	N/A
Frequency band	N/A	Option 004 4 GHz operation	N/A	See PDBD frequency band options		

[1] Defined as ±0.5 dB from ideal square law response

PDBD Frequency Band Options

8474B options	001	002	004	008
Frequency range (GHz)	0.01 to 18	0.01 to 2	2 to 4	4 to 8
Frequency response (dB)	±0.35	±0.25	±0.25	±0.25
Maximum SWR	1.31	1.09	1.1	1.2

8474C options	001	008	012	033
Frequency range (GHz)	0.01 to 33	4 to 8	8 to 12.4	26.5 to 33
Frequency response (dB)	±0.3	±0.2	±0.25	±0.3
Maximum SWR	2.2	1.16	1.2	2.2

Environmental Specifications

Operating temperature: –20 °C to +85 °C (Except Keysight 8474B: 0 °C to +75 °C)
Temperature cycling: –55 °C to +85 °C; MIL-STD 883, Method 1010 (non-operating)
Vibration: 0.6 inches D.A. 10 to 80 Hz; 20 g, 80 to 200 Hz; MIL-STD 883, Method 2007
Shock: 500 g, 0.5 ms; MIL-STD 883, Method 2002
Acceleration: 500 g; MIL-STD 883, Method 2001
Altitude: 50,000 ft (15,240 m); MIL-STD 883, Method 1001
Salt atmosphere: 48 hr, 5% solution; MIL-STD 883, Method 1009
Moisture resistance: 25 °C to 40 °C, 95% RH; MIL-STD 883, Method 1004
RFI: MIL-STD 461B
ESD: 10 discharges at 25 kV to the body, not to the center conductor

Outline Drawings

Diagram 1

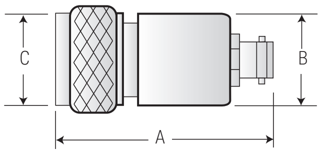


Diagram 2

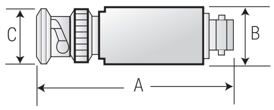


Diagram 3

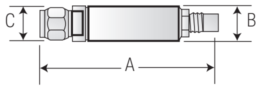
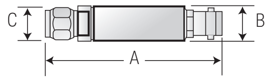


Diagram 4



Model	Length (Dim A)	Barrel diameter (Dim B)	Input connector diameter (Dim C)	Net weight	Shipping weight
Diagram 1					
8474B	60 mm (2.36 in)	19 mm (0.74 in)	21 mm (0.82 in)	85 g (3 oz)	454 g (16 oz)
Diagram 2					
8471D	63 mm (2.50 in)	16 mm (0.62 in)	14 mm (0.54 in)	39 g (1.4 oz)	454 g (16 oz)
Diagram 3					
8471E	39 mm (1.54 in)	9.3 mm (0.36 in)	7.9 mm (0.31 in)	39 g (1.4 oz)	454 g (16 oz)
8474C	41 mm (1.62 in)	9.7 mm (0.38 in)	7.9 mm (0.31 in)	14 g (0.5 oz)	454 g (16 oz)
8474E	41 mm (1.62 in)	9.7 mm (0.38 in)	7.9 mm (0.31 in)	9 g (0.3 oz)	454 g (16 oz)
Diagram 4					
8473D	48 mm (1.89 in)	10 mm (0.39 in)	7.9 mm (0.31 in)	57 g (2 oz)	454 g (16 oz)

Ordering Information

8471D
- **8471D-102** square law load
- **8471D-103** positive polarity

8471E
- **8471E-004** 0.01 to 4 GHz octave only
- **8471E-103** positive polarity

8473D
- **8473D-003** positive polarity

8474B
- **8474B-002** 0.01 to 2 GHz octave only
- **8474B-004** 2 to 4 GHz octave only
- 8474B-008 4 to 8 GHz octave only
- **8474B-102** [1] square law load
- **8474B-103** positive polarity

8474C
- **8474C-008** 4 to 8 GHz octave only
- **8474C-012** 8 to 12.4 GHz octave only
- **8474C-033** 26.5 to 33 GHz octave only
- **8474C-103** positive polarity

1 Option 102 external square law load extends the square law region of the detector with deviation of ± 0.5 dB from the ideal square law response.

Related Literature

8471D coaxial RF microwave detectors datasheet,
part number **5952-0644**
8471E coaxial RF microwave detectors datasheet,
part number **5952-0802**
8473D planar-Doped barrier detector datasheet,
part number **5954-8878**
8474B/C/E coaxial GaAs microwave detectors datasheet,
part number **5952-0801**

Web Link

www.keysight.com/find/mta

DETECTORS – Low-Barrier Schottky Diode Detector

33330B LBSD detector

33330C LBSD detector

423B LBSD detector

8470B LBSD detector

8472B LBSD detector

8473B LBSD detector

8473C LBSD detector

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Low-Barrier Schottky Diode (LBSD) Detectors

Keysight 423B, 8470B, 8472B, 8473B/C, 33330B/C LBSD detectors have been widely used for many years in a variety of applications including leveling and power sensing. They offer good performance and ruggedness. Matched pairs (Option 001) offer very good detector tracking. A square law load option (Option 002) extends the square law region to at least 0.1 mW (–10 dBm).

Specifications

Model	423B	8470B	8472B	8473B	33330B	8473C	33330C
Freq. range (GHz)	0.01 to 12.4	0.01 to 18	0.01 to 18	0.01 to 18	0.01 to 18	0.01 to 26.5	0.01 to 26.5
Freq. response (dB) (±0.2 dB over any octave from 0.01 to 8 GHz on all models)	±0.3 to 12.4 GHz	±0.3 to 12.4 GHz ±0.5 to 15 GHz ±0.6 to 18 GHz	±0.3 to 12.4 GHz ±0.5 to 15 GHz ±0.6 to 18 GHz	±0.3 to 12.4 GHz ±0.6 to 18 GHz	±0.3 to 12.4 GHz ±0.6 to 18 GHz	±0.3 to 12.4 GHz ±0.6 to 20 GHz ±1.5 to 26.5 GHz [1]	±0.3 to 12.4 GHz ±0.6 to 20 GHz ±1.5 to 26.5 GHz
Maximum SWR (measured at –20 dBm)	1.15 to 4 GHz 1.3 to 12.4 GHz	1.15 to 4 GHz 1.3 to 15 GHz 1.7 to 18 GHz	1.2 to 4.5 GHz 1.35 to 7 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	1.2 to 4 GHz 1.5 to 18 GHz	1.2 to 4 GHz 1.5 to 18 GHz	1.2 to 4 GHz 1.5 to 18 GHz 2.2 to 26.5 GHz	1.2 to 4 GHz 1.5 to 18 GHz 2.2 to 26.5 GHz
Low-level sensitivity (mV/µW)	> 0.5	> 0.5	> 0.5	> 0.5	> 0.5	> 0.5 to 18 GHz > 0.18 to 26.5 GHz	> 0.5 to 18 GHz > 0.18 to 26.5 GHz
Maximum operating input power	200 mW	200 mW	200 mW	200 mW	200 mW	200 mW	200 mW
Typical short term maximum input power (< 1 minute)	1 W	1 W	1 W	1 W	1 W	1 W	1 W
Noise	< 50 µV	< 50 µV	< 50 µV	< 50 µV	< 50 µV	< 50 µV	< 50 µV
Video impedance (nom)	1.3 kΩ	1.3 kΩ	1.3 kΩ	1.3 kΩ	1.3 kΩ	1.3 kΩ	1.3 kΩ
RF bypass capacitance (nom)	50 pF	50 pF	50 pF	30 pF	30 pF	30 pF	30 pF
Output polarity	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Input connector	Type-N (m)	APC-7 (m)	SMA (m)	3.5 mm (m)	3.5 mm (m)	3.5 mm (m)	3.5 mm (m)
Output connector	BNC (f)	BNC (f)	BNC (f)	BNC (f)	SMC (m)	BNC (f)	SMC (m)

Options

Model	423B	8470B	8472B	8473B	33330B	8473C	33330C
Matched response [2] (Option 001)	±0.2 dB to 12.4 GHz	±0.2 dB to 12.4 GHz ±0.3 dB to 18 GHz	±0.2 dB to 12.4 GHz ±0.3 dB to 18 GHz	±0.2 dB to 12.4 GHz ±0.3 dB to 18 GHz	±0.2 dB to 12.4 GHz ±0.3 dB to 18 GHz	±0.2 dB to 12.4 GHz ±0.3 dB to 18 GHz ±0.5 dB to 26.5 GHz	±0.2 dB to 12.4 GHz ±0.3 dB to 18 GHz ±0.5 dB to 26.5 GHz
Optimal square law load [3]	Option 002	Option 002	Option 002	Option 002		Option 002	
Positive polarity output	Option 003	Option 003	Option 003	Option 003	Option 003	Option 003	Option 003
Connector		Option 012 Type-N (m) input connector	Option 100 OSSM (f) output connector				

1 From a –3.3 dB linear slope beginning at 20 GHz
2 Must order a quantity of 2 standard units and quantity of 2 Option 001 for a pair of detectors with matched frequency response
3 Defined as ±0.5 dB from ideal square law response

Environmental Specifications

Operating temperature: –20 °C to +85 °C (except Keysight 423B: 0 °C to +55 °C)
Vibration: 20 g; 80 to 2000 Hz
Shock: 100 g, 11 ms

8

DETECTORS – Low-Barrier Schottky Diode Detector (continued)

Dimension Drawings

Diagram 1

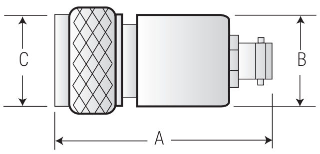


Diagram 2

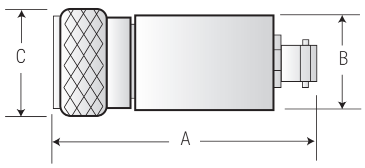


Diagram 3

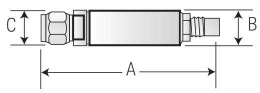
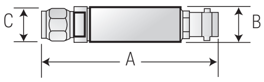


Diagram 4



Model	Length (Dim A)	Barrel diameter (Dim B)	Input connector diameter (Dim C)	Net weight	Shipping weight
Diagram 1					
423B	63 mm (2.47 in)	20 mm (0.78 in)	21 mm (0.82 in)	114 g (4 oz)	454 g (16 oz)
Diagram 2					
8470B	64 mm (2.50 in)	19 mm (0.75 in)	22 mm (0.87 in)	114 g (4 oz)	454 g (16 oz)
Diagram 3					
33330B	43 mm (1.70 in)	9.7 mm (0.38 in)	7.9 mm (0.31 in)	14 g (0.5 oz)	454 g (16 oz)
33330C	43 mm (1.70 in)	9.7 mm (0.38 in)	7.9 mm (0.31 in)	14 g (0.5 oz)	454 g (16 oz)
Diagram 4					
8472B	64 mm (2.50 in)	14 mm (0.56 in)	7.9 mm (0.31 in)	57 g (2 oz)	454 g (16 oz)
8473B	48 mm (1.89 in)	10 mm (0.39 in)	7.9 mm (0.31 in)	14 g (0.5 oz)	454 g (16 oz)
8473C	48 mm (1.89 in)	10 mm (0.39 in)	7.9 mm (0.31 in)	14 g (0.5 oz)	454 g (16 oz)

Ordering Information

To add options to a product, use the following ordering scheme:
Model: 847xB/C (x= 0, 2 or 3)
Example options: 8472B–001, 8473C–001

423B–001 matched pair of detectors
847xB/C–001
33330B/C–001

423B–002 external square-law load
847xB/C–002

423B-003 positive polarity output
847xB/C-003
33330B/C-003

Related Literature

423B, 8470B, 8472B, 8473B/C Low barrier schottky diode detectors datasheet, part number **5952-8299**
33330B/C coaxial detectors datasheet , part number **5952-8164E**

Web Link

www.keysight.com/find/mta

83036C broadband directional detector

83036C Broadband Directional Detector

This broadband microwave power sampler operates in much the same way as a directional coupler and detector combination. Comprised of a resistive bridge and PDB diode, this broadband device offers excellent frequency, temperature, and square law response characteristics.

With a 10 MHz to 26.5 GHz frequency range, a single 83036C can be used in many applications where two directional couplers and detectors were once required.

The maximum SWR is 1.7 above 50 MHz on both the input and output ports. Directivity of 14 dB matches that of most miniature couplers currently available. The maximum insertion loss is 2.2 dB.

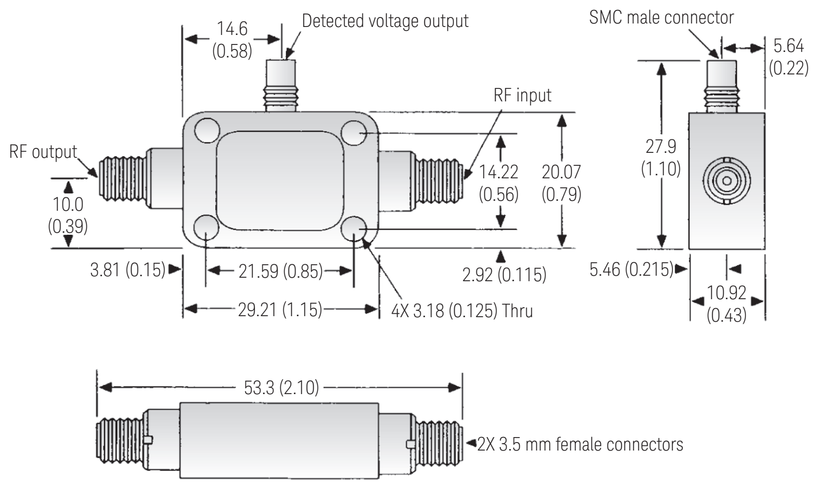
The 83036C has been used with great success as the sampling element for external leveling of broadband swept frequency sources. The detector's extended frequency range increases the usable band to 100 MHz to 26 GHz, giving the user full use of a broadband source with external leveling. Other uses include the internal leveling element for sources, and forward/reverse power monitoring.

Specifications

Model	Frequency range (GHz)	Frequency response (dB)	Max. SWR input/output (50 Ω nom)	Maximum thru line loss (dB)	Low level sensitivity	Maximum input power [1] (into 50 Ω Load)	Maximum input power [1] (into Open)	Input/output connector
83036C	0.01 to 26.5	±1.0	1.7	2.2	18 µV/µW	32 dBm	21 dBm	3.5 mm (f)

[1] With 2:1 source match

83036C Drawing



Dimensions are in mm (inches) nominal, unless otherwise specified.

Related Literature

83036C coaxial GaAs directional detector datasheet, part number **5952-1874**

Web Link

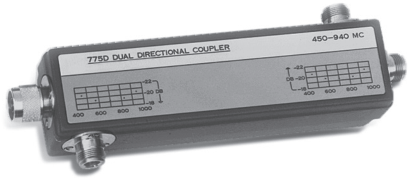
www.keysight.com/find/mta

9 Directional Couplers and Bridges

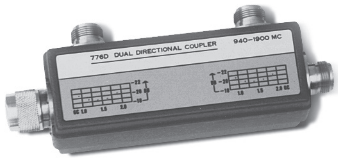
DIRECTIONAL COUPLERS AND BRIDGES

772D coaxial dual-directional coupler

773D coaxial directional coupler



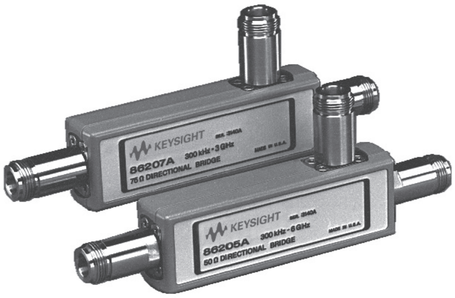
775D coaxial dual-directional coupler



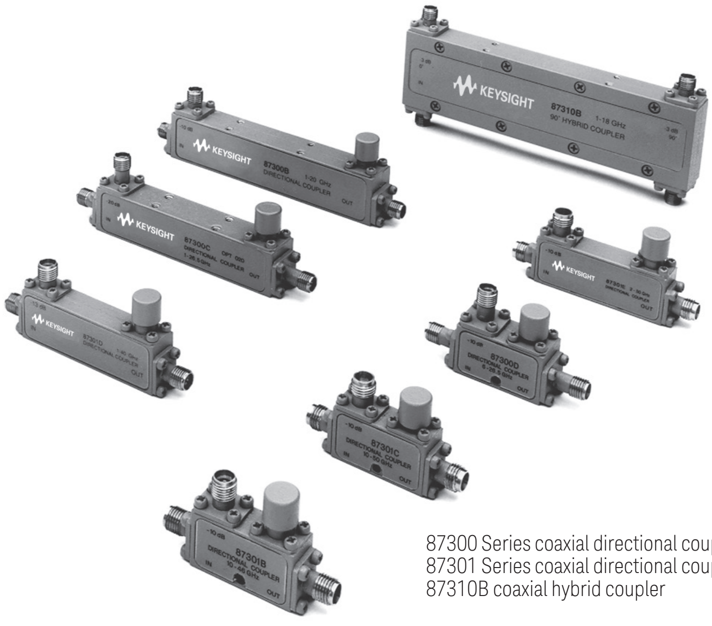
776D coaxial dual-directional coupler

777D coaxial dual-directional coupler

778D coaxial dual-directional coupler



86205A RF bridge
86207A RF bridge



87300 Series coaxial directional coupler
87301 Series coaxial directional coupler
87310B coaxial hybrid coupler

Overview

Directional couplers are general purpose tools used in RF and microwave signal routing for isolating, separating or combining signals. They find use in a variety of measurement applications:

- Power monitoring
- Source leveling
- Isolation of signal sources
- Swept transmission and reflection measurements

Key Specifications

The key specifications for a directional coupler depend on its application. Each of them should be carefully evaluated to ensure that the coupler meets its intended use.

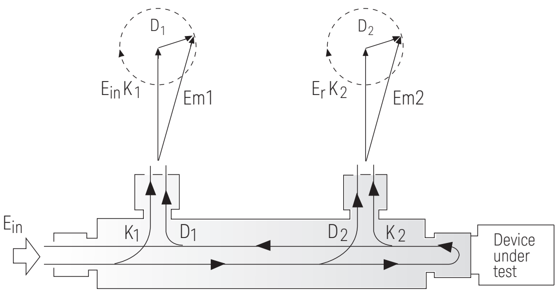
- Directivity
- SWR
- Coupling coefficient
- Transmission loss
- Input power

Directivity

Directivity is a measure of how well the coupler isolates two opposite-travelling (forward and reverse) signals. In the case of measuring reflection coefficient (return loss) of a device under test, directivity is a crucial parameter in the uncertainty of the result. Figure 1 shows how the reflection signal, E_r, is degraded by the undesired portion of the incident signal D_2. And since the undesired signal, D_2, combines with the reflected signal as a phasor, the error in the measured signal Em_2 can only be compensated or corrected on a broadband basis using vector analyzers.

Because the reverse-coupled signal is very small, it adds a negligible amount of uncertainty when measuring large reflections. But as the reflected signal becomes smaller, the reverse-coupled signal becomes more significant.

For example, when the return loss in dB equals the value of directivity, the measurement error can be between –6 to +8 dB. The higher the directivity specified in dB, the higher the measurement accuracy. The effect of the directivity error on the forward-coupler output, Em1, is less important because the desired signal is usually a large value. When Keysight couplers are used for power monitoring and leveling, directivity is less important than coupling coefficient flatness.



K_1 and K_2 : Coupling coefficients (dB)
D_1 and D_2 : Directivities (dB)
E_{in} = Input signal
E_r = Reflected signal from DUT
E_m = Measured signal (includes directivity error)

Figure 1. Effect of directivity on reflection measurement

SWR

For many applications, coupler SWR is important to minimize low mismatch errors and to improve measurement accuracy. For example, when making swept reflection measurements, it is customary to set a full reflection (0 dB return loss) reference by connecting a short at the test port of the coupler. Some of the reflected signal re-reflects due to the output port (test port) SWR. This re-reflected signal goes through a wide phase variation because of the width of the frequency sweep, adding to and subtracting from the reflected signal. This phase variation creates a ripple in the full reflection (0 dB return loss) reference. The magnitude of the re-reflected signal, and thus the measurement uncertainty, can be minimized by selecting couplers with the lowest SWR.

Coupling Coefficient

In power monitoring and leveling, the most desired specification is a highly accurate and flat coupling value, because the coupling factor directly affects the measurement data. For wideband leveling, the coupling factor directly influences the flatness of the output power. Coupling values of 10 and 20 dB are most common but for high power and pulsed systems, there can be a need for 40 dB coupling.

In reflection measurements, coupling factor is less important than directivity and SWR, since both the forward and reverse coupling elements are usually identical, and so the variation of coupling factors match versus frequency.

Transmission Loss

Transmission loss is the total loss in the main line of a directional coupler, and includes both insertion loss and coupling loss. For example, for a 10 dB coupler, 10% of the forward signal is coupled off, which represents approximately 0.4 dB of signal loss added to the inherent losses in the main transmission line.

Transmission loss is usually not important at low frequencies where most swept sources have sufficient available power. However, in the millimeter ranges, power sources are limited and lower loss devices become significant. In general, broadband couplers have transmission losses on the order of 1 dB. On the other hand, directional bridges, which are sometimes used in place of couplers for reflection/transmission measurements, have insertion losses of at least 6 dB. This loss directly subtracts from the dynamic range of the measurement.

Input Power

High power handling characteristics of directional couplers are critical when used for monitoring pulsed power systems. Most couplers designed for test and measurement applications are not ideal for system powers in the kilowatt range. One reason is that the coupler's secondary transmission line often has an internal termination that limits the coupler's mainline power handling capability. A second reason is the maximum power rating of the connectors. Such models have a power rating from 20 to 50 W average.

87300/301 Series Directional Couplers

This line of compact, broadband directional couplers is ideal for signal monitoring, or, when combined with a coaxial detector, for signal leveling. The 8474 series coaxial detectors are recommended if output detection is desired. A broad offering of products is available with frequencies up to 50 GHz.

87310B Hybrid Coupler

The 87310B is a 3 dB hybrid coupler, intended for applications requiring a 90 degree phase difference between output ports. In that sense, it is different from typical power dividers and power splitters, which have matched signal phase at their output ports.

773D Directional Coupler
772D Dual-Directional Coupler

These high-performance couplers are designed for broadband swept measurements in the 2 to 18 GHz range. The 773D is ideal for leveling broadband sources when used with an 8474B detector. (Also, see the Keysight 83036C directional detector). For reflectometer applications, the 772D dual coupler is the best coupler to use with Keysight power sensors and power meters (such as the 438A dual power meter). Forward and reverse power measurements on transmitters, components, or other broadband systems are made simpler by using the 772D. The broadband design allows the use of a single test setup and calibration for tests spanning the entire 2 to 18 GHz frequency range.

775/6/7/8D Dual-Directional Couplers

These couplers cover a frequency spread of more than 2:1, each centered on one of the important VHF/UHF bands. Keysight 778D covers a multi-octave band from 100 to 2000 MHz. With their high directivity and mean coupling accuracy of ±0.5 dB, these are ideal couplers for reflectometer applications. Power ratings are 50 W average, 500 W peak.

RF Bridges

These high directivity RF bridges are ideal for accurate reflection measurements and signal-leveling applications. They combine the directivity and broadband frequency range of directional bridges and the low insertion loss and flat coupling factor of directional couplers. These bridges can be used with the Keysight 8711A RF scalar network analyzer, the Keysight 8753 family of RF vector analyzers as well as Keysight spectrum analyzers.

86205A RF Bridge

This 50 Ω bridge offers high directivity and excellent port match from 300 kHz to 6 GHz. Directivity is 30 dB to 3 GHz. Coupling factor is 16 dB with a slope of +0.15 dB per GHz to 3 GHz. Insertion loss is 1.5 dB with a slope of +0.1 dB per GHz. Connectors are type-N (f).

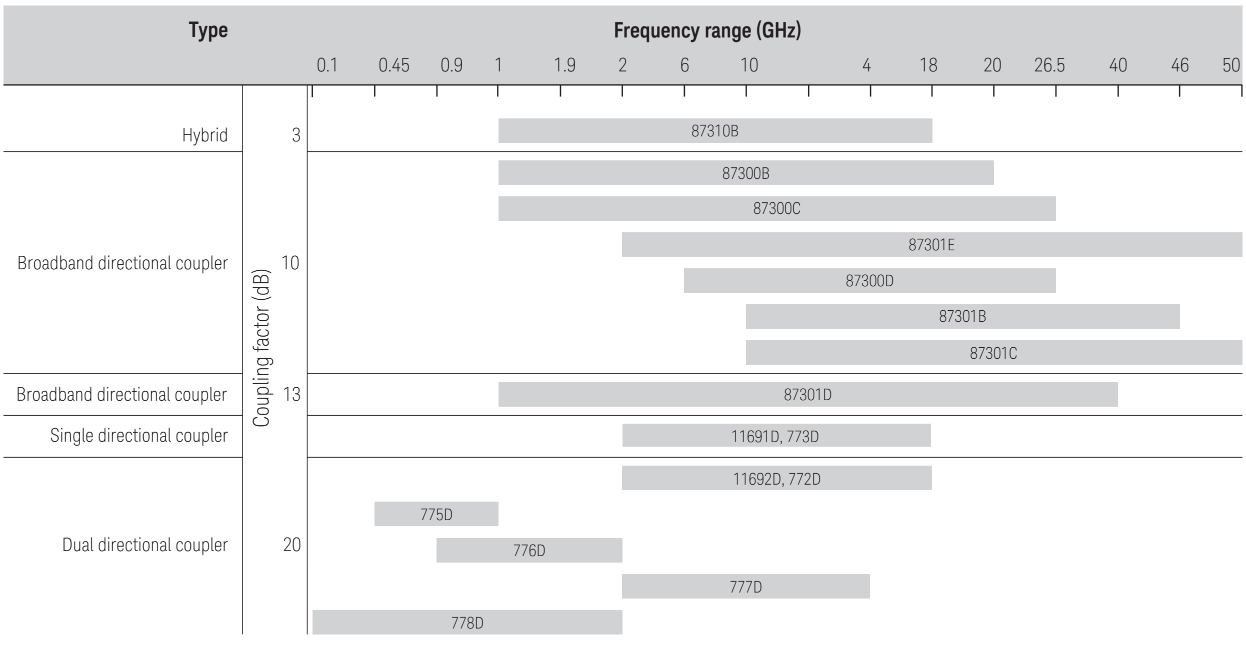
86205B RF Bridge

This 50 Ω bridge offers a high directivity and excellent port to port match from 300 kHz to 3 GHz. Directivity is 33 dB to 3 GHz. Coupling factor is 18 dB with a slope of +/– 3 dB. Insertion loss is 2.5 dB to 3 GHz and the connector type is 3.5 mm and APC-7

86207A RF Bridge

This 75 Ω type-N bridge has high directivity and excellent port match from 300 kHz to 3 GHz. It is used for external reflection measurements or coupling signal from main path. Directivity is 30 dB to 5 MHz, 40 dB to 1.3 GHz, 35 dB to 2 GHz, and 30 dB to 3 GHz. Coupling factor is 16 dB with a slope of +0.15 dB per GHz to 3 GHz. Insertion loss is 1.5 dB with a slope of +0.1 dB per GHz. Connectors are type-N (f).

Directional Coupler Selection Guide



Product Specifications

Model	Frequency range (GHz)	Coupling	Amplitude imbalance	Phase imbalance	Isolation	Maximum SWR (dB)	Insertion loss (dB)	Power rating average, peak	Connectors
Hybrid coupler									
87310B	1 to 18	3 dB	±0.5 dB at each port, centered at –3 dB	±10 Degrees	> 17 dB	1.35	< 2.0	20 W, 3 kW	SMA (f)

Model	Frequency range (GHz)	Nominal coupling & variation (dB)	Directivity (dB)	Maximum SWR (dB)	Insertion loss (dB)	Power rating average, peak
Broadband directional coupler						
87300B	1 to 20	10 ±0.5	> 16	1.35	< 1.5	20 W, 3 kW
87300C	1 to 26.5	10 ±1.0	> 14 to 12.4 GHz > 12 to 26.5 GHz	1.35 to 12.4 GHz 1.5 to 26.5 GHz	< 1.2 to 12.4 GHz < 1.7 to 26.5 GHz	20 W, 3 kW
87300D	6 to 26.5	10 ±0.5	> 13	1.4	< 1.3	20 W, 3 kW
87301B	10 to 46	10 ±0.7	> 10	1.8	< 1.9	20 W, 3 kW
87301C	10 to 50	10 ±0.7	> 10	1.8	< 1.9	20 W, 3 kW
87301D	1 to 40	13 ±1.0	> 14 to 20 GHz > 10 to 40 GHz	1.5 to 20 GHz 1.7 to 40 GHz	< 1.2 to 20 GHz < 1.9 to 40 GHz	20 W, 3 kW
87301E	2 to 50	10 ±1.0	> 13 to 26.5 GHz > 10 to 50 GHz	1.5 to 26.5 GHz 1.8 to 50 GHz	< 2.0	20 W, 3 kW
Single directional coupler						
773D [1]	2 to 18	20 ±0.9	> 30 to 12.4 GHz > 27 to 18 GHz	1.2	< 0.9	50 W, 250 W
Dual directional coupler						
772D [1]	2 to 18	20 ±0.9	> 30 to 12.4 GHz > 27 to 18 GHz	1.28 to 12.4 GHz 1.4 to 18 GHz	< 1.5	50 W, 250 W
775D [2]	0.45 to 0.94	20 ±1	> 40	1.15	< 0.40	50 W, 500 W
776D [2]	0.94 to 1.9	20 ±1	> 40	1.15	< 0.35	50 W, 500 W
777D [2]	1.9 to 4	20 ±0.4	> 30	1.2	< 0.75	50 W, 500 W
778D	0.1 to 2	20 ±1.5	> 36 to 1 GHz 3 > 32 to 2 GHz [3]	1.1	< 0.60	50 W, 500 W

[1] See data sheet for typical out of band data from 0.1 to 2 GHz and 18 to 20 GHz
[2] Maximum auxiliary arm tracking: 0.3 dB for Keysight 776D; 0.5 dB for Keysight 777D
[3] 30 dB to 2.0 GHz, input port

87310B Hybrid Coupler Specifications

Frequency range	1 to 18 GHz
Coupling	3 dB
Amplitude imbalance	±0.5 dB at each port, centered at –3 dB
Phase imbalance	±10 Degrees
Isolation	> 17 dB
Maximum SWR	1.35
Insertion loss	< 2.0 dB
Power rating Average Peak	 20 W 3 kW
Connectors	SMA (f)
Weight in grams (oz)	148 (5.2)

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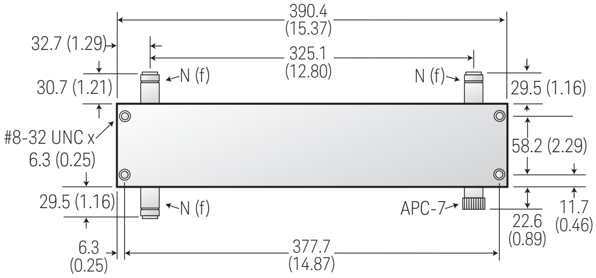
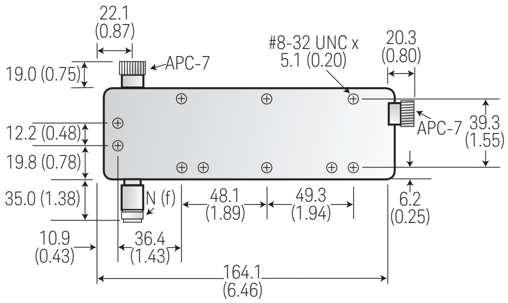
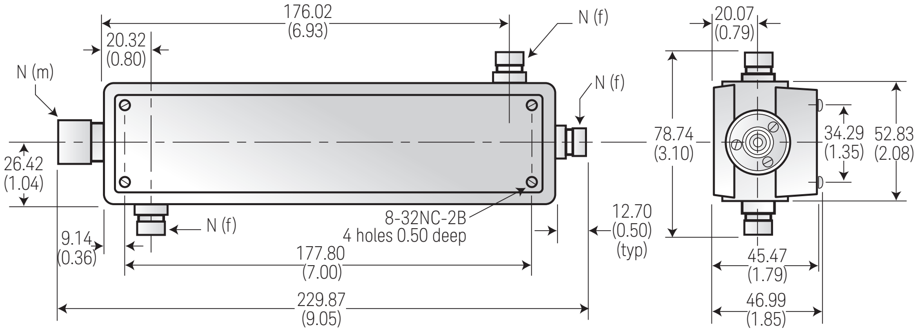
772D Coaxial Dual-Directional Coupler



773D Coaxial Directional Coupler

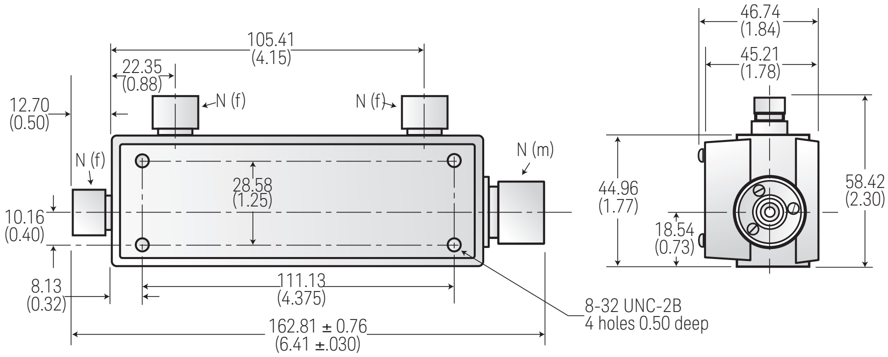


775D Coaxial Dual-Directional Coupler

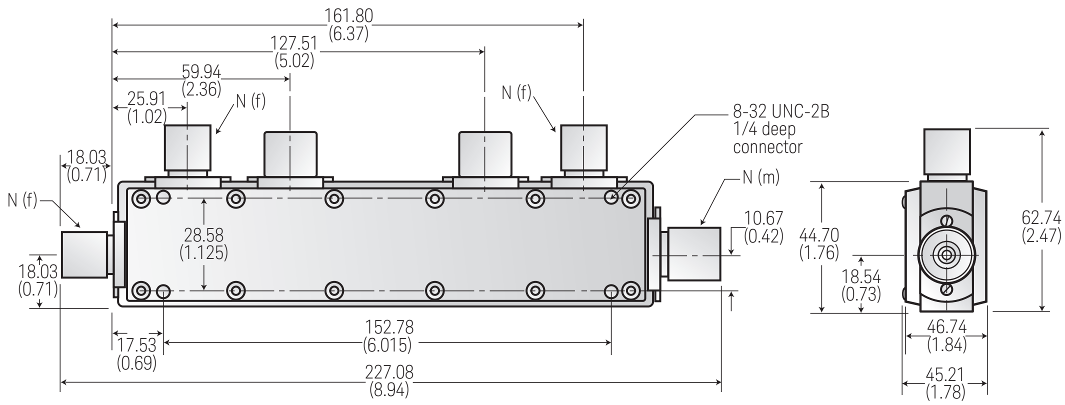


Dimensions are in mm (inches) nominal, unless otherwise specified.

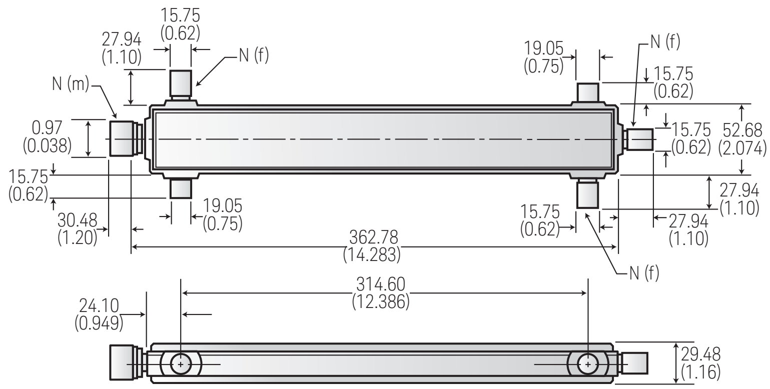
776D Coaxial Dual-Directional Coupler



777D Coaxial Dual-Directional Coupler

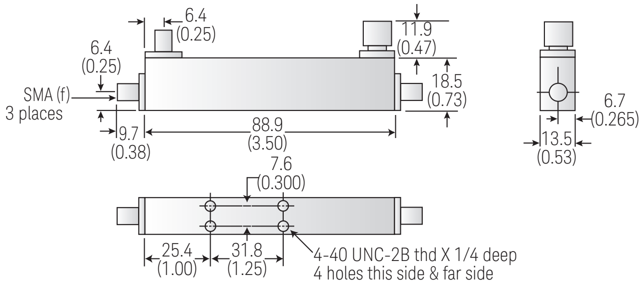


778D Coaxial Dual-Directional Coupler

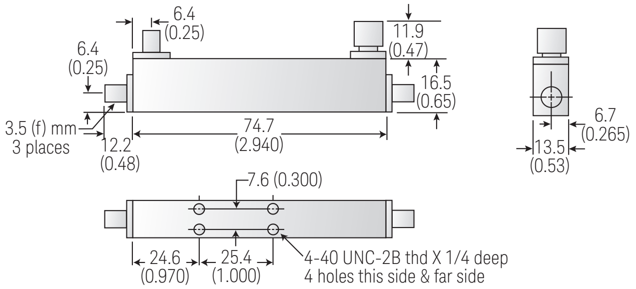


Dimensions are in mm (inches) nominal, unless otherwise specified.

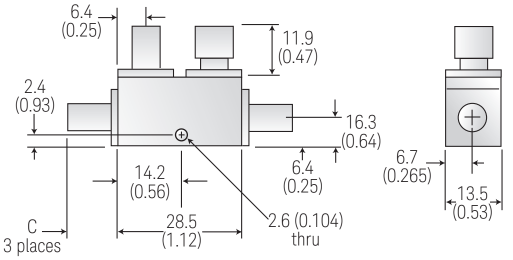
87300B Coaxial Directional Coupler



87300C Coaxial Directional Coupler



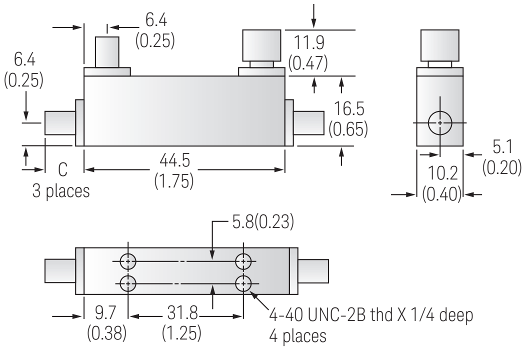
87300D, 87301B, 87301C Coaxial Directional Coupler



Model	Connector type	Connector dimension
87300D	3.5 mm (f)	12.2 (0.48)
87301B	2.9 mm (f)	9.7 (0.38)
87301C	2.4 mm (f)	28.4 (1.0)

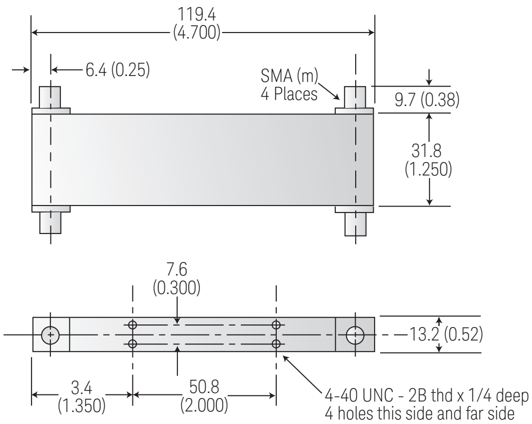
Dimensions are in mm (inches) nominal, unless otherwise specified.

87301D, 87301E Coaxial Directional Coupler

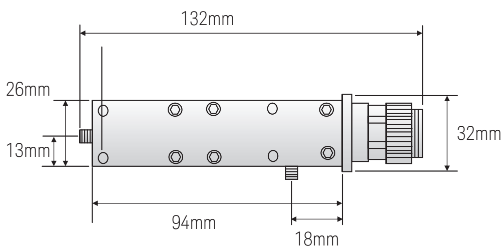


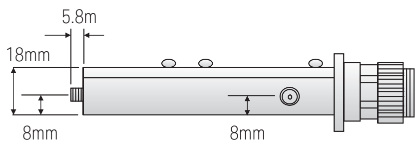
Model	Connector type	Connector dimension
87301D	2.4 mm (f)	9.7 (0.38)
87301E	2.92 mm (f)	9.7 (0.38)

87310B Coaxial Hybrid Coupler



86205B RF Bridge





Dimensions are in mm (inches) nominal, unless otherwise specified.

Model	86205A	86205B	86207A
Frequency range	300 kHz to 6 GHz	300 kHz to 3 GHz	300 kHz to 3 GHz
Impedance	50 Ω	50 Ω	75 Ω
Directivity (min)	30 dB, 0.3 MHz to 5 MHz 40 dB, 5 MHz to 2 GHz 30 dB, 2 GHz to 3 GHz 20 dB, 3 GHz to 5 GHz (typical) 16 dB, 5 GHz to 6 GHz (typical)	38 dB, 0.3 MHz to 1.3 MHz 33 dB, 1.3 MHz to 3 GHz	30 dB, 0.3 MHz to 5 MHz 40 dB, 5 MHz to 1.3 GHz 35 dB, 1.3 GHz to 2 GHz 30 dB, 2 GHz to 3 GHz (typical)
Return loss (min)	23 dB, 0.3 MHz to 2 GHz 20 dB, 2 GHz to 3 GHz 18 dB, 3 GHz to 5 GHz (typical) 16 dB, 5 GHz to 6 GHz (typical)	14 dB, 0.3 MHz to 3 GHz	20 dB, 0.3 MHz to 1.3 GHz 18 dB, 1.3 GHz to 2 GHz 18 dB, 2 GHz to 3 GHz (typical)
Insertion loss (max)	1.5 dB, +0.1 dB/GHz	2.0 dB, 0.3 MHz to 1 GHz 2.5 dB, 1 GHz to 3 GHz	1.5 dB, +0.1 dB/GHz
Coupling factor (nom)	(< 3 GHz) 16.0 dB, +0.15 dB/GHz (> 3 GHz) 16.5 dB, –0.20 dB/GHz	–21 dB to –15 dB, 0.3 MHz to 3 GHz	(< 3 GHz) 16.0 dB, +0.15 dB/GHz

Ordering Information

	Standard connector	
Model	**Primary line**	**Auxiliary arm**
772D		
772D-STD	APC-7, APC-7	N(f)
772D-001	N(f), N(f)	N(f)
773D		
773D-STD/101	APC-7, APC-7	N(f)
773D-001	N(f), N(f)	N(f)
773D-010	N(m), N(f)	N(f)
773D-002	N(f), N(m)	N(f)
775D/777D		
775D/777D-STD	N(m), N(f)	N(f)
778D		
778D-STD	N(f), N(m)	N(f), N(f)
778D-011	APC-7, N(f)	N(f), N(f)
778D-012	N(m), N(f)	N(f)
87301D		
87301D-240	2.4 mm(f), 2.4 mm(f)	2.4 mm(f)
87301D-292	2.92 mm(f), 2.92 mm(f)	2.92 mm(f)
87300B	SMA (f), SMA (f)	SMA (f)
87300C	3.5 mm(f), 3.5 mm(f)	3.5 mm(f)
87300D	3.5 mm(f), 3.5 mm(f)	3.5 mm(f)
87301B	2.92 mm(f), 2.92 mm(f)	2.92 mm(f)
87301C	2.4 mm(f), 2.4 mm(f)	2.4 mm(f)
87301E	2.4 mm(f), 2.4 mm(f)	2.4 mm(f)
87310B	SMA (m), SMA (m)	SMA (m)

Related Literature

772D, 773D directional couplers 2 to 18 GHz technical overview, part number **5959-8753**

775D dual Directional couplers operating and service manual, part number **00774-90009**

778D dual Directional coupler 100 to 2000 MHz datasheet, part number **5952-8133**

86205A & 86207A 50 Ω & 75 Ω RF bridges technical data, part number **5091-3117E**

87300/301 Series directional couplers & 87310B hybrid coupler product overview, part number **5091-6188E**

Couplers quick fact sheet, part number **5990-5353EN**

RF and microwave test accessories selection guide, part number **5990-5499EN**

Web Link

www.keysight.com/find/adapters

10 Power Limiters

N9355B power limiter
N9356B power limiter

N9355F power limiter

11930A power limiter
11930B power limiter

N9355C power limiter
N9356C power limiter

11930A/B Power Limiters

The 11930A/B limiters provide input protection for a variety of RF and microwave instrumentation. For example, the input circuits of network analyzers may be protected for inputs up to 6 watts peak or 3 watts average power using the 11930A. The 11930B provides the same protection to spectrum analyzers and sources. At even greater power levels, failure mode for the limiter is either an open circuit or a short circuit to ground, thereby protecting the instrument from damage.

11867A Power Limiter, DC to 1.8 GHz

The 11867A RF limiter can be used to protect the input circuits of spectrum analyzers, counters, amplifiers, and other instruments from high power levels with minimal effect on measurement performance. This limiter reflects signals up to 10 watts average power and 100 watts peak power.

N9355B Power Limiter, 0.01 to 18 GHz

The N9355B power limiter provides the best broadband input power protection to sensitive RF and microwave instruments and components.

N9355C Power Limiter, 0.01 to 26.5 GHz

The N9355C power limiter provides the best broadband input power protection to sensitive RF and microwave instruments and components.

N9355F Power Limiter, 0.01 to 50 GHz

The N9355F power limiter provides the best broadband input power protection to sensitive RF and microwave instruments and components. N9355F provides a 10 dBm limiting threshold.

N9356B Power Limiter, 0.01 to 18 GHz

The N9356B power limiter provides the best broadband input power protection to sensitive RF and microwave instruments and components.

N9356C Power Limiter, 0.01 to 26.5 GHz

The N9356C power limiter provides the best broadband input power protection to sensitive RF and microwave instruments and components.

Product Specification

Model	Impedance (Ω) (nominal)	Frequency range	Insertion loss	Return loss	Maximum continuous RF input power (Watts)	Limited threshold (dBm) (typical)	Maximum DC voltage (V)	Input/output connectors
11867A	50	DC to 1.8 GHz	< 0.75	> 20 dB	10	0	N/A	Type-N
11930A	50	DC to 6 GHz	< 1.0 dB DC to 3 GHz < 1.5 dB 3 to 6 GHz	> 22 dB 30 kHz to 3 GHz > 20 dB 3 to 6 GHz	3	30	30	APC-7 (7 mm)
11930B	50	5 MHz to 6.5 GHz [3]	< 1.0 dB DC to 3 GHz [2] < 1.5 dB 3 to 6.5 GHz	> 21 dB 16 MHz to 3 GHz [2] > 17 dB 3 to 6.5 GHz	3	30	30	Type-N
N9355B	50	10 MHz to 18 GHz	< 1.75 dB	> 15 dB [1]	1	10	30	Type-N
N9356B	50	10 MHz to 18 GHz	< 1.75 dB	> 15 dB [1]	6	25	30	Type-N
N9355C	50	10 MHz to 26.5 GHz	< 2 dB	> 15 dB [1]	1	10	30	3.5 mm
N9356C	50	10 MHz to 26.5 GHz	< 2.25 dB	> 15 dB [1]	4	25	30	3.5 mm
N9355F	50	10 MHz to 50 GHz	< 2 dB 10 MHz to 26.5 GHz < 2.75 dB 26.5 to 40 GHz < 3.5 dB 40 to 50 GHz	> 10 dB [1]	0.63	10	30	2.4 mm

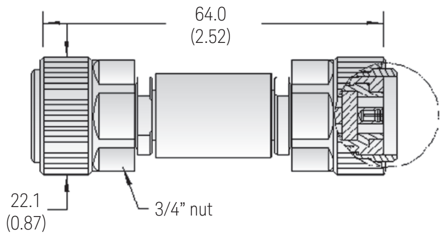
Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters. These are denoted as "typical", or "nominal".

1 10 to 30 MHz return loss specification is 8.5 dB

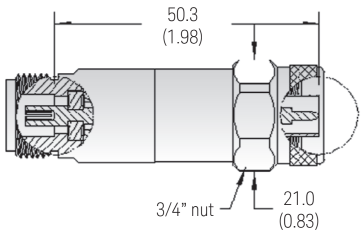
2 5 to 16 MHz insertion and return loss limited by internal blocking capacitor

3 6 to 6.5 GHz typical

11930A Power Limiter

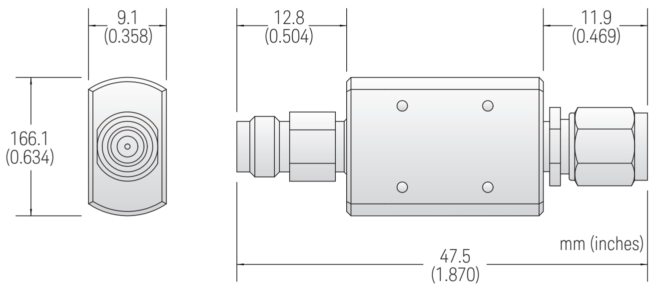


11930B Power Limiter

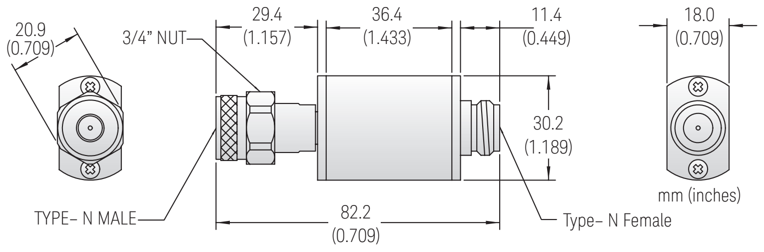


Dimensions are in mm (inches) nominal, unless otherwise specified.

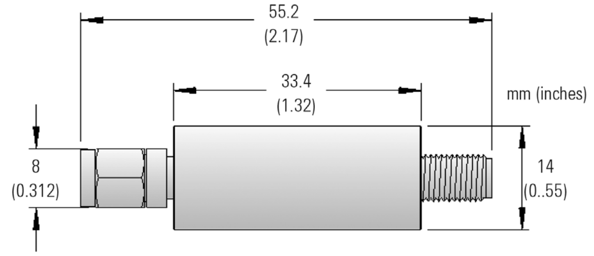
N9355F Power Limiter



N9355/6B Power Limiter



N9355/6C Power Limiter



Dimensions are in mm (inches) nominal, unless otherwise specified.

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Ordering Information/Accessories

11867A DC to 1.8 GHz power limiter
11930A DC to 6 GHz power limiter
11930B 5 MHz to 6 GHz power limiter
N9355B 0.01 to 18 GHz power limiter with 10 dBm limiting threshold
N9355C 0.01 to 26.5 GHz power limiter with 10 dBm limiting threshold
N9355F 0.01 to 50 GHz power limiter with 10 dBm limiting threshold
N9356B 0.01 to 18 GHz power limiter with 25 dBm limiting threshold
N9356C 0.01 to 26.5 GHz power limiter with 25 dBm limiting threshold

Related Literature

11930A/B power limiter technical overview, part number **5966-2006E**
N9355/6 power limiter technical overview, part number **5989-3637EN**
N9355/6 power limiter flyer, part number **5989-3740EN**
N9355/6 power limiter application note, part number **5989-4880EN**

Web Link

www.keysight.com/find/mta

11 Power Dividers and Splitters

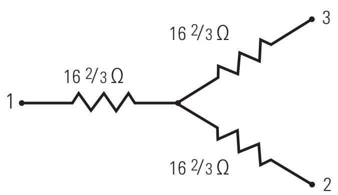
Overview

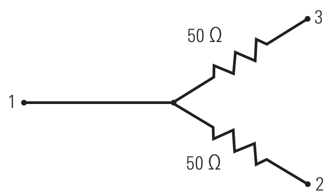
Power dividers are an RF microwave accessory constructed with equivalent 50 Ω resistance at each port. These accessories divide power of a uniform transmission line equally between ports to enable comparison measurements. Power dividers provide a good impedance match at both the output ports when the input is terminated in the system characteristic impedance (50 Ω). Once a good source match has been achieved, a power divider is used to divide the output into equal signals for comparison measurements. The power divider also can be used in test systems to measure two different characteristics of a signal, such as frequency and power for broadband independent signal sampling. In addition to dividing power it also can act as power combiners as they are bi-directional.

Power splitters are constructed of two resistors. They are used for leveling and ratio measurement applications to improve the effective output match of microwave sources. The two-resistor configuration also provides 50 Ω output impedance to minimize measurement uncertainty in source leveling or ratio measurement applications.

Characteristics of Power Dividers and Power Splitters

Power dividers	Power splitters
– Divide a signal equally for comparison measurements	– Used in ratio measurements and leveling loop applications
– All ports have equivalent 16 ⅔ resistance	– Only the input port has a 50 Ω resistance, the other two ports have 83.33 Ω impedance
– Can be used as power combiners	– SWR 1:1
– SWR 3:1	





Related Literature

Differences in application between power dividers and power splitters application note, part number **5989-6699EN**

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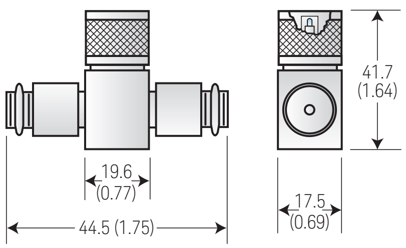
Web Link

www.keysight.com/find/mta

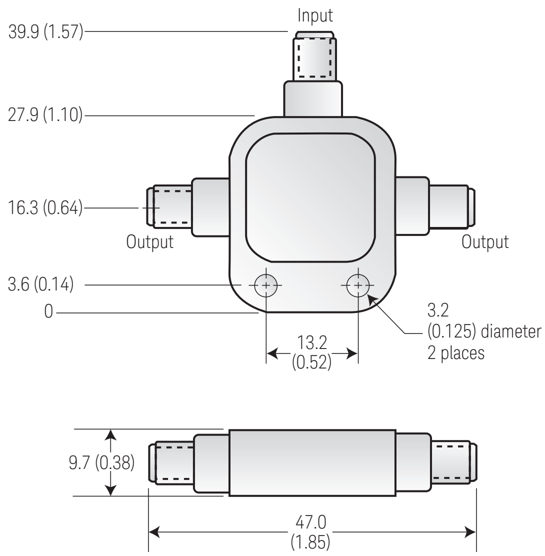
11636A/B/C Power Dividers

These power dividers provide good match and excellent tracking characteristics from DC to 50 GHz. Power dividers are recommended for applications such as transmission line fault testing and power combining. They are not recommended for ratio and leveling applications.

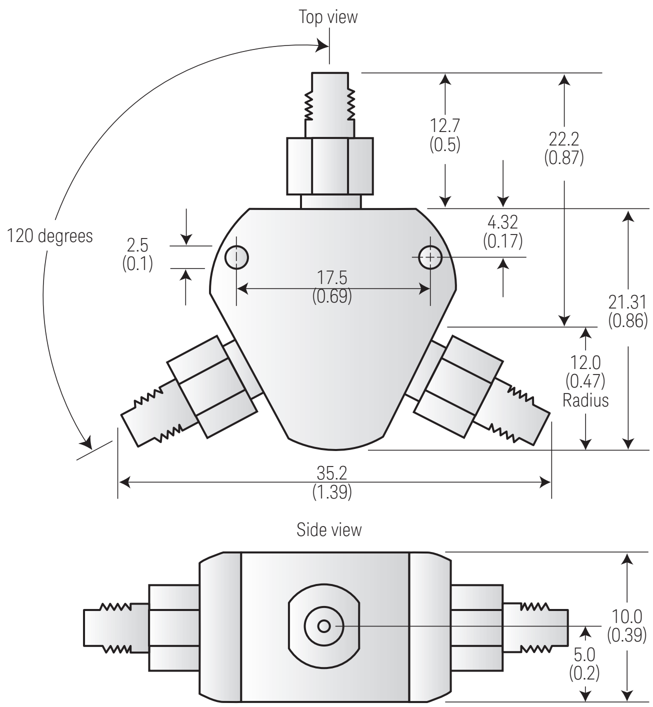
11636A Power Divider



11636B Power Divider



11636C Power Divider

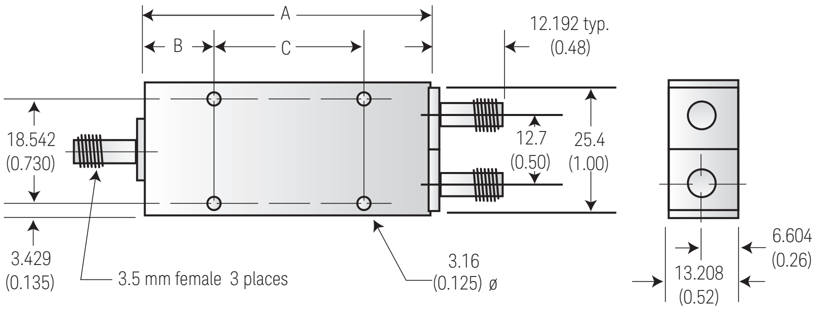


Dimensions are in mm (inches) nominal, unless otherwise specified.

87302/303/304C Hybrid Power Dividers

These power dividers are designed for power splitting applications that require minimal insertion loss and high isolation between ports. They are available in three models that cover multi-octave bands to 26.5 GHz. Models with narrower frequency coverage have less insertion loss. Hybrid dividers have insertion loss between the main line and output port which is 1 to 2 dB less than equivalent resistive power splitters. Designed for critical signal processing applications, phase and amplitude tracking between the two output ports is controlled and specified.

87302/303/304C Hybrid Power Dividers



Model	**A**	**B**	**C**
87302C	196.85 (7.75)	28.702 (1.13)	139.7 (5.50)
87303C	105.41 (4.15)	26.162 (1.03)	53.34 (2.10)
87304C	57.15 (2.25)	28.702 (1.13)	0.00 (0.00)

Dimensions are in mm (inches) nominal, unless otherwise specified

Power Divider Selection Guide

Connector type		**Frequency range**					
Input	Output	DC to 18 GHz	DC to 26.5 GHz	DC to 50 GHz	0.5 to 26.5 GHz	1 to 26.5 GHz	2 to 26.5 GHz
Type-N (m)	Type-N (f)	11636A					
3.5 mm (f)	3.5 mm (f)		11636B		87302C	87303C	87304C
2.4 mm (f)	2.4 mm (f)			11636C			

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Specifications

Model	**Frequency range (GHz)**	**Band segment (GHz)**	**Max. SWR**	**Maximum insertion Loss (dB) [1]**	**Maximum amplitude tracking (dB) [2]**	**Maximum phase tracking (deg) [2]**
11636A	DC to 18	DC to 4 4 to 10 10 to 18	1.25 1.25 1.35	4.2 4.2 4.5	0.2 0.4 0.5	2
11636B	DC to 26.5	DC to 10 10 to 18 18 to 26.5	1.22 1.29 1.29	4.5 4.5 4.5	0.25 0.25 0.5	3
11636C	DC to 50	DC to 18 18 to 26.5 26.5 to 40 40 to 50	1.22 1.38 1.50 1.67	3.5 4 5 5.5	0.3	2
87302C	0.5 to 26.5	0.5 to 18 18 to 26.5	1.45 1.60	1.5 1.9	0.3 0.5	6 10
87303C	1 to 26.5	1 to 18 18 to 26.5	1.45 1.60	1.2 1.6	0.3 0.5	6 10
87304C	2 to 26.5	2 to 18 18 to 26.5	1.45 1.60	1.1 1.4	0.3 0.5	6 10

1 Insertion loss is in addition to 3 dB coupling loss
2 Amplitude and phase tracking are the ratio of one output to the other in dB or degrees respectively

11667A power splitter

11667B power splitter

11667C power splitter

11667L power splitter

11667L Power Splitters

The 11667L power splitter is a two-resistor type power splitter operating from DC to 2 GHz. The 11667L power splitter provides excellent amplitude and phase tracking for highly accurate power splitting, also offering excellent output power symmetry between the two output ports. This power splitter is recommended for applications that require external source leveling or for ratio measurements The power splitters are not recommended for power dividing and combining applications.

11667A/B Power Splitters

These power splitters feature excellent match and tracking between outputs, operating from DC to 26.5 GHz. Power splitters are recommended for external source leveling and ratio measurements.

11667C Power Splitter

This two-resistor power splitter is recommended for applications that require external source leveling, or for ratio measurements. It covers the entire DC to 50 GHz frequency band by attaching 2.4 mm connectors and advanced micro-circuitry for the resistive components. These two-resistor type splitters provide excellent output SWR at the auxiliary arm when used for source leveling or ratio measurement applications. The tracking between output arms over a frequency range from DC to 50 GHz allows wideband measurements to be made with a minimum of uncertainty.

Power Splitter Selection Guide

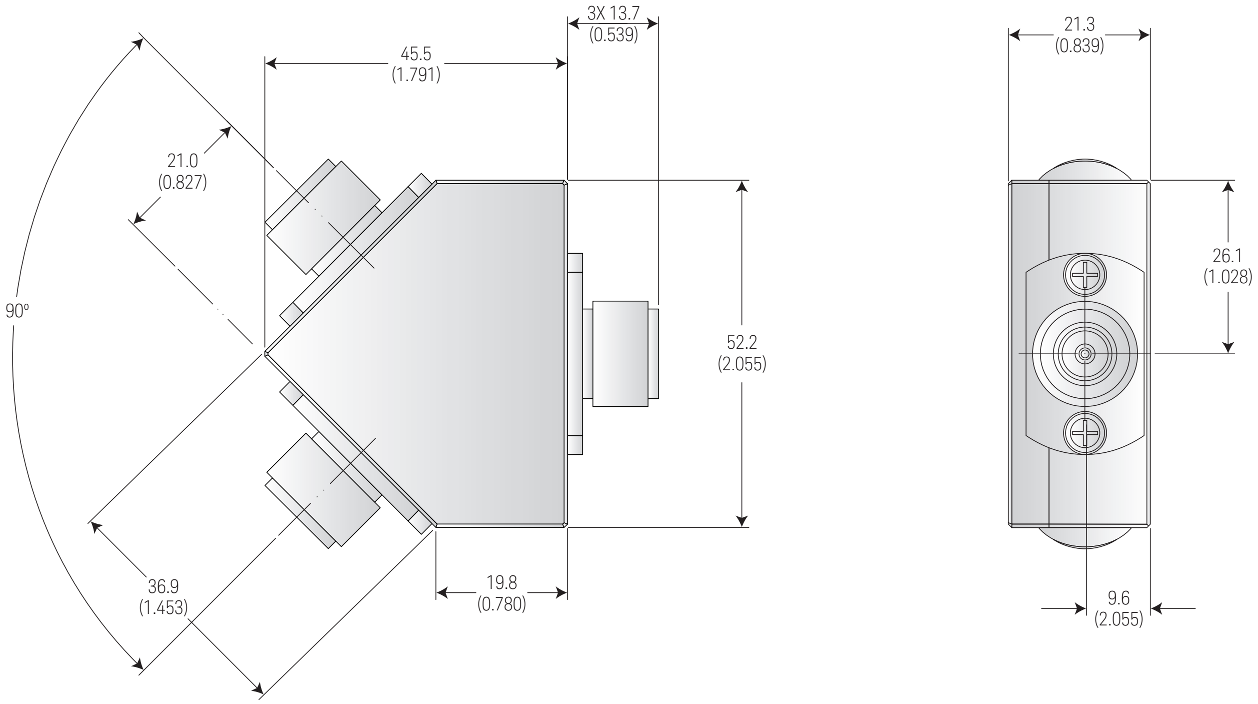
Connector type		**Frequency range**			
Input	Output	DC to 2 GHz	DC to 18 GHz	DC to 26.5 GHz	DC to 50 GHz
BNC (f)	BNC (f)	11667L			
Type-N (f)	Type-N (f)		11667A		
Type-N (m)	Type-N (f)		11667A Option 001		
Type-N (f)	APC 7		11667A Option 002		
3.5 mm (f)	3.5 mm (f)			11667B	
2.4 mm (f)	2.4 mm (f)				11667C

Specifications

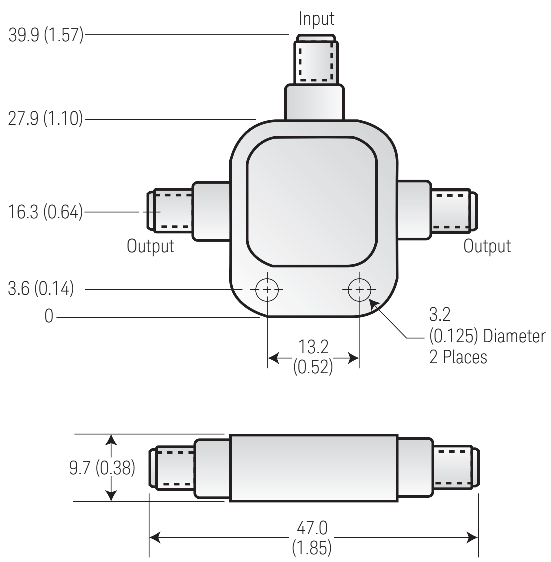
Model	**Frequency range (GHz)**	**Maximum input power (W)**	**Band segment (GHz)**	**Equivalent output SWR (nominal 50 Ω)**	**Insertion loss (dB)**	**Amplitude tracking (dB)** [2]	**Phase tracking (deg)** [2]	**Shipping weight (kg)**
11667L	DC to 2	0.5	DC to 0.1	1.78	6.2	0.1	1	0.33
	DC to 2	0.5	0.1 to 2	1.78	6.6	0.2	3	0.33
11667A	DC to 18	0.5	DC to 4	1.10	6.6	0.15	0.5	0.2
Option 001	DC to 18	0.5	4 to 8	1.20	7	0.2	1.5	0.2
Option 002	DC to 18	0.5	8 to 18	1.33 [1]	7.8	0.25	3	0.2
11667B	DC to 26.5	0.5	DC to 18	1.22	7	0.25	1.5	0.14
	DC to 26.5	0.5	DC to 26.5	1.22	7.5	0.4	2.5	0.14
11667C	DC to 50	0.5	DC to 18	1.29	6	0.3	2	0.14
	DC to 50	0.5	DC to 26.5	1.29	7	0.35	2.5	0.14
	DC to 50	0.5	DC to 40	1.50	8	0.4	3	0.14
	DC to 50	0.5	DC to 50	1.65	8.5	0.4	3	0.14

[1] 1.38 for option 002
[2] Amplitude and phase tracking are the ratio of one output to the other in dB or degrees respectively

11667A Power Splitters



11667B Power Splitters



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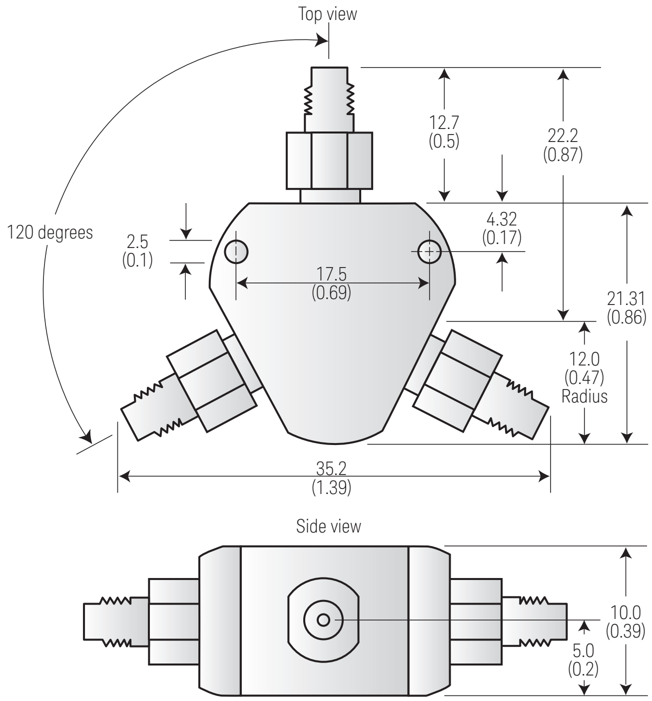
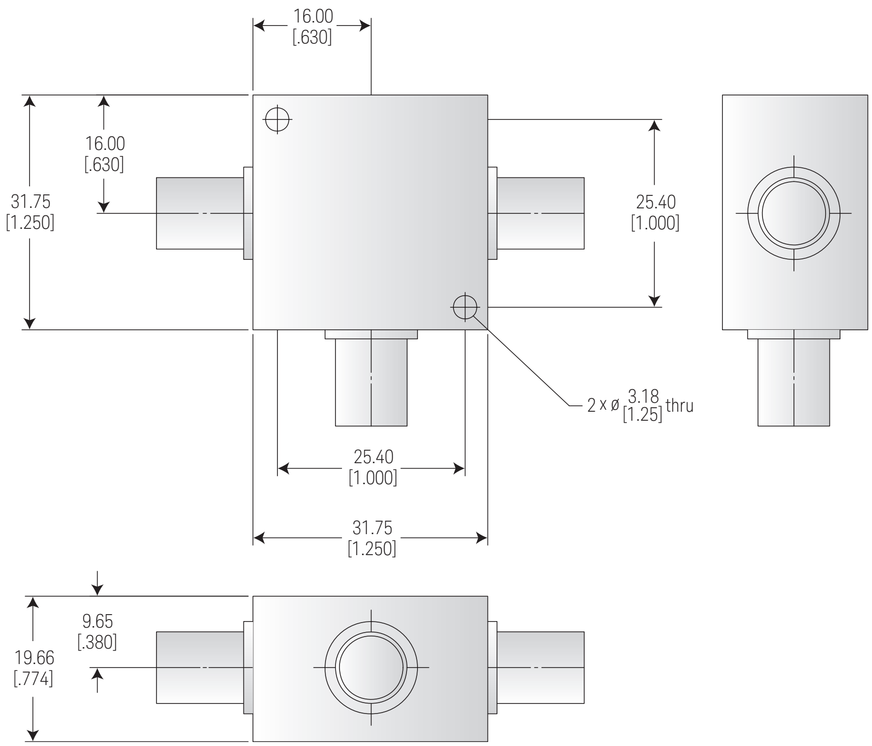
Dimensions are in mm (inches) nominal, unless otherwise specified.

11667C Power Splitters



11667L Power Splitters



Dimensions are in mm (inches) nominal, unless otherwise specified.

12 Electromechanical Switches & PXI Modular Switches

Overview

Technology

Keysight electromechanical coaxial switches feature low insertion loss, high isolation, broadband performance, long life and exceptional repeatability. Keysight coaxial switches are all designed with an "edge-line" coaxial structure. This transmission line structure provides for movement of the edge-line center conductor between two fixed, continuous ground planes. The main advantage of this innovation is that the moving contacts can be easily activated, yet maintain high isolation and low insertion loss.

The RF contact configuration is designed for controlled wiping action. Since the outer conductor is not part of the switching function, repeatability and life are enhanced. The switching action occurs typically within 15 to 30 milliseconds, after which permanent magnets latch the contacts to retain the new switch position.

Repeatability

Repeatability plays an important role in any test system. In test applications where accuracies of less than a few tenths of a dB are required, the system designer must consider the effects of switch repeatability in addition to test equipment capabilities. In automated test systems where switches are used for signal routing, every switch will add to the repeatability error. Such errors cannot be calibrated out of the system due to their random nature. Keysight switches are designed for high repeatability, 0.03 dB maximum over 5 million cycles.

Repeatability is a measure of the change in a specification from cycle to cycle over time. When used as part of a measurement system, switch repeatability is critical to overall system measurement accuracy. Repeatability can be defined for any of the specifications of a switch, which includes: insertion loss, reflection, isolation and phase. Insertion loss repeatability is specified for all Keysight switches, as this tends to be the specification most sensitive to changes in switch performance.

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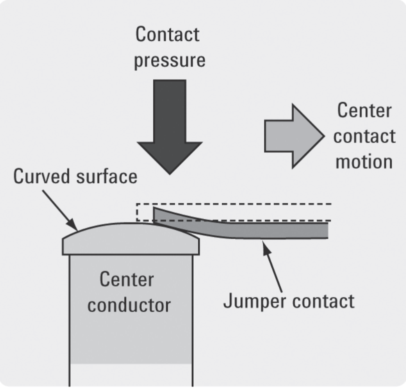
Factors that affect insertion loss repeatability include:
- Debris
- Contact pressure
- Plating quality
- Contact shape and wiping action

Debris is generated in a switch when two surfaces come in contact during movement. The debris may find its way between contacts, causing an open circuit. Keysight has developed processes that control contamination and debris generation to minimize these effects.

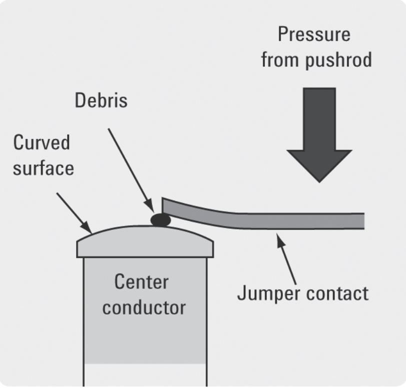
Switch contacts are typically gold plated to maximize conductivity and minimize surface corrosion. Special plating materials, surface finish, contact shape and wiping pressure all combine to minimize surface effects on insertion loss repeatability.

Contact resistance is inversely proportional to contact pressure. Insufficient pressure increases life but also increases contact loss. Too much pressure damages the contact surfaces, with little insertion loss improvement. Contact surface wiping provides a means for breaking through surface corrosion and moving debris away from the contacts. This allows the switch to clean the contact surfaces with each switch cycle.

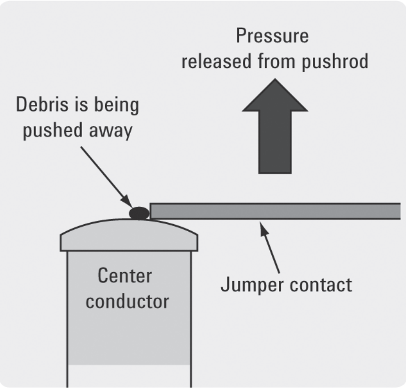
Unique design — a wiping mechanism eliminates particle buildup to ensure reliable switching



EM switch mating configuration illustrating microscopic wiping



A piece of small debris is stuck on the surface of center conductor



Debris is being pushed away by wiping process of the jumper contact

Input power

The ability of a switch to handle power depends very much on the materials used for the signal carrying components of the switch and on the switch design. Two switching conditions should be considered: "hot" switching and "cold" switching. Hot switching occurs when RF/microwave power is present at the ports of the switch at the time of the switching function. Cold switching occurs when the signal power is removed before activating the switching function.

Hot switching causes the most stress on internal contacts, and can lead to premature failure. Cold switching results in lower contact stress and longer life, and is recommended in situations where the signal power can be removed before switching.

Life

The life of a switch is usually specified in cycles, i.e. the number of times it switches from one position to another and back. Keysight determines life by cycling switches to the point of degradation. Typically, Keysight switches, in life cycle tests, perform to specifications for at least twice as many cycles as warranted.

Six Keysight's switch Series have a specified life of 5 million cycles. This long life results in lower cost of ownership by reducing periodic maintenance, downtime and repairs.

Related Literature

Coaxial electromechanical switches: how operating life and repeatability of Keysight's electromechanical switches minimize system uncertainty, part number **5989-6085EN**

Power handling capability of electromechanical switches, application note, part number **5989-6032EN**

RF and microwave switch selection guide, part number **5989-6031EN**

Web Link

www.keysight.com/find/switches

High Performance Switches

Keysight's high-performance electromechanical coaxial switches provide reliable switching in signal routing, switch matrices, and ATE systems. With 0.03 dB insertion loss repeatability up to five million cycles and exceptional isolation, Keysight's high-performance switches provide the performance you need from DC to 50 GHz.

Selection Guide

Product family		Model	Frequency range (GHz)
SPDT switch	50Ω	N1810UL	67
		N1810TL	67
Bypass switch	4-ports	N1811TL	67
	5-ports	N1812UL	67
Multiport switch	SP3T	8766K	40
	SP4T	87104A	4
		87204A	4
		87104B	20
		87204B	20
		87104C	26.5
		87204C	26.5
		8767K	26.5
		87104D	40
		8767M	50
	SP5T	8768K	26.5
		8768M	50
	SP6T	87106A	4
		87206A	4
		87106B	20
		87206B	20
		87106C	26.5
		87206C	26.5
		8769K	26.5
		87106D	40
		8769M	50
Transfer switch		87222C	26.5
		87222D	40
		87222E	50
Matrix switch		87406B	26.5
		87606B	26.5

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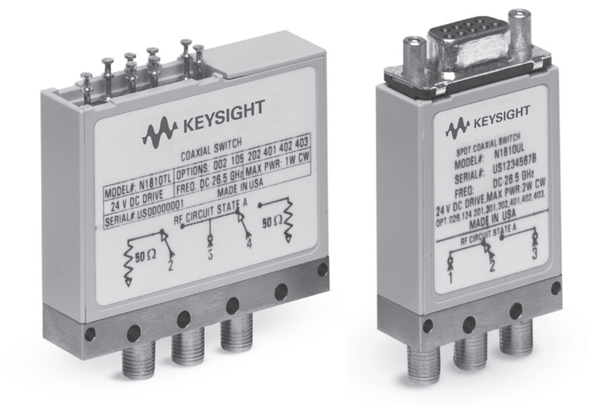


N1810 Series switches

N1810 Series Switches

The N181x Series of coaxial latching switches combines unmatched configuration flexibility with excellent repeatability, reliability, and a long life. Options include choice of DC connector type, coil voltage level, standard or high performance, position indictors, current interrupts, and TTL/5V CMOS compatibility. All switches have SMA (f) connectors and are offered in frequency ranges up to 26.5 GHz.

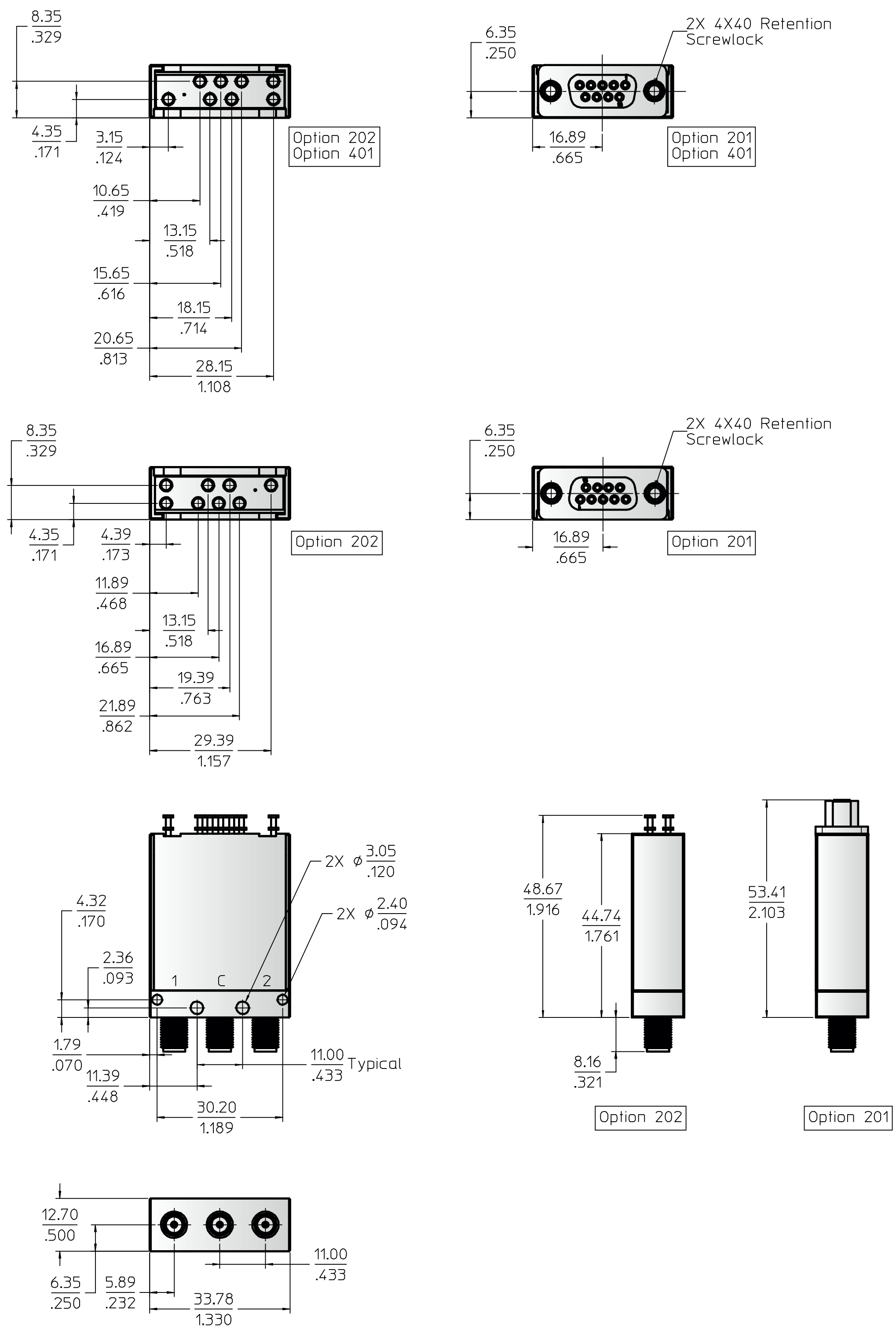
The N1810UL is a three-port single pole double throw (SPDT) switch. The N1810TL is a single pole double throw switch with two 50 Ω terminations, making it ideal for applications where port matching is required.

Specifications

Model	N1810UL	N1810TL
Features	Break-before-make Unterminated Current Interrupt	Break-before-make Terminated Current Interrupt
Impedance	50 Ω	50 Ω
Frequency range	DC to 4/20/26.5/40/50/67 GHz	
Insertion loss (dB)	Option 004/020/026 0.35 + (0.45/26.5)f [1] Option 040: 0.35 + (0.45/26.5)f [1] Option 050: 0.20 + (0.8/50)f [1] Option 067: 0.35 + (0.45/26.5)f [1] to 26.5 GHz 0.59 + (0.53/67)f [1] to 67 GHz	
SWR	Option 004/020/026 <1.15 to 4 GHz <1.25 to 12.4 GHz < 1.30 to 20 GHz < 1.60 to 26.5 GHz Option 040/050: < 1.15 to 4 GHz < 1.25 to 12.4 GHz < 1.40 to 20 GHz (for option 040) < 1.50 to 20 GHz (for option 050) < 1.60 to 26.5 GHz < 1.80 to 40 GHz (for option 040) < 1.80 to 50 GHz (for option 050) Option 067: < 1.15 to 4 GHz < 1.25 to 12.4 GHz < 1.30 to 20 GHz < 1.70 to 26.5 GHz < 1.90 to 67 GHz	
Isolation (dB)	Option 001/020/026: 90 – (30/26.5)f [1] Option 040/050/067: 100 – (30/26.5)f [1] to 26.5 GHz 70 to 67 GHz	
Input power Average Peak [2]	 1 W 50 W (10 us max)	
Switching time (max)	15 ms	
Insertion loss repeatability [3]	< 0.03 dB	
Life (min)	5 million cycles	
RF connectors	SMA (f) [5]	
DC connectors	D-subminі 9 pin or solder terminals	
Supply voltage	Option: nominal (range) 105: 5 (4.5 to 7) VDC 115: 15 (12 to 20) VDC 124: 24 (20 to 30) VDC	
Supply current	Option: nominal 105: 300 mA at 5 V 115: 125 mA at 15 V 124: 75 mA at 24 V	Option: nominal 105: 600 mA at 5 V 115: 250 mA at 15 V 124: 150 mA at 24 V
High isolation option (Optional) [4]	Option 301: Isolation: 125 - (35/26.5)f [1]	
Low SWR & insertion loss option (Optional) [4]	Option 302: SWR: < 1.10 to 4 GHz < 1.20 to 12.4 GHz < 1.23 to 20 GHz < 1.45 to 26.5 GHz Insertion Loss: 0.20 + (0.45/26.5)f [1]	

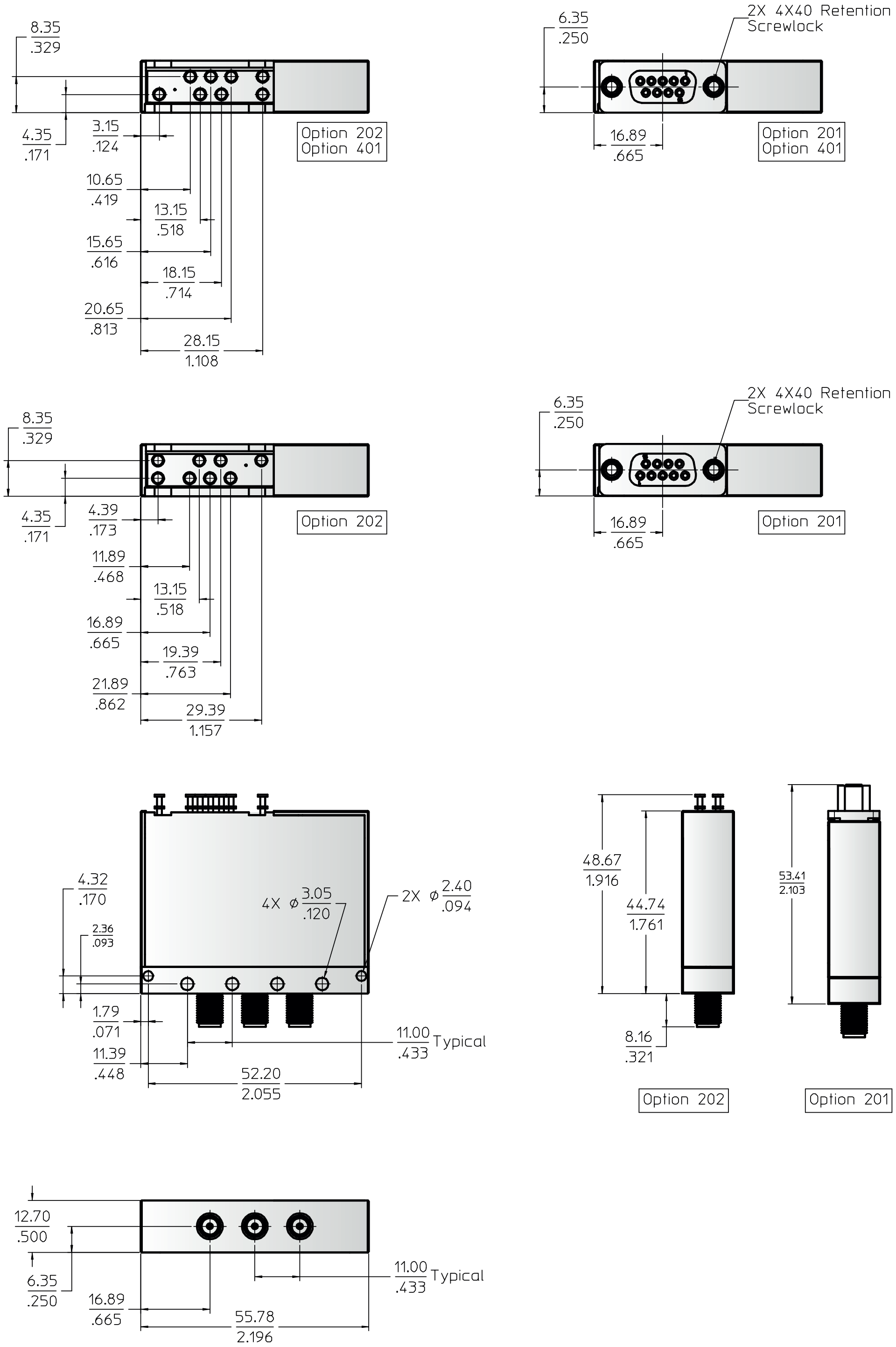
[1] f is frequency in GHz
[2] Not to exceed average power (non-switching).
[3] Up to 5 million cycles measured at 25°C
[4] Not available for option 040, 050 and 067
[5] Option 040: 2.92 mm(f)
Option 050: 2.4 mm(f)
Option 067: 1.85 mm(f)

N1810UL Coaxial Switch



Dimensions are in mm (inches) nominal, unless otherwise specified.

N1810TL Coaxial Switch



Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

N1810UL/TL ordering example

N1810UL/TL	Option 004	Option 105	Option 201	Option 301	Option 401
	Frequency range	**Coil voltage** [1]	**DC connector**	**Performance** [2]	**Drive** [2]
	004: DC to 4 GHz 020: DC to 20 GHz 026: DC to 26.5 GHz 040: DC to 40 GHz 050: DC to 50 GHz 067: DC to 67 GHz	105: 5 VDC 115: 15 VDC 124: 24 VDC	201: D-submini 9 pin (f) 202: Solder lug	301 [3]: High Isolation 302 [3]: Low SWR & insertion loss UK6: Commercial calibration certificate with test data	401: TTL/5V CMOS compatible 402: Position indicators

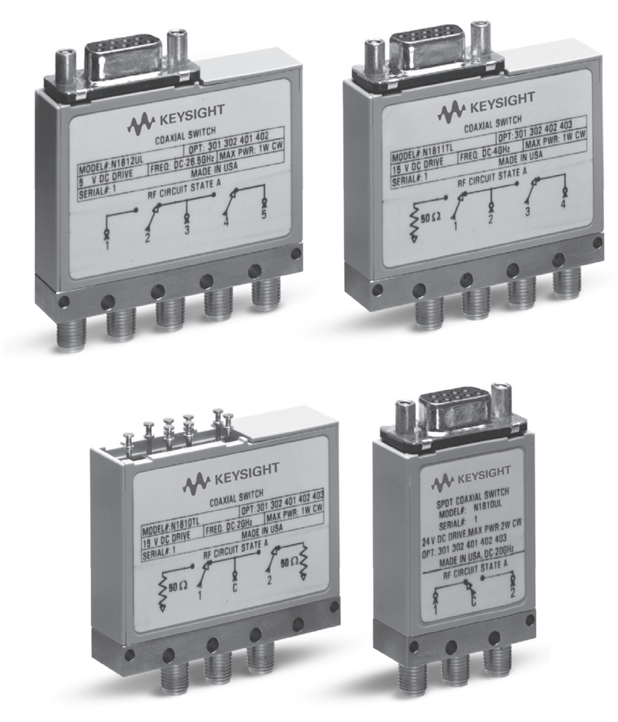
[1] Option 105 includes option 402
[2] Optional
[3] Not available for option 040, 050 and 067

Related Literature

N1810/1/2 coaxial switches technical overview, part number **5968-9653E**

Web Link

www.keysight.com/find/switches



N181x Series

N1811/12 Series Coaxial Switches

The N181x Series of coaxial latching switches combines unmatched configuration flexibility with excellent repeatability, reliability, and a long life. Options include choice of DC connector type, coil voltage level, standard or high performance, position indictors, current interrupts, and TTL/5V CMOS compatibility. All switches have SMA (f) connectors and are offered in frequency ranges up to 26.5 GHz.

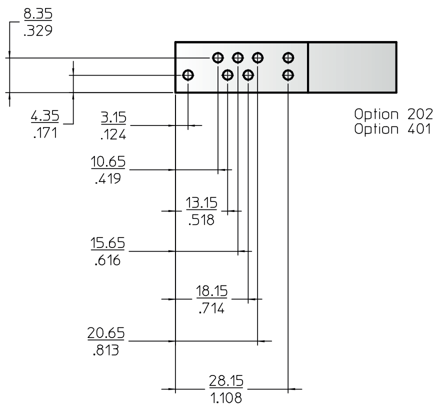
The N1811TL is a four-port switch with one internal load that can terminate the device under test when in the bypass mode (up to 1 watt). The N1812UL is a versatile, unterminated five-port switch that can be used in transfer switch applications and for signal path reversal.

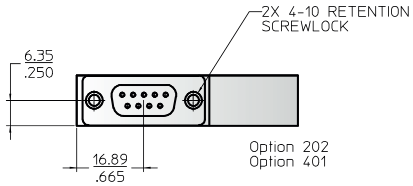
Specifications

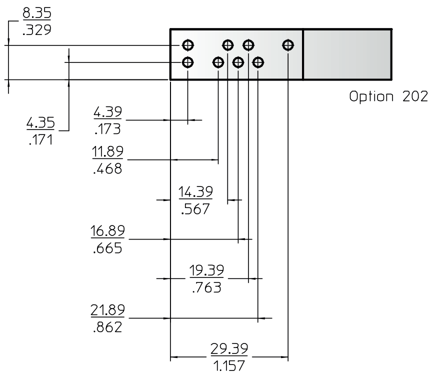
<table>
<tr><th>Keysight Model</th><th>N1811TL</th><th>N1812UL</th></tr>
<tr><td>Features</td><td>4-port
Terminated
Current Interrupt
Break-before-make</td><td>5-port
Unterminated
Current Interrupt
Break-before-make</td></tr>
<tr><td>Impedance</td><td>50 Ω</td><td>50 Ω</td></tr>
<tr><td>Frequency range</td><td colspan="2">DC to 4/20/26.5/40/50/67 GHz</td></tr>
<tr><td>Insertion loss (dB)</td><td colspan="2">Option 004/020/026
0.35 + (0.45/26.5)f [1]
Option 040:
0.35 + (0.45/26.5)f [1]
Option 050:
0.20 + (0.8/50)f [1]
Option 067:
0.35 + (0.45/26.5)f [1] to 26.5 GHz
0.59 + (0.53/67)f [1] to 67 GHz</td></tr>
<tr><td>SWR</td><td colspan="2">Option 004/020/026
< 1.15 to 4 GHz
< 1.25 to 12.4 GHz
< 1.30 to 20 GHz
< 1.60 to 26.5 GHz
Option 040/050:
< 1.15 to 4 GHz
< 1.25 to 12.4 GHz
< 1.40 to 20 GHz (for option 040)
< 1.50 to 20 GHz (for option 050)
< 1.60 to 26.5 GHz
< 1.80 to 40 GHz (for option 040)
< 1.80 to 50 GHz (for option 050)
Option 067:
< 1.15 to 4 GHz
< 1.25 to 12.4 GHz
< 1.30 to 20 GHz
< 1.70 to 26.5 GHz
< 1.90 to 67 GHz</td></tr>
<tr><td>Isolation (dB)</td><td colspan="2">Option 001/020/026:
90 – (30/26.5)f [1]
Option 040/050/067:
100 – (30/26.5)f [1] to 26.5 GHz
70 to 67 GHz</td></tr>
<tr><td>Input power
Average
Peak [2]</td><td colspan="2">
1 W
50 W (10 us max)</td></tr>
<tr><td>Switching time (max)</td><td colspan="2">15 ms</td></tr>
<tr><td>Insertion loss repeatability [3]</td><td colspan="2">< 0.03 dB</td></tr>
<tr><td>Life (min)</td><td colspan="2">5 million cycles</td></tr>
<tr><td>RF connectors</td><td colspan="2">SMA (f) [5]</td></tr>
<tr><td>DC connectors</td><td colspan="2">D-submini 9 pin or solder terminals</td></tr>
<tr><td>Supply voltage</td><td colspan="2">Option: nominal (range)
105: 5 (4.5 to 7) VDC
115: 15 (12 to 20) VDC
124: 24 (20 to 30) VDC</td></tr>
<tr><td>Supply current</td><td colspan="2">Option: nominal
105: 600 mA at 5 V
115: 250 mA at 15 V
124: 150 mA at 24 V</td></tr>
<tr><td>High isolation option (Optional) [4]</td><td colspan="2">Option 301:
Isolation: 125 – (35/26.5)f [1]</td></tr>
<tr><td>Low SWR & insertion loss option (Optional) [4]</td><td colspan="2">Option 302:
SWR: < 1.10 to 4 GHz
< 1.20 to 12.4 GHz
< 1.23 to 20 GHz
< 1.45 to 26.5 GHz
Insertion Loss: 0.20 + (0.45/26.5)f [1]</td></tr>
</table>

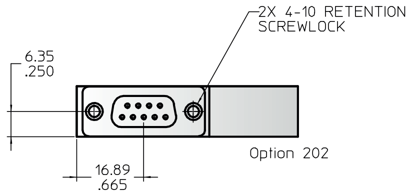
1 *f* is frequency in GHz
2 Not to exceed average power (non-switching).
3 Up to 5 million cycles measured at 25°C.
4 Not available for option 040, 050 and 067
5 Option 040: 2.92 mm(f)
Option 050: 2.4 mm(f)
Option 067: 1.85 mm(f)

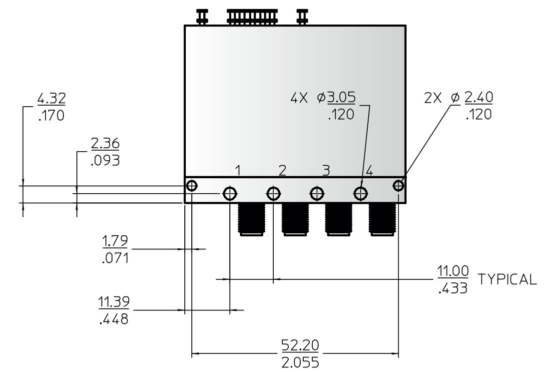
N1811TL 4-Port Coaxial Switch

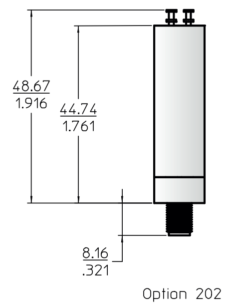


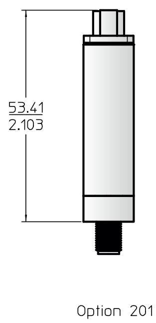


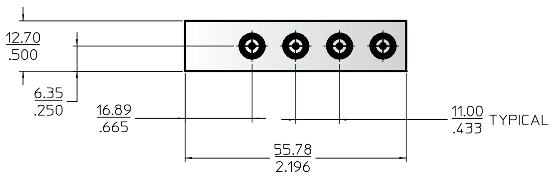












Dimensions are in mm (inches) nominal, unless otherwise specified.

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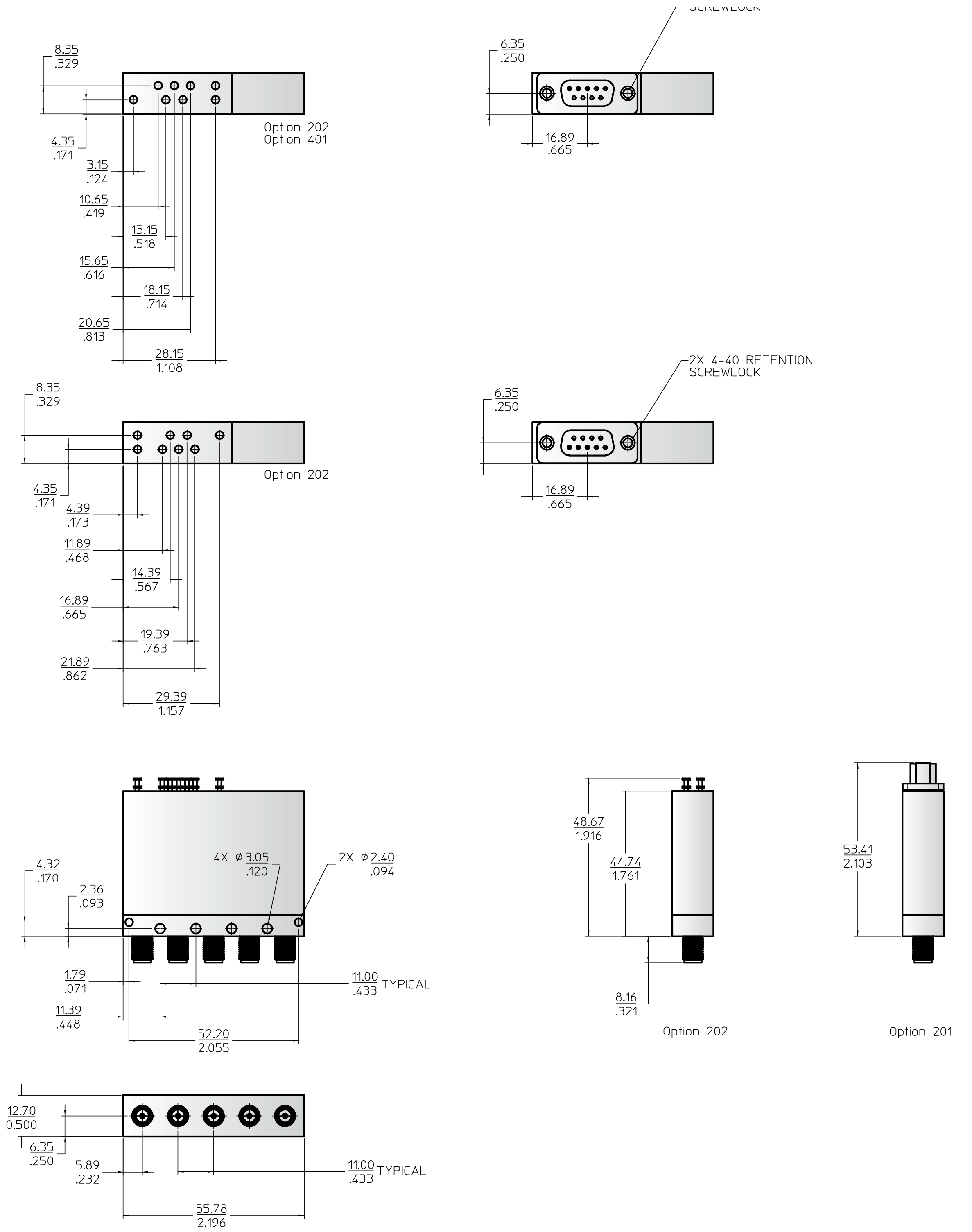
N1812UL 5-Port Coaxial Switch



Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

N1811TL/12UL ordering example

N1811TL/12UL	Option 002	Option 105	Option 201	Option 301	Option 401
	Frequency range	**Coil voltage**	**DC connector**	**Performance**	**Drive**
	004: DC to 4 GHz 020: DC to 20 GHz 026: DC to 26.5 GHz 040: DC to 40 GHz 050: DC to 50 GHz 067: DC to 67 GHz	105 [1]: 5 VDC 115: 15 VDC 124: 24 VDC	201: D-submini 9 pin (f) 202: Solder lug	301 [2]: High isolation 302 [2]: Low SWR & insertion loss UK6: Commercial calibration certificate with test data	401: TTL/5V CMOS compatible 402: Position indicators

1 Option 105 includes option 402
2 Not available for option 040, 050 and 067

Related Literature

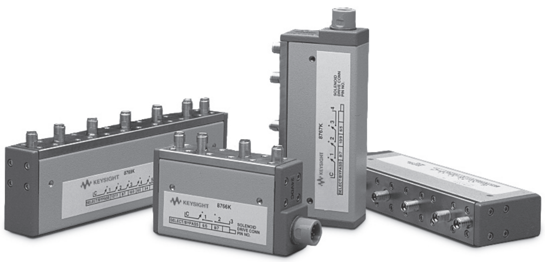
N1810/1/2 coaxial switches technical overview,
part number **5968-9653E**

Web Link

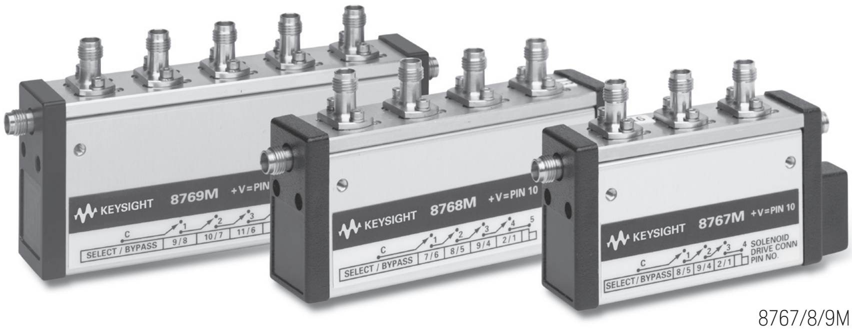
www.keysight.com/find/switches

12

87104/106/204/206 Series



8766/7/8/9K Series



8767/8/9M Series

87104/106/204/206 Series

The 87104/106 Series multiport switches operate up to 40 GHz. These switches offer warranted repeatability of 0.03 dB maximum over 5 million switching cycles.

For rigorous requirements such as matrix switching, you can rely on the superior port-to-port isolation. When used in switching trees or in full access matrixes, isolation and insertion loss repeatability is crucial to measurement confidence.

The 87104 is a single-pole-4-throw (SP4T) and the 87106 is a SP6T function. Both switches have internal solid-state logic that automatically programs the non-used ports to a matched load when any one port is programmed to “on”. This relieves the user from having to provide external logic drive pulses. For user-designed circuit drivers, Option T24 is available. It provides internal circuits that are compatible with external TTL/5V CMOS digital ICs.

Internal current interrupts and position indicators are optoelectronically coupled to the electromechanical switch action. These solenoids are all magnetically latched, eliminating the need for maintaining coil current. This provides highly-reliable solenoid control along with accurate position indication to monitor circuits. Unselected RF ports are terminated in a well-matched 50 Ω load for eliminating unwanted reflections in unused signal lines.

The 87104/106 models have the capability to perform switching with a make-before-break action, by energizing the coils in the proper logic sequence. When this function is engaged, the impedance momentarily goes to 25 Ω, and then returns to the nominal 50 Ω match.

The 87204/206 Series multiport switches operate up to 26.5 GHz. The standard 87204/206 provides a 16-pin drive connector while option 100 provides solder terminals. The 87204/206 can perform make-before-break or break-before-make switching.

8766/67/68/69 Series

The 8766/67/68/69 Series switches are for applications requiring a single-pole, 3-throw, 4-throw, 5-throw or 6-throw coaxial switch that operates up to 50 GHz. The switch ports are unterminated. These switches offer warranted repeatability of 0.03 dB maximum over 5 million switching cycles.

The switches are available with several optional cables and connectors to make them compatible with standard 14-pin DIP sockets. Isolation and insertion loss vary with frequency, and depend upon the port selected.

87-Series Multiport Specifications

Model	87104A 87104B 87104C 87104D	87106A 87106B 87106C 87106D	87204A 87204B 87204C	87206A 87206B 87206C
Configuration	SP4T	SP6T	SP4T	SP6T
Features	Terminated Break-before-make or make-before-break Optoelectronic current interrupts Optoelectronic position indicator [1] Internal control logic		Terminated Break-before-make or make-before-break Optoelectronic current interrupts Direct path control	
Impedance	50 Ω	50 Ω	50 Ω	50 Ω
Frequency range	A: DC to 4 GHz B: DC to 20 GHz C: DC to 26.5 GHz D: DC to 40 GHz		A: DC to 4 GHz B: DC to 20 GHz C: DC to 26.5 GHz	
Insertion Loss (dB)	$0.3 + 0.015f^2$ max to 26.5 GHz $0.03f^2 - 0.1$ max to 40 GHz		$0.3 + 0.015f^2$ max	
SWR	< 1.30 to 4 GHz < 1.35 to 12.4 GHz < 1.45 to 18 GHz < 1.70 to 26.5 GHz For D model: < 1.30 to 4 GHz < 1.35 to 12.4 GHz < 1.50 to 18 GHz < 1.70 to 26.5 GHz < 1.95 to 40 GHz		< 1.20 to 4 GHz < 1.35 to 12.4 GHz < 1.45 to 18 GHz < 1.70 to 26.5 GHz	
Isolation (dB)	> 100 dB to 12 GHz > 80 dB to 15 GHz > 70 dB to 20 GHz > 65 dB to 40 GHz		> 100 dB to 12 GHz > 80 dB to 15 GHz > 70 dB to 20 GHz > 65 dB to 26.5 GHz	
Input power Average Peak [3]	 1 W 50 W (10 us max)	 1 W 50 W (10 us max)	 1 W 50 W (10 us max)	 1 W 50 W (10 us max)
Switching time (max)	15 ms	15 ms	15 ms	15 ms
Insertion loss repeatability [4]	< 0.03 dB	< 0.03 dB	< 0.03 dB	< 0.03 dB
Life (min)	5 million cycles	5 million cycles	5 million cycles	5 million cycles
RF connectors	SMA (f) For D model: 2.92 mm (f)			
DC connectors	Ribbon cable receptacle	Ribbon cable receptacle	Ribbon cable receptacle	Ribbon cable receptacle
Supply voltage range	20 to 32 VDC	20 to 32 VDC	20 to 32 VDC	20 to 32 VDC
Supply voltage	24 VDC	24 VDC	24 VDC	24 VDC
Current (nom) [5]	200 mA	200 mA	200 mA	200 mA

1 Provides position sensing when used with customer supplied external circuitry.
2 f is frequency in GHz
3 Not to exceed average power (non-switching)
4 Up to 5 million cycles measured at 25 °C
5 Closing one RF path requires 20 mA. Add 200 mA for each additional RF path closed or opened.

876xK-Series Multiport Specifications

Model	8766K	8767K	8768K	8769K
Configuration	SP3T	SP4T	SP5T	SP6T
Features	← Unterminated Break-before-make Current interrupts Position indication capability [1] →			
Impedance	50 Ω	50 Ω	50 Ω	50 Ω
Frequency range	DC to 26.5 GHz	DC to 26.5 GHz	DC to 26.5 GHz	DC to 26.5 GHz
Insertion loss (dB), max	← Common to Port 1: 0.2 + 0.050f [2] Common to Port 2: 0.2 + 0.060f [2] Common to Port 3: 0.2 + 0.080f [2] Common to Port 4: 0.2 + 0.095f [2] Common to Port 5: 0.2 + 0.108f [2] Common to Port 6: 0.2 + 0.120f [2] →			
SWR	< 1.30 to 8 GHz < 1.50 to 12.4 GHz < 1.60 to 18 GHz < 1.80 to 26.5 GHz	< 1.30 to 8 GHz < 1.50 to 12.4 GHz < 1.60 to 18 GHz < 1.80 to 26.5 GHz	< 1.30 to 8 GHz < 1.50 to 12.4 GHz < 1.60 to 18 GHz < 1.80 to 26.5 GHz	< 1.30 to 8 GHz < 1.55 to 12.4 GHz < 1.80 to 18 GHz < 2.05 to 26.5 GHz
Isolation (dB)	← See “Isolation calculation characteristics” on page 109 →			
Input power Average Peak [3]	 1 W 100 W (10 us max)	 1 W 100 W (10 us max)	 1 W 100 W (10 us max)	 1 W 100 W (10 us max)
Switching time (max)	20 ms	20 ms	20 ms	20 ms
Insertion loss repeatability [4]	< 0.03 dB to 18 GHz < 0.05 dB to 26.5 GHz	< 0.03 dB to 18 GHz < 0.05 dB to 26.5 GHz	< 0.03 dB to 18 GHz < 0.05 dB to 26.5 GHz	< 0.03 dB to 18 GHz < 0.05 dB to 26.5 GHz
Life (min)	5 million cycles	5 million cycles	5 million cycles	5 million cycles
RF connectors	3.5 mm (f)	3.5 mm (f)	3.5 mm (f)	3.5 mm (f)
DC connectors	Viking cable connector	Viking cable connector	Viking cable connector	Viking cable connector
Supply voltage	← Option : nominal (range) 024 (STD): 24 (20 to 30) VDC 015: 15 (13 to 22) VDC 011: 5 (4 to 7) VDC →			
Supply current	← Option : nominal 024 (STD): 130 mA at 24 V 015: 187 mA at 15 V 011: 332 mA at 5 V →			

1 Provides position sensing when used with customer supplied external circuitry.
2 f is frequency in GHz
3 Not to exceed average power (non-switching)
4 Up to 5 million cycles measured at 25 °C

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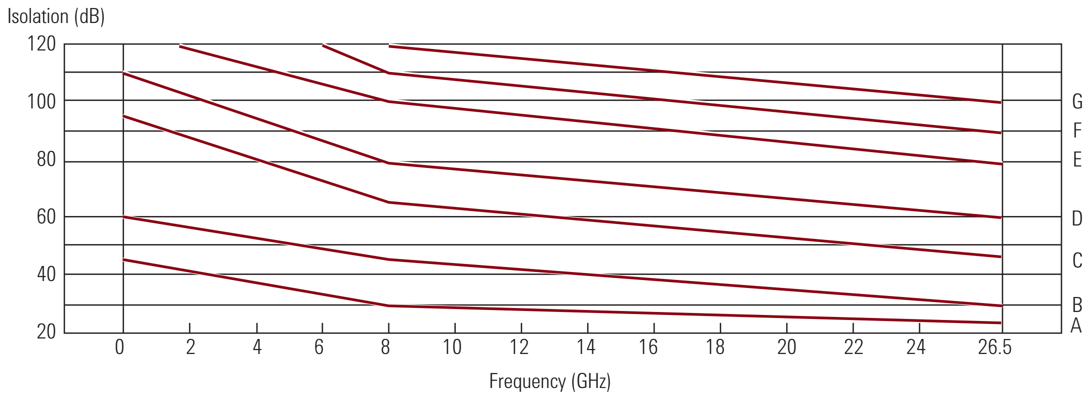
876xM Multiport Specifications

Model	8767M	8768M	8769M
Configuration	SP4T	SP5T	SP6T
Features	Unterminated Break-before-make Current interrupts Position indication capability [1]		
Impedance	50 Ω	50 Ω	50 Ω
Frequency range	DC to 50 GHz	DC to 50 GHz	DC to 50 GHz
Insertion loss (dB), max	DC to 40 GHz Common to Port 1: 0.4 + 0.025f [2] Common to Port 2: 0.5 + 0.030f [2] Common to Port 3: 0.6 + 0.030f [2] Common to Port 4: 0.6 + 0.030f [2] 40 to 50 GHz Common to Port 1: 1.8 Common to Port 2: 2.2 Common to Port 3: 2.6 Common to Port 4: 2.6	DC to 40 GHz Common to Port 1: 0.4 + 0.025f [2] Common to Port 2: 0.5 + 0.030f [2] Common to Port 3: 0.6 + 0.030f [2] Common to Port 4: 0.8 + 0.040f [2] Common to Port 5: 0.8 + 0.040f [2] 40 to 50 GHz Common to Port 1: 1.8 Common to Port 2: 2.2 Common to Port 3: 2.6 Common to Port 4: 3.0 Common to Port 5: 3.0	DC to 40 GHz Common to Port 1: 0.4 + 0.025f [2] Common to Port 2: 0.5 + 0.030f [2] Common to Port 3: 0.6 + 0.030f [2] Common to Port 4: 0.8 + 0.040f [2] Common to Port 5: 1.0 + 0.050f [2] Common to Port 6: 1.0 + 0.050f [2] 40 to 50 GHz Common to Port 1: 1.8 Common to Port 2: 2.2 Common to Port 3: 2.6 Common to Port 4: 3.0 Common to Port 5: 3.4 Common to Port 6: 3.4
SWR	< 1.35 to 12.4 GHz < 1.80 to 34 GHz < 1.90 to 40 GHz < 2.30 to 50 GHz	< 1.35 to 12.4 GHz < 1.80 to 34 GHz < 1.90 to 40 GHz < 2.30 to 50 GHz	< 1.35 to 12.4 GHz < 1.80 to 34 GHz < 1.90 to 40 GHz < 2.30 to 50 GHz (2.6 for path Common to Port 6 only)
Isolation (dB)	Isolation / Relevent port location [3] 35 - 0.25f [2] / Lower number ports 70 - 0.50f [2] / Higher number ports		
Input power Average Peak [4]	 1 W 100 W (10 us max)	 1 W 100 W (10 us max)	 1 W 100 W (10 us max)
Switching time (max)	20 ms	20 ms	20 ms
Insertion loss repeatability [5]	< 0.03 dB typical	< 0.03 dB typical	< 0.03 dB typical
Life (min)	5 million cycles	5 million cycles	5 million cycles
RF connectors	2.4 mm (f)	2.4 mm (f)	2.4 mm (f)
DC connectors	10 pin DIP	10 pin DIP	14 pin DIP
Supply voltage	Option: nominal (range) 024 (STD): 24 (20 to 30) VDC 015: 15 (13 to 22) VDC 011: 5 (4.5 to 7) VDC		
Supply current	Option: nominal 024 (STD): 125 mA at 5 V 015: 188 mA at 15 V 011: 325 mA at 24 V		

1 Provides position sensing when used with customer supplied external circuitry.
2 *f* is frequency in GHz
3 For example: if Common port connected to Port 2, Port 1 is lower number port and Port 3, 4, 5 are higher number ports.
4 Not to exceed average power (non-switching)
5 Up to 5 million cycles measured at 25 °C

Isolation Calculation Characteristics

Isolation and insertion loss vary with frequency and depend on the port selected as shown in the chart and tables below. The input connector "C" is always defined as the connector at the end of the switch opposite the DC drive cable. The output ports are numbered sequentially from the input connector. For example, if an 8768K is being used, use the 8768K table to determine the isolation to each port. If port three (the third connector from the input) is selected, the isolation to ports 1 and 2 will follow curve A. Isolation to port 4 will follow curve B and isolation to port 5 will follow curve C. At 8 GHz, the worst case isolation to ports 1 and 2 will be 30 dB; to port 4, 45 dB, and to port 5, 65 dB. Note: in selecting ports 1 or 2, isolation to disconnected ports can be varied by choosing the position of each section to "bypass" or "select". Depending on the user's application, port assignments can be critical for optimizing performance at higher frequencies.



8766K SP3T switch

	Section status		Isolation curve for Port ( )		
Section	**1**	**2**	**1**	**2**	**3**
Common to Port 1	Select	Select	–	B	D
Common to Port 1	Select	Bypass	–	C	B
Common to Port 2	Bypass	Select	A	–	B
Common to Port 3	Bypass	Bypass	A	A	–

8767K SP4T switch

	Section status			Isolation curve for Port ( )			
Section	**1**	**2**	**3**	**1**	**2**	**3**	**4**
Common to Port 1	Select	Select	Select	–	B	D	E
Common to Port 1	Select	Select	Bypass	–	B	E	D
Common to Port 1	Select	Bypass	Select	–	C	B	C
Common to Port 1	Select	Bypass	Bypass	–	C	C	B
Common to Port 2	Bypass	Select	Select	A	–	B	C
Common to Port 2	Bypass	Select	Bypass	A	–	C	B
Common to Port 3	Bypass	Bypass	Select	A	A	–	A
Common to Port 4	Bypass	Bypass	Bypass	A	A	A	–

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Isolation Calculation Characteristics

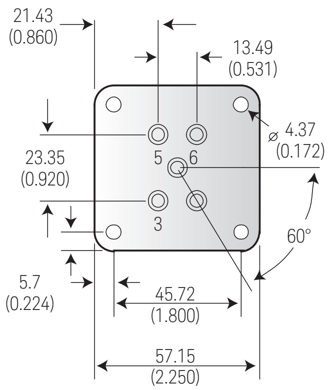
8768K SP5T switch

	Section status				Isolation curve for Port ( )				
Section	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**
Common to Port 1	Select	Select	Select	Select	–	B	D	E	F
Common to Port 1	Select	Select	Bypass	Select	–	B	E	D	E
Common to Port 1	Select	Bypass	Select	Select	–	C	B	D	E
Common to Port 1	Select	Bypass	Bypass	Select	–	C	C	B	C
Common to Port 2	Bypass	Select	Select	Select	A	–	B	D	E
Common to Port 2	Bypass	Select	Bypass	Select	A	–	C	B	C
Common to Port 3	Bypass	Bypass	Select	Select	A	A	–	B	C
Common to Port 4	Bypass	Bypass	Bypass	Select	A	A	A	–	A
Common to Port 5	Bypass	Bypass	Bypass	Bypass	A	A	A	A	–

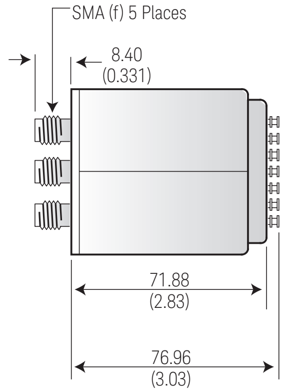
8769K SP6T switch

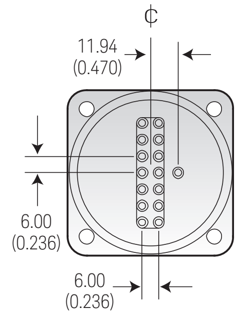
	Section status					Isolation curve for Port ( )					
Section	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**
Common to Port 1	Select	Select	Select	Select	Select	–	B	D	E	F	G
Common to Port 1	Select	Select	Select	Bypass	Select	–	B	D	F	E	F
Common to Port 1	Select	Select	Bypass	Select	Select	–	B	E	D	E	F
Common to Port 1	Select	Bypass	Select	Select	Select	–	C	B	D	E	F
Common to Port 1	Select	Bypass	Bypass	Select	Select	–	C	C	B	C	E
Common to Port 1	Select	Bypass	Bypass	Bypass	Select	–	C	C	C	B	D
Common to Port 1	Select	Bypass	Bypass	Bypass	Bypass	–	C	C	C	C	B
Common to Port 2	Bypass	Select	Select	Select	Select	A	–	B	D	E	E
Common to Port 2	Bypass	Select	Bypass	Select	Select	A	–	C	B	C	F
Common to Port 2	Bypass	Select	Bypass	Bypass	Bypass	A	–	C	C	C	B
Common to Port 3	Bypass	Bypass	Select	Select	Select	A	A	–	B	C	E
Common to Port 3	Bypass	Bypass	Select	Bypass	Select	A	A	–	A	B	D
Common to Port 3	Bypass	Bypass	Select	Bypass	Bypass	A	A	–	C	C	A
Common to Port 4	Bypass	Bypass	Bypass	Select	Bypass	A	A	A	–	A	C
Common to Port 5	Bypass	Bypass	Bypass	Bypass	Select	A	A	A	A	–	B
Common to Port 6	Bypass	Bypass	Bypass	Bypass	Bypass	A	A	A	A	A	–

87104/106, 87204/206 Series Multiport Switches

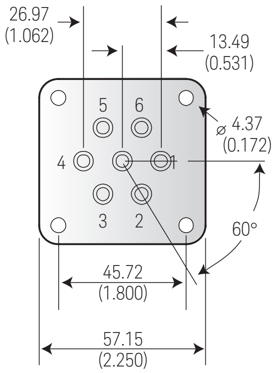


Square





Solder terminals



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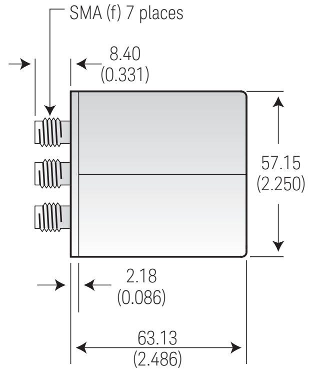
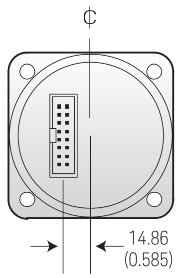


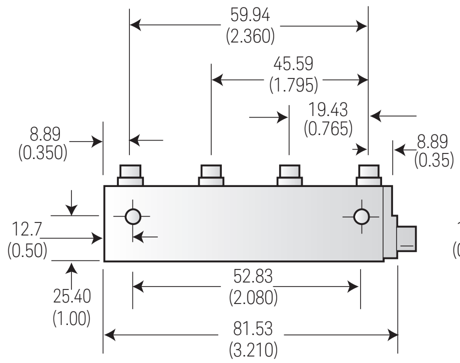


Ribbon cable connector

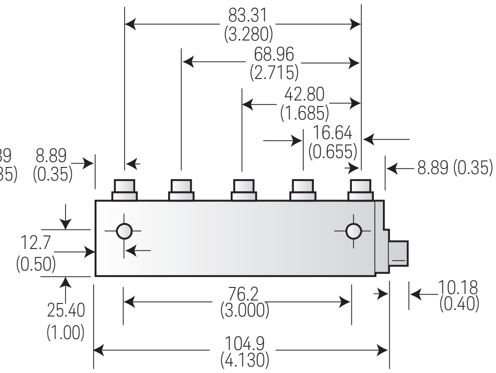
Dimensions are in mm (inches) nominal, unless otherwise specified.

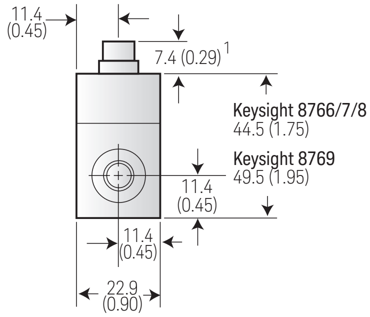
ELECTROMECHANICAL SWITCHES – High Performance Multiport Switches (continued)

8766K Multiport Switches



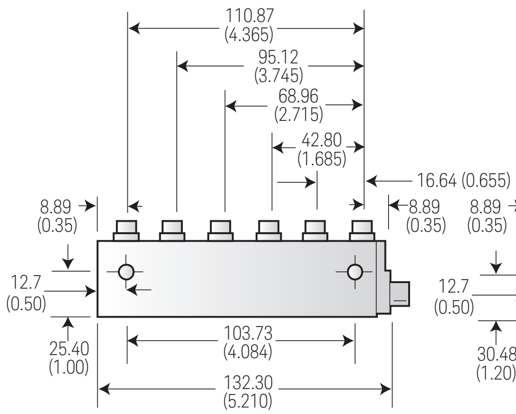
8767K Multiport Switches



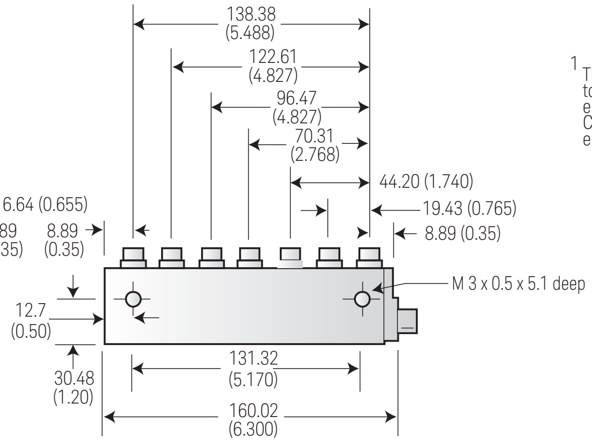


1 This dimension applies to connectors on each end of the switch. Connectors between the ends are 0.05 inches taller.

8768K Multiport Switches



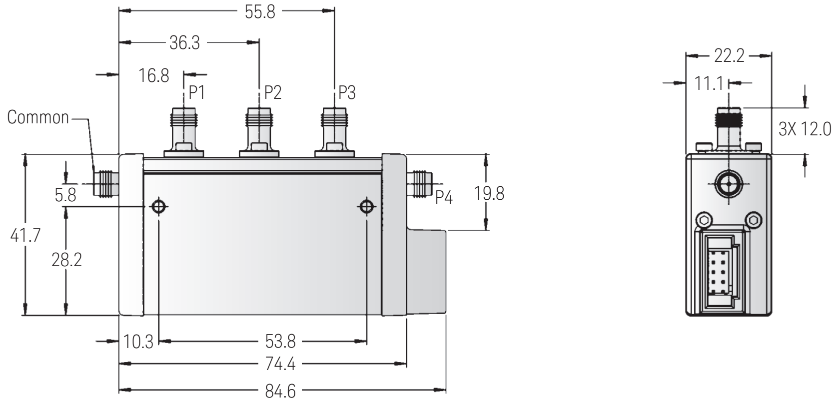
8769K Multiport Switches

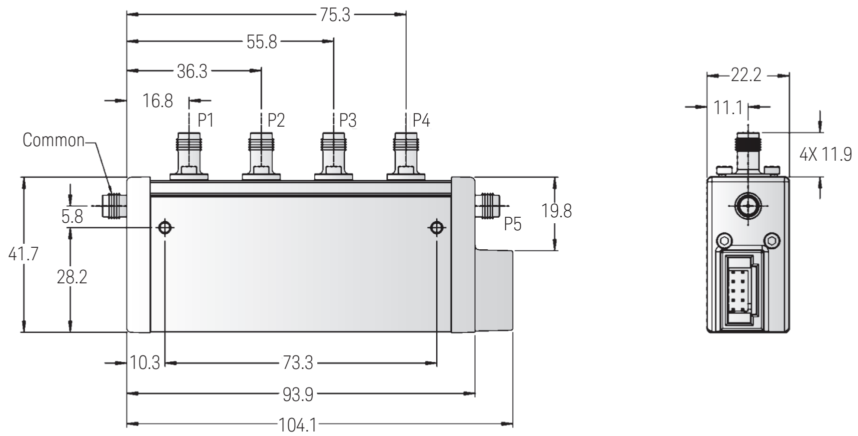


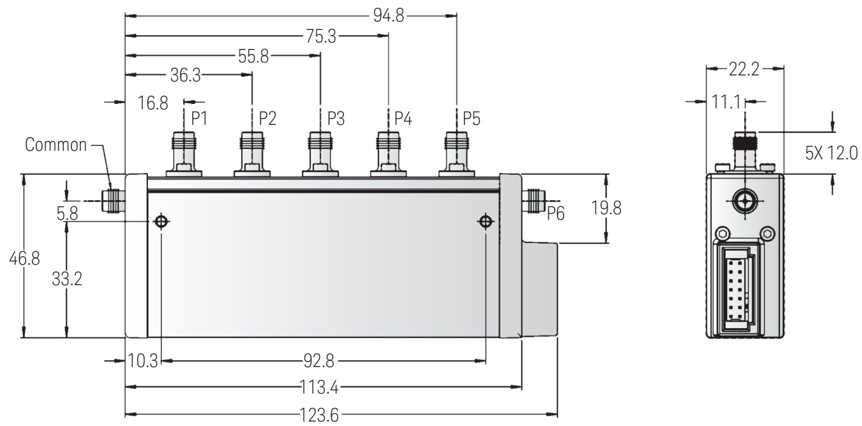
12

All connectors are 3.5 mm (f).
Dimensions are in mm (inches) nominal, unless otherwise specified.

8766K Multiport Switches







Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

87104/106/204/206 Series ordering example

Sensing type

1: Provides position sensing when used with customer supplied external circuitry only.
2: Provides position sensing when used with Keysight 87130A/70611A driver or customer supplied external circuitry.

87 2 0 4	B	Option 100	Option T24	Option UK6
Switch type	**Frequency range**	**DC connector**	**Control logic** [1]	**Calibration documentation**
4: SP4T 6: SP6T	A: 4 GHz B: 20 GHz C: 26.5 GHz D[2]: 40 GHz	161[3]: Ribbon receptacle 100: Solder terminals	024[3]: 24 VDC drive T24: TTL/5V CMOS compatible logic with 24 VDC supply	UK6: Commercial calibration test data with certificate

[1] Option T24 not available with Keysight 87204/206 Series products
[2] Only 87104D and 87106D
[3] Option 024 and 161 are default options unless specified otherwise

8766/67/68/69 Series ordering example

876 7	K	Option 011	Option 002	Option 060	Option UK6
Type	**Frequency range**	**Supply voltage**	**RF connector**	**DC connector**	**Calibration documentation**
6: SP3T 7: SP4T 8: SP5T 9: SP6T	K: 26.5 GHz M: 50 GHz	024: 24 VDC 011: 5 VDC 015: 15 VDC	K model only: 004: 3.5 mm (f) 002: SMA (f) M model only: 100: 2.4 mm (f) on DC drive cable end 2.4 mm (m) on opposite end 101: 2.4 mm (f) on DC drive cable end 2.4 mm (f) on opposite end	K model only: 060: Viking cable connector 016: 10 pin DIP connector	UK6: Commercial calibration test data with certificate

Related Literature

87104/87106A/B/C multiport coaxial switches datasheet,
part number **5091-3366E**
87104/87106D multiport coaxial switches datasheet,
part number **5989-7217EN**
87204/87206A/B/C multiport coaxial switches datasheet,
part number **5965-3309E**
8766/7/8/9K microwave single-pole multi-throw switches datasheet,
part number **5959-7831**
8767/8/9M microwave single-pole multi-throw switches datasheet,
part number **5988-2477EN**

Web Link

www.keysight.com/find/switches


87222 Series transfer switches

Transfer Switches

The 87222C/D/E transfer switches can be used in many different applications to increase system flexibility and simplify system design. The following are five examples: switch between two inputs and two outputs, use as a drop-out switch, use for signal reversal, configure as a SPDT switch, and bypass an active device.

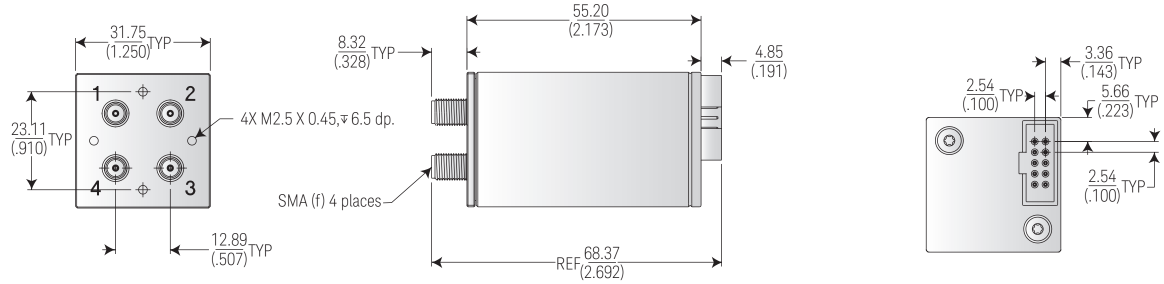
Specifications

Model	87222C	87222D	87222E
Features	←	Unterminated Optoelectronic current interrupts Optoelectronic position indicator TTL/5V CMOS compatible	→
Impedance	50 Ω	50 Ω	50 Ω
Frequency range	DC to 26.5 GHz	DC to 40 GHz	DC to 50 GHz
Insertion loss (dB)	0.2 + 0.025f [1] max	0.2 + 0.025f [1] max	0.15 + 0.020f [1] max
SWR	< 1.10 to 2 GHz < 1.15 to 4 GHz < 1.25 to 12.4 GHz < 1.40 to 20 GHz < 1.65 to 26.5 GHz	< 1.30 to 12.4 GHz < 1.40 to 25 GHz < 1.70 to 40 GHz	< 1.30 to 12.4 GHz < 1.40 to 20 GHz < 1.50 to 30 GHz < 1.60 to 40 GHz < 1.70 to 50 GHz
Isolation (dB)	120 – 2f [1] min	120 – 2f [1] min (to 26.5 GHz) 60 dB min (to 40 GHz)	120 – 2f [1] min (to 26.5 GHz) 60 dB min (to 50 GHz)
Input power Average Peak [2]	 1 W 50 W (10 us max)	 1 W 50 W (10 us max)	 1 W 50 W (10 us max)
Switching time (max)	15 ms	15 ms	15 ms
Insertion loss repeatability [3]	< 0.03 dB	< 0.03 dB	< 0.03 dB
Life (min)	5 million cycles	5 million cycles	5 million cycles
RF connectors	SMA (f)	2.92 mm (f)	2.4 mm (f)
DC connectors	Ribbon cable receptacle	Ribbon cable receptacle	Ribbon cable receptacle
Supply voltage range	20 to 32 VDC	20 to 32 VDC	20 to 32 VDC
Supply voltage	24 VDC	24 VDC	24 VDC
Current (nom)	200 mA	200 mA	200 mA

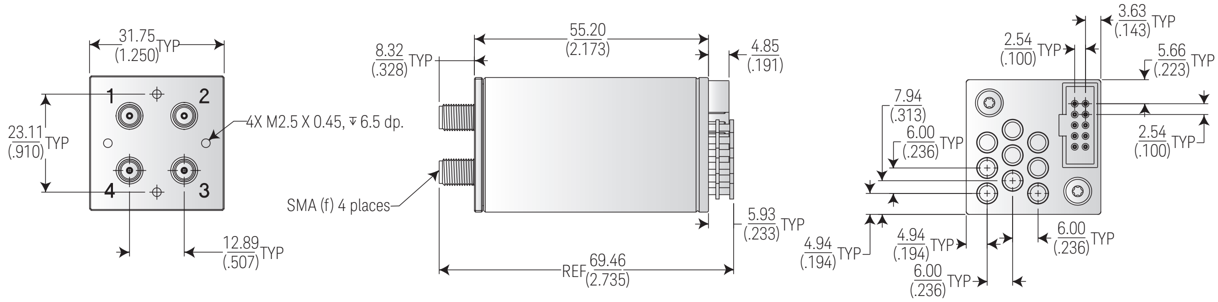
1 *f* is frequency in GHz
2 Not to exceed average power (non-switching)
3 Up to 5 million cycles measured at 25 °C

ELECTROMECHANICAL SWITCHES – High Performance Transfer Switches (continued)

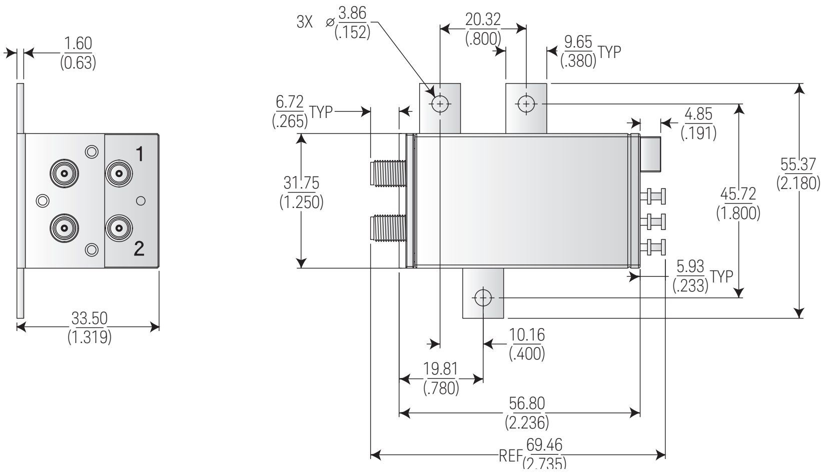
87222C Standard



87222C Option 100



87222C Option 100 and 201



Dimensions are in millimeters and (inches) nominal unless otherwise specified.

Ordering Information

87222C-100 Solder terminals in addition to ribbon cable
87222C-201 Mounting bracket; assembly required

Related Literature

87222C/D/E coaxial transfer switches DC to 26.5, 40, 50 GHz datasheet, part number **5968-2216E**

Web Link

www.keysight.com/find/switches

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Keysight 87406B & 87606B

Matrix

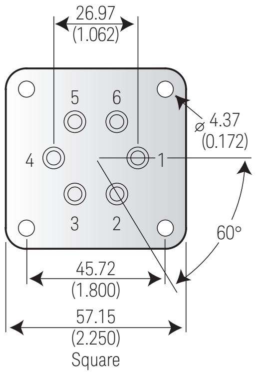
The 87406B and 87606B matrix switches consist of 6 ports which can be individually connected via internal microwave switches to form an RF path. The switch can be configured for blocking 1 x 5, 2 x 4, or 3 x 3 switching applications.

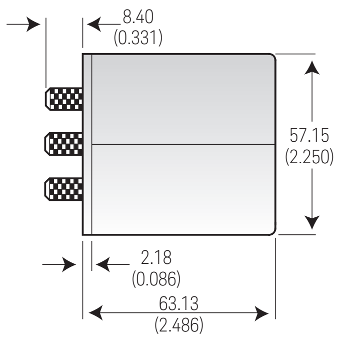
Specifications

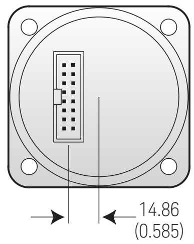
Model	87406B	87606B
Features	Terminated Break-before-make or make-before-break 3x3, 2x4 and 1x5 blocking matrix configurations	
	Optoelectronic position indicator [1] Optoelectronic current interrupt	Self interrupting drive circuit
Impedance	50 Ω	50 Ω
Frequency range	DC to 20 GHz	DC to 20 GHz
Insertion loss (dB)	$0.34 + 0.033f^{2}$ max	$0.34 + 0.033f^{2}$ max
SWR	< 1.21 to 4 GHz < 1.35 to 10 GHz < 1.50 to 15 GHz < 1.70 to 18 GHz < 1.90 to 20 GHz	< 1.21 to 4 GHz < 1.35 to 10 GHz < 1.50 to 15 GHz < 1.70 to 18 GHz < 1.90 to 20 GHz
Isolation (dB)	> 100 dB to 12 GHz > 80 dB to 15 GHz >70 dB to 20 GHz	> 100 dB to 12 GHz > 80 dB to 15 GHz >70 dB to 20 GHz
Input power Average Peak [3]	 1 W 50 W (10 us max)	 1 W 50 W (10 us max)
Switching time (max)	15 ms	15 ms
Insertion loss repeatability [4]	< 0.03 dB	< 0.03 dB
Life (min)	5 million cycles	5 million cycles
RF connectors	SMA (f)	SMA (f)
DC connectors	Ribbon cable receptacle	Ribbon cable receptacle
Supply voltage range	20 to 32 VDC	20 to 32 VDC
Supply voltage	24 VDC	24 VDC
Current (nom) [5]	200 mA	200 mA

1. Provides position sensing when used with customer supplied external circuitry.
2. f is frequency in GHz
3. Not to exceed average power (non-switching)
4. Up to 5 million cycles measured at 25 °C
5. 200 mA is required for each RF port closed or open. Using “open all ports” (pin 16) will require up to 1200 mA (6 ports x 200 mA each).

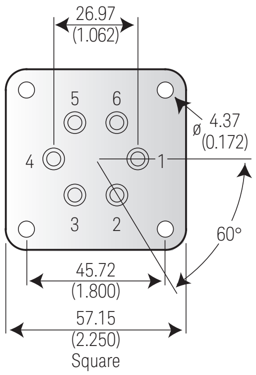
Product Outline

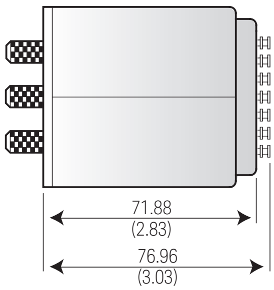


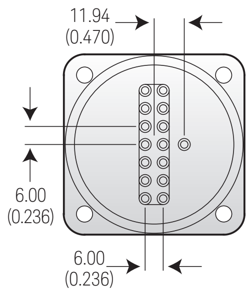




Standard/Option T24
ribbon cable connector







Option 100/T00
solder terminals

All connectors are 3.5 mm (f).
Dimensions are in millimeters (inches) nominal, unless otherwise specified.

Ordering Information

87406B
- **87406B-100** solder terminals to replace ribbon cable
- **87406B-T24** TTL/5V CMOS compatibility (requires 24 VDC power supply)

87606B
- **87606B-100** solder terminals to replace ribbon cable

Related Literature

87406B coaxial matrix switch DC to 20 GHz datasheet, part number **5965-7841E**
87606B coaxial matrix switch DC to 20 GHz datasheet, part number **5965-7842E**

Web Link
www.keysight.com/find/switches

Low Cost

Keysight's low-cost switches offer high-performance capability at a fraction of the cost. The L Series offers 0.03 dB insertion loss repeatability up to two million cycles and exceptional isolation. Keysight low-cost switches provide the performance you need from DC to 26.5 GHz.

Selection Guide

Product family		Model	Frequency range (GHz)
SPDT switch	50Ω	8762A	4
		8762B	18
		8762C	26.5
		8765A	4
		8765B	20
		8765C	20
		8765D	40
	75Ω	8762F	4
		8765F	4
Bypass switch	4-ports	8763A	4
		8763B	18
		8763C	26.5
	5-ports	8764A	4
		8764B	18
		8764C	26.5
Multiport switch	SP4T	L7104A	4
		L7204A	4
		L7104B	20
		L7204B	20
		L7104C	26.5
		L7204C	26.5
	SP6T	L7106A	4
		L7206A	4
		L7106B	20
		L7206B	20
		L7106C	26.5
		L7206C	26.5
Transfer switch		L7222C	26.5

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8762/A/B/C Series

8762 Series Coaxial Switches

Keysight 8762A/B/C switches operate up to 26.5 GHz. They provide exceptional isolation of 90 dB to 18 GHz and switched terminations, so that all ports maintain a 50 Ω match. Internal loads are rated at 1 watt average (100 W peak, 10 µsec pulse width). Control voltage Options T15 and T24 are compatible with TTL/5V CMOS drive circuitry. Another model, Keysight 8762F, is designed for 75 Ω transmission lines, making it valuable for communication applications up to 4 GHz.

Specifications

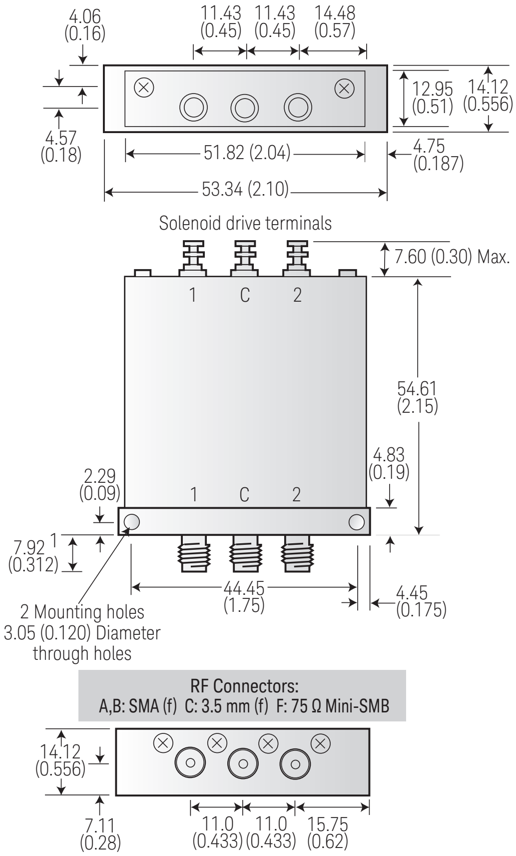
Model	8762A	8762B	8762C	8762F
Features	← Break-before-make Terminated Current Interrupts →			
Impedance	50 Ω	50 Ω	50 Ω	75 Ω
Frequency range	DC to 4 GHz	DC to 18 GHz	DC to 26.5 GHz	DC to 4 GHz
Insertion loss (dB)	< 0.20 to 2 GHz < 0.25 to 4 GHz	< 0.20 to 2 GHz < 0.50 to 18 GHz	< 0.25 to 2 GHz < 0.50 to 18 GHz < 1.25 to 26.5 GHz	< 0.4
SWR	< 1.1 to 2 GHz < 1.2 to 4 GHz	< 1.1 to 2 GHz < 1.2 to 12.4 GHz < 1.3 to 18 GHz	< 1.15 to 2 GHz < 1.25 to 12.4 GHz < 1.4 to 18 GHz < 1.8 to 26.5 GHz	< 1.3
Isolation (dB)	> 100 to 4 GHz	> 90 to 18 GHz	> 90 to 18 GHz > 50 to 26.5 GHz	> 100
Input power Average Peak [1]	 1 W 100 W (10 us max)	 1 W 100 W (10 us max)	 1 W 100 W (10 us max)	 1 W 100 W (10 us max)
Switching time (max)	30 ms	30 ms	30 ms	30 ms
Insertion loss repeatability [2]	< 0.03 dB	< 0.03 dB	< 0.03 dB to 18 GHz < 0.05 dB to 26.5 GHz	< 0.03 dB
Life (min)	1 million cycles	1 million cycles	1 million cycles	1 million cycles
RF connectors	SMA (f)	SMA (f)	3.5 mm (f)	Min SMB (m) [3] (75 W)
DC connectors	Solder terminals	Solder terminals	Solder terminals	Solder terminals
Supply voltage	← Option: nominal (range) 011: 5 (4.5 to 7) VDC 015/T15: 15 (12 to 20) VDC 024/T24: 24 (20 to 32) VDC →			
Supply current	← Option: nominal 011: 400 mA at 5 V 015/T15: 182 mA at 15 V 024/T24: 120 mA at 24 V →			

1 Not to exceed average power (non-switching)

2 Up to 1 million cycles measured at 25 °C

3 75 Ω Mini SMB does not mate with 75 Ω SMB. See datasheet for more information.

8762 Series Coaxial Switches



1 10.0 (0.393) for F version

Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

8762 Series ordering example

8762 B — **Option T15** — **Option UK6**

Frequency range

A: 4 GHz
B: 18 GHz
C: 26.5 GHz
F: 4 GHz (75 Ω)

Supply voltage/control logic

024: 24 VDC
011: 5 VDC
015: 15 VDC
T15: TTL/5V CMOS compatible with 15 VDC supply [1]
T24: TTL/5V CMOS compatible with 24 VDC supply [1]

Calibration documentation [1]

UK6: Commercial calibration test data with certificate

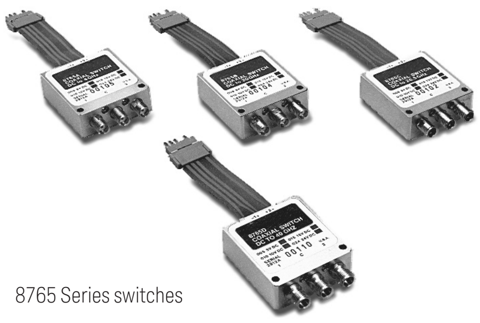
[1] Not available with Keysight 8762F

Related Literature

8762/3/4A,B,C coaxial switches datasheet, part number **5952-1873E**
8762F coaxial switch 75 Ω datasheet, part number **5964-3704E**

Web Link

www.keysight.com/find/switches



8765 Series switches

8765 Series Switches

The 8765A/B/C/D are SPDT switches that offer outstanding performance and a life of 5 million cycles. This switch family is available in four models up to 40 GHz. Unlike the 8762 switches, they do not have internal RF loads or DC current interrupts. Coil voltage options cover the complete range from 5 VDC to 24 VDC. Since the switches are magnetically latched, the coil voltage may be switched off after 15 ms.

The standard 8765 switch comes with ribbon cables and a standard printed circuit board with a 0.025-inch connector for convenient assembly. Optional solder terminals are available.

75 Ω Switch

The 8765F brings a new standard of performance to 75 Ω coaxial components. Designed for ATE switching systems, the 8765F offers the performance being demanded by the cable television distribution equipment and communications equipment industries. It gives the ATE system designer the tools to design high performance, reliable switching interfaces.

The 8765F uses a mini 75 Ω SMB connector for the coaxial interface. The mini 75 Ω SMB connector is designed to terminate RG-179 75 Ω coaxial cable. The 8765F is designed to work in virtually any system by virtue of the variety of voltage options covering 4.5 V to 32 V DC available for activating the switch solenoids. While the standard configuration for the switch comes with a DC ribbon cable connector, solder terminals are also available as an option.

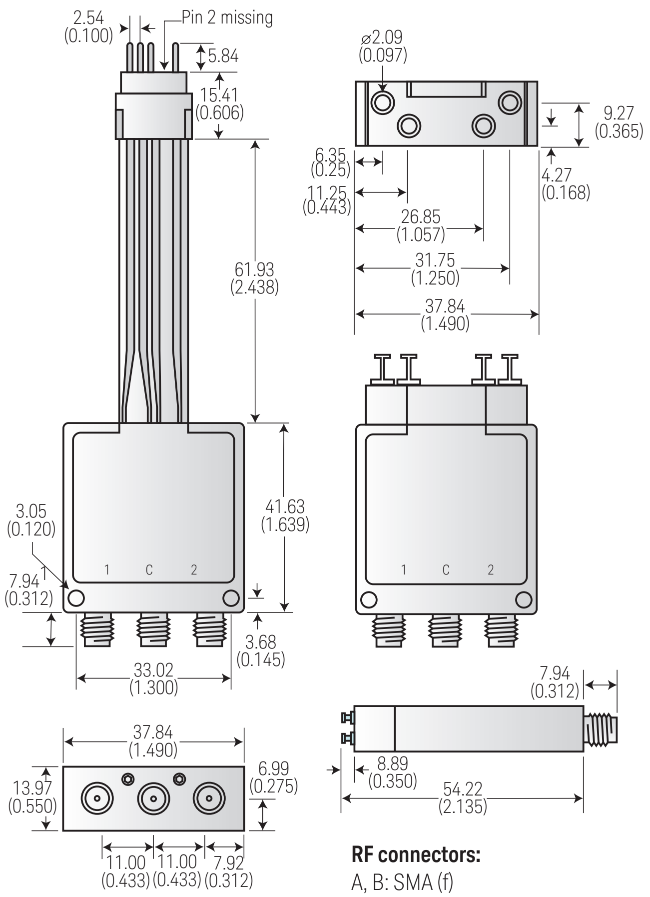
As with its 50 Ω counterparts, the 8765A/B/C/D, the 8765F was designed for maximum dependability and performance. It has been designed to operate within its specifications for over 5 million cycles.

Specifications

Model	8765A	8765B	8765C	8765D	8765F
Features	Break-before-make Unterminated Without current interrupt				
Impedance	50 Ω	50 Ω	50 Ω	50 Ω	75 Ω
Frequency range	DC to 4 GHz	DC to 20 GHz	DC to 26.5 GHz	DC to 40 GHz	DC to 4 GHz
Insertion Loss (dB)	0.2 + 0.025f [1] max		0.2 + 0.027f [1] max	0.2 + 0.023f [1] max 0.75 + 0.023f [1] max (26.5 ≤ f ≤ 40)	< 0.18 to 1 GHz < 0.24 to 2 GHz < 0.40 to 4 GHz
SWR	< 1.20 to 4 GHz	< 1.20 to 4 GHz < 1.35 to 12.4 GHz < 1.45 to 18 GHz < 1.70 to 20 GHz	< 1.25 to 4 GHz < 1.45 to 18 GHz < 1.70 to 26.5 GHz	< 1.10 to 4 GHz < 1.30 to 18 GHz < 1.50 to 40 GHz	< 1.15 to 1 GHz < 1.20 to 4 GHz
Isolation (dB)	110 - 2.25f [1] min				> 100 to 1 GHz > 90 to 4 GHz
Input power Average Peak [2]	2 W 100 W (10 us max)				
Switching time (max)	15 ms				
Insertion loss repeatability [3]	< 0.03 dB				
Life (min)	5 million cycles				
RF connectors	SMA (f)	SMA (f)	3.5 mm (f)	2.4 mm (f)	Mini SMB (m) [4]
DC connectors	Ribbon cable or solder terminals				
Supply voltage	Option: nominal (range) 005/305: 5 (4.5 to 7) VDC 010/310: 10 (7 to 12) VDC 015/315: 15 (12 to 20) VDC 024/324: 24 (20 to 30) VDC				
Supply current	Option: nominal 005/305: 385 mA at 5 V 010/310: 300 mA at 10 V 015/315: 200 mA at 15 V 024/324: 120 mA at 24 V				

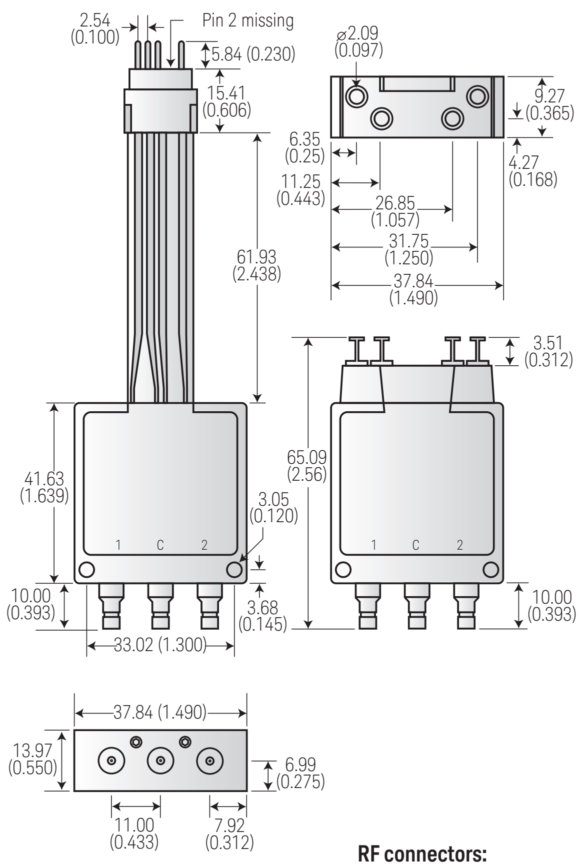
1. *f* is frequency in GHz
2. Not to exceed average power (non-switching)
3. Up to 5 million cycles measured at 25 °C
4. 75 Ω Mini SMB does not mate with 75 Ω SMB. See datasheet for more information.

8765A/B/C/D SPDT Switches



RF connectors:
A, B: SMA (f)
C: 3.5 mm (f)
D: 2.4 mm (f)

8765F Coaxial Switch



RF connectors:
75 Ω Mini-SMB (m) [2]

[1] 8.46 (0.333) for D versions
[2] 75 Ω Mini-SMB (m) does not mate with 75 Ω SMB connectors. See data sheet for details.

Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

8765 Series ordering example

8765 B	Option 005	Option 292	Option 108	Option UK6
Frequency range	**Supply voltage and DC connector**	**RF connector** [1]	**DC connector accessories** [2]	**Calibration documentation** [2,3]
A: 4 GHz B: 20 GHz C: 26.5 GHz D: 40 GHz F: 4 GHz (75 Ω)	005: 5 VDC with 3-inch ribbon cable 010: 10 VDC with 3-inch ribbon cable 015: 15 VDC with 3-inch ribbon cable 024: 24 VDC with 3-inch ribbon cable 305: 5 VDC with solder terminals 310: 10 VDC with solder terminals 315: 15 VDC with solder terminals 324: 24 VDC with solder terminals	241: 2.4 mm (f) 292: 2.92 mm (f)	108: 8-inch ribbon cable extension 116: 16-inch ribbon cable extension	UK6: Commercial calibration test data with certificate

1 Available with Keysight 8765D only
2 Optional
3 Not available for Keysight 8765D Option 292, or 8765F

Related Literature

8765A/B/C/D microwave SPDT switches DC to 4, 20, 26.5 and 40 GHz datasheet, part number **5952-2231E**
8765F coaxial switch 75 Ω datasheet, part number **5091-2679E**

8763/64 Series

8763/64 Series Coaxial Switches

8763A/B/C switches operate up to 26.5 GHz. They are preferred for drop-in, drop-out applications because of their compact design. These switches are used to automatically insert or remove a test component from a signal path. Because of their excellent isolation, they can also be used as the intersection (crosspoint) switch in full-access matrix switching applications. One port is internally terminated. Options T15 and T24 are available for TTL/5V CMOS compatibility.

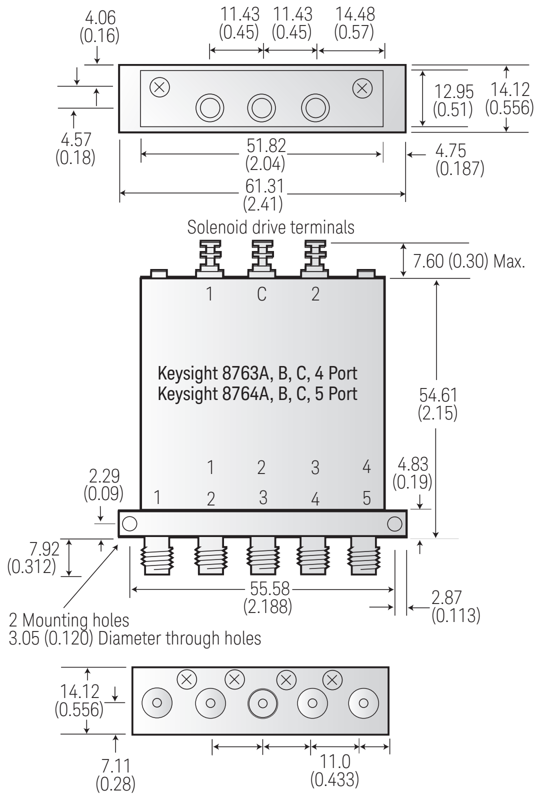
8764A/B/C switches operate up to 26.5 GHz, similar to the Keysight 8763, but with the internal termination replaced by a fifth port. The fifth port can be utilized for signal path reversal or as a calibration port. Options T15 and T24 offer TTL/5V CMOS compatibility.

Specifications

Model	8763A	8763B	8763C	8764A	8764B	8764C
Features	4-port	4-port	4-port	5-port	5-port	5-port
	Terminated	Terminated	Terminated	Unterminated	Unterminated	Unterminated
	← Current interrupt →					
	← Break-before-make →					
Impedance	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω
Frequency range	DC to 4 GHz	DC to 18 GHz	DC to 26.5 GHz	DC to 4 GHz	DC to 18 GHz	DC to 26.5 GHz
Insertion loss (dB)	< 0.20 to 2 GHz < 0.25 to 4 GHz	< 0.20 to 2 GHz < 0.50 to 18 GHz	< 0.20 to 2 GHz < 0.50 to 18 GHz < 1.25 to 26.5 GHz	< 0.20 to 2 GHz < 0.25 to 4 GHz	< 0.20 to 2 GHz < 0.50 to 18 GHz	< 0.20 to 2 GHz < 0.50 to 18 GHz < 1.25 to 26.5 GHz
SWR	< 1.1 to 2 GHz < 1.2 to 4 GHz	< 1.1 to 2 GHz < 1.2 to 12.4GHz < 1.3 to 18 GHz	< 1.15 to 2 GHz < 1.25 to 12.4 GHz < 1.4 to 18 GHz < 1.8 to 26.5 GHz	< 1.1 to 2 GHz < 1.2 to 4 GHz	< 1.1 to 2 GHz < 1.2 to 12.4GHz < 1.3 to 18 GHz	< 1.15 to 2 GHz < 1.25 to 12.4 GHz < 1.4 to 18 GHz < 1.8 to 26.5 GHz
Isolation (dB)	> 100 to 4 GHz	> 90 to 18 GHz	> 90 to 18 GHz > 50 to 26.5 GHz	> 100 to 4 GHz	> 90 to 18 GHz	> 90 to 18 GHz > 50 to 26.5 GHz
Input power Average Peak [1]	1 W 100 W (10 us max)	1 W 100 W (10 us max)	1 W 100 W (10 us max)	1 W 100 W (10 us max)	1 W 100 W (10 us max)	1 W 100 W (10 us max)
Switching time (max)	30 ms	30 ms	30 ms	30 ms	30 ms	30 ms
Insertion loss repeatability [2]	< 0.03 dB	< 0.03 dB	< 0.03 dB to 18 GHz < 0.05 dB to 26.5 GHz	< 0.03 dB	< 0.03 dB	< 0.03 dB to 18 GHz < 0.05 dB to 26.5 GHz
Life (min)	1 million cycles	1 million cycles	1 million cycles	1 million cycles	1 million cycles	1 million cycles
RF connectors	SMA (f)	SMA (f)	3.5 mm (f)	SMA (f)	SMA (f)	3.5 mm (f)
DC connectors	Solder terminals	Solder terminals	Solder terminals	Solder terminals	Solder terminals	Solder terminals
Supply voltage	← Option: nominal (range) 011: 5 (4.5 to 7) VDC 015/T15: 15 (12 to 20) VDC 024/T24: 24 (20 to 32) VDC →					
Supply current	← Option: nominal 011: 400 mA at 5 V 015/T15: 182 mA at 15 V 024/T24: 120 mA at 24 V →					

[1] Not to exceed average power (non-switching)
[2] Up to 1 million cycles measured at 25 °C

8763/64 Series Coaxial Switches



RF Connectors: A,B: SMA (f) C: 3.5 mm (f)

Dimensions are in millimeters (inches) nominal, unless otherwise specified.

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Ordering Information

8763/64 Series ordering example

876 3 B **Option 015** **Option UK6**

Type	Frequency range	Supply voltage/control logic	Calibration documentation
3: 4 port 4: 5 port	A: 4 GHz B: 18 GHz C: 26.5 GHz	024: 24 VDC 011: 5 VDC 015: 15 VDC T15: TTL/5V CMOS compatible logic with 15 VDC supply T24: TTL/5V CMOS compatible logic with 24 VDC supply	UK6: Commercial calibration test data with certificate

Related Literature

8762/3/4A/B/C coaxial switches datasheet, part number **5952-1873E**

Web Link

www.keysight.com/find/switches

L7104/106/204/206 Series multiport switches

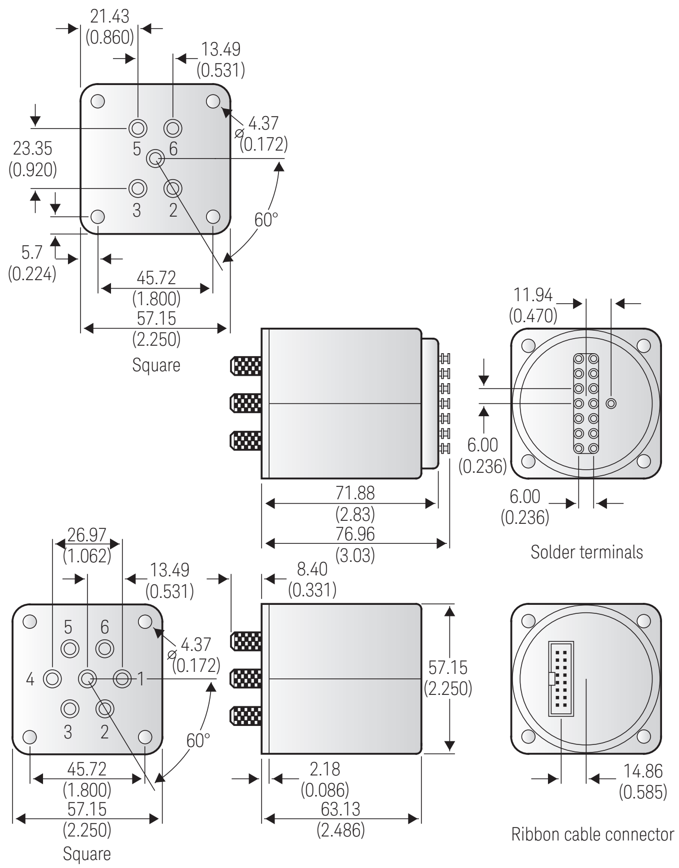
The L7104/L7204A, B, C SP4T and L7106/L7206A, B, C SP6T multiport switches provide the life and reliability required for automated test and measurement, signal monitoring, and routing applications. Innovative design and careful process control creates switches that meet the requirements for highly repeatable switching elements in test instruments and switching interfaces. The exceptional 0.03 dB insertion loss repeatability is warranted for 2 million cycles at 25 °C. This reduces sources of random errors in the measurement path and improves measurement uncertainty. Switch life is a critical consideration in production test systems, satellite and antenna monitoring systems, and test instrumentation. The longevity of these switches increases system uptime, and lowers the cost of ownership by reducing calibration cycles and switch maintenance.

Specifications

Model	**L7104A L7104B L7104C**	**L7106A L7106B L7106C**	**L7204A L7204B L7204C**	**L7206A L7206B L7206C**
Configuration	SP4T	SP6T	SP4T	SP6T
Features	← Terminated, Break-before-make or make-before-break, Optoelectronic current interrupts, Optoelectronic position indicator [1] →		← Unterminated, Break-before-make or make-before-break, Optoelectronic current interrupts, Optoelectronic position indicator [1] →	
Impedance	50 Ω	50 Ω	50 Ω	50 Ω
Frequency range	← A: DC to 4 GHz, B: DC to 20 GHz, C: DC to 26.5 GHz →			
Insertion loss (dB)	$0.3 + 0.015f^2$ max	$0.3 + 0.015f^2$ max	$0.3 + 0.015f^2$ max	$0.3 + 0.015f^2$ max
SWR	← < 1.20 to 4 GHz, < 1.35 to 12.4 GHz, < 1.45 to 18 GHz, < 1.70 to 26.5 GHz →			
Isolation (dB)	← > 90 dB to 12 GHz, > 70 dB to 15 GHz, > 65 dB to 20 GHz, > 60 dB to 26.5 GHz →			
Input power				
Average	1 W	1 W	1 W	1 W
Peak [3]	50 W (10 us max)	50 W (10 us max)	50 W (10 us max)	50 W (10 us max)
Switching time (max)	15 ms	15 ms	15 ms	15 ms
Insertion loss repeatability [4]	< 0.03 dB	< 0.03 dB	< 0.03 dB	< 0.03 dB
Life (min)	2 million cycles	2 million cycles	2 million cycles	2 million cycles
RF connectors	SMA (f)	SMA (f)	SMA (f)	SMA (f)
DC connectors	Ribbon cable receptacle	Ribbon cable receptacle	Ribbon cable receptacle	Ribbon cable receptacle
Supply voltage range	20 to 32 VDC	20 to 32 VDC	20 to 32 VDC	20 to 32 VDC
Supply voltage	24 VDC	24 VDC	24 VDC	24 VDC
Current (nom) [5]	200 mA	200 mA	200 mA	200 mA

1 Provides position sensing when used with customer supplied external circuitry.
2 f is frequency in GHz
3 Not to exceed average power (non-switching)
4 Up to 2 million cycles measured at 25 °C
5 Closing one RF path requires 20 mA. Add 200 mA for each additional RF path closed or opened.

L7104 A/B/C, L7106 A/B/C, L7204 A/B/C, and L7206 A/B/C



Dimensions are in millimeters (inches) nominal, unless otherwise specified.

Ordering Information

L7104/106/204/206 Series ordering example

L7 2 0 4 **B** **Option 100** **Option T24**

Termination

1: Terminated
2: Unterminated

Switch type

4: SP4T
6: SP6T

Frequency range

A: 4 GHz
B: 20 GHz
C: 26.5 GHz

DC connector

161: Ribbon receptacle
100: Solder terminals

Control logic

024: 24 VDC drive
T24: TTL/5V CMOS compatible logic with 24 VDC supply

Related Literature

L Series multiport electromechanical coaxial switches datasheet, part number **5989-6030EN**

Web Link

www.keysight.com/find/switches

L7222C coaxial transfer switches

The L7222C can be used in a variety of applications, such as switching two inputs and two outputs, signal reversal switching or as a drop-out switch. Innovative design and careful process control means the L7222C meets the requirements for highly repeatable switching elements in test instruments and switching interfaces. They offer exceptional insertion loss repeatability, reducing sources of random errors in the measurement path, and improving measurement uncertainty.

Operating from DC to 26.5 GHz, these switches exhibit exceptional isolation performance required to maintain measurement integrity. Isolation between ports is typically > 90 dB to 12 GHz, > 80 dB to 26.5 GHz, reducing the influence of signals from other channels and system measurement uncertainties. Hence, the L7222C is ideal for integration into complex, multi-tiered switching systems.

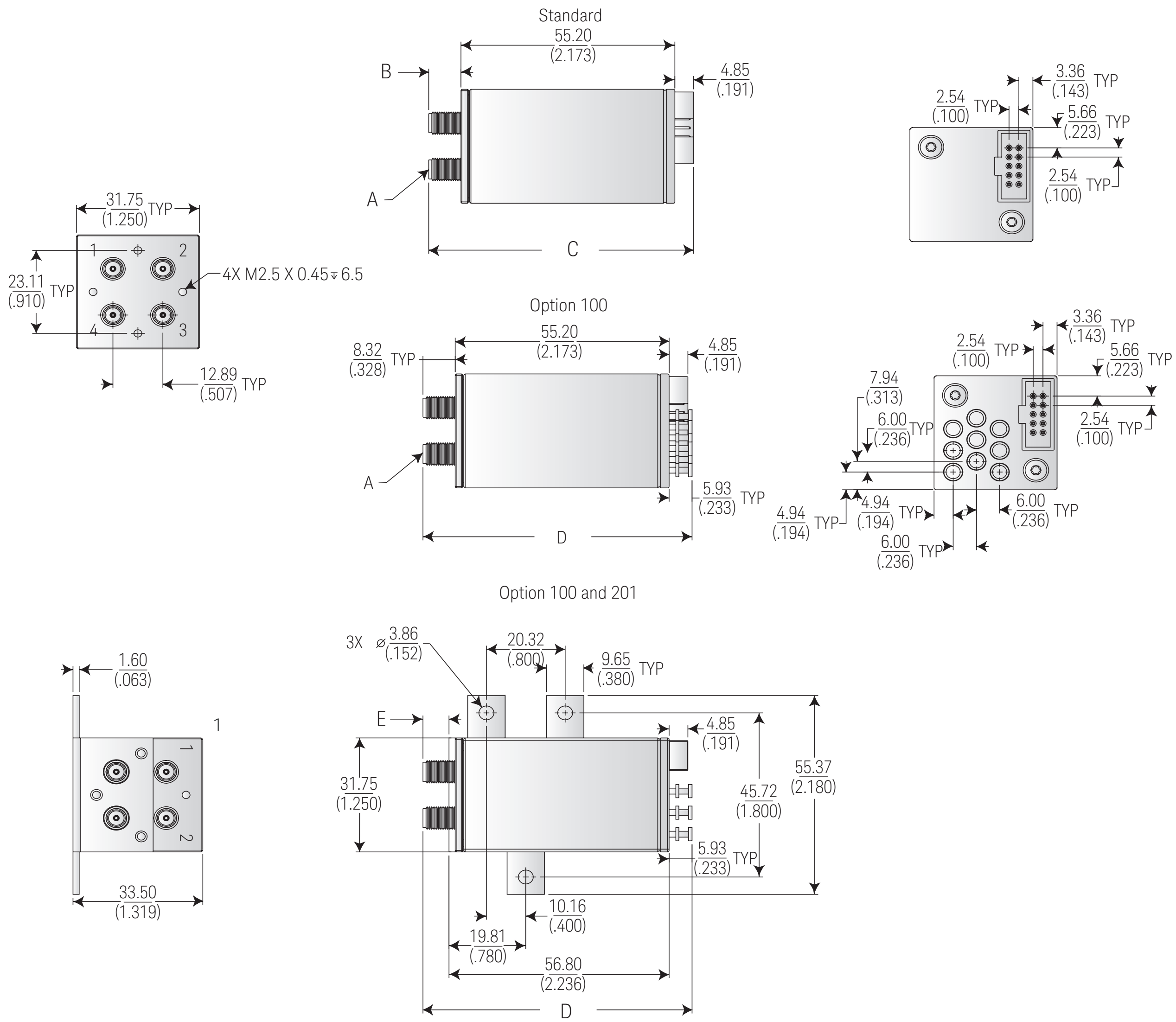
Specifications

Model	**L7222C**
Features	Unterminated Optoelectronic current interrupts Optoelectronic position
Impedance	50 Ω
Frequency range	DC to 26.5 GHz
Insertion loss (dB)	$0.2 + 0.025f$ [1] max
SWR	< 1.10 to 2 GHz < 1.15 to 4 GHz < 1.25 to 12.4 GHz < 1.40 to 20 GHz < 1.65 to 26.5 GHz
Isolation (dB)	$110 - 2f$ [1] min
Input power Average Peak [2]	 1 W 50 W (10 us max)
Switching time (max)	15 ms
Insertion loss repeatability [3]	< 0.03 dB
Life (min)	2 million cycles
RF connectors	SMA (f)
DC connectors	Ribbon cable receptacle
Supply voltage range	20 to 32 VDC
Supply voltage	24 VDC
Current (nom)	200 mA

1 f is frequency in GHz
2 Not to exceed average power (non-switching)
3 Up to 2 million cycles measured at 25 °C

ELECTROMECHANICAL SWITCHES – Low Cost Transfer Switches (continued)

Product Outlines



Model number	A	B	C	D	E
L7222C millimeter (inches)	SMA (f)	8.32 (.328) TYP	REF 68.37 (2.692)	REF 69.46 (2.735)	REF 6.72 (.265)

Dimensions are in millimeters (inches) nominal, unless otherwise specified.

Ordering Information

L7222C-100 Solder terminals in addition to ribbon cable
L7222C-201 Mounting bracket; assembly required

Related Literature

L7222C coaxial transfer switches DC to 26.5 GHz technical overview, part number **5989-6084EN**

Web Link

www.keysight.com/find/switches

8761A/B coaxial switches

The 8761A and 8761B are single-pole, double-throw coaxial switches with excellent electrical and mechanical characteristics for 50 Ω transmission systems operating from DC to 18 GHz. Both switches feature broadband operation, long life, low SWR, excellent repeatability, and magnetic latching solenoids. The 8761A and 8761B switches are small and lightweight, making them ideal for applications where space is limited. Because of their versatility and excellent electrical performance, they are well suited for automated testing and systems applications. The A version is for 12 to 15 VDC operation, and the version B uses 24 to 30 VDC solenoid drive voltage.

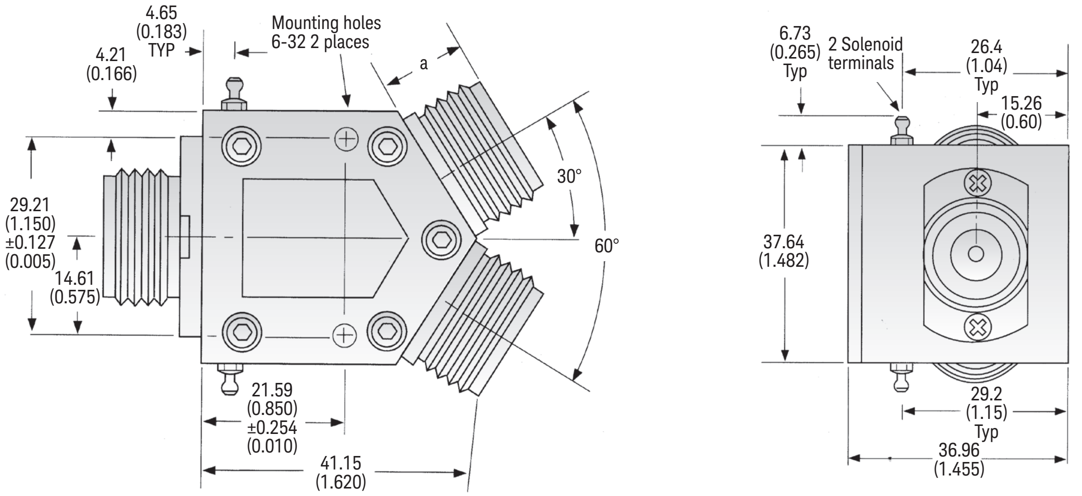
The 8761A/B Series can be custom configured with an combination for type-N, SMA, and precision 7-mm connectors thus enabling the user to "custom design" a connector arrangement and eliminate the need for connector adapters.

Specifications

Model	8761A	8761B
Features	Break-before-make Unterminated	Break-before-make Unterminated
Impedance	50 Ω	50 Ω
Frequency range	DC to 18 GHz	DC to 18 GHz
Insertion loss (dB)	< 0.5 to 12.4 GHz < 0.8 to 18 GHz	< 0.5 to 12.4 GHz < 0.8 to 18 GHz
SWR (through line)	Connector type: Type-N: < 1.20 to 12.4 GHz : < 1.25 to 18 GHz 7-mm (APC-7): < 1.15 to 12.4 GHz : < 1.20 to 18 GHz SMA: < 1.30 to 12.4 GHz : < 1.35 to 18 GHz 50 Ω load: SWR degraded by 0.05 when used with above connector types.	
Isolation (dB)	> 50 to 12.4 GHz > 45 to 18 GHz	> 50 to 12.4 GHz > 45 to 18 GHz
Input power Average Peak [1]	 10 W 5 kW [2] (10 us max)	 10 W 5 kW [2] (10 us max)
Switching time (max)	50 ms	50 ms
Insertion loss repeatability [3]	< 0.03 dB	< 0.03 dB
Life (min)	1 million cycles	1 million cycles
RF connectors	See connector options in ordering information	
DC connectors	Solder terminals	Solder terminals
Supply voltage	12 V (12 to 15 V)	26 V (24 to 30 V)
Supply current	80 mA at 12 V	65 mA at 26 V

1. Not to exceed average power (non-switching)
2. Option 107 and 207: 2 W average, 100 W peak (10 us max)
3. Up to 1 million cycles measured at 25 °C.

ELECTROMECHANICAL SWITCHES – High Power SPDT Switches (continued)



Dimensions are in mm (inches) nominal, unless otherwise specified.

Connector Options for 8761A/B Coaxial Switches

Connector options	Connector type	Dimension "a" mm (in.)
100, 200, 300	Type-N female	13.72 (0.540)
101, 201, 301	Type-N male	19.79 (0.775)
102, 202, 302	7-mm threaded sleeve (APC-7)	9.27 (0.365)
103, 203, 303	7-mm coupling nut (APC-7)	11.94 (0.470)
104, 204, 304	7-mm for UT-250 coax	9.27 (0.365)
105, 205, 305	SMA female	16.13 (0.635)
106, 206, 306	SMA male	17.15 (0.675)
107, 207	50 Ω termination [1]	30.5 (1.20)

[1] Option 107, 207 available on port 1 or port 2 only

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Ordering Information

–100, 200, 300 type-N female
–101, 201, 301 type-N male
–102, 202, 302 7-mm threaded sleeve (APC-7) [1]
–103, 203, 303 7-mm coupling nut (APC-7) [1]
–104, 204, 304 7-mm for UT-250 coax
–105, 205, 305 SMA female
–106, 206, 306 SMA male
–107, 207 50 Ω termination

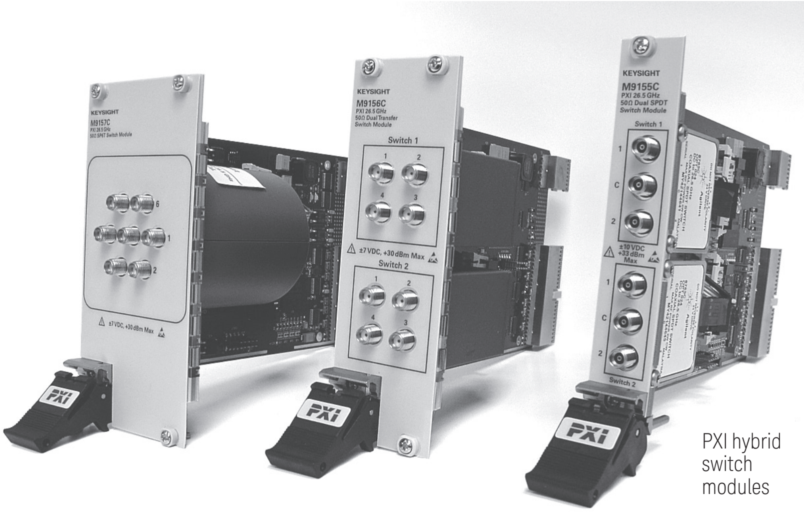
[1] Either option will connect to a standard, sexless, 7-mm connector. To daisy-chain two 8761x's you must use one option of 102, 202, or 302 and one option of 103, 203, or 303 on the two mating connectors. If you have two of the same options, you will need to use a cable with two standard 7-mm connectors.

Related Literature

8761A/B microwave switches datasheet, part number **5952-1911**

Web Link

www.keysight.com/find/switches



PXI hybrid switch modules

A Readily Scaled Integrated Switching Solution to Satisfy Your Unique Platform Needs

– Route RF and microwave signals in automated test applications
– Flexibility to build switch matrix as desired, hence a low cost solution
– Peace of mind in switch technology from Keysight who has a proven track record for providing quality switches

Superior RF Performance

– 0.03 dB insertion loss repeatability throughout the 5 million cycle operating life ensures accuracy of your test results
– Unmatched isolation 92 dB at 8 GHz minimizes cross talk
– Broadband from DC to 26.5/40 GHz fits most communication and aerospace/defense applications

Reliable and Repeatable Switches Fit Your Application

– Exceptional 0.03 dB insertion loss repeatability
– Long life cycles – 5 million cycles, 10 million cycles typical

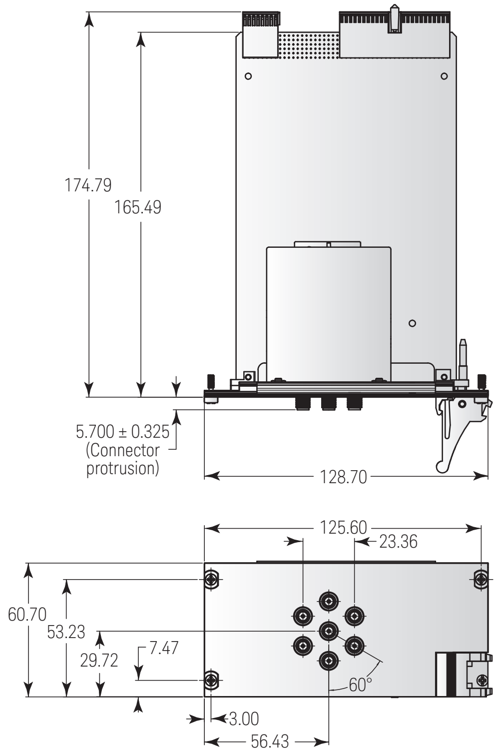
Specifications

Model	**M9155C**	**M9156C**	**M9157C**
Type	Dual SPDT switches	Dual transfer switches	Single SP6T switch
Slot size	1 slot	2 slots	3 slots
Frequency range	DC to 26.5 GHz [1]	DC to 26.5 GHz [1]	DC to 26.5 GHz [1]
Insertion loss	0.25 + 0.027 GHz DC: 0.25 dB 8 GHz: 0.47 dB 12.4 GHz: 0.58 dB 18 GHz: 0.74 dB 26.5 GHz: 0.96 dB	0.2 + 0.025 GHz DC: 0.20 dB 8 GHz: 0.40 dB 12.4 GHz: 0.51 dB 18 GHz: 0.65 dB 26.5 GHz: 0.86 dB	0.3 + 0.015 GHz DC: 0.30 dB 8 GHz: 0.42 dB 12.4 GHz: 0.49 dB 18 GHz: 0.57 dB 26.5 GHz: 0.70 dB
Isolation	110 – 2.25f (where f is specified in GHz) DC: 110 dB 8 GHz: 92 dB 12.4 GHz: 82 dB 18 GHz: 70 dB 26.5 GHz: 50 dB	110 – 2.2f (where f is specified in GHz) DC: 110 dB 8 GHz: 94 dB 12.4 GHz: 85 dB 18 GHz: 74 dB 26.5 GHz: 57 dB	DC to 12 GHz: 90 dB 12 to 15 GHz: 70 dB 15 to 20 GHz: 65 dB 20 to 26.5 GHz: 60 dB
VSWR	DC to 4 GHz: 1.25 4 to 18 GHz: 1.45 18 to 26.5 GHz: 1.70	DC to 2 GHz: 1.10 2 to 4 GHz: 1.15 12.4 to 20 GHz: 1.40 20 to 26.5 GHz: 1.65	DC to 4 GHz: 1.20 4 to 12.4 GHz: 1.35 12.4 to 20 GHz: 1.45 20 to 26.5 GHz: 1.70
Insertion loss repeatability	0.03 dB	0.03 dB	0.03 dB
Operating life	5 million cycles, 10 million cycles typical	2 million cycles, 5 million cycles typical	2 million cycles, 5 million cycles typical
Connector	3.5 mm (f)	SMA (f)	SMA (f)

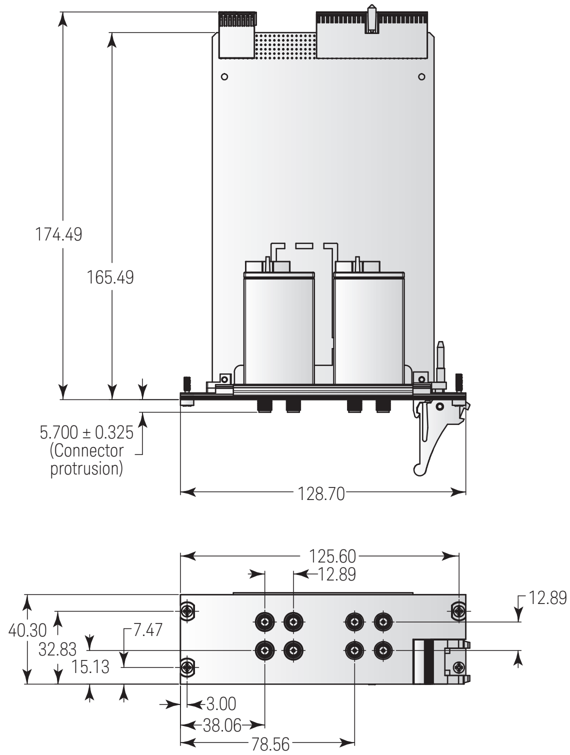
[1] M9155CH40, M9156CH40 and M9157CH40 DC to 40 GHz modules are also available. Refer http://literature.cdn.keysight.com/litweb/pdf/5990-6170EN.pdf

12

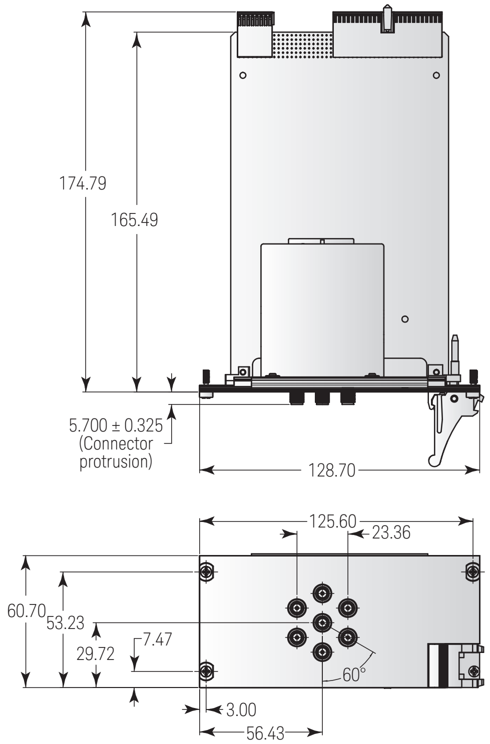
M9155C/CH40 Dual SPDT Switch



M9156C/CH40 Dual Transfer Switch



M9157C/CH40 Single SP6T Switch



Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

M9155C PXI hybrid coaxial switch, DC to 26.5 GHz, dual SPDT, unterminated
M9156C PXI hybrid coaxial switch, DC to 26.5 GHz, dual transfer
M9157C PXI hybrid coaxial switch, DC to 26.5 GHz, single SP6T, terminated
M9155CH40 PXI hybrid coaxial switch, DC to 40 GHz, dual SPDT, unterminated
M9156CH40 PXI hybrid coaxial switch, DC to 40 GHz, dual transfer
M9157CH40 PXI hybrid coaxial switch, DC to 40 GHz, single SP6T, terminated

Related Literature

M9155/6/7C PXI hybrid switch modules DC to 26.5 GHz datasheet, part number **5990-6269EN**

M9155/6/7C and M9155/6/7CH40 DC to 26.5/40 GHz PXI Hybrid Switch Modules flyer, part number **5990-6170EN**

Web Link

www.keysight.com/find/PXIswitch

13 Solid State Switches

Overview

Solid state switches are more reliable and exhibit longer lifetimes than their electromechanical counterparts due to their superior resistance to shock, vibration and mechanical wear. They also offer faster switching times. However, solid state switches have higher insertion loss than electromechanical switches due to their higher innate ON resistance. Therefore solid state switches are preferred in systems where fast switching and long lifetime are essential.

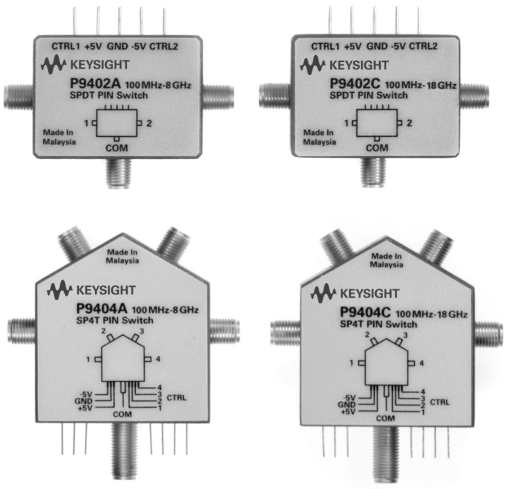
Solid state switches are often used in switch matrix systems for testing of semiconductor devices where high switching speed is critical and power handling requirements are lower.

Specifications

	FET hybrid			PIN diode		
Frequency configuration	**SPDT**	**SP4T**	**Transfer**	**SPDT**	**SP4T**	**Transfer**
300 kHz to 8 GHz	■		■			
100 MHz to 8 GHz				■	■	■
300 kHz to 18 GHz	■		■			
100 MHz to 18 GHz				■	■	■
45 MHz to 50 GHz				■	■	

Family	Model	Frequency	Termination	Isolation (dB)	Insertion loss (dB)	Return loss for ON port (dB)	Switching speed rise/ fall	Typical video leakage (mVpp)	Connector	Input power (average) (dBm)	Driving voltage (VDC)
PIN SPDT											
SPDT	P9402A	100 MHz to 8 GHz	Absorptive	80	3.2	15	380 ns	3400	SMA (f)	23	5
SPDT	P9402C	100 MHz to 18 GHz	Absorptive	80	4	10	380 ns	3400	SMA (f)	23	5
SPDT	85331B	45 MHz to 50 GHz	Absorptive	75	15.5	4.5	1.5 µs	7000	2.4 mm (f)	27	7
SP4T	P9404A	100 MHz to 8 GHz	Absorptive	80	3.5	15	450 ns	2800	SMA (f)	27	5
SP4T	P9404C	100 MHz to 18 GHz	Absorptive	80	4.5	10	450 ns	2800	SMA (f)	27	5
SP4T	85332B	45 MHz to 50 GHz	Absorptive	75	15.5	4.5	1.5 µs	7000	2.4 mm (f)	27	7
PIN transfer											
Transfer	P9400A	100 MHz to 8 GHz	NA	80	3.5	15	200 ns	600	SMA (f)	23	5
Transfer	P9400C	100 MHz to 18 GHz	NA	80	4.2	10	200 ns	600	SMA (f)	23	5
FET SPDT											
FET SPDT	U9397A	300 kHz to 8 GHz	Absorptive	100	3.5	15	5 /0.5 µs	10	SMA (f)	29	12 to 24 V
FET SPDT	U9397C	300 kHz to 18 GHz	Absorptive	90	6.5	10	5 /0.5 µs	10	SMA (f)	27	12 to 24 V
FET transfer											
FET transfer	U9400A	300 kHz to 8 GHz	NA	100	3.5	15	4 /0.5 µs	5	SMA (f)	29	11 to 26 V
FET transfer	U9400C	300 kHz to 18 GHz	NA	90	6.5	10	5 /1 µs	5	SMA (f)	27	11 to 26 V

Solid state switches are standard and do not require option selection.



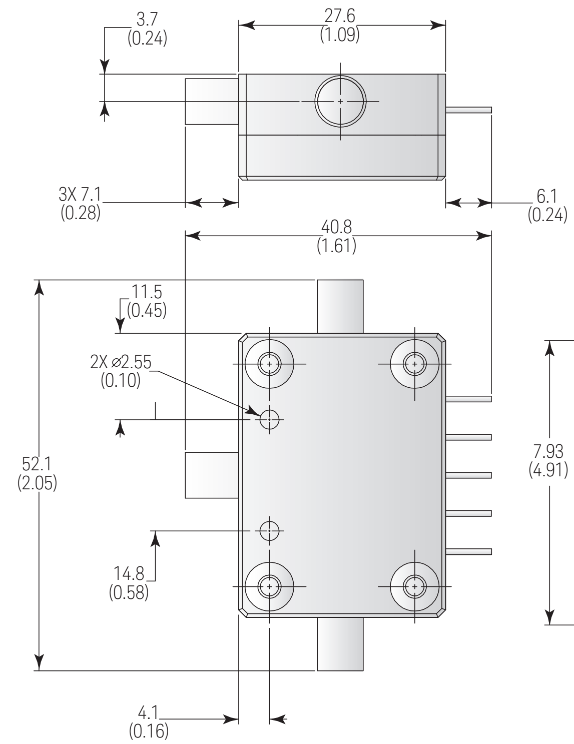
P940xA/C Absorptive Solid State Switches

The P940xA/C absorptive solid state switches, based on PIN diode technology, provide superior performance in terms of isolation, insertion loss and return loss across a broad operating frequency range. The P940xA/C are particularly suitable for high-speed RF and microwave switching applications in instrumentation, communication, radar, switch matrices as well as many other test systems.

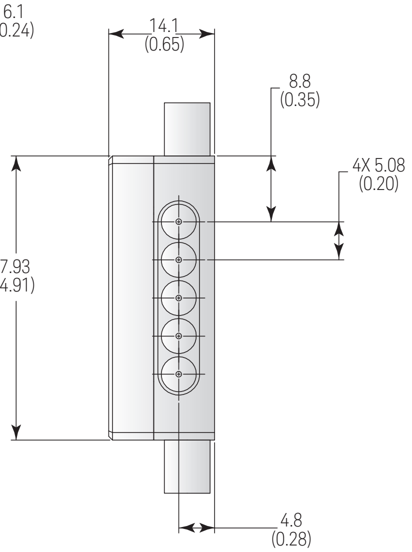
The P9402A/C switches have a SPDT PIN diode individual control switch IC and discrete shunt pin diodes on the RF path. The discrete shunt pin diodes enhance the isolation between ports. The switch's individual control pin controls the port between the ON and OFF state. With these features, the switch provides good port match even when it is off. Hence, this SPDT switch has three switching states, switching between the common port and port 1 or port 2 or ports OFF.

The P9404A/C switches have a SP4T PIN diode switch IC and discrete shunt pin diodes on the RF path. The P9404A/C SP4T switches have five switching states, switching between the common port to any one of the 4 output ports or, all ports to the OFF state (terminated at 50 Ω).

P9402A/C Solid State Switch

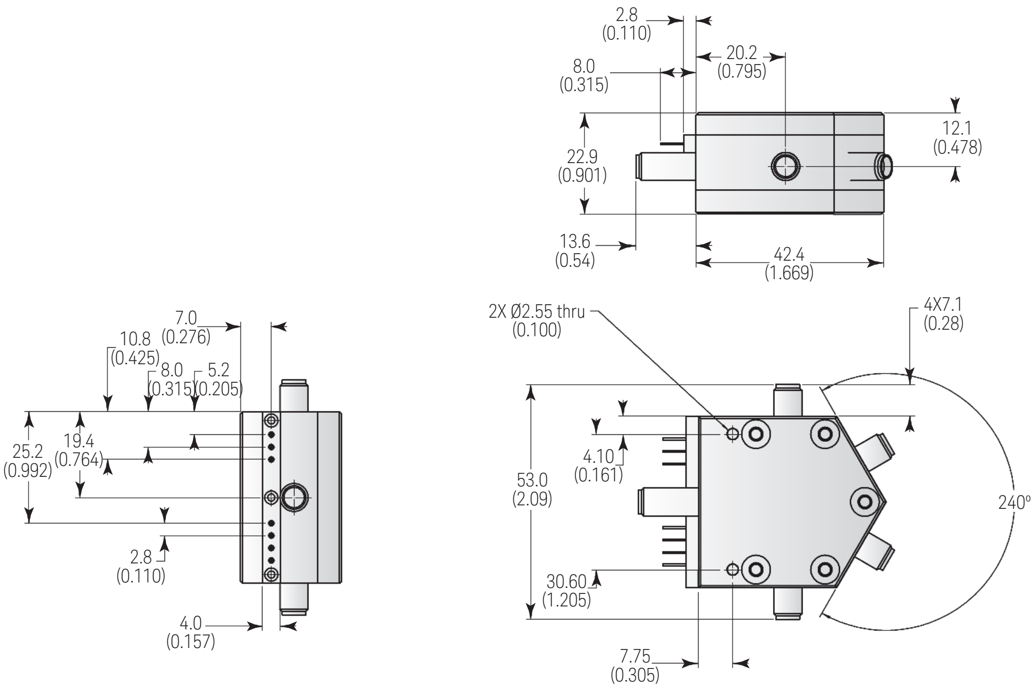


Model	Weight
P9402A/C	50 g
P9404A/C	105 g



Dimensions are in mm (inches) nominal, unless otherwise specified.

P9404A/C Solid State Switch



Dimensions are in mm (inches) nominal, unless otherwise specified.

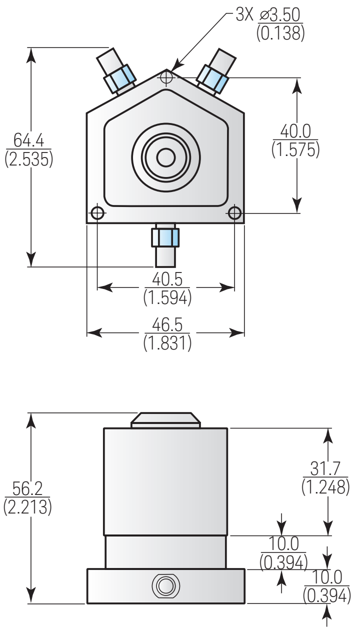
85331B and 85332B Solid State Switches

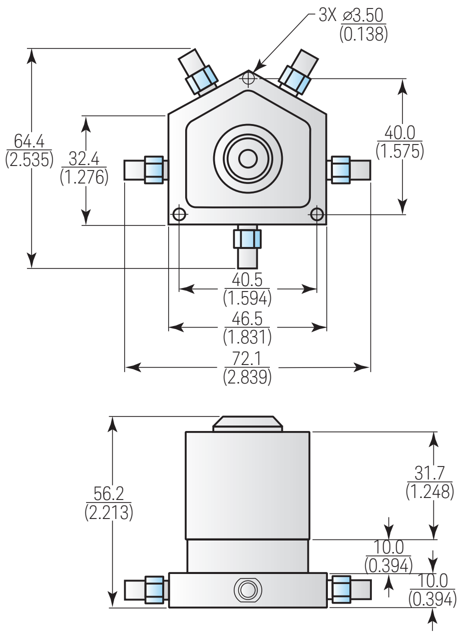
The 85331B and 85332B are absorptive PIN diode solid state switches which provide superior performance in terms of high isolation and fast switching speed across a broad operating frequency range. The absorptive solid state switches are designed for high frequency, single- SP2T/SP4T operation and are extremely useful for applications in instrumentation, communications, radar, and many other test systems that require high speed RF & microwave switching.

The absorptive characteristic of the switches, provide a good impedance match, which is key to achieving accurate measurements.

Each output port has a PIN diode in series. The DC bias is used to turn on and off the pin diode depending on which port is selected. There are some PIN diodes that shunt to ground in RF port, to improve the isolation of the switches.

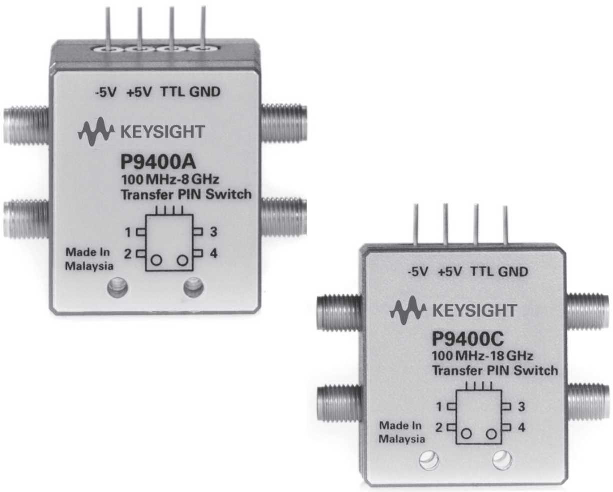
85331B and 85332B Solid State Switch





Model	Weight
85331B	360 g
85332B	360 g

Dimensions are in mm (inches) nominal, unless otherwise specified.



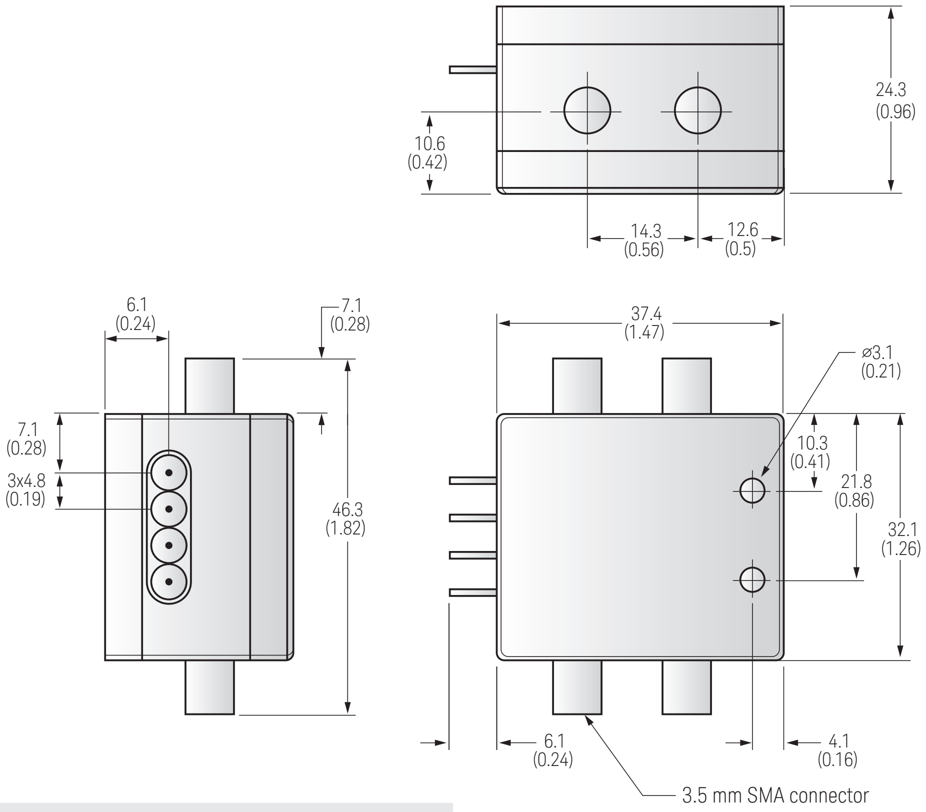
P9400A/C Solid State Switch

P9400A/C Solid State Switches

The P9400A/C solid state PIN diode transfer switches offer outstanding performance in isolation, insertion loss and return loss across a broad operating frequency range. Based on PIN diode technology, P9400A/C fit exceptionally well into ultra-fast RF and microwave switching applications in instrumentation, communications, radar, switch matrices and various other test systems where speed and lifetime of a switch are critical.

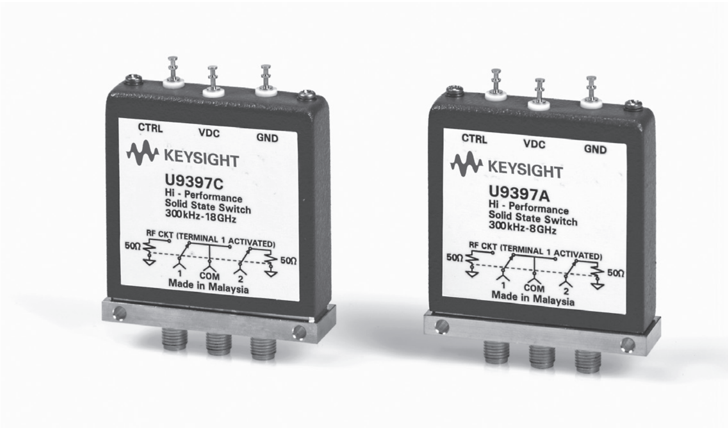
A PIN diode switch IC and multiple shunt PIN diodes on the RF path of the P9400A/C ensure unmatched isolation performance between ports. Keysight's careful selection of the PIN diodes provides accurate low frequency measurements down to 100 MHz, while maintaining superb performance up to 8 GHz (P9400A) and 18 GHz (P9400C).

P9400A/C have an integrated TTL-compatible driver for easy operation. These transfer switches increase system flexibility and are useful in systems where superior RF performance switches is critical.



	P9400A	P9400C
Length, mm (inches)	46.2 (1.82)	46.2 (1.82)
Width, mm (inches)	43.4 (1.71)	43.4 (1.71)
Net weight, kg (lb)	0.07 (0.154)	0.07 (0.154)

Dimensions are in mm (inches) nominal, unless otherwise specified.



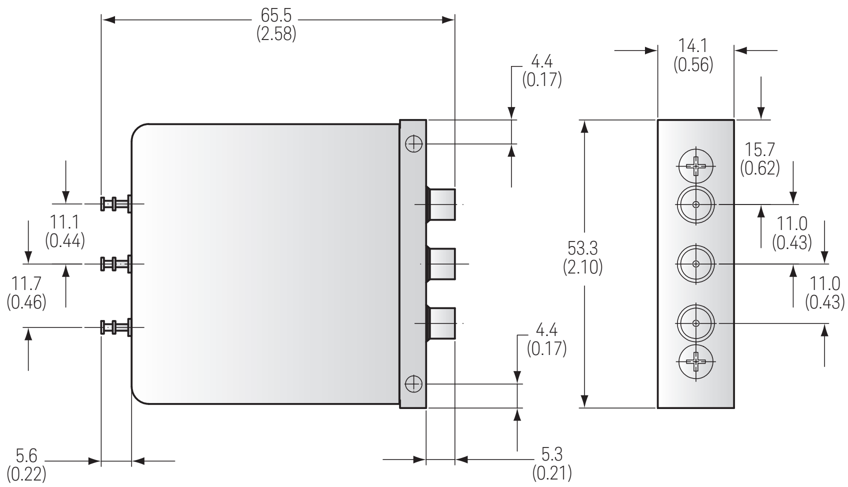
U9397A/C Solid State Switches

The U9397A and U9397C FET solid state switches, SPDT provide superior performance in terms of video leakage, isolation, settling time and insertion loss across a broad operating frequency range. The U9397A/C are particularly suitable for measuring sensitive devices and components, such as mixers and amplifiers, where video leakage may cause damage or reliability issues. High isolation minimizes crosstalk between measurements, ensuring accurate testing and improving yields. A switching speed of 500 ns makes these switches ideal for high-speed RF and microwave SPDT switching applications in instrumentation, communications, radar, and many other test systems.

The U9397A/C incorporate a patented design which reduces the settling time to < 350 µs (measured to 0.04 dB of the final value). Other FET switches available today have a typical settling time of > 50 ms.

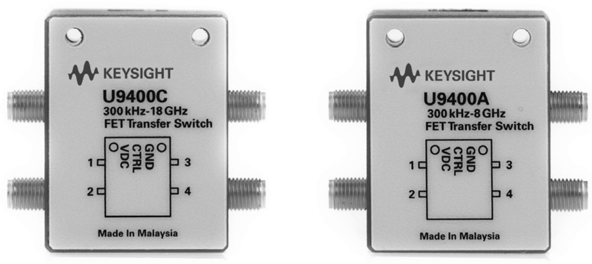
The U9397A/C switches have a GaAs FET MMIC at each RF port, and the integrated TTL/CMOS driver is configured in such a way that when either the RF1 or RF2 port is not selected to RFCOM, the port is terminated to 50 Ω.

U9397A/C Solid State Switch



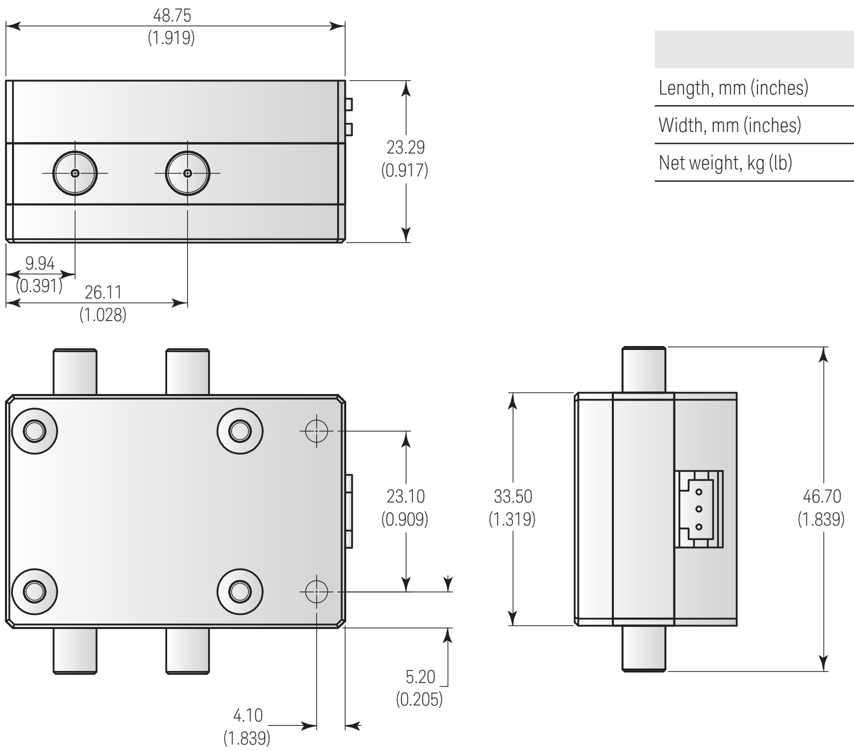
	U9397A	U9397C
Length, mm (inches)	65.5 (2.58)	65.5 (2.58)
Width, mm (inches)	53.3 (2.1)	53.3 (2.1)
Net weight, kg (lb)	0.055 (0.121)	0.055 (0.121)

Dimensions are in mm (inches) nominal, unless otherwise specified.



The U9400A/C solid state FET transfer switches offer superior performance in terms of isolation and video leakage across a broad operating frequency range. The U9400A/C enable high-performance testing from frequencies as low as 300 kHz up to 8 GHz within the U9400A and 18 GHz with the U9400C. These transfer switches are used to increase system flexibility and simplicity, and are easily controlled with an integrated TL-compatible driver.

U9400A/C Solid State Switch



Dimensions are in mm (inches) nominal, unless otherwise specified.

Related Literature

RF and microwave switch selection guide, part number **5989-6031EN**
Video leakage effects on devices in component test application note, part number **5989-6086EN**
Selecting the right switch technology for your application, part number **5989-5189EN**
Understanding RF/microwave solid state switches and their applications, part number **5989-7618EN**
Keysight antenna test selection guide, part number **5968-6759E**

U9400A/C Solid State Switches

The U9400A/C switches offer unmatched isolation performance between ports, as high as 100 dB at 8 GHz and 90 dB at 18 GHz. In addition, The U9400A/C FET switches provide low video leakage of less than 5mVpp which ensures safe testing of sensitive components. High video leakage can degrade measurement accuracy and possibly damage sensitive components or equipment. Low video leakage makes these switches particularly suited for measuring sensitive devices and components such as mixers and amplifiers. To learn more about video leakage and how it can affect measurements and devices, see Keysight Video Leakage Effects on Device in Component Test Application Note, part number 5989-6086EN.

The U9400A/C also feature an industry-leading settling time of < 0.35 ms, measured to 0.04 dB of the final value (the typical settling time of FET switches is > 50 ms). This equates to a 500 ns switching speed making the U9400A/C ideal for RF and microwave switching applications in instrumentation, communication, radar, switch matrices and various other test systems where speed and lifetime of a switch are critical.

	U9400A	U9400C
Length, mm (inches)	48.75 (1.919)	48.75 (1.919)
Width, mm (inches)	46.7 (1.839)	46.7 (1.839)
Net weight, kg (lb)	0.095 (0.209)	0.095 (0.209)

Web Link

www.keysight.com/find/mta

14 Loads & Impedance Matching Pad

909 Series Fixed Loads

The 909 Series are fixed low-reflection loads for terminating a 50 Ω (75 Ω for 909E) coaxial system in its characteristic impedance. Whereas the 909A is designed for general purpose applications, the 909C/D/E/F series are intended for use as calibration standards. All loads are widely used as accessories for both broadband and narrowband measurement instruments, with models covering DC to 26.5 GHz.

909A coaxial termination, DC to 18 GHz

909C coaxial termination, DC to 2 GHz

909D coaxial termination, DC to 26.5 GHz

909E coaxial termination, DC to 3 GHz

909F coaxial termination, DC to 18 GHz

Specifications

Model	Impedance	Frequency range (GHz)	Specification (VSWR)	Maximum power	Connector type	Length mm (in)	Diameter mm (in)	Shipping weight kg (lb)
909A	50 Ω	DC to 18	DC to 4 GHz: 1.05 4 to 12.4 GHz: 1.1 12.4 to 18 GHz: 1.25	2 W avg. 300 W peak	APC-7	45 (1.8)	22 (0.9)	0.2 (0.5)
909A Option 012	50 Ω	DC to 18	DC to 4 GHz: 1.06 4 to 12.4 GHz: 1.11 12.4 to 18 GHz: 1.30	2 W avg. 300 W peak	N (m)	52 (2.1)	22 (0.9)	0.2 (0.5)
909A Option 013	50 Ω	DC to 18	DC to 4 GHz: 1.06 4 to 12.4 GHz: 1.11 12.4 to 18 GHz: 1.30	2 W avg. 300 W peak	N (f)	52 (2.1)	18 (0.7)	0.2 (0.5)
909C	50 Ω	DC to 2	1.005	1/2 W avg. 100 W peak	APC-7	51 (2)	22 (0.9)	0.2 (0.5)
909C Option 012	50 Ω	DC to 2	1.01	1/2 W avg. 100 W peak	N (m)	51 (2)	21 (0.8)	0.2 (0.5)
909C Option 013	50 Ω	DC to 2	1.01	1/2 W avg. 100 W peak	N (f)	51 (2)	17 (0.7)	0.2 (0.5)
909D	50 Ω	DC to 26.5	DC to 3 GHz: 1.02 3 to 6 GHz: 1.036 6 to 26.5 GHz: 1.12	2 W avg. 100 W peak	3.5 mm (m)	23 (0.9)	9 (0.4)	0.2 (0.5)
909D Option 011	50 Ω	DC to 26.5	DC to 3 GHz: 1.02 3 to 6 GHz: 1.036 6 to 26.5 GHz: 1.12	2 W avg. 100 W peak	3.5 mm (f)	23 (0.9)	8 (0.3)	0.2 (0.5)
909D Option 040	50 Ω	DC to 26.5	DC to 4 GHz: 1.02 4 to 6 GHz: 1.036 6 to 26.5 GHz: 1.12	2 W avg. 100 W peak	3.5 mm (m)	23 (0.9)	8 (0.3)	0.2 (0.5)
909E	75 Ω	DC to 3	DC to 2 GHz: 1.01 2 to 3 GHz: 1.02	1/2 W avg. 100 W peak	N (m)	51 (2)	21 (0.8)	0.2 (0.5)
909E Option 011	75 Ω	DC to 3	DC to 2 GHz: 1.01 2 to 3 GHz: 1.02	1/2 W avg. 100 W peak	N (f)	51 (2)	16 (0.6)	0.2 (0.5)
909F	50 Ω	DC to 18	DC to 5 GHz: 1.005 5 to 6 GHz: 1.01 6 to 18 GHz: 1.15	1/2 W avg. 100 W peak	APC-7	51 (2)	22 (0.9)	0.2 (0.5)
909F Option 012	50 Ω	DC to 18	DC to 2 GHz: 1.007 2 to 3 GHz: 1.01 3 to 6 GHz: 1.02 6 to 18 GHz: 1.15	1/2 W avg. 100 W peak	N (m)	51 (2)	21 (0.8)	0.2 (0.5)
909F Option 013	50 Ω	DC to 18	DC to 2 GHz: 1.007 2 to 3 GHz: 1.01 3 to 6 GHz: 1.02 6 to 18 GHz: 1.15	1/2 W avg. 100 W peak	N (f)	51 (2)	17 (0.7)	0.2 (0.5)
85138A	50 Ω	DC to 50	DC to 26.5 GHz: 1.065 26.5 to 40 GHz: 1.118 40 to 50 GHz: 1.220	1/2 W avg. 100 W peak	2.4 mm (m)	20 (0.78)	8 (0.31)	0.3 (0.6)
85138B	50 Ω	DC to 50	DC to 26.5 GHz: 1.065 26.5 to 40 GHz: 1.118 40 to 50 GHz: 1.220	1/2 W avg. 100 W peak	2.4 mm (f)	20.95 (0.82)	8.25 (0.32)	0.3 (0.6)

LOADS – Fixed Terminations (continued)

Selection Guide

Connector type		APC-7	Type-N (m)	Type-N (f)	3.5 mm (m)	3.5 mm (f)	2.4 mm (m)	2.4 mm (f)
50 Ω	DC to 2 GHz	909C	909C Option 012	909C Option 013				
50 Ω	DC to 18 GHz	909A 909F	909A Option 012 909F Option 012	909A Option 013 909F Option 013				
50 Ω	DC to 26.5 GHz				909D 909D Option 040	909D Option 011		
50 Ω	DC to 50 GHz						85138A	85138B
75 Ω	DC to 3 GHz		909E	909E Option 011				

Ordering Information/Accessories

909A coaxial 50 Ω termination, DC to 18 GHz
- **909A-012** type N (m) connector
- **909A-013** type N (f) connector
- **909A-701** APC-7 connector

909C coaxial 50 Ω termination, DC to 2 GHz
- **909C-012** type N (m) connector
- **909C-013** type N (f) connector
- **909C-701** APC-7 connector

909D coaxial 50 Ω termination, DC to 26.5 GHz
- **909D-011** 3.5 mm female termination
- **909D-040** 3.5 mm male termination DC to –4 GHz 1.01 MAX SWR
- **909D-301** 3.5 mm (m) termination

909E Coaxial 75 Ω termination, DC to 3 GHz
- **909E-011** type N (f) connector
- **909E-101** type N (m) connector

909F coaxial 50 Ω termination, DC to 18 GHz
- **909F-012** type N (m) connector
- **909F-013** type N (f) connector
- **909F-701** APC-7 connector

85138A coaxial 50 Ω termination 2.4 mm male connector

85138B coaxial 50 Ω termination 2.4 mm female connector

Related Literature

909A coaxial termination technical overview, part number **5990-8462EN**

909C precision coaxial termination datasheet, part number **5952-0273**

909D coaxial termination datasheet, part number **5952-0274**

909E precision coaxial termination datasheet, part number **5952-0832**

909F precision coaxial termination datasheet, part number **5091-2815E**

Web Link

www.keysight.com/find/mta

11852B impedance matching adapter

Overview

Impedance matching adapters are instrument grade tools used in RF and microwave signal matching that adapt 50 Ω impedance to 75 Ω impedance and vice versa. They are used in measurement setups that require impedance conversion.

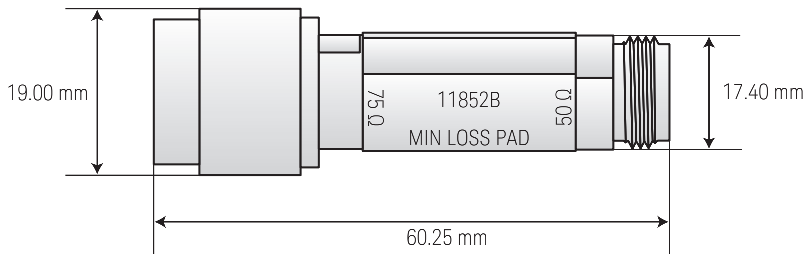
11852B Impedance Matching Adapter

The 11852B 50 Ω/75 Ω minimum loss adapter is a 50 Ω to 75 Ω or 75 Ω to 50 Ω impedance converter with type-N connectors. Use the 11852B minimum loss pad with 75 Ω network analyzers, such as 8753ES-075, and 50 Ω network analyzers, such as 8753A. Or use it in any application that requires 50 Ω/75 Ω impedance conversion with low SWR.

Specifications

Model	Type	Frequency range (GHz)	Return loss (VSWR)	Insertion loss (dB)	Max input power (mW)
11852B	50 Ω type-N (f), 75 Ω type-N (m)	DC to 3	75 Ω side (50 Ω side terminated): 1.05	5.7	250
11852B Option 004	75 Ω type-N (f), 50 Ω type-N (m)	DC to 3	50 Ω side (75 Ω side terminated): 1.09	5.7	250

11852B Impedance Matching Adapter



Dimensions are in mm (inches) nominal, unless otherwise specified.

Ordering Information

Standard connectors 50 Ω type-N (f), 75 Ω type-N (m)
Option 004 connectors 75 Ω type-N (f), 50 Ω type-N (m)

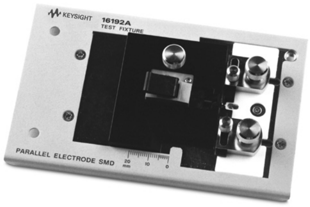
Related Literature

11825B minimum loss pad user's and service guide, part number **11852-90009**

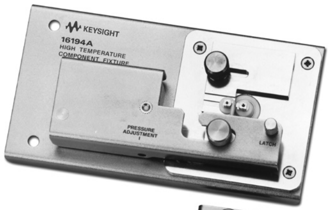
Web Link

www.keysight.com/find/mta

15 Impedance Test Accessories



16192A parallel electrode
SMD test fixture

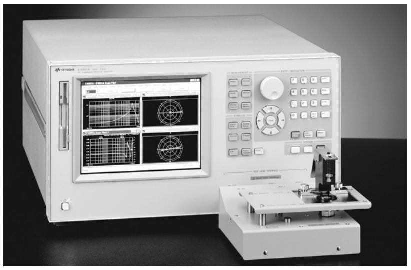


16194A high temperature
component test fixture

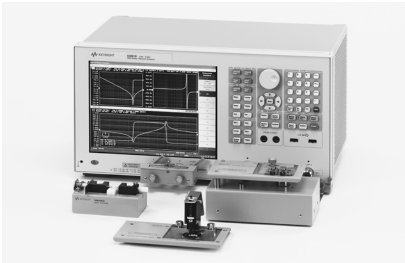
16196A/B/C/D parallel electrode
SMD test fixture

16197A bottom electrode
SMD test fixture

4287A
RF LCR meter 1 MHz to 3 GHz



E4991A
RF impedance/material analyzer
1 MHz to 3 GHz



E5061B
* 16201A Terminal adapter is required to connect 7-mm test fixtures for the E5061B-3L5
* E5061B Option 005 adds impedance analysis function to the E5061B-3L5

Overview

Impedance test accessories are designed to make measurements of passive components simple and reliable when using the Keysight RF LCR meters or impedance analyzers. Keysight 16192A, 16194A, 16196A/B/C/D and 16197A Series test fixtures allow impedance measurements of SMD passive components up to 3 GHz.

16192A Parallel Electrode SMD Test Fixture

This test fixture is designed for impedance evaluations of parallel electrode SMD components. The minimum SMD size that this fixture is adapted to evaluate is 1 (L) [mm].

16194A High Temperature Component Test Fixture

This test fixture is designed for measuring both axial/radial leaded devices and SMD components within the temperature range from –55 to +200 °C (recommended to be used with Keysight E4991A-007 temperature characteristic test kit (–55 to +150 °C).

16196A/B/C/D Parallel Electrode SMD Test Fixture

This test fixture is designed for impedance evaluations of parallel electrode SMD components. It accommodates small SMD sizes : 0603 (inch)/1608 (mm), 0402 (inch)/1005 (mm), 0201 (inch)/0603 (mm) or 01005 (inch)/0402 (mm). In addition, it provides highly repeatable measurements and achieves stable frequency characteristics at 3 GHz.

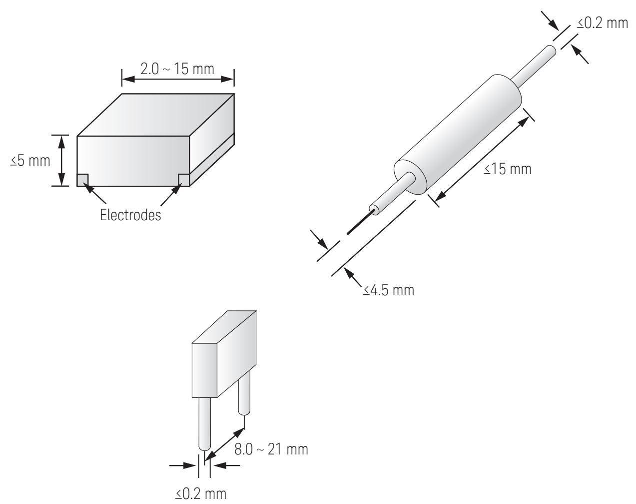
16197A Bottom Electrode SMD Test Fixture

This test fixture is designed for impedance evaluations of bottom electrode SMD components up to 3 GHz. This test fixture accommodates various sizes of SMDs; as small as 1005 (mm)/0402 (inch) and as large as 3225 (mm)/1210 (inch). Accommodation of the 0603 (mm)/0201 (inch) SMD is available with Option 001.

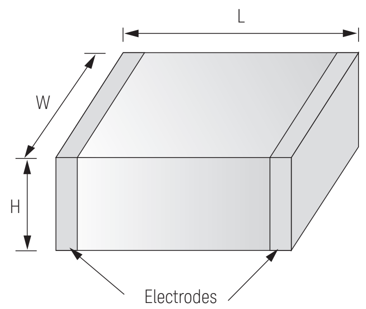
Specifications/Applicable DUT Size

Keysight model	Frequency range	Terminal connector	Maximum voltage peak max (AC + DC)	Operating temperature	Electrode configuration	Device under test size
16192A	DC to 2 GHz	7 mm	±42 V	–55 to +85 °C	Parallel	1.0 to 20 mm (length)
16194A	DC to 2 GHz	7 mm	±42 V	–55 to +200 °C	Bottom	See figures below
16196A	DC to 3 GHz	7 mm	±42 V	–55 to +85 °C	Parallel	0603 (inch)/1608 (mm)
16196B	DC to 3 GHz	7 mm	±42 V	–55 to +85 °C	Parallel	0402 (inch)/1005 (mm)
16196C	DC to 3 GHz	7 mm	±42 V	–55 to +85 °C	Parallel	0201 (inch)/0603 (mm)
16196D	DC to 3 GHz	7 mm	±42 V	–55 to +85 °C	Parallel	01005 (inch)/0402 (mm)
16197A	DC to 3 GHz	7 mm	±42 V	–55 to +85 °C	Bottom	0.6 (Opt.001) to 3.2 mm (length)

16194A



16196A/B/C/D



Model	Length (L) x Width (W) x Height (H)
16196A	(1.6 ± 0.15) x (0.8 ± 0.15) x (0.4 to 0.95) mm
16196B	(1.0 ± 0.1) x (0.5 ± 0.1) x (0.3 to 0.6) mm
16196C	(0.6 ± 0.03) x (0.3 ± 0.03) x (0.27 to 0.33) mm
16196D	(0.4

Ordering Information/Accessories

16192A parallel electrode SMD test fixture
- **16192A-010** EIA/EIAJ industry sized short bar set
- **16192A-701** short bars set
  (1 x 1 x 2.4, 1.6 x 2.4 x 2, 3.2 x 2.4 x 2.4, 4.5 x 2.4 x 2.4) mm
- **16192A-710** add magnifying lens and tweezers

16194A high temperature component test fixture
- **16194A-010** EIA/EIAJ industry sized short bar set
- **16194A-701** short bars set
  (1 x 1 x 2.4, 1.6 x 2.4 x 2, 3.2 x 2.4 x 2.4, 4.5 x 2.4 x 2.4) mm

16196A parallel electrode SMD test fixture for 0603 (inch)/1608 (mm)
- **16196A-710** add magnifying lens and tweezers

16196B parallel electrode SMD test fixture for 0402 (inch)/1005 (mm)
- **16196B-710** add magnifying lens and tweezers

16196C parallel electrode SMD test fixture for 0201 (inch)/0603 (mm)
- **16196C-710** add magnifying lens and tweezers

16196D parallel electrode SMD test fixture for 01005 (inch)/0402 (mm)
- **16196D-710** add magnifying lens and tweezers

16197A bottom electrode SMD test fixture
- **16197A-001** add 0201 (inch)/0603 (mm) device guide set

Related Literature

Keysight LCR meters, impedance analyzers and test fixtures selection guide, part number **5952-1430E**
Keysight accessories selection guide for impedance measurements, part number **5965-4792E**

Web Link

www.keysight.com/find/impedance

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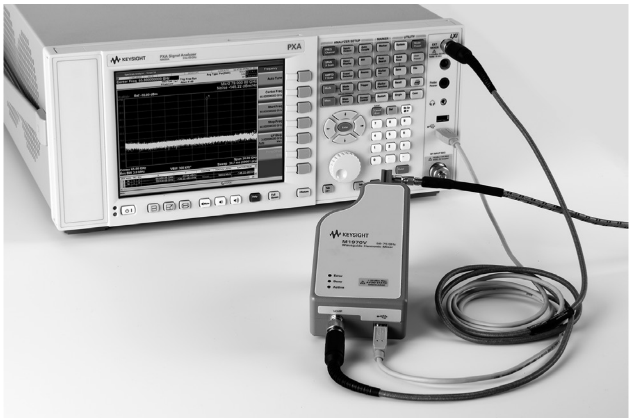
External Mixers



M1970x Series Waveguide Harmonic Mixers

M1970 Series Waveguide Harmonic Mixers

Keysight smart mixers are used to extend the operating frequencies of the N9040B UXA, N9030A PXA, N9020A MXA, and N9010A EXA signal analyzers up to 110 GHz for millimeter-wave applications. These smart mixers use a simple USB plug-and-play connection that can automatically configure the UXA/PXA/MXA/EXA for the specific mixer connected, including downloading conversion loss data and automatically compensate for local oscillator path loss. Therefore, it provides you with the most efficient test setup and reduce the overall startup operations with better performance with its embedded smart features when used with Keysight X-series signal analyzers.

M1970 Series Compatibility

The M1970 series waveguide harmonic mixers are compatible with Keysight N9040B UXA, N9030A PXA, N9020A MXA, and N9010A EXA signal analyzers.

Features

- Automatic amplitude correction and transfer of conversion loss data through USB plug and play features
- Automatic LO amplitude adjustment to compensate for cable loss (up to 3 m or 10 dB loss)
- Automatically detect mixer model/serial number when used with N9040B UXA, N9030A PXA, N9020A MXA, and N9010A EXA signal analyzer
  - Automatic setting of the default frequency range and LO harmonic numbers
  - Automatic LO alignment at start up
  - Automatic run calibration when time and temperature changes

11970 Series Harmonic Mixers

These waveguide mixers are general purpose harmonic mixers, covering from 18 to 110 GHz. They employ a dual-diode design to achieve flat frequency response and low conversion loss without external DC bias. Manual operation and automatically controlled hardware operation are simplified because mixer bias and tuning adjustment are not required. Each mixer is calibrated across its full band.

11970 Series Compatibility

The 11970 Series harmonic mixers extend the frequency coverage of the Keysight spectrum analyzers including PSA (E4440A/46A/48A), ESA (E4407B), 856xEC, and others.

The 11970 Series harmonic mixers (11970K excluded) are also compatible with the Keysight N9030A PXA high-performance signal analyzers with external mixing (Option EXM). An external diplexer and a PXA-based calibration file are required. The PXA with 11970 Series mixers offers sensitivity advantages in the frequencies covered.

11970 Series Specifications

IF range DC to 1.3 GHz
LO amplitude range +14 to +16 dB; +16 optimum
Calibration accuracy ±2.0 dB for 11970 Series with optimum LO amplitude
Typical RF input SWR < 2.2:1, < 3.0:1 for 11974 Series
Bias requirements none
Typical odd-order harmonic suppression > 20 dB (does not apply to Keysight 11974 Series)
Maximum CW RF input level +20 dBm (100 mW), +25 dBm for 11974 Series
Maximum peak pulse power 24 dBm (250 mW) with < 1 µs pulse (average power = +20 dBm)
Bandwidth 100 MHz minimum (11974 Series only)
Environmental Meets MIL-T-28800C, Type III, Class 3, Style C
IF/LO connectors SMA female
Tune IN connector BNC
LO range 3.0 to 6.1 GHz

Specifications (Apply when connected to Keysight X-Series signal analyzers)

Model	Frequency range (GHz)	IF bandwidth[1] (MHz)	Maximum conversion loss[2] (dB)	Calibration accuracy[3] (dB) (nominal)	Gain compression level (< 1 dB) (nominal)	Input SWR (nominal)	Noise figure[4] (dB) (nominal)	System displayed average noise level (DANL) at 1 Hz resolution bandwidth[5] (dBm) (nominal)
M1970E	60 to 90		27				38	-136
M1970V	50 to 75/80		23				34	-141
M1970W	75 to 110	200 to 500	25	+/- 2.2	0 dBm	2.6	36	-138

[1] The M1970E/V/W are designed to work with the EXA/PXA IF frequencies. With PXA option CR3, other IF frequencies can be supported for special applications
[2] Connversion loss value shown include the effect of an internal IF amplifier
[3] Calibration accuracy is the difference between the conversion loss factors measured and programmed into the M1970E/V/W at the factory and the actual conversion loss of the mixer experienced when used with an X-series signal analyzer with option EXM. The values shown include test system uncertainty, interpolation error, and the effects of the difference between the X-series environment and the factory calibration environment. The system amplitude accuracy is worse than this M1970E/V/W only calibration accuracy due to SWR effects between the M1970E/V/W and the X-series IF input, and due to Gain Accuracy at the IF input in Option EXM of the X-series analyzer used.
[4] The values shown are the noise figures of the M1970E/V/W alone. They include effects of the internal IF amplifier. The system noise figure when connected to an X-series analyzer will be higher, by nominally 0.8 dB
[5] System DANL includes the effect of an X-series analyzer and cable as well as the M1970E/V/W. DANL is defined with log-scale averaging according to the industry conventions. The noise density is about 2.25 dB higher than DANL

Specifications (Apply when connected to the Keysight PSA, ESA, 856x or 7000 Series Spectrum Analyzers)

Model	Frequency range (GHz)	LO harmonic number	Maximum conversion loss (dB)	Noise level (dBm) 1 kHz RBW	Frequency[1] response (dB)	1 dB Gain[2] compression (dBm)
11970K	18 to 26.5	6	24	–105	±1.9	–3
11970A	26.5 to 40	8	26	–102	±1.9	–5
11970Q	33 to 50	10	28	–101	±1.9	–7
11970U	40 to 60	10	28	–101	±1.9	–7
11970V	50 to 75	14	40	–92	±2.1	–3
11970W	75 to 110	18	47	–85	±3.0	–1

[1] Frequency of the mixers is reduced by 1 dB with LO input power of 14.5 to 16.0 dBm.
[2] Typical characteristic

Specifications (Apply when connected to the Keysight PXA Signal Analyzer)

Model	Frequency range (GHz)	LO harmonic number[1]	Maximum conversion loss (dB)	Noise level (dBm)[2] 1 kHz BW	Frequency[1] response (dB)	Typical Gain compression (dBm)
11970A	26.5 to 40	6/8	26	–110/–108	±1.9	–5
11970Q	33 to 50	8/10	28	–108/–106	±1.9	–7
11970U	40 to 60	10	28	–106	±1.9	–7
11970V	50 to 75	12/14	40	–96/–94	±2.1	–3
11970W	75 to 110	18	46	–88	±3.0	–1

[1] When used with 11970 Series mixer in A-, Q-, or V-band, the PXA's LO harmonics are automatically switched between 2 different numbers as listed to optimize conversion loss.
[2] If the LO harmonics are switched, the noise levels for the signal analyzer/mixer combination will change corresponding to the different LO harmonic numbers.

Ordering Information

U7227A 10 MHz to 4 GHz USB preamplifier
U7227C 100 MHz to 26.5 GHz USB preamplifier
U7227F 2 to 50 GHz USB preamplfier
M1970E 60 to 90 GHz waveguide harmonic mixer
M1970V
Option 001: 50 to 75 GHz waveguide harmonic mixer
Option 002: 50 to 80 GHz waveguide harmonic mixer
M1970W 75 to 110 GHz waveguide harmonic mixer
LO cable options (optional)
Option 101: 1 meter LO cable
Option 102: 3 meter LO cable

USB cable options (optional)
Option 201: 1.8 meter USB cable
Option 202: 3 meter USB cable
Jackstand (optional)
Option 301: Standard jackstand for mixer
11970 Series Harmonic Mixers
11970 Series mixer, carrying case with storage space for cables and tools included.
11970-009 mixer connection set adds three-1 meter low-loss SMA cables, wrench, allen driver for any
11970A 26.5 to 40 GHz mixer
11970K 18 to 26.5 GHz mixer
11970Q 33 to 50 GHz mixer
11970U 40 to 60 GHz mixer
11970V 50 to 75 GHz mixer
11970W 75 to 110 GHz mixer

Web Link
www.keysight.com/find/mta

Web Link
www.keysight.com/find/smartmixers

17 Network Analyzer Accessories and Calibration Kits

Overview

Accessories for the ENA Series and PNA Series network analyzers include a variety of calibration kits, verification kits, cables, and adapters from DC to 110 GHz.

Calibration Kits

Error-correction procedures require that the systematic errors in the measurement system be characterized by measuring known devices (standards) on the system over the frequency range of interest. Keysight offers two types of calibration kits: mechanical and electronic.

Electronic Calibration Kits

ECal modules consist of a connector-specific electronic calibration standard. Modules are available with type-F, type-N (50 and 75 Ω), 7-16, 7 mm, 3.5 mm, 2.92 mm, 2.4 mm, and 1.85 mm connectors. All 2-port modules, except 7 mm, have one male and one female connector. Options exist for modules with two male or two female connectors. Keysight also makes 4-port ECal modules with different connector types and various combinations of male and female connectors. ECal modules are controlled directly by the ENA Series and PNA Series network analyzers via its USB port.

Mechanical Calibration Kits

All network analyzer coaxial mechanical calibration kits contain precision standard devices to characterize the systematic errors of the ENA Series and PNA Series network analyzers. Many mechanical calibration kits also contain adapters for test ports and a torque wrench for proper connection.

Verification Kits

Measuring known devices, other than the calibration standards, is a straightforward way of verifying that the network analyzer system is operating properly. Keysight offers verification kits that include precision airlines, mismatch airlines, and precision-fixed attenuators. Traceable measurement data is shipped with each kit on disk and USB memory stick. Verification kits may be recertified by Keysight Technologies. This recertification includes a new measurement of all standards and new data with uncertainties.

Coaxial Mechanical Calibration Kits

Connector	Frequency range (GHz)	Type	VNA calibration accuracy	Model	Available options	Page
Type-F (75 Ω)	DC to 3	Economy	5% – 1%	85039B	1A7, A6J, UK6, 00M, 00F, M0F	161
Type-N (75 Ω)	DC to 3	Economy	5% – 1%	85036E	UK6	161
Type-N (75 Ω)	DC to 3	Standard	5% – 1%	85036B	1A7, A6J, UK6	161
Type-N (50 Ω)	DC to 6	Economy	5% – 1%	85032E	1A7, A6J, UK6	162
Type-N (50 Ω)	DC to 9	Standard	5% – 1%	85032F	1A7, A6J, UK6, 100, 200, 300, 500*	163
Type-N (50 Ω)	DC to 18	Economy	5% – 1%	85054D	1A7, A6J, UK6	164
Type-N (50 Ω)	DC to 18	Standard	2% – 0.3%	85054B	UK6	163
7-16	DC to 7.5	Standard	2%	85038A	N/A	164
7-16 (female)	DC to 7.5	Standard	2%	85038F	N/A	164
7-16 (male)	DC to 7.5	Standard	2%	85038M	N/A	164
7 mm	DC to 6	Economy	2% – 0.3%	85031B	1A7, A6J, UK6	165
7 mm	DC to 18	Economy	5% – 1%	85050D	N/A	165
7 mm	DC to 18	Standard	2% – 0.05%	85050B	N/A	166
7 mm	DC to 18	Precision	0.3% – 0.05%	85050C	UK6	166
3.5 mm	DC to 9	Standard	5% – 1%	85033E	1A7, A6J, UK6, 100, 200, 300, 400, 500	167
3.5 mm	DC to 26.5	Economy	5% – 1%	85052D	1A7, A6J, UK6	168
3.5 mm	DC to 26.5	Standard	3% – 0.5%	85052B	1A7, A6J, UK6	169
3.5 mm	DC to 26.5	Precision	2% – 0.5%	85052C	1A7, A6J, UK6	170
2.4 mm	DC to 50	Economy	5% – 1%	85056D	UK6	171
2.4 mm	DC to 50	Standard	4% – 0.5%	85056A	A6J, UK6	172
1.85 mm	DC to 67	Economy		85058E	1A7, A6J, UK6	173
1.85 mm	DC to 67	Standard		85058B	1A7, A6J, UK6	174
1 mm	DC to 110	Precision	5% – 1%	85059A	1A7, A6J, UK6	175

Waveguide Mechanical Calibration Kits

Connector	Frequency range (GHz)	Type	VNA calibration accuracy	Model	Available options	Page
WR-90	8.2 to 12.4	Precision	0.3% – 0.05%	X11644A	1A7, A6J, UK6	176
WR-62	12.4 to 18	Precision	0.3% – 0.05%	P11644A	1A7, A6J, UK6	176
WR-42	18 to 26.5	Precision	0.3% – 0.05%	K11644A	1A7, A6J, UK6	177
WR-28	26.5 to 40	Precision	0.3% – 0.05%	R11644A	1A7, A6J, UK6	177
WR-22	33 to 50	Precision	0.3% – 0.05%	Q11644A	1A7, A6J, UK6	178
WR-19	40 to 60	Precision	0.3% – 0.05%	U11644A	1A7, A6J, UK6	178
WR-15	50 to 75	Precision	0.3% – 0.05%	V11644A	1A7, A6J, UK6	179
WR-10	75 to 110	Precision	0.3% – 0.05%	W11644A	1A7, A6J, UK6	179

Option description
1A7 ISO 17025 compliant calibration
A6J ANSI Z540 compliant calibration
UK6 Commercial calibration certificate with test data
00M Includes male standards and male-male adapter
00F Includes female standards and female-female adapter
M0F Includes male and female standards & adapters
001 Adds 2.4 mm sliding load and 2.4 mm gauges
100 Includes female-female adapter
200 Includes male-male adapter
300 Includes male-female adapter
400 Adds four 3.5 mm to type-N adapters
500 Adds four 7 mm to 3.5 mm adapters
500* Adds four 7 mm to type-N adapters

Class assignments and standard definitions may change as more accurate model and calibration methods are developed. You can download the most recent class assignments and standard definitions from Keysight's Calibration Kit Definitions Web page at **http://na.support.keysight.com/pna/caldefs/stddefs.html**

Coaxial Electronic Calibration Kits (ECal)

Connector	Frequency range (GHz)	Type	VNA calibration accuracy	Model	Available options	Page
Type-F (75 Ω)	300 kHz to 3 GHz	2-port	N/A	85099C	UK6, 00F, 00M, M0F, 00A	180
Type-N (75 Ω)	300 kHz to 3 GHz	2-port	N/A	85096C	UK6, 00F, 00M, M0F, 00A	180
Type-N (50 Ω)	300 kHz to 9 GHz	2-port	1% – 0.1%	85092C	1A7, A6J, UK6, 00F, 00M, M0F, 00A	180
Type-N (50 Ω)	300 kHz to 13.5 GHz	4-port		N4431B Option 020	1A7, A6J, UK6	180
Type-N (50 Ω)	300 kHz to 18 GHz	2-port		N4690B	1A7, A6J, UK6, 00F, 00M, M0F, 00A	180
Type-N (50 Ω)	300 kHz to 18 GHz	4-port		N4432A Option 020	N/A	
7-16	300 kHz to 7.5 GHz	2-port	N/A	85098C	UK6, 00F, 00M, M0F, 00A [1]	180
7 mm	300 kHz to 9 GHz	2-port	1% – 0.1%	85091C	1A7, A6J, UK6	180
7 mm	300 kHz to 18 GHz	2-port		N4696B	1A7, A6J, UK6	180
7 mm	300 kHz to 18 GHz	4-port		N4432A Option 030	N/A	
3.5 mm	300 kHz to 9 GHz	2-port	2% – 0.2%	85093C	1A7, A6J, UK6, 00F, 00M, M0F, 00A [2]	180
3.5 mm	300 kHz to 13.5 GHz	4-port		N4431B Option 010	1A7, A6J, UK6	180
3.5 mm	300 kHz to 20 GHz	4-port		N4433A Option 010	N/A	
3.5 mm	300 kHz to 26.5 GHz	2-port		N4691B	1A7, A6J, UK6, 00F, 00M, M0F, 00A [2]	180
2.92 mm	10 MHz to 40 GHz	2-port		N4692A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [3]	180
2.4 mm	10 MHz to 50 GHz	2-port		N4693A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [4]	180
1.85 mm	10 MHz to 67 GHz	2-port		N4694A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [5]	180

Mechanical Verification Kits

Connector	Frequency range (GHz)	Type	VNA calibration accuracy	Keysight model	Available options	Page
Type-N (50 Ω)	300 kHz to 18 GHz	Precision	N/A	85055A	1A7, A6J, UK6	181
7 mm	300 kHz to 18 GHz	Precision	N/A	85051B	1A7, A6J, UK6	181
3.5 mm	300 kHz to 26.5 GHz	Precision	N/A	85053B	1A7, A6J, UK6	181
2.4 mm	0.045 to 50 GHz	Precision	N/A	85057B	1A7, A6J, UK6	181
1.85 mm	0.010 to 67	Precision	N/A	85058V	1A7, A6J, UK6	182
WR-28	26.5 to 40	Precision	N/A	R11645A	1A7, A6J, UK6	182
WR-22	33 to 50	Precision	N/A	Q11645A	1A7, A6J, UK6	182
WR-19	40 to 60	Precision	N/A	U11645A	1A7, A6J, UK6	182
WR-15	50 to 75	Precision	N/A	V11645A	1A7, A6J, UK6	183
WR-10	75 to 110	Precision	N/A	W11645A	1A7, A6J, UK6	183

Option description
1A7 ISO 17025 compliant calibration
A6J ANSI Z540 compliant calibration
UK6 Commercial calibration certificate with test data
00M Includes male standards and male-male adapter
00F Includes female standards and female-female adapter
M0F Includes male and female standards & adapters
00A Add type-N adapters
00A [1] Add 7-16 adapters
00A [2] Add 3.5 mm adapters
00A [3] Add 2.92 mm adapters
00A [4] Add 2.4 mm adapters
00A [5] Add 1.85 mm adapters
001 Adds data for Keysight 8702 lightwave component analyzer
010 Four 3.5 mm (f) connectors
020 Four type-N, 50 Ω (f) connectors
030 Four 7 mm connectors


85039B


85036E


85036B

85039B Calibration Kit, Type-F

The 85039B 75 Ω type-F calibration kit is used to calibrate PNA Series and ENA Series network analyzers for measurements of components with 75 Ω type-F connectors up to 3 GHz.

This kit includes 75 Ω type-F loads (male, female), opens (male, female), and shorts (male, female) in both sexes.

Electrical specifications

75 Ω type-F device	Specifications	Frequency (GHz)
Male load, female load	Return loss ≥ 45 dB (ρ ≤ 0.006) Return loss ≥ 38 dB (ρ ≤ 0.013)	DC to ≤ 1 > 1 to ≤ 3
Male short [1], female short	±0.60° from nominal ±1.00° from nominal	DC to ≤ 1 > 1 to ≤ 3
Male open [1], female open	±0.55° from nominal ±1.30° from nominal	DC to ≤ 1 > 1 to ≤ 3

Adapters

Type-F to type-F	Return loss ≥ 40 dB (ρ ≤ 0.013) Return loss ≥ 32 dB (ρ ≤ 0.025)	DC to ≤ 1 > 1 to ≤ 3
Type-N to type-F	Return loss ≥ 38 dB (ρ ≤ 0.013) Return loss ≥ 32 dB (ρ ≤ 0.025)	DC to ≤ 1 > 1 to ≤ 3

Accessories

86211A 75 Ω type-N to type-F adapter kit

Adapter kit provides type-N to type-F adapters necessary when measuring type-F devices on a network analyzer with 75 Ω type-N test ports.

Adapter kit

86211A	75 Ω type-N to type-F adapter kit
	Type-F (f) to type-F (f) Type-F (m) to type-N (f) Type-F (m) to type-N (m)

85036E Economy Calibration Kit, Type-N, 75 Ω

The 85036E economy calibration kit contains precision type-N (m) fixed termination and a one piece type-N (m) open/short circuit. The kit is specified from DC to 3 GHz.

This kit includes 75 Ω type-N male broadband load and male combined open/short.

85036B Calibration Kit, Type-N, 75 Ω

The 85036B calibration kit contains precision Type-N standards used to calibrate Keysight network analyzers for measurement of devices with 75 Ω type-N connectors. Standards include fixed terminations, open circuits, and short circuits in both sexes. Precision phase-matched adapters are included for accurate measurements of non-insertable devices. This kit is specified from DC to 3 GHz.

This kit includes 75 Ω type-N broadband loads (male, female) opens (male, female) and shorts (male, female) in both sexes.

Electrical specifications

75 Ω device	Specifications	Frequency (GHz)
Type-N loads	Return loss ≥ 46 dB (ρ ≤ 0.00501)	DC to ≤ 2
	Return loss ≥ 40 dB (ρ ≤ 0.01000)	> 2 to ≤ 3

85032E Economy Calibration Kit, Type-N, 50 Ω

The 85032E economy calibration kit contains a type-N (m) fixed termination and a one piece type-N (m) open/short circuit. The kit is specified from DC to 6 GHz.

This kit includes 50 Ω type-N male broadband load and male combined open/short.

Accessory kits

11853A
Type-N accessory kit, 50 Ω

Part number	Qty	Description
1250-1472	2	Type-N female to type-N female adapter
1250-1475	2	Type-N male to type-N male adapter
11511A	1	Type-N female short
11512A	1	Type-N male short

11854A
BNC accessory kit, 50 Ω

Part number	Qty	Description
1250-0929	1	BNC male short
1250-1473	2	BNC male to type-N male adapter
1250-1474	2	BNC female to type-N female adapter
1250-1476	2	BNC female to type-N male adapter
1250-1477	2	BNC male to type-N female adapter

86211A
Type-F accessory kit, 75 Ω

Part number	Qty	Description
1250-2350	2	Type-F female to type-F female
1250-2368	1	75 Ω type-N female to type-F male
1250-2369	1	75 Ω type-N male to type-F male

Electrical specifications

The electrical specifications below apply to the devices in the 85032E 50 Ω, type-N calibration kit.

Electrical specifications for 50 Ω type-N devices

Device	Frequency (GHz)	Parameter	Specifications
Load	DC to ≤ 2 > 2 to ≤ 3 > 3 to ≤ 6	Return loss Return loss Return loss	≥ 49 dB (≤ 0.00355 ρ) ≥ 46 dB (≤ 0.00501 ρ) ≥ 40 dB (≤ 0.01000 ρ)
Male open [1]	DC to ≤ 6	Deviation from nominal: phase	±0.501° ±0.234°/GHz
Male short [1]	DC to ≤ 6	Deviation from nominal: phase	±0.441° ±0.444°/GHz

1 The specifications for the opens and shorts are given as allowed deviation from the nominal model as defined in the standard definitions

85032F Calibration Kit, Type-N, 50 Ω

The 85032F calibration kit contains precision 50 Ω type-N standards used to calibrate Keysight ENA and PNA Series for measurements of devices with 50 Ω type-N connectors. Standards include fixed terminations, open circuits, and short circuits in both sexes. This kit is specified from DC to 9 GHz. Option 100 adds a type-N female to female adapter, Option 200 adds a type-N male to male adapter, and Option 300 adds a type-N female to male adapter. Precision phase-matched 7 mm to 50 Ω type-N adapters for accurate measurements of non-insertable devices is added with Option 500.

This kit includes type-N 50 Ω broadband loads (male, female) opens (male, female) and shorts (male, female) in both sexes.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Loads	DC to ≤ 2 > 2 to ≤ 3 > 3 to ≤ 6 > 6 to ≤ 9	Return loss Return loss Return loss Return loss	≥ 48 dB (≤ 0.00398 ρ) ≥ 45 dB (≤ 0.00562 ρ) ≥ 40 dB (≤ 0.010 ρ) ≥ 38 dB (≤ 0.0126 ρ)
Opens	DC to ≤ 3 > 3 to ≤ 9	Deviation from nominal phase Deviation from nominal phase	±0.65° ±1.00°
Shorts	DC to ≤ 3 > 3 to ≤ 9	Deviation from nominal phase Deviation from nominal phase	±0.65° ±1.00°
Adapters (Options 100, 200, 300)	DC to ≤ 9	Return loss	≥ 38 dB (≤ 0.0126 ρ)

85054B Calibration Kit, Type-N, 50 Ω

The 85054B calibration kit contains precision standard devices to characterize the systematic errors of the PNA Series network analyzers with type-N interface. This kit also contains adapters to change the sex of the test port, connector gages for verifying and maintaining in the connector interface, and a torque wrench for proper connection.

This kit includes type-N 50 Ω sliding loads (male, female), load band loads (male, female) and offset shorts (male, female) in both sexes.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Lowband loads	DC to ≤ 2	Return loss	≥ 48 dB (≤ 0.00398 ρ)
Sliding loads	> 2 to ≤ 18	Return loss	≥ 42 dB (≤ 0.00794 ρ)
Adapters (both types)	DC to ≤ 8 > 8 to ≤ 18	Return loss Return loss	≥ 34 dB (≤ 0.00200 ρ) ≥ 28 dB (≤ 0.00398 ρ)
Offset opens	at 18	Deviation from nominal phase	±1.5°
Offset shorts	at 18	Deviation from nominal phase	±1.0°

85054D Economy Calibration Kit, Type-N, 50 Ω

The 85054D type-N economy calibration kit is used to calibrate network analyzer systems for measurements of components with type-N connectors up to 18 GHz.

This kit includes type-N 50 Ω broadband loads, offset opens, shorts and type-N to 7 mm adapters in both sexes.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Broadband loads	DC to ≤ 2 > 2 to ≤ 8 > 8 to ≤ 18	Return loss Return loss Return loss	≥ 40 dB (≤ 0.01000 ρ) ≥ 36 dB (≤ 0.01585 ρ) ≥ 42 dB (≤ 0.01995 ρ)
Adapters (both types)	DC to ≤ 8 > 8 to ≤ 18	Return loss Return loss	≥ 34 dB (≤ 0.00200 ρ) ≥ 28 dB (≤ 0.00398 ρ)
Offset opens	at 18	Deviation from nominal phase	±1.5°
Offset shorts	at 18	Deviation from nominal phase	±1.0°

85038A 7-16 Calibration Kit

The 85038A 7-16 calibration kit contains fixed loads and open and short circuits in both sexes. It can be used to calibrate the ENA and PNA Series network analyzers for measurement of components with 50 Ω 7-16 connectors up to 7.5 GHz.

85038M and 85038F are single sex calibration kits and contain male only and female only standards respectively.

Electrical specifications

Frequency range	DC to 7.5 GHz
Reference impedance	50 Ω
Short circuits Reflection coefficient	 0.99 minimum
Open circuits Reflection coefficient Reflection phase	 0.99 minimum ±1 degree
Fixed termination VSWR	 1.02 maximum

85031B Calibration Kit, 7 mm

The 85031B calibration kit contains a set of precision 7 mm fixed terminations, and a one-piece open/short circuit used to calibrate the ENA, and PNA Series for measurement of devices with precision 7 mm connectors. This kit is specified from DC to 6 GHz.

Electrical specifications

Device	Specifications	Frequency (GHz)
50 Ω loads	DC to 5 GHz 5 to 6 GHz 6 to 18 GHz	Return loss ≥ 52 dB Return loss ≥ 46 dB Return loss (typical) ≥ 26.4 dB

85050D 7 mm Economy Calibration Kit

The 85050D economy calibration kit contains precision standard devices to characterize the systematic errors of the PNA Series network analyzers in the 7 mm interface.

This kit includes 50 Ω 7 mm broadband loads, open and short calibration standards.

Electrical specifications

Device	Specifications	Frequency (GHz)
Broadband loads	≥ 38 dB return loss	DC to 18
Short (collet style)	±0.2° from nominal ±0.3° from nominal ±0.5° from nominal	DC to 2 2 to 8 8 to 18
Open (with collet pusher)	±0.3° from nominal ±0.4° from nominal ±0.6° from nominal	DC to 2 2 to 18 8 to 18

85050B Calibration Kit, 7 mm

The 85050B calibration kit contains precision standard devices to characterize the systematic errors of the PNA Series network analyzers in the 7 mm interface.

This kit includes 50 Ω 7 mm sliding load, low band load, broadband load, open and short calibration standards.

Electrical specifications

Device	Specifications	Frequency (GHz)
Lowband loads	≥ 52 dB return loss	DC to 2
Broadband loads	≥ 38 dB return loss	DC to 18
Short (collet style)	±0.2° from nominal ±0.3° from nominal ±0.5° from nominal	DC to 2 2 to 8 8 to 18
Open (with collet pusher)	±0.3° from nominal ±0.4° from nominal ±0.6° from nominal	DC to 2 2 to 8 8 to 18

85050C 7 mm Precision Calibration Kit

The 85050C precision calibration kit contains precision standard devices to characterize the systematic errors of the PNA Series network analyzers in the 7 mm interface.

This kit includes 50 Ω 7 mm broadband load, low band load, open, two shorts, precision airline and TRL adapter calibration standards for traditional SOLT or TRL calibrations.

Electrical specifications

Device	Specifications	Frequency (GHz)
Lowband loads	≥ 52 dB return loss	DC to 2
Broadband loads	≥ 38 dB return loss	DC to 18
Short (collet style)	±0.2° from nominal ±0.3° from nominal ±0.5° from nominal	DC to 2 2 to 8 8 to 18
Open (with collet pusher)	±0.3° from nominal ±0.4° from nominal ±0.6° from nominal	DC to 2 2 to 8 8 to 18
Precision airline	> 60 dB return loss	2 to 18

85033E Calibration Kit, 3.5 mm

The 85033E calibration kit contains precision 3.5 mm standards used to calibrate the ENA and PNA Series for measurements of devices 3.5 mm connectors. Standards include fixed terminations, open circuits, and short circuits in both sexes. This kit is specified from DC to 9 GHz. Option 100 adds a 3.5 mm female to female adapter, Option 200 adds a 3.5 mm male to male adapter, and Option 300 adds a 3.5 mm female to male adapter. Precision phase-matched type-N to 3.5 mm adapters for accurate measurements of non-insertable devices is added with Option 400 while Option 500 provides phase-matched 7 mm to 3.5 mm adapters.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Loads	DC to ≤ 2 > 2 to ≤ 3 > 3 to ≤ 9	Return loss Return loss Return loss	≥ 46 dB (≤ 0.005 ρ) ≥ 44 dB (≤ 0.006 ρ) ≥ 38 dB (≤ 0.013 ρ)
Opens	DC to ≤ 2 > 2 to ≤ 3 > 3 to ≤ 6 > 6 to ≤ 9	Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase	±0.55° ±0.65° ±0.85° ±1.00°
Shorts	DC to ≤ 2 > 2 to ≤ 3 > 3 to ≤ 6 > 6 to ≤ 9	Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase	±0.48° ±0.50° ±0.55° ±0.65°

85052D Economy Calibration Kit, 3.5 mm

The 85052D economy calibration kit contains precision standard devices to characterize the systematic errors of the PNA Series network analyzers in the 3.5 mm interface.

This kit includes 50 Ω 3.5 mm broadband load, opens and shorts in both sexes calibration standards.

Electrical specifications

Device	Specifications	Frequency (GHz)
Broadband loads	≥ 46 dB return loss (≤ 0.00501 ρ) ≥ 44 dB return loss (≤ 0.00631 ρ) ≥ 38 dB return loss (≤ 0.01259 ρ) ≥ 36 dB return loss (≤ 0.01585 ρ) ≥ 34 dB return loss (≤ 0.01995 ρ)	DC to ≤ 2 > 2 to ≤ 3 > 3 to ≤ 8 > 8 to ≤ 20 > 20 to ≤ 26.5
Adapters	≥ 30 dB return loss (≤ 0.03162 ρ) ≥ 28 dB return loss (≤ 0.03981 ρ) ≥ 26 dB return loss (≤ 0.05012 ρ)	DC to ≤ 8 > 8 to ≤ 18 > 18 to ≤ 26.5
Offset opens	±0.65° from nominal ±1.20° from nominal ±2.00° from nominal ±2.00° from nominal	DC to ≤ 3 > 3 to ≤ 8 > 8 to ≤ 20 > 20 to ≤ 26.5
Offset shorts	±0.50° from nominal ±1.00° from nominal ±1.75° from nominal ±1.75° from nominal	DC to ≤ 3 > 3 to ≤ 8 > 8 to ≤ 20 > 20 to ≤ 26.5

85052B Calibration Kit, 3.5 mm

The 85052B calibration kit contains precision standard devices to characterize the systematic errors of the PNA Series network analyzers in the 3.5 mm interface.

This kit includes 50 Ω 3.5 mm sliding loads, broadband loads, offset opens and offset shorts calibration standards in both sexes.

Electrical specifications

Device	Specifications	Frequency (GHz)
Broadband loads	≥ 46 dB return loss (≤ 0.00501 ρ) ≥ 44 dB return loss (≤ 0.00631 ρ) ≥ 38 dB return loss (≤ 0.01259 ρ) ≥ 36 dB return loss (≤ 0.01585 ρ) ≥ 34 dB return loss (≤ 0.01995 ρ)	DC to ≤ 2 > 2 to ≤ 3 > 3 to ≤ 8 > 8 to ≤ 20 > 20 to ≤ 26.5
Sliding loads	≥ 44 dB return loss (≤ 0.00631 ρ)	3 to ≤ 26.5
Adapters	≥ 30 dB return loss (≤ 0.03162 ρ) ≥ 28 dB return loss (≤ 0.03981 ρ) ≥ 26 dB return loss (≤ 0.05012 ρ)	DC to ≤ 8 > 8 to ≤ 18 > 18 to ≤ 26.5
Offset opens	±0.65° from nominal ±1.20° from nominal ±2.00° from nominal ±2.00° from nominal	DC to ≤ 3 3 to ≤ 8 > 8 to ≤ 20 20 to ≤ 26.5
Offset shorts	±0.50° from nominal ±1.00° from nominal ±1.75° from nominal ±1.75° from nominal	DC to ≤ 3 > 3 to ≤ 8 > 8 to ≤ 20 > 20 to ≤ 26.5

85052C Calibration Kit, 3.5 mm

The 85052C is a laboratory-grade 3.5 mm calibration kit. Its purpose is to provide high-quality calibrations up to 26.5 GHz for microwave network analyzers such as the PNA Series using the TRL (thru-reflect-line) calibration method. The calibration devices in this kit have very precise mechanical dimensions and must be handled with care.

This kit includes 50 Ω 3.5 mm broadband loads, offset opens and offset shorts, long precision and short precision airlines calibration standards in both sexes for traditional SOLT or TRL calibrations.

Electrical specifications

Device	Specifications	Frequency (GHz)
Broadband loads	≥ 46 dB return loss (≤ 0.00501 ρ) ≥ 44 dB return loss (≤ 0.00631 ρ) ≥ 38 dB return loss (≤ 0.01259 ρ) ≥ 36 dB return loss (≤ 0.01585 ρ) ≥ 34 dB return loss (≤ 0.01995 ρ)	DC to ≤ 2 > 2 to ≤ 3 > 3 to ≤ 8 > 8 to ≤ 20 > 20 to ≤ 26.5
Long precision airline	≥ 56 dB return loss (≤ 0.00158 ρ)	> 2 to ≤ 7
Short precision airline	≥ 50 dB return loss (≤ 0.00316 ρ)	> 7 to ≤ 26.5
Precision adapters	≥ 30 dB return loss (≤ 0.03162 ρ) ≥ 27 dB return loss (≤ 0.00447 ρ)	DC to ≤ 20 > 20 to ≤ 26.5
Offset opens	±0.65° from nominal ±1.20° from nominal ±2.00° from nominal ±2.00° from nominal	DC to ≤ 3 > 3 to ≤ 8 > 8 to ≤ 20 > 20 to ≤ 26.5
Offset shorts	±0.50° from nominal ±1.00° from nominal ±1.75° from nominal ±1.75° from nominal	DC to ≤ 3 > 3 to ≤ 8 > 8 to ≤ 20 > 20 to ≤ 26.5

85056D Economy Calibration Kit, 2.4 mm

The 85056D economy calibration kit contains precision standard devices to characterize the systematic errors of the PNA Series network analyzers in the 2.4 mm interface.

This kit includes 50 Ω 2.4 mm broadband loads, offset opens and offset shorts calibration standards in both sexes.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Broadband loads	DC to ≤ 4 > 4 to ≤ 20 > 20 to ≤ 26.5 > 26.5 to ≤ 50	Return loss Return loss Return loss Return loss	≥ 42 dB (≤ 0.00794 ρ) ≥ 34 dB (≤ 0.01995 ρ) ≥ 30 dB (≤ 0.03163 ρ) ≥ 30 dB (≤ 0.05019 ρ)
Adapters (2.4 mm to 2.4 mm)	DC to ≤ 4 > 4 to ≤ 26.5 > 26.5 to ≤ 40 > 40 to ≤ 50	Return loss Return loss Return loss Return loss	≥ 32 dB (≤ 0.02512 ρ) ≥ 30 dB (≤ 0.03162 ρ) ≥ 25 dB (≤ 0.05623 ρ) ≥ 20 dB (≤ 0.01000 ρ)
Offset opens	DC to ≤ 2 > 2 to ≤ 20 > 20 to ≤ 40 > 40 to ≤ 50	Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase	±0.5° ±1.25° ±1.75° ±2.25°
Offset shorts	DC to ≤ 2 > 2 to ≤ 20 > 20 to ≤ 40 > 40 to ≤ 50	Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase	±0.5° ±1.25° ±1.5° ±2.0°

85056A Calibration Kit, 2.4 mm

The 85056A 2.4 mm calibration kit is used to calibrate network analyzer systems (such as the PNA Series) for measurements of components with 2.4 mm connectors upto 50 GHz.

This kit includes 50 Ω 2.4 mm sliding loads, broadband loads, offset opens and offset shorts calibration standards in both sexes.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Broadband loads	DC to ≤ 4 > 4 to ≤ 20 > 20 to ≤ 26.5 > 26.5 to ≤ 50	Return loss Return loss Return loss Return loss	≥ 42 dB (≤ 0.00794 ρ) ≥ 34 dB (≤ 0.01995 ρ) ≥ 30 dB (≤ 0.03163 ρ) ≥ 30 dB (≤ 0.05019 ρ)
Sliding loads	4 to ≤ 20 > 20 to ≤ 36 > 36 to ≤ 40 > 40 to ≤ 50	Return loss Return loss Return loss Return loss	≥ 42 dB (≤ 0.00794 ρ) ≥ 40 dB (≤ 0.01000 ρ) ≥ 38 dB (≤ 0.01259 ρ) ≥ 36 dB (≤ 0.01585 ρ)
Adapters (2.4 mm to 2.4 mm)	DC to ≤ 4 > 4 to ≤ 26.5 > 26.5 to ≤ 40 > 40 to ≤ 50	Return loss Return loss Return loss Return loss	≥ 32 dB (≤ 0.02512 ρ) ≥ 30 dB (≤ 0.03162 ρ) ≥ 25 dB (≤ 0.05623 ρ) ≥ 20 dB (≤ 0.01000 ρ)
Offset opens	DC to ≤ 2 > 2 to ≤ 20 > 20 to ≤ 40 > 40 to ≤ 50	Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase	±0.5° ±1.25° ±1.75° ±2.25°
Offset shorts	DC to ≤ 2 > 2 to ≤ 20 > 20 to ≤ 40 > 40 to ≤ 50	Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase Deviation from nominal phase	±0.5° ±1.25° ±1.5° ±2.0°

85058E Economy Calibration Kit, 1.85 mm

The 85058E economy calibration kit contains six standard devices to characterize the systematic errors of Keysight network analyzers up to 67 GHz for measurements of components with 1.85 mm connectors. The standards allow one to perform simple 1- or 2-port and thru-reflect-match (TRM) calibrations. This kit also contains adapters and a torque wrench for proper connection. Each calibration kit includes two models for defining calibration standards; the data-based model (85058E), and the polynomial model (85058EP). The data-based model provides a higher accuracy method for describing calibration standards than the polynomial model.

This kit includes 50 Ω 1.85 mm broadband loads, offset opens and offset shorts calibration standards in both sexes.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications			
			Male		Female	
			Polynomial model	Data-based model	Polynomial model	Data-based model
Broadband termination	DC to 35 35 to 67	Return loss	30 dB 28 dB	30 dB 28 dB	30 dB 28 dB	30 dB 28 dB
Open	DC to 10 10 to 50 50 to 67	Deviation from nominal phase	2.5° 4.0° 5.5°	2.0° 3.0° 4.5°	3.0° 4.5° 6.0°	2.5° 3.5° 5.0°
Short 1	DC to 20 20 to 30 30 to 40 40 to 50 50 to 67	Deviation from nominal phase	2.0° 3.0° 3.0° 3.0° 4.0°	1.5° 2.0° 2.0° 2.0° 3.0°	2.0° 3.0° 3.5° 4.5° 5.0°	1.5° 2.0° 2.5° 3.5° 4.0°

Device	Frequency (GHz)	Parameter	Specifications
		Return loss	Insertion loss
Adapters	DC to 4 4 to 26.5 26.5 to 50 50 to 67	33 dB 24 dB 22 dB 20 dB	0.3 dB 0.5 dB 0.7 dB 0.9 dB

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85058B Calibration Kit, 1.85 mm

The 85058B calibration kit contains twelve standard devices to characterize the systematic errors of Keysight network analyzers up to 67 GHz for measurements of components with 1.85 mm connectors. The standards allow one to perform simple 1- or 2-port and thru-reflect-match (TRM) calibrations. This kit also contains adapters and a torque wrench for proper connection. Each calibration kit includes two models for defining calibration standards; the data-based model (85058B), and the polynomial model (85058BP). The data-based model provides a higher accuracy method for describing calibration standards than the polynomial model.

This kit includes 50 Ω 1.85 mm broadband loads, offset opens and offset shorts calibration standards in both sexes.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications			
			Male		Female	
			Polynomial model	Data-based model	Polynomial model	Data-based model
Load	DC to 10	Return loss	36 dB	36 dB	35 dB	35 dB
	10 to 20		34 dB	34 dB	34 dB	34 dB
	20 to 35		31 dB	31 dB	29 dB	29 dB
	35 to 60 [1]		22 dB	22 dB	12 dB	12 dB
	60 to 67 [1]		19 dB	19 dB	10 dB	10 dB
Open	DC to 10	Deviation from nominal phase	2.2°	2.0°	2.7°	2.5°
	10 to 35		3.2°	3.0°	3.7°	3.5°
	35 to 50		N/A [2]	3.0°	N/A [2]	3.5°
	50 to 67		N/A [2]	4.5°	N/A [2]	5.0°
Short 1	DC to 20	Deviation from nominal phase	1.7°	1.5°	1.7°	1.5°
	20 to 30		2.2°	2.0°	2.2°	2.0°
	30 to 35		2.2°	2.0°	2.7°	2.5°
	35 to 40		N/A [2]	2.0°	N/A [2]	2.5°
	40 to 50		N/A [2]	2.0°	N/A [2]	3.5°
	50 to 67		N/A [2]	3.0°	N/A [2]	4.0°
Short 2	DC to 20	Deviation from nominal phase	N/A [2]	1.5°	N/A [2]	1.5°
	20 to 30		N/A [2]	2.0°	N/A [2]	2.0°
	30 to 35		N/A [2]	2.0°	N/A [2]	2.5°
	35 to 40		2.4°	2.0°	2.9°	2.5°
	40 to 50		2.6°	2.0°	4.1°	3.5°
	50 to 67		3.6°	3.0°	4.6°	4.0°
Short 3	DC to 20	Deviation from nominal phase	N/A [2]	1.5°	N/A [2]	1.5°
	20 to 30		N/A [2]	2.0°	N/A [2]	2.0°
	30 to 35		N/A [2]	2.0°	N/A [2]	2.5°
	35 to 40		2.4°	2.0°	2.9°	2.5°
	40 to 50		2.6°	2.0°	4.1°	3.5°
	50 to 67		4.4°	3.0°	5.4°	4.0°
Short 4	DC to 20	Deviation from nominal phase	N/A [2]	1.5°	N/A [2]	1.5°
	20 to 30		N/A [2]	2.0°	N/A [2]	2.0°
	30 to 35		N/A [2]	2.0°	N/A [2]	2.5°
	35 to 40		2.7°	2.0°	2.9°	2.5°
	40 to 50		3.1°	2.0°	4.6°	3.5°
	50 to 67		4.2°	3.0°	5.2°	4.0°

1 Typical performance
2 This cal device is not used in this frequency range when your calibration is using a polynomial model with Expanded Math unselected. Refer to "Two Models for Defining Calibration Standards" (pages 1 – 2 of the 85058B/E Operation Manual)

Device	Frequency (GHz)	Parameter	Specifications
		Return loss	Insertion loss
Adapters	DC to 4	33 dB	0.3 dB
	4 to 26.5	24 dB	0.5 dB
	26.5 to 50	22 dB	0.7 dB
	50 to 67	20 dB	0.9 dB

85059A Precision Calibration/ Verification Kit, 1.0 mm

The 85059A is a 1.0 mm calibration/verification kit designed for vector network analyzer systems operating over the frequency range of 10 MHz to 110 GHz. The opens, shorts and loads in this kit were optimized to provide accurate calibrations over the specified frequency range. For best results, the calibration techniques recommended are the open-short-load-thru (OSLT) calibration from 10 MHz to 50 GHz, and the offset-shorts calibration from 50 GHz to 110 GHz, all in one calibration sequence.

This kit includes 50 Ω 1.00 mm loads, opens, and offset shorts in both sexes. Two delay lines, one 1.00 mm coaxial cable and verification devices are also included with this calibration kit.

Electrical specifications for 1.0 mm 50 Ω devices

Device	Frequency (GHz)	Parameter	Specifications	
			Male	Female
Loads	DC to 2 2 to 18 18 to 40 40 to 50	Return loss	30 dB 30 dB 26 dB 24 dB	30 dB 30 dB 26 dB 24 dB
Opens	DC to 2 2 to 18 18 to 50	Deviation from nominal phase	±1.0° ±1.5° ±2.5°	±1.0° ±3.0° ±4.0°
Short 3	DC to 2 2 to 18 18 to 50 50 to 110	Deviation from nominal phase	±0.8° ±1.2° ±1.5° ±3.0°	±1.0° ±2.0° ±2.5° ±5.0°
Short 1	50 to 110	Deviation from nominal phase	±2.5°	±4.0°
Short 2	75 to 110	Deviation from nominal phase	±2.5°	±4.0°
Short 4	50 to 75	Deviation from nominal phase	±2°	±4.5°

Device	Frequency (GHz)	Parameter	Specifications
Lossy delay line	DC to 110	Return loss	18 dB
Adapters	DC to 20 20 to 50 50 to 75 75 to 110	Return loss	24 dB 20 dB 18 dB 14 dB
Verification match thru (adapter)	DC to 20 20 to 50 50 to 75 75 to 110	Return loss	24 dB 20 dB 18 dB 14 dB
Verification mismatch thru (adapter)	DC to 110	Return loss	6 dB at ~22.6 GHz intervals

X11644A WR-90 Mechanical Calibration Kit, 8.2 GHz to 12.4 GHz

The X11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the PNA series network analyzers. This calibration kit has calibration standards for performing the thru-reflect-line (TRL) calibration. This kit also contains a flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

Device	Specifications
Frequency range	8.2 to 12.4 GHz
Termination	≥ 42 dB return loss

Adapter characteristics

SWR	< 1.05
Insertion loss	0.08 dB
Center conductor	0.0076 to 0.038 mm
Pin recession tolerance	(0.0003 to 0.0015 in)
Equivalent flange type	UG-135/U

P11644A WR-62 Mechanical Calibration Kit, 12.4 GHz to 18.0 GHz

The P11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the PNA Series network analyzers. This calibration kit has calibration standards for performing the thru-reflect-line (TRL) calibration. This kit also contains a flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

Device	Specifications
Frequency range	12.4 to 18 GHz
Termination	≥ 42 dB return loss

Adapter characteristics

SWR	<1 .06
Insertion loss	0.10 dB
Center conductor	0.0076 to 0.038 mm
Pin recession tolerance	(0.0003 to 0.0015 in)
Equivalent flange type	UG-419/U

K11644A WR-42 Mechanical Calibration Kit, 18 GHz to 26.5 GHz

The K11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the PNA Series network analyzers. This calibration kit has calibration standards for performing the thru-reflect-line (TRL) calibration. This kit also contains a flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

Device	Specifications
Frequency range	18 to 26.5 GHz
Termination	≥ 42 dB return loss

Adapter characteristics

SWR	< 1.07
Insertion loss	0.12 dB
Center conductor	0.0076 to 0.038 mm
Pin recession tolerance	(0.0003 to 0.0015 in)
Equivalent flange type	UG-597/U

R11644A WR-28 Mechanical Calibration Kit, 26.5 GHz to 40 GHz

The R11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the PNA Series network analyzers. This calibration kit has calibration standards for performing the thru-reflect-line (TRL) calibration. This kit also contains a flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

Device	Specifications
Frequency range	26.5 to 40 GHz
Termination	≥ 46 dB effective return loss

Q11644A WR-22 Mechanical Calibration Kit, 33 GHz to 50 GHz

The Q11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the PNA Series network analyzers. This calibration kit has calibration standards for performing the thru-reflect-line (TRL) calibration. This kit also contains a flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

Device	Specifications
Frequency range	33 to 50 GHz
Termination	≥ 46 dB effective return loss

U11644A WR-19 Mechanical Calibration Kit, 40 GHz to 60 GHz

The U11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the PNA Series network analyzers. This calibration kit has calibration standards for performing the thru-reflect-line (TRL) calibration. This kit also contains a flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

Device	Specifications
Frequency range	40 to 60 GHz
Termination	≥ 46 dB effective return loss

V11644A WR-15 Mechanical Calibration Kit, 50 GHz to 75 GHz

The V11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the PNA Series network analyzers. This calibration kit has calibration standards for performing the thru-reflect-line (TRL) calibration. This kit also contains a flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

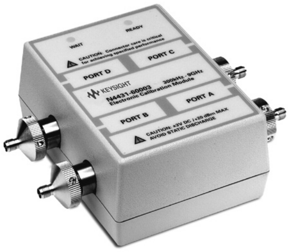
Device	Specifications
Frequency range	50 to 75 GHz
Termination	≥ 38.2 dB return loss
Equivalent SWR	±1.025

W11644A WR-10 Mechanical Calibration Kit, 75 GHz to 110 GHz

The W11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the PNA Series network analyzers. This calibration kit has calibration standards for performing the thru-reflect-line (TRL) calibration. This kit also contains a flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

Device	Specifications
Frequency range	75 to 110 GHz
Termination	≥ 36.6 dB return loss
Equivalent SWR	±1.03



Overview

Electronic calibration (ECal) is a precision, single-connection, one, two or four-port calibration technique for your Keysight vector network analyzer. Keysight ECal modules use fully traceable and verifiable electronic impedance standards. The modules are state-of-the-art, solid-state devices with programmable and highly repeatable impedance states. ECal modules are transfer standards that provide consistent calibrations and eliminate operator errors while bringing convenience and simplicity to your calibration routine. Consistent calibrations provide consistent measurements.

ECal replaces the traditional calibration technique that uses mechanical standards. With mechanical standards, you are required to make numerous connections to the test ports for a single calibration. These traditional calibrations require intensive operator interaction, which are prone to error. With ECal, a full two-port calibration can be accomplished with a single connection to the ECal module and minimal operator interaction. This results in faster and more repeatable calibrations with less wear on the connectors – and on you. Calibrations for non-insertable devices are equally convenient and straightforward.

ECal modules and available options

Connector type	Frequency range (GHz)	Type	Keysight model	Available options
Type-F (75 Ω)	300 kHz to 3 GHz [1]	2-port	85099C	UK6, 00F, 00M, M0F, 00A
Type-N (75 Ω)	300 kHz to 3 GHz [1]	2-port	85096C	UK6, 00F, 00M, M0F, 00A
Type-N (50 Ω)	300 kHz to 9 GHz [1]	2-port	85092C	1A7, A6J, UK6, 00F, 00M, M0F, 00A
Type-N (50 Ω)	300 kHz to 13.5 GHz [1]	4-port	N4431B Option 020	1A7, A6J, UK6
Type-N (50 Ω)	300 kHz to 18 GHz	2-port	N4690C	1A7, A6J, UK6, 00F, 00M, M0F, 00A
Type-N (50 Ω)	300 kHz to 18 GHz	4-port	N4432A	N/A
7-16	300 kHz to 7.5 GHz [1]	2-port	85098C	UK6, 00F, 00M, M0F, 00A [1]
7 mm	300 kHz to 9 GHz [1]	2-port	85091C	1A7, A6J, UK6
7 mm	300 kHz to 18 GHz	2-port	N4696B	1A7, A6J, UK6
7 mm	300 kHz to 18 GHz	4-port	N4432A Option 030	N/A
3.5 mm	300 kHz to 9 GHz [1]	2-port	85093C	1A7, A6J, UK6, 00F, 00M, M0F, 00A [2]
3.5 mm	300 kHz to 13.5 GHz [1]	4-port	N4431B Option 010	1A7, A6J, UK6
3.5 mm	300 kHz to 20 GHz	4-port	N4433A Option 010	N/A
3.5 mm	300 kHz to 26.5 GHz	2-port	N4691B	1A7, A6J, UK6, 00F, 00M, M0F, 00A [2]
2.92 mm	10 MHz to 40 GHz	2-port	N4692A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [3]
2.4 mm	10 MHz to 50 GHz	2-port	N4693A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [4]
1.85 mm	10 MHz to 67 GHz	2-port	N4694A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [5]

[1] ECal modules are specified to operate from 300 kHz, with typical performance down to 30 kHz

Option description
1A7 ISO 17025 compliant calibration
A6J ANSI Z540 compliant calibration
UK6 Commercial calibration certificate with test data
00M Connectors are male-male
00F Connectors are female-female
M0F Connectors are one male and one female

00A Adds type-N adapters
00A [1] Adds 7-16 adapters
00A [2] Adds 3.5 mm adapters
00A [3] Adds 2.92 mm adapters
00A [4] Adds 2.4 mm adapters
00A [5] Adds 1.85 mm adapters

Power Limits

Maximum input power 8509x N469x	 +20 dBm +10 dBm
Minimum input power	–45 dBm

Ordering Information

Electronic calibration modules reference guide, part number **N4693-90001**

85055A Verification Kit, Type-N

The 85055A type-N verification kit is used with an 85054B type-N calibration kit and network analyzers, such as the PNA Series. Use the 85055A verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S. National Institute of Standards and Technology (NIST).

This type-N verification kit includes 20 and 50 dB attenuators with data, 50 Ω airline with data, and 25 Ω mismatch airline with data.

85051B Verification Kit, 7 mm

The 85051B 7 mm verification kit is used with an 85050B/C/D 7 mm calibration kit and network analyzers, such as the PNA Series. Use the 85051B verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S National Institute of Standards and Technology (NIST).

This 7 mm verification kit includes 20 and 50 dB attenuators with data, 50 Ω airline with data, and 25 Ω mismatch airline with data.

85053B Verification Kit, 3.5 mm

The 85053B 3.5 mm verification kit is used with a 85052B/C/D 3.5 mm calibration kit and network analyzers, such as the PNA Series. Use the 85053B verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S National Institute of Standards and Technology (NIST).

This 3.5 mm verification kit includes 20 and 40 dB attenuators with data, 50 Ω airline with data, and 25 Ω mismatch airline with data.

85057B Verification Kit, 2.4 mm

The 85057B 2.4 mm verification kit is used with an 85056A 2.4 mm calibration kit and network analyzers, such as the PNA Series. Use the Keysight 85057B verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S National Institute of Standards and Technology (NIST).

This verification kit includes 20 and 40 dB attenuators with data, 50 Ω airline with data, and 25 Ω mismatch airline with data.

85058V Verification Kit, 1.85 mm

The 85058V 1.85 mm verification kit is used with an 85058B/E 1.85 mm calibration kit and the PNA Series network analyzers. Use the 85058V verification kit to verify your measurement calibration and also to verify that your network analyzer system is operating within its specifications. This verification kit is traceable to the U.S. National Institute of Standards and Technology (NIST).

This 1.85 mm verification kit includes 10 and 40 dB attenuators with data, 50 Ω airline with data, and 25 Ω mismatch airline with data.

R11645A W-28 Verification Kit

The R band millimeter-waveguide verification kit is used with the R11644A calibration kit and network analyzer systems, such as the PNA Series. Use the R11645A series verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S National Institute of Standards and Technology (NIST).

This wave guide WR-28 verification kit includes 20 and 50 dB attenuators with data, match waveguide section with data, and mismatch waveguide section with data.

Q11645A W-22 Verification Kit

The Q band millimeter-waveguide verification kit is used with the Q11644A calibration kit and network analyzer systems, such as the PNA Series. Use the Q11645A Series verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S National Institute of Standards and Technology (NIST).

This wave guide WR-22 verification kit includes 20 and 50 dB attenuators with data, match waveguide section with data, and mismatch waveguide section with data.

U11645A W-19 Verification Kit

The U band millimeter-waveguide verification kit is used with the U11644A calibration kit and network analyzer systems, such as the Keysight PNA Series. Use the U11645A Series verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S National Institute of Standards and Technology (NIST).

This wave guide WR-19 verification kit includes 20 and 50 dB attenuators with data, match waveguide section with data, and mismatch waveguide section with data.

V11645A W-15 Verification Kit

The V band millimeter-waveguide verification kit is used with the V11644A calibration kit and network analyzer systems, such as the PNA Series. Use the V11645A Series verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S National Institute of Standards and Technology (NIST).

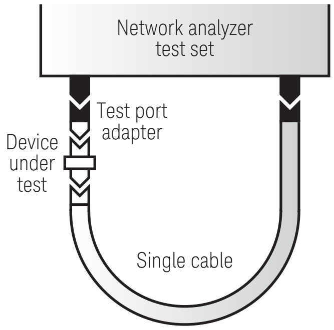
This wave guide WR-15 verification kit includes 20 and 50 dB attenuators with data, match waveguide section with data, and mismatch waveguide section with data.

W11645A W-10 Verification Kit

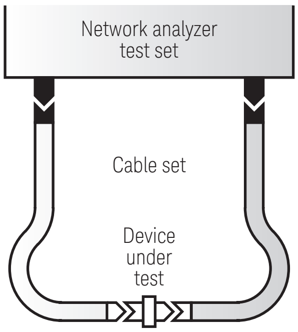
The W band millimeter-waveguide verification kit is used with the W11644A calibration kit and network analyzer systems, such as the PNA Series. Use the W11645A Series verification kit to verify that your network analyzer system is working within its specifications, and that you have performed a valid measurement calibration. This verification kit is traceable to the U.S National Institute of Standards and Technology (NIST).

This wave guide WR-10 verification kit includes 20 and 50 dB attenuators with data, match waveguide section with data, and mismatch waveguide section with data.

Configuration A



Configuration B



Test Port Cables and Adapters

Test port cables and adapter sets are available for various connector types. The cable/adapter configurations are described below. Cables used with the network analyzers are designed with one end that connects directly to the special rugged ports of the network analyzer test set, and one end that connects to the device under test. Special test port adapter sets are also available to convert the rugged port so the network analyzer test set to the desired connector interface. Each kit contains two adapters, one male and one female.

These cables and special adapters have a 3.5 mm, 2.4 mm, and 1.85 mm ruggedized female connector on one end, which is designed to connect to the network analyzer two-port test set. This connector cannot be mated to standard 3.5 mm, 2.4 mm, and 1.85 mm connectors. However, the other end of the cable or adapter has a connector that can be mated to standard 3.5 mm, 2.4 mm, and 1.85 mm connectors.

Test port cables are available for two test configurations as shown below. Configuration A utilizes a single (96.5 cm, [38 inches] long) test port cable for use when the device under test (DUT) is connected directly to the port on the test set. Configuration B utilizes two test port cables, each cable is 62.2 cm [24.5 inches] long. It provides more flexibility since the DUT is connected between the test port cables. See next page for recommended cables/ adapters associated with each configuration.

DUT connector	**Configuration A** **3.5 mm test set ports** **Cables/adapters**	**Configuration B** **3.5 mm test set ports** **Cables/adapters**
3.5 mm	85131C semi-rigid cable with a 3.5 mm (f) connector 85131E flexible cable with a 3.5 mm (f) connector 85130D adapter set with NMD [1] 3.5 mm (f) to 3.5 mm (m,f)	85131D semi-rigid cable with a 3.5 mm (f) connector 85131F flexible cable with a 3.5 mm (f) connector
7 mm	85132C semi-rigid cable with 7 mm connector 85132E flexible cable with a 7 mm connector 85130B adapter set with NMD [1] 3.5 mm (f) to 7 mm connectors	85132D semi-rigid cable with 7 mm connector 85132F flexible cable with a 7 mm connector
Type-N	Use 7 mm cables and the 7 mm to type-N adapters included in the 85054B,D calibration kit.	Use 7 mm cables and the 7 mm to Type-N adapters inlcuded in the 85054B,D calibration kit.

DUT connector	**Configuration A** **2.4 mm test set ports** **Cables/adapters**	**Configuration B** **2.4 mm test set ports** **Cables/adapters**
2.4 mm	85133C semi-rigid cable with a 2.4 mm (f) connector 85133E flexible cable with a 2.4 mm (f) connector 85130G adapter set with NMD [1] 2.4 mm (f) to 2.4 mm (m,f)	85133D semi-rigid cable set with 2.4 mm (m,f) connectors 85133F flexible cable set with 2.4 mm (m,f) connectors
3.5 mm	85134C semi-rigid cable with a 3.5 mm (f) connector 85134E flexible cable with a 3.5 mm (f) connector 85130F adapter set with NMD [1] 2.4 mm (f) to 3.5 mm (m,f)	85134D semi-rigid cable set with 3.5 mm (m,f) connectors 85134F flexible cable set with 3.5 mm (m,f) connectors
7 mm	85135C semi-rigid cable with a 7 mm connector 85135E flexible cable with a 7 mm connector 85130E adapter set with NMD [1] 2.4 mm (f) to 7 mm connectors	85135D semi-rigid cable set with 7 mm connectors 85135F flexible cable set with 7 mm connectors

[1] Special rugged female connector specifically for connecting to network analyzer test port, but does not mate with a standard male connector.

DUT connector	Configuration A 1.85 mm test set ports Cables/adapters	Configuration B 1.85 mm test set ports Cables/adapters
1.85 mm [2]	N4697E flexible cable with a 1.85 mm (f) 85130H adapter set with NMD [1] 1.85 mm (f) to 1.85 mm (m,f)	N4697E flexible cable set with a 1.85 mm (m,f)

[1] Special rugged female connector specifically for connecting to network analyzer test port, but does not mate with a standard male connector.
[2] 1.85 mm is mateable with 2.4 mm connectors

Cables (for network analyzer)
11857B 75 Ω type-N test port cables (two)
11857D 50 Ω, APC-7, test-port extension cables
11857F 75 Ω type-F cables (two)
N6314A 50 Ω type-N cable (one) / male to male
N6315A 50 Ω type-N cable (one) / male to female

Accessories

11742A blocking capacitor

The 11742A blocking capacitor blocks DC signals below 45 MHz and passes signals up to 26.5 GHz. Ideal for use with high-frequency oscilloscopes or in biased microwave circuits, the 11742A will suppress low-frequency signals that can damage expensive measuring equipment or will affect the accuracy of your RF and microwave measurements.

85024A high-frequency probe

Makes in-circuit measurements easy. Input capacitance of only 0.7 pF shunted by 1 MΩ resistance permits high-frequency probing without adverse loading of the circuit under test. Excellent frequency response and unity gain guarantee highly accurate swept measurements. High-sensitivity and low-distortion levels allow measurements that take full advantage of the analyzer's dynamic range. Directly compatible with many Keysight RF spectrum and network analyzer.

Key Features

Keysight's U9391C/F/G comb generators are designed as a phase reference standard for the PNA-X nonlinear vector network analyzer (NVNA).

- Excellent amplitude and phase flatness enable it to be used as a precision calibration phase reference standard for the NVNA
- NIST referenced phase calibration guarantees a reliable reference to international standards
- Embedded calibration data can be easily accessed via the plug-and-play USB interface
- The USB interface facilitates frequency divider control and calibration data retrieval via the PNA-X
- Rugged 1.85-mm, 2.4-mm and 3.5-mm bulk-head connectors guarantee high repeatability throughout multiple connects and disconnects

Description

The U9391C/F/G comb generators were developed to provide precision phase calibration, referenced to the National Institute of Standards and Technology (NIST) standard, for non-linear measurements using the PNA-X nonlinear vector network analyzer (NVNA)[1]. NVNA component characterization software converts a 4-port PNA-X with Option 510 into an innovative, high-performance, non-linear network analyzer which uses U9391C/F/G comb generators as a precision phase calibration standard. Comb generators generate frequency harmonics at integer multiples from an RF input signal. Generally, comb generators available in the open market today are made with SRD diodes, U9391C/F/G comb generators are based on Keysight InP MMIC technology[2] to ensure superior phase stability of the combs.

U9391C/F/G modules are solid state devices which provide excellent phase and amplitude flatness in the combs making them ideal for use in phase calibration applications. A built-in frequency divider, selectable via the PNA-X, reduces the noise of the combs. You can set drive frequency at 1, 2 , 4, 8 or 16 times the pulse repetition frequency (PRF). Combining a frequency divider with a wide input signal frequency range allows for a broad range of possible harmonics spacing, making this suitable for characterizing non-linear devices. This module has a trigger output which enables synchronization with the pulse's repetition frequency. Calibration data stored inside the U9391C/F/G can be accessed directly by the PNA-X via the USB interface for phase calibration. The comb generator comes with the option of female or male output connectors.

Keysight's comb generators offer the advantage of wide bandwidth output (10 MHz to 26.5/50/67 GHz) and small minimum tone spacing (10 MHz). When driven by low phase noise sources, these comb generators will operate at frequencies lower than 10 MHz, but performance is not guaranteed. The input power and fundamental frequency have lower sensitivity than other comb generators. This means a comb generator calibrated at a single power level and frequency can be used across a wide range of input power levels and frequencies.

Accurate Transfer of NIST Standard

Keysight characterizes the U9391C/F/G comb generators' phase standard using a precision calibration technique that is referenced to NIST. Each comb generator's amplitude and phase data is stored in the module's memory. The N5242A-510 and N5245A-510 NVNA component characterization software uses the phase data from the U9391C/F/G to calculate the non-linear error terms for the PNA-X network analyzers.

1 The U9391C/F/G was designed for use with the PNA-X ONLY
2 Indium phosphide monolithic microwave integrated circuit

Web Link

www.keysight.com/find/mta

Overview

Keysight models 11590B, 11612A/B and 11612VK67 with different frequency range coverage are standalone bias network provide a means of supplying DC bias to the center conductor of a coaxial line of a bias able component or device while blocking the DC bias to the RF input port of a network analyzer.

The Keysight model 11612T/V-Kxx Series bias tees are bias networks with force/sense capability. This type of bias networks used for device bias requires precise voltage and current control. These bias networks provide a force connection to allow input of a current or voltage signal and a sense connection to allow monitoring of voltage or current. A ground connection for application of an active ground is also provided. The force, sense and ground are triaxial connectors.

11612T/V-Kxx High-Frequency Bias Networks

Accurate DC- and S-parameter measurements

To complement your PNA series network analyzers, Keysight offers the 11612T/V-Kxx family of bias networks. The bias networks allow you to conveniently connect a device to the measurement system and accurately measure DC and S-parameters while suppressing bias oscillations. The 11612T/V-Kxx bias networks are supplied as part of the 85225A/B/C/D/E/F performance device modeling systems. The bias network maximum current rating is 2 amperes.

Prior to the 11612T/V-Kxx it was necessary to apply DC at the bias tee inputs located at the rear of the network analyzer test set. While this is still a good method for applying bias to circuits such as amplifiers, it introduces two problems when measuring DC parameters of semiconductor devices. First, for high-current devices, DC losses through the test set and RF cables result in a significant offset voltage error. Second, the accuracy of low-current DC measurements is degraded due to leakage through an internal 1 M Ω bleed resistor in the test set. The 11612T/V-Kxx bias networks overcome these problems by applying DC as close to the device as possible and by bypassing the internal shunt resistor.

Simple connection between the device and measurement system

The 11612T/V-Kxx bias networks provide a simple connection between the measurement system and the device under test. The DC connections are applied through force and sense triaxial connectors that take advantage of the kelvin sensing capability of the E5270A 8-slot parametric measurement mainframe with E5281A medium or E5280A high power source/monitor units or the 4156C precision semiconductor parameter analyzer and 41501B SMU and pulse generator expander. This provides the highest DC accuracy while eliminating the need to use patch panels or adapter connectors.

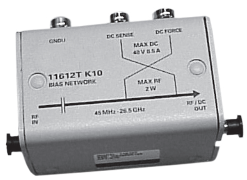
Built-in oscillation suppression network

To avoid potential low-frequency device oscillations, the bias networks also contain a resistive/capacitive bias-oscillation suppression network.

Model	11612T-K10/K20 [1]	11612T-K12/K22 [1]	11612V-K11/K21 [1]	11612V-K22/K23	11612V-K68/K69
Frequency range	45 MHz to 26.5 GHz	400 MHz to 26.5 GHz	45 MHz to 50 GHz	400 MHz to 50 GHz	10 MHz to 67 GHz
Connector type: RF input & output DC force, sense, ground	3.5 mm (f) Triaxial (f)	3.5 mm (f) Triaxial (f)	2.4 mm (f) Triaxial (f)	2.4 mm (f) Triaxial (f)	1.85 mm (f) Triaxial (f)
Maximum current	0.5 Amps	2 Amps	0.5 Amps	2 Amps	0.5 Amps
Maximum voltage	40 Volts	40 Volts	40 Volts	100 Volts	40 Volts
Maximum RF power	2 Watts	2 Watts	2 Watts	2 Watts	1 Watt

[1] Special option number K1x refers to port 1 bias network, K2x refers to port 2 bias network (this convention does not apply to the K22/K23 and K68/K69)

Supplemental characteristics

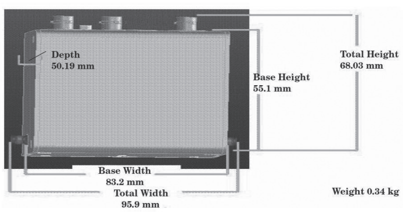


11612T-K10

Footprint for 11612T-K10/K20, K12/K22:
105 mm x 70 mm (includes connector protrusions)

Height: 50 mm

Net Weight: 370 g (0.8 lb)

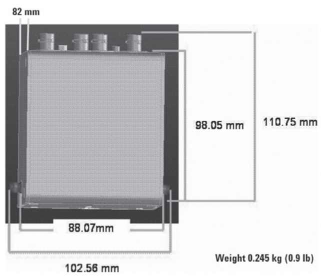


11612V-K22

Footprint for 11612V-K11/K21, K22/K23:
96 mm x 68 mm (includes connector protrusions)

Height: 50 mm

Net Weight: 340 g (0.74 lb)



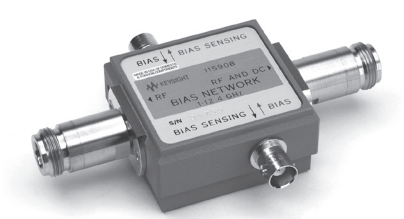
11612V-K68/69

Footprint for 11612V-K68/K69:
103 mm x 111 mm

Height: 82 mm

Net Weight: 245 g (0.9 lb)

Bias Network Series



11590B

11612A


11612VK67

Specifications and Ordering Information

Model	11590B	11612A	11612B	11612VK67
Frequency range	100 MHz to 12.4 GHz Option 001, 18 GHz	45 MHz to 26.5 GHz	45 MHz to 50 GHz	10 MHz to 67 GHz
Connector type: RF input & output	Type N (f)	3.5mm (f)	2.4mm (f)	1.85mm (f)
DC Bias	BNC (f)	smb (m)	smb (m)	3 pin connector (1)
Maximum current	0.5 Amps	0.5 Amps	0.5 Amps	0.5 Amps
Maximum voltage	100 Volts	40 Volts	40 Volts	40 Volts
Max. RF power	10 Watts	0.25 Watts	0.25 Watts	1 Watts

Optional Accessories

11612T-K32 or K33 Pair of mounting brackets for simple connection to Cascade Microtech, Inc. probe positioners. The brackets can be attached to the bias networks, which are then mounted onto the probe positioners (Cascade Microtech part number 101-543).

11612T-K32 is a pair of plates used to mount 11612T/V-Kx and 11612T/V-K2x Bias Tee on Cascade Microtech, Inc. positioners (part number: 101-543). 11612T-K32 is 10 mm longer than 11612T-K33.

11612T-K33 is a pair of plates used to mount 11612T/V-Kx and 11612T/V-K2x Bias Tee on Cascade Microtech, Inc. positioners (part number: 101-543). 11612T-K33 is 10 mm shorter than 11612T-K32.

Web Link

www.keysight.com/find/mta

18 Spectrum Analyzer Accessories

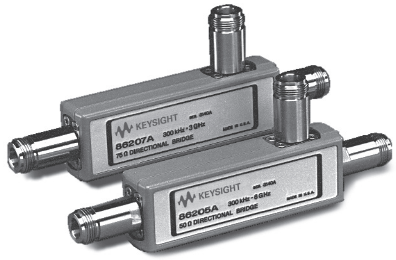
SPECTRUM ANALYZER ACCESSORIES

87415A microwave component amplifier

83017A microwave system amplifier

83051A microwave system amplifier


U7227A/C/F USB Preamplfiers



86205A/86207A RF bridge


85024A high frequency probe

11867A limiter

87405B preamplifier

U1818A/B active differential probes

M1970 Series Waveguide Harmonic Mixers

Keysight smart mixers are used to extend the operating frequencies of the N9040B UXA, N9030A PXA, N9020A MXA, and N9010A EXA signal analyzers up to 110 GHz for millimeter-wave applications. These smart mixers use a simple USB plug-and-play connection that can automatically configure the UXA/PXA/MXA/EXA for the specific mixer connected, including downloading conversion loss data and automatically compensate for local oscillator path loss. Therefore, it provides you with the most efficient test setup and reduce the overall startup operations with better performance with its embedded smart features when used with Keysight X-Series signal analyzers.

U7227 Series USB Preamplfiers

The U7227A/C/F USB preamplifiers are designed to bring reliable gain and low noise figure to measurement systems improving the overall system performance and reducing systematic errors; a total solution with the X-Series signal analyzers to perform noise figure measurements up to 50 GHz. When connected to the X-Series signal analyzers, the USB preamplifiers can automatically configure the analyzers to detect the specific preamplifier connected and download the embedded calibration data such as gain, noise figure and S-parameters. The calibration data provides accurate correction data and repeatable results for each actual measurement made. 87415A Amplifier

The 87415A microwave component amplifier brings compact, reliable gain block performance to systems integrators and microwave designers. With 25 dB minimum gain and over 23 dBm output power from 2 to 8 GHz, this amplifier offers output power where it is needed: at the test port. Refer to Amplifier chapter for more details.

83017A Amplifier

The 83017A microwave system amplifier is a compact, off-the-shelf amplifier designed for systems designers and integrators. This amplifier provides power where you need it to recover system losses and to boost available power in RF and microwave ATE systems. The ultrabroad bandwidth from 500 MHz to 26.5 GHz allows the designer to replace several narrow bandwidth amplifiers with a single Keysight amplifier, eliminating the need for crossover networks or multiple bias supplies. Refer to Amplifier chapter for more details.

83051A Amplifier

The 83051A microwave system amplifier is a compact, off-the-shelf amplifier designed for systems designers and integrators. This amplifier provides power where you need it to recover system losses and to boost available power in RF and microwave ATE systems. The ultrabroad bandwidth from 45 MHz to 50 GHz allows the designer to replace several narrow bandwidth amplifiers with a single Keysight amplifier, eliminating the need for crossover networks or multiple bias supplies.

86205A RF Bridge (300 kHz to 6 GHz, 50 Ω)

The 86205A high directivity 50 Ω RF bridge offers unparalleled performance in a variety of general-purpose applications. It is ideal for accurate reflection measurements and signal leveling applications.

86207A RF Bridge (300 kHz to 3 GHz, 75 Ω)

This 75 Ω type-N RF bridge has high directivity and excellent port match from 300 kHz to 3 GHz. It is used for external reflection measurements or coupling signals from its main path.

85024A High Frequency Probe

Makes in-circuit measurements easy. Input capacitance of only 0.7 pF shunted by 1 MΩ resistance permits high frequency probing (300 kHz to 3 GHz) without adverse loading of the circuit under test. Excellent frequency response and unity gain guarantee highly accurate swept measurements. High sensitivity and low distortion levels allow measurements that take full advantage of the analyzer's dynamic range. Directly compatible with many Keysight signal/spectrum analyzers including the X-Series, PSA, ESA, and 856xEC Series and network analyzers like the PNA Series, 4395, 871x, 875x and 872x.

U1818A 7 GHz and U1818B 12 GHz Active Differential Probes

The U1818A/B active differential probes makes it easy to perform high frequency (100 kHz to 7/12 GHz) in-circuit measurements using network, spectrum and signal source analyzers. With flat frequency response, low noise floor, and direct power from instrument connection, the U1818A/B allows measurements to be made while taking full advantage of Keysight's RF analyzers dynamic range.

41800A Active Probe

This probe offers high input impedance from 5 Hz to 500 MHz. It works with many Keysight spectrum analyzers to evaluate the quality of circuits by measuring spurious level, harmonics, and noise. Low input capacitance offers probing with negligible circuit loading for precise, in-circuit measurements of audio, video, HF, and VHF bands.

11742A Blocking Capacitor

The 11742A blocking capacitor blocks DC signals below 45 MHz and passes signals up to 26.5 GHz. Ideal for use with high frequency oscilloscopes or in biased microwave circuits, the 11742A suppresses low frequency signals that can damage expensive measuring equipment or affect the accuracy of your RF and microwave measurements.

87405B Preamplifier (10 MHz to 4 GHz)

The 87405B microwave component preamplifier brings compact, reliable gain block performance to system integrators and microwave designers. With 22 dB minimum gain block, 5 dB noise figure, and over 8 dBm output power, this amplifier offers output power where it is needed; at the test port.

11867A Limiters

These limiters can be used to protect the input circuits of signal/spectrum analyzers, counters, amplifiers, and other instruments from high power levels with minimal effect on measurement performance. The 11867A RF limiter (DC to 1800 MHz) reflects signals up to 10 watts average power and 100 watts peak power. Insertion loss is less than 0.75 dB.

11852B 75 Ω Minimum Loss Pad

The 11852B is an instrument-grade, 50 Ω type-N female to 75 Ω type-N male adapter. This product is also available in a 50 Ω type-N male to 75 Ω type-N female configuration. The 11852B Option 004 has a 50 Ω type-N (m) and 75 Ω type-N (f) connector.

Ordering Information/Accessories

U7227A 10 MHz to 4 GHz USB preamplifier
U7227C 100 MHz to 26.5 GHz USB preamplifier
U7227F 2 to 50 GHz USB preamplfier
M1970E 60 to 90 GHz waveguide harmonic mixer
M1970V
Option 001: 50 to 75 GHz waveguide harmonic mixer
Option 002: 50 to 80 GHz waveguide harmonic mixer
M1970W 75 to 110 GHz waveguide harmonic mixer
LO cable options
Option 101: 1 meter LO cable
Option 102: 3 meter LO cable
USB cable options
Option 201: 1.8 meter USB cable
Option 202: 3 meter USB cable
Jackstand (optional)
Option 301: Standard jackstand for mixer
11852B 75 Ω minimum-loss pad
11852B-004 50 Ω type-N (m), 75 Ω type-N (f)
11867A DC to 1.8 GHz limiter
41800A active probe (5 Hz to 500 MHz)
83017A 0.5 to 26.5 GHz microwave system amplifier
83051A 45 MHz to 50 GHz microwave system amplifier
85024A high-frequency probe (300 kHz to 3 GHz)
86205A 50 Ω RF bridge (300 kHz to 6 GHz)
86207A 75 Ω RF bridge (300 kHz to 3 GHz)
87405B 10 MHz to 4 GHz preamplifier
87415A 2 GHz to 8 GHz microwave system amplifier
U1818A active differential probe (100 kHz to 7 GHz)
U1818B active differential probe (100 kHz to 12 GHz)

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19 Waveguide Accessories

Waveguide Accessory Selection Guide

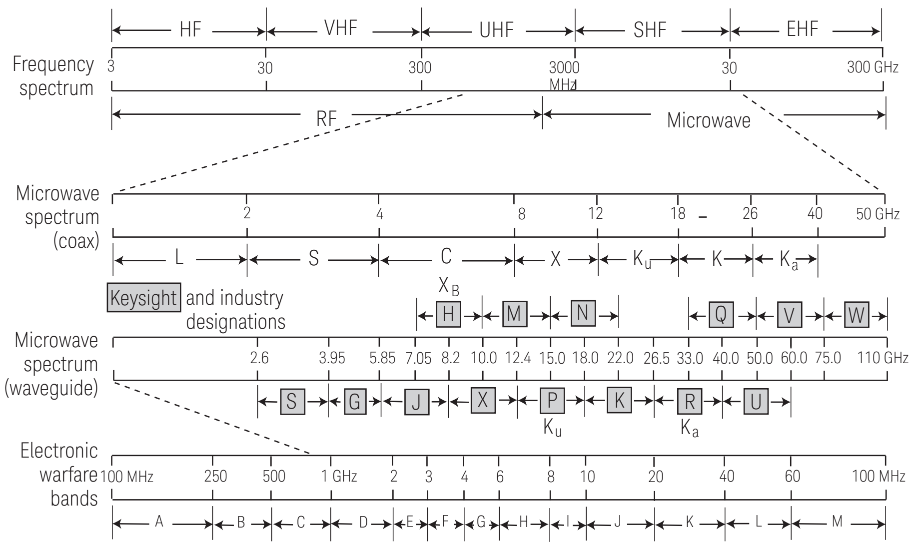
Type	Application	Model number Series [1]	Frequency coverage by band (GHz)							
			X	P	K	R	Q	U	V	W
			8.20 – 12.4	12.4 – 18.0	18.0 – 26.5	26.5 – 40.0	33.0 – 50.0	40.0 – 60.0	50.0 – 75.0	75.0 – 110.0
Adapters	Coaxial to waveguide interconnect	281A	■			■	■	■	■	
		281B		■		■	■	■	■	
		281C	■	■	■				■	■
		281D							■	■
Detectors	Detect RF power, CW or pulsed; measure reflection coefficient, insertion loss	422C				■				
Calibration and verification kits [2]	Network analyzer accessories	11644A	■	■	■	■	■	■	■	■
		11645A				■	■	■	■	■

1 For complete model number, add the appropriate waveguide band designator as a prefix to the model number (except mixers) e.g. the model number for a coaxial to waveguide adapter in "X" band would be X281A.
2 See Network Analyzer Accessories section of this catalog for product details.

Waveguide Product Data

Keysight band designation	Waveguide dimensions							Cutoff frequency (GHz)	Theoretical attenuation low to high frequency (dB/100 ft)	Theoretical peak power rating- low to high frequency megawatts (kw)	Theoretical CW power rating- low to high frequency kilowatts (watts)
	Inside dimensions			Outside dimensions			Nom. wall thickness mm (in)				
	Width mm (in)	Height mm (in)	Tol ± mm (in)	Width mm (in)	Height mm (in)	Tol ± mm (in)					
X	22.86 (0.900)	10.16 (0.40)	0.10 (0.004)	25.40 (1.0)	12.70 (0.5)	0.10 (0.004)	1.27 (0.05)	6.560 6.560	6.424 to 4.445 6.506 to 4.502	0.758 to 1.124 0.758 to 1.124	0.8621 to 1.246 0.8169 to 1.180
P	15.80 (0.622)	7.90 (0.311)	0.06 (0.0025)	17.83 (0.702)	9.93 (0.391)	0.08 (0.003)	1.02 (1.02)	9.490 9.490	9.578 to 7.041 9.700 to 7.131	0.457 to 0.633 0.457 to 0.633	0.4513 to 0.6139 0.4276 to 0.5816
K	10.67 (0.42)	4.32 (0.17)	0.05 (0.002)	12.70 (0.5)	6.35 (0.25)	0.08 (0.003)	1.02 (0.04)	14.08 14.08	20.48 to 15.04 20.74 to 15.23	0.171 to 0.246 0.171 to 0.246	0.1565 to 0.2132 0.1483 to 0.2020
R	7.11 (0.280)	3.56 (0.14)	0.04 (0.0015)	9.14 (0.36)	5.59 (0.22)	0.05 (0.002)	1.02 (0.04)	21.10 21.10	23.02 to 15.77 34.46 to 23.59	(96.0 to 146) (96.0 to 146)	(109.7 to 160.1) (73.27 to 107.0)
Q	5.69 (0.224)	2.84 (0.112)	0.03 (0.001)	7.72 (0.304)	4.88 (0.192)	0.05 (0.002)	1.02 (0.04)	26.35 26.35	32.44 to 22.05 48.53 to 32.99	(64.4 to 97.0) (64.4 to 97.0)	(68.89 to 101.4) (46.05 to 67.74)
U	4.78 (0.188)	2.39 (0.094)	0.03 (0.001)	6.81 (0.268)	4.42 (0.174)	0.05 (0.002)	1.02 (0.04)	30.69 30.69	39.81 to 28.60 –	(48.0 to 70.0) (48.0 to 70.0)	(51.32 to 71.43) –
V	3.76 (0.148)	1.88 (0.074)	0.03 (0.001)	5.79 (0.228)	3.91 (0.154)	0.05 (0.002)	1.02 (0.04)	39.90 39.90	60.25 to 41.17 –	(30.0 to 40.0) (30.0 to 40.0)	(30.27 to 44.30) –
W	2.54 (0.100)	1.27 (0.05)	0.03 (0.001)	4.57 (0.18)	3.30 (0.13)	0.05 (0.002)	1.02 (0.04)	58.85 58.85	105.6 to 74.26 –	(14.0 to 20.0) (14.0 to 20.0)	(14.73 to 20.86) –

Frequency Band Data



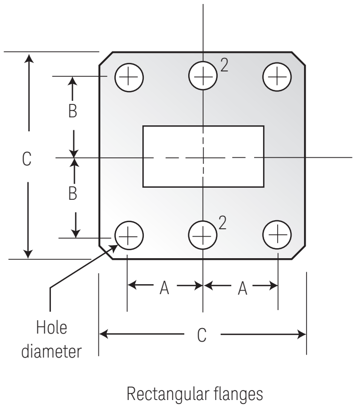


Figure 1. Rectangular flanges X, P, K, R bands

Flange Data (8.20 to 40.0 GHz) [1]

	Waveguide designator			Flange designator			Dimensions mm (in)			
Keysight band	**Frequency range (GHz)**	**EIA**	**MIL-W-85/( )**	**Material B: copper alloy A: aium. alloy**	**JAN UG-( )/U**	**MIL-F-3922/( )**	**A**	**B**	**C**	**Hole diameter**
X	8.2 to 12.4	WR-90	1-079 1-078	B A	39 135	54C-007 54C-008	15.5 (0.61)	16.3 (0.64)	41.3 (1.625)	4.3 (0.169)
P	12.4 to 18	WR-62	1-089 1-091	B A	419 –	70A-007 70A-008	12.6 (0.497)	12.1 (0.478)	33.5 (1.32)	3.7 (0.144)
K	18 to 26.5	WR-42	1-102 1-104	B A	595 597	54C-001 54C-002	8.1 (0.32)	8.5 (0.335)	22.2 (0.875)	2.9 (0.116)
R	26.5 to 40	WR-28	3-007 3-009	B A	599 –	54-003 –	6.35 (0.25)	6.7 (0.265)	19.1 (0.75)	2.9 (0.116)

1. See figure 1
2. R band only, hole diameter 2.38 mm, –0, + 0.025

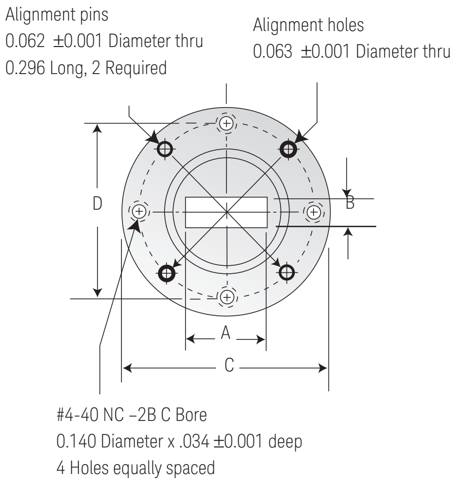


Figure 2. K, R, Q, U, V, W bands

Precision Circular Flange Data (18.0 to 110.0 GHz) [1]

	Waveguide designator			Flange designator			Dimensions mm (in)			
Keysight band	Frequency range (GHz)	EIA	MIL-W-85/( )	Material B: Copper alloy A: Alum. alloy	MIL-F-3922/( )	JAN UG-( )/U	A	B	C diameter	D diameter
K	18 to 26.5	WR-42	1-102 1-104	B A	67B-004 67B-011	425 –	10.7 (0.42)	4.3 (0.17)	28.6 (1.125)	23.8 (0.9375)
R	26.5 to 40	WR-28	3-007 3-009	B A	67B-005 67B-012	381 –	7.1 (0.28)	3.6 (0.14)	28.6 (1.125)	23.8 (0.9375)
Q	33 to 50	WR-22	3-011 3-013	B A	67B-006 67B-013	383 –	5.7 (0.224)	2.8 (0.112)	28.6 (1.125)	23.8 (0.9375)
U	40 to 60	WR-19	3-015 –	B A	67B-007 –	383 (mod) –	4.8 (0.188)	2.4 (0.094)	28.6 (1.125)	23.8 (0.9375)
V	50 to 75	WR-15	3-018 –	B A	67B-002 –	385 –	3.8 (0.148)	1.9 (0.074)	19.1 (0.75)	14.3 (0.5625)
W	75 to 110	WR-10	3-024 –	B A	67B-010 –	387 (mod) –	2.5 (0.10)	1.3 (0.050)	19.1 (0.75)	14.3 (0.5625)

[1] See Figure 2

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281 Series Adapters

281A/B/C Series adapters transform waveguide transmission line into 50 Ω coaxial line. Power can be transmitted in either direction, and each adapter covers the full frequency range of its waveguide band with SWR less than 1.3.

Specifications

Model	Frequency range (GHz)	Maximum SWR	Waveguide [1] designator EIA MIL-W-85/( )	Flange [1] designator UG-( )/U MIL-F-3922/( )	Coaxial connector	Length mm (in)	Shipping weight kg (lb)
X281A [2]	8.2 to 12.4	1.25	WR-90 1-077	135 54C-008	N (f)	35 (1.38)	0.45 (1)
X281C [2]	8.2 to 12.4	1.05	WR-90 1-077	135 54C-008	APC-7 Option 012: N (m) Option 013: N (f)	73 (2.88)	0.5 (1)
P281B	12.4 to 18	1.25	WR-62 1-090	419 70A-008	APC-7 Option 013: N (f)	64 (2.5)	0.5 (1)
P281C [2]	12.4 to 18	1.06	WR-62 1-090	419 70A-008	APC-7	52 (2)	0.5 (1)
K281C [2]	18 to 26.5	1.07	WR-42 1-103	597 54C-002	3.5 mm (f) Option 012: 3.5 mm (m)	35 (1.38)	0.5 (1)
R281A	26.5 to 40	1.13	WR-28 3-009	599 –	2.4 mm (f)	39 (1.5)	0.2 (0.5)
R281B	26.5 to 40	1.13	WR-28 3-009	599 –	2.4 mm (m)	39 (1.5)	0.2 (0.5)
Q281A	33 to 50	1.17	WR-22 3-013	383 67B-013	2.4 mm (f)	39 (1.5)	0.2 (0.5)
Q281B	33 to 50	1.17	WR-22 3-013	383 67B-013	2.4 mm (m)	39 (1.5)	0.2 (0.5)
U281A	40 to 60	1.17	WR-19 –	383 (mod) –	1.85 mm (f)	39 (1.5)	0.2 (0.5)
U281B	40 to 60	1.17	WR-19 –	383 (mod) –	1.85 mm (m)	39 (1.5)	0.2 (0.5)
V281A	50 to 67	1.22	WR-15 –	385 –	1.85 mm (f)	32 (1.25)	0.2 (0.5)
V281B	50 to 67	1.22	WR-15 –	385 –	1.85 mm (m)	32 (1.25)	0.2 (0.5)
V281C	50 to 75	1.38	WR-15 3-018	385 67B-002	1.0 mm (f)	32 (1.25)	0.1 (0.2)
V281D	50 to 75	1.38	WR-15 3-018	385 67B-002	1.0 mm (m)	32 (1.25)	0.1 (0.2)
W281C	75 to 110	1.38	WR-10 3-024	387 67B-010	1.0 mm (f)	32 (1.25)	0.1 (0.2)
W281D	75 to 110	1.38	WR-10 3-024	387 67B-010	1.0 mm (m)	32 (1.25)	0.1 (0.2)

1 The Waveguide/Flange Designator is provided to determine interface dimensions and generic material of Keysight products.
2 Option 006 adds two alignment holes

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R422C Detector

The R422C is a 26.5 to 40 GHz GaAs planar doped barrier diode detector. It comes standard with negative output polarity.

Specifications

Model	R422C
Frequency range	26.5 to 40 GHz
Frequency response (dB)	±0.6
Maximum SWR	1.78
Low level sensitivity (mV/µW)	> 0.42
Maximum input power (avg)	100 mW
Typical short term power (max. < 1 minute)	1 W
Video impedance	1.5 kΩ
RF bypass capacitance (nominal)	10 pF
Standard output polarity	Negative
Waveguide designator [1] EIA MIL-W-85/( )	 WR-28 3-008
Flange designator [1] UG-( )/U	 599
MIL-F-3922/( )	54-003
Output connector	BNC (f)
Shipping weight – kg (lb)	0.5 (1)

[1] The waveguide/flange designator is provided to determine interface dimensions and generic material of Keysight products

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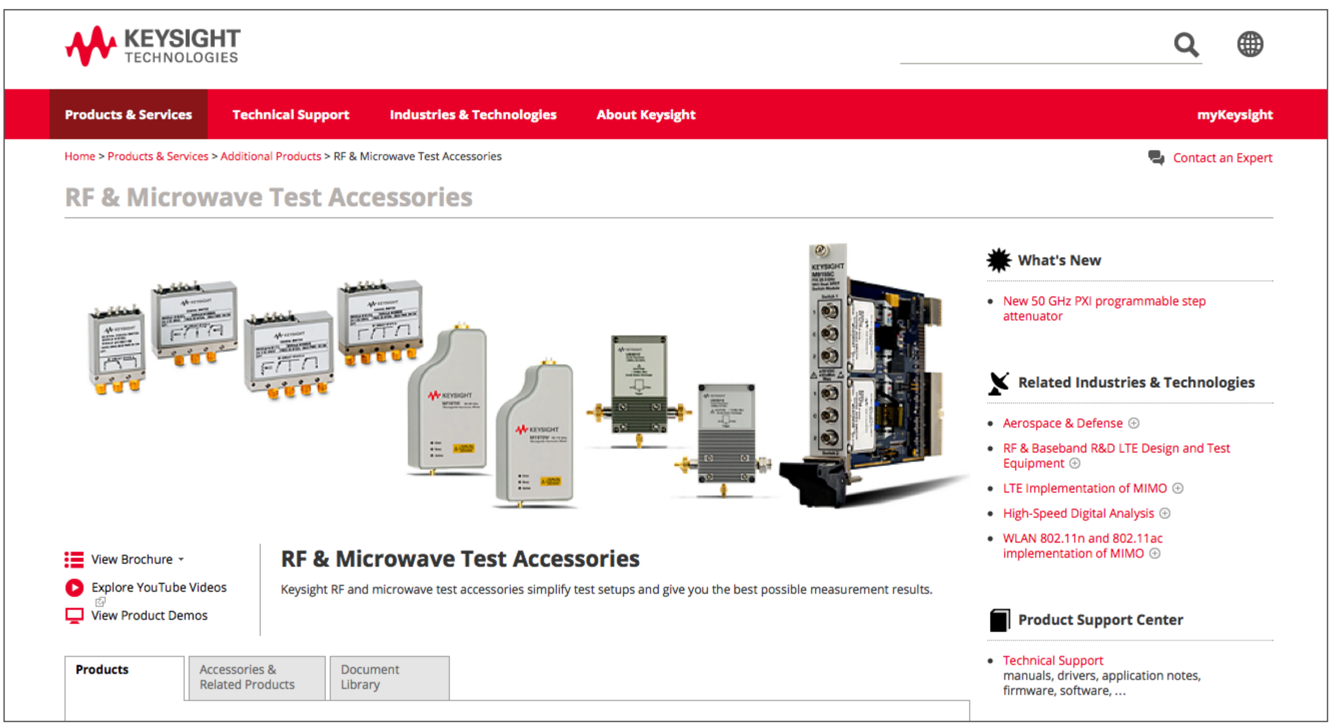

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