Agilent RF and Microwave Test Accessories

Catalog 2006/07

Agilent Technologies

About Agilent's RF and Microwave Test Accessories
Catalog 2006/07

The Agilent Technologies 2006/07 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.agilent.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 Agilent's high-performance RF and microwave test accessories.

Agilent Technologies

Agilent Technologies: An Overview

While, physically, we have outgrown HP's garage, we continue to live the values handed down from Bill and Dave: uncompromising integrity; trust, respect and teamwork; and innovation that makes a difference.

Our products and technology innovations continue to enable real breakthroughs that matter, blazing trails in the fields that are shaping the modern world.

Overview

Agilent delivers critical tools and technologies that sense, measure and interpret the physical and biological world. Our innovative solutions enable a wide range of customers in communications, electronics, life sciences and chemical analysis to make technological advancements that drive productivity and improve the way people live and work.

Agilent Technologies' Test and Measurement Organization

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.

Markets: Our test and measurement markets include the communications test and general-purpose test markets.

Product Areas: Communications test products include testing solutions for fiber optic networks; transport networks; broadband and data networks; wireless communications; microwave networks; installation and maintenance solutions; and operations support systems, including monitoring and network management systems. General-purpose test solutions include general-purpose instruments; modular instruments and test software; digital design products; and high-frequency electronic design tools.

History and Culture

Agilent's pioneering spirit was kindled more than 60 years ago, when two engineers – Bill Hewlett and Dave Packard – invented the future in their garage. In 1999, Agilent was spun off from Hewlett-Packard Company, and we have continued to support the values important to the two visionary founders.

Quality

Quality innovation is not only a passion for the Agilent 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 Agilent product.

Agilent Around the World

Agilent has facilities in more than 30 countries and develops products at manufacturing sites in the U.S., China, Germany, Japan, Malaysia, Singapore, Australia and the U.K. Agilent Labs has its headquarters in Palo Alto, California, with additional sites in Fort Collins, Colorado; South Queensferry, Scotland; and Beijing, China.

Introduction and Index

1

Table of Contents

Agilent RF and Microwave Test Accessories Catalog 2006/07

Table of Contents

Product Number Index

Model Number & Description

Product Number Index

Model Number & Description (continued)

9

E

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2

2

Agilent N9355/6 Power Limiters

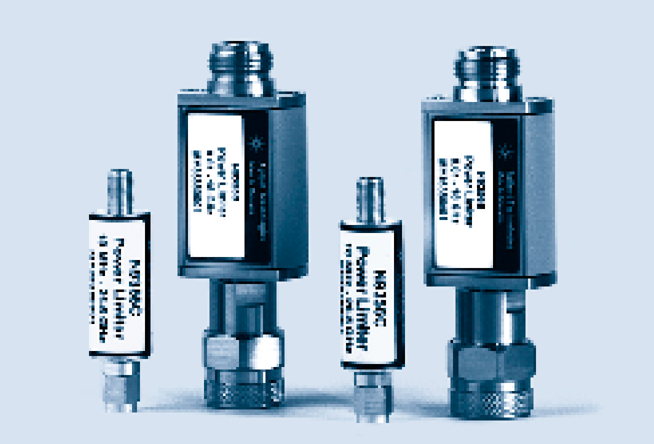
Agilent offers a new series of industry-leading limiters, specifically designed to provide input protection for RF and microwave instruments and components used in telecommunication, component test, aerospace and defense industries. This new product includes five unique designs with different frequency ranges and limiting thresholds. The N9355/6 series of high performance limiters will safe-guard your investments from damage due to excess RF power, DC transients and electro-static-discharge.

Agilent allows you to pay only for the performance you need, with the following selections:

- Frequency range
- Connector type
- Limiting threshold

Key specifications & features

- Maximum input power of 3 Watts
- Maximum insertion loss of 2.75 dB
- Minimum return loss of 15 dB (SWR of 1.43)
- Integrated DC block
- Bi-directional functionality



Agilent N9355B & N9356B Power Limiters

The Agilent N9355B and N9356B limiters' operating frequency ranges from 10 MHz to 18 GHz, and offer a limiting threshold of 10 and 25 dBm respectively. Both are furnished with a pair of premium quality male and female Type-N connectors.

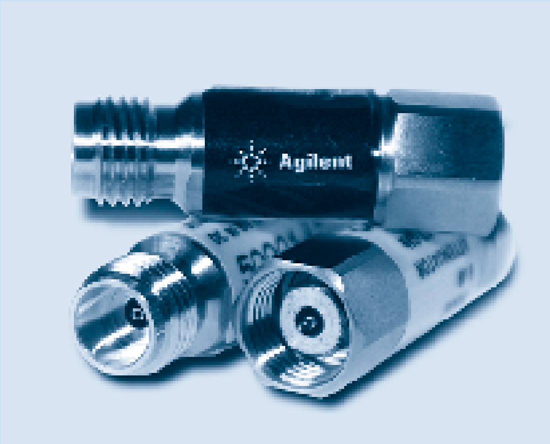
Agilent N9355C & N9356C Power Limiters

The Agilent N9355C and N9356C wideband limiters operate from 10 MHz to 26.5 GHz and provide a limiting threshold of 10 and 25 dBm respectively. Both are furnished with a pair of premium quality male and female 3.5 mm connectors.

Agilent N9355F Power Limiter

The Agilent N9355F is an ultra-broadband limiter (10 MHz to 50 GHz) that comes with a limiting threshold of 10 dBm. It is furnished with a pair of premium quality male and female 2.4 mm connectors. (Will be available Spring 2006)

2



Agilent 8490G Coaxial Fixed Attenuators

Agilent coaxial fixed attenuators are rugged, reliable, accurate and small enough for use in both bench and in-system applications. With their broad DC to 67 GHz frequency range and reasonable cost, these attenuators are ideal for education, telecommunications, component test, aerospace and defense industries.

Key specifications

- Broadband: DC to 67 GHz
- Low Standing Wave Ratio (SWR): 1.45 up to 67 GHz
- Excellent attenuation accuracy

The Agilent 8490G precision coaxial fixed attenuators offer unparalleled performance up to 67 GHz. These attenuators come with 1.85 mm coaxial connector, exhibit excellent SWR and attenuation accuracy from DC to 67 GHz. The 8490G provides attenuation values of 3, 6, 10, 20, 30 and 40 dB.

With high accuracy and low SWR, the attenuators are ideal for extending the dynamic range of power meters. This helps enable higher power measurements, and reduce input power levels into sensitive components and instruments. Coaxial fixed attenuators are also commonly used to reduce measurement mismatch errors. (Will be available Winter 2006)

Agilent N9397A/C Solid State Switches

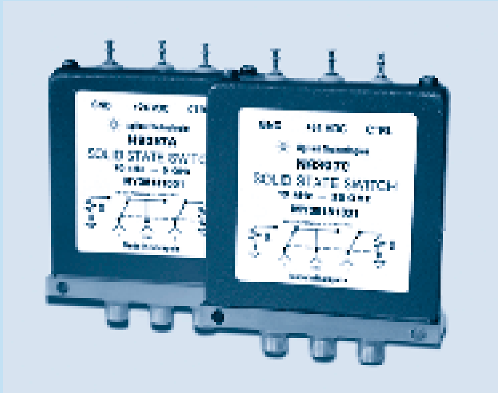
Agilent RF & microwave switches find use in a wide variety of signal routing applications for test and measurement systems. Typical applications include:

- Selection of multiple signal sources to one output
- Selection of multiple input signals to one measurement instrument

The Agilent N9397A/C solid state switches are based on GaAs Monolithic Microwave Integrated Circuit (MMIC). The switches are designed for superior performance offering low insertion loss, excellent return loss and broad operating frequency bandwidth. This single pole double throw (SPDT) switch can be used in a variety of test systems requiring high speed RF and microwave signal routing.

Key specifications & features

- Broadband: up to 20 GHz
- High isolation: >90 dB at 20 GHz standard
- Maximum insertion loss of 5.5 dB (N9397A), 7 dB (N9397C)
- Minimum return loss of 15 dB (N9397A), 10 dB (N9397C)
- ESD or excess power protection at all RF ports
- Integrated TTL/5V CMOS compatible drive
- Single DC bias voltage
- Terminated single-pole double-throw switch
- Solder lug terminals for biasing and control



Agilent N9397A Solid State Switch

The Agilent N9397A is a 300 kHz to 8 GHz solid state switch that comes with a TTL compatible integrated driver. The built in limiters help protect the switch from damage due to excess RF power, DC transients and ESD.

Agilent N9397C Solid State Switch

The Agilent N9397C is a 10 MHz to 20 GHz version of the solid state switch with features identical to the N9397A.

Both switches are furnished with premium quality female SMA connectors. (Will be available Winter 2006)

Adapters and Connectors

3

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. Agilent 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 Ω connector was designed in the 1940s for military systems operating below 4 GHz. In the 1960s, improvements pushed performance to 12 GHz and later, mode-free, to 18 GHz. Agilent offers some products with slotless type-N center conductors for improved performance to 18 GHz. Agilent type-N connectors are completely compatible with MIL-C-39012. Certain 75 Ω products use a type-N design with smaller center conductor diameters, and thus are not compatible with 50 Ω 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 Agilent 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 is mode-free to 34 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 offers mode-free performance to 40 GHz.

2.4 mm connector

The 2.4 mm connector was developed by HP, Amphenol, and M/A-COM for use 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 Agilent Technologies – for mode-free performance 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 all the way 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.

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 Agilent 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. Table 1 shows the recommended torque for various connector types.

3

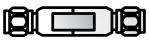
Table 1. Recommended torque values for connectors

Connector type	Torque lb-inch (N-cm)
Precision 7 mm	12 (136)
Precision 3.5 mm	8 (90)
SMA	5 (56) Use the SMA torque value to connect male SMA connectors to female precision 3.5 mm connectors. Use the 3.5 mm torque value to connect male 3.5 mm connectors to the female SMA (8 lb-inch).
Precision 2.4 mm	8 (90)
Precision 1.85 mm	8 (90)
Precision 1.0 mm	4 (45)
Type-N	Type-N connectors may be connected finger tight. If a torque wrench is used, 12 lb-inch (136 N-cm) is recommended.

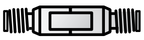
Metrology/instrument grade adapter selection guide

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

Typical configuration



Agilent 11900A
Agilent 11901A
Agilent 11904A
Agilent 83059A
Agilent 1250-1159
Agilent 1250-1748
85058-60007



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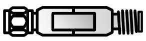
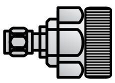
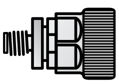
Agilent 11901B
Agilent 11904B
Agilent 83059B
Agilent 1250-1158
Agilent 1250-1749
85058-60008



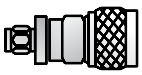
Agilent 11900C
Agilent 11901C
Agilent 11901D
Agilent 11904C
Agilent 11904D
Agilent 83059C
Agilent 1250-1462
85058-60009



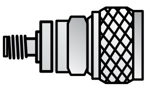
Agilent 11533A
Agilent 1250-1746



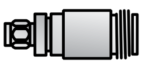
Agilent 11534A
Agilent 1250-1747



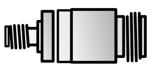
Agilent 11903A
Agilent 1250-1636
Agilent 1250-1743



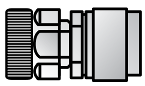
Agilent 11903D
Agilent 1250-1250
Agilent 1250-1744



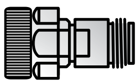
Agilent 11903C
Agilent 1250-1562
Agilent 1250-1750



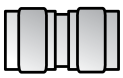
Agilent 11903B
Agilent 1250-1745
Agilent 1250-1772



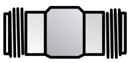
Agilent 11525A



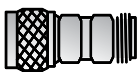
Agilent 11524A



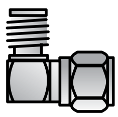
Agilent 1250-0778
Agilent 1250-1475
Agilent 1250-1528



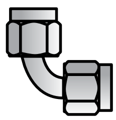
Agilent 1250-0777
Agilent 1250-1472
Agilent 1250-1529



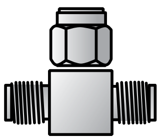
Agilent 11852B
Agilent 11852B Option 004
Agilent 1250-0597



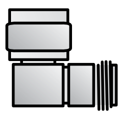
Agilent 1250-1249



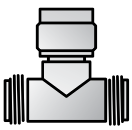
Agilent 1250-1397



Agilent 1250-1698



Agilent 1250-0176



Agilent 1250-0559

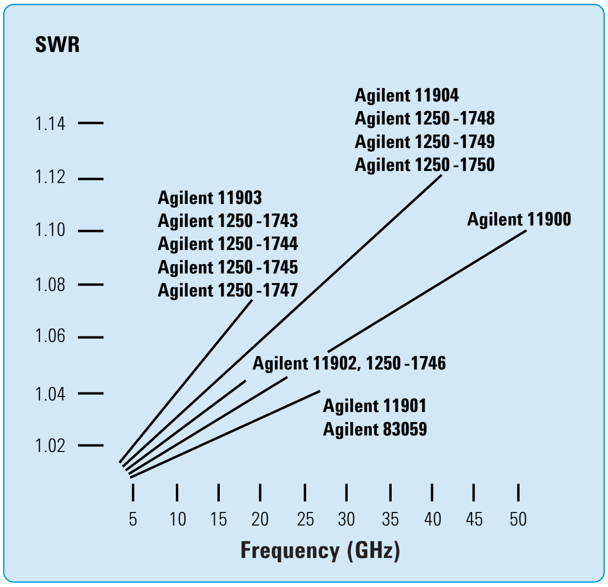
Agilent 1250-0846

Metrology grade adapters [1]

Agilent 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] Agilent 1190x adapters are phase matched within each family.
[2] f = jack, m = plug.
[3] Repeatability = –20 Log | Δr | , where | Δr | = | $r\ m_1 - r\ m_2$ |.
[4] 2.92 mm is compatible with 3.5 mm.

Typical precision adapter performance



Instrument grade adapters

Agilent 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 Agilent 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 Agilent 1190x series adapters.*
[4] *Insertion loss is 5.7 dB typical.*

Selected instrument grade adapters

1 Agilent 1250-1744 Adapter, 3.5 mm (f) to Type-N (m), DC to 18 GHz
2 Agilent 1250-1743 Adapter, 3.5 mm (m) to Type-N (m), DC to 18 GHz
3 Agilent 1250-1747 SMA (f) to APC-7 Adapter
4 Agilent 1250-1746 SMA (m) to APC-7 Adapter
5 Agilent 1250-1750 3.5 mm (m) to Type-N (f)
6 Agilent 1250-1745 3.5 mm (f) to Type-N (f)
7 Agilent 1250-1748 3.5 mm (m) to 3.5 mm (m) Instrument-Grade Adapter
8 Agilent 1250-1749 3.5 mm (f) to 3.5 mm (f)

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 1250-1694		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			1250-0827 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

3

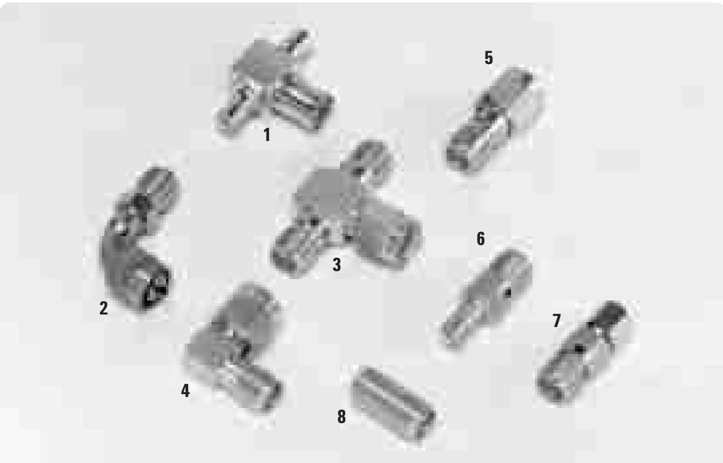
General purpose grade adapters

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 Agilent instruments for inter-module RF connections. SMB is snap-on configuration. SMC is screw-on configuration.*

1 Agilent 1250-1200 Adapter, BNC (f) to SMA (m)
2 Agilent 1250-1899 Adapter, BNC (f) to SMB (m)
3 Agilent 1250-0556 Adapter, BNC (f) to WECO Video (m)
4 Agilent 1250-1477 Standard, N (f) to BNC (m), Precision 50 Ω
5 Agilent 1250-1473 Standard, N (m) to BNC (m), Precision 50 Ω Adapter
6 Agilent 1250-0595 Adapter, BNC (f) to BNC Triaxial (m)
7 Agilent 1250-1930 Adapter, BNC (m) to BNC Triaxial (f)
8 Agilent 1250-1830 Adapter, BNC (f) to BNC Triaxial (f)
9 Agilent 1250-1857 Adapter, SMB (f) to BNC (m)
10 Agilent 1250-0562 Adapter, BNC (f) to SMA (f)
11 Agilent 1250-1236 Adapter, SMB (f) to BNC (f)



1 Agilent 1250-1391 Adapter, SMB Tee (f) (m) (m)
2 Agilent 1250-1741 SMA (f) to SMA (m) Right Angle Adapter
3 Agilent 1250-1698 Adapter, SMA Tee (m) (f) (f)
4 Agilent 1250-1249 Adapter, SMA Right Angle (m) (f)
5 Agilent 1250-1462 Adapter, SMA (m) to SMA (f)
6 Agilent 1250-0674 Adapter, SMB (m) to SMA (f)
7 Agilent 1250-1694 SMA (m) to SMA (f) Adapter
8 Agilent 1250-1158 SMA (f) to SMA (f) Adapter

General Purpose Adapters (continued)

1 Agilent 1250-0597 Adapter, Type-N (m) 50 Ω to Type-N (f) 75 Ω
2 Agilent 1250-1778 Standard N (m) to Standard N (m) Adapter, 50 Ω
3 Agilent 1250-1529 Standard N (f) to Standard N (f) Adapter, 75 Ω
4 Agilent 1250-1152 Adapter, SMC (f) to Type-N (m)
5 Agilent 1250-1404 Adapter, SMA (f) to Type-N (f)
6 Agilent 1250-1023 Adapter, SMC (m) to Type-N (m)
7 Agilent 1250-1535 Adapter, N (m) to BNC (f) Adapter, 75 Ω
8 Agilent 1250-1533 Standard N (m) to BNC (m) Adapter, 75 Ω
9 Agilent 1250-1250 Adapter, Type-N (m) to SMA (f), 50 Ω
10 Agilent 1250-0846 Tee Adapter, Standard N (f) (f) (f)
11 Agilent 1250-1636 Adapter, Type-N (m) to SMA (m) 50 Ω
12 Agilent 1250-0559 Tee Adapter, Standard N (m) (f) (f)
13 Agilent 1250-0176 Right Angle Standard N (m) to Standard N (f)

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)				11855A 86213A	11856A	86211A		
7-16	11906D	11906C	11906B					11906A

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 Agilent 11920/1/2 series 1.0 mm adapters provide an easy way of measuring coaxial devices at high frequencies. The Agilent 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 Agilent 11921 A/B/C/D, 1.0 mm to 1.85 mm, and the Agilent 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 Agilent 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 Agilent 1.0 mm adapters provide ease-of-use for microwave engineers who need to connect their test systems. The Agilent 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 Adapters

Agilent 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	–0.5 dB	–0.5 dB	–0.7 dB	–1.0 dB
Return loss	–24 dB DC to 20 GHz –20 dB 20 to 50 GHz –18 dB 50 to 75 GHz –14 dB 75 to 110 GHz	–20 dB	–20 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:	1 mm (m) to 1 mm (m)	1 mm (m) to 1.85 mm (m)	1 mm (m) to 2.4 mm (m)	1 mm (f) to circuit card launch
B, F:	1 mm (f) to 1 mm (f)	1 mm (f) to 1.85 mm (f)	1 mm (f) to 2.4 mm (f)	
C, G:	1 mm (m) to 1 mm (f)	1 mm (m) to 1.85 mm (f)	1 mm (m) to 2.4 mm (f)	
D, H:		1 mm (f) to 1.85 mm (m)	1 mm (f) to 2.4 mm (m)	

[1] *Measured at 25° C.*

Flexible microcircuit packaging

The Agilent 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 Agilent 11923A connector launch is intended for use with the N5250A and other test systems up to 110 GHz. The Agilent 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 Agilent 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.

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

Supplemental characteristics

Model number	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)

Note: 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.

Key literature

Agilent 11923A Operating and Service Guide 11923-90001

Slotless connectors

Precision Slotless sockets (female connectors) were developed by Agilent 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:

Agilent 85052B/C/D
Agilent 85054B/D
Agilent 85056A/D

Coaxial mechanical calibration kits

Connector	Frequency range	Type	VNA calibration accuracy	Agilent model	Available options
Type-F (75 Ω)	DC to 3 GHz	Economy	5% – 1%	**85039B**	1A7, A6J, UK6, 00M, 00F, MOF
Type-N (75 Ω)	DC to 3 GHz	Economy	5% – 1%	**85036E**	1A7, A6J, UK6
Type-N (75 Ω)	DC to 3 GHz	Standard	5% – 1%	**85036B**	1A7, A6J, UK6
Type-N (50 Ω)	DC to 6 GHz	Economy	5% – 1%	**85032E**	1A7, A6J, UK6
Type-N (50 Ω)	DC to 9 GHz	Standard	5% – 1%	**85032F**	1A7, A6J, UK6, 100, 200, 300, 500*
Type-N (50 Ω)	DC to 18 GHz	Economy	5% – 1%	**85054D**	1A7, A6J, UK6
Type-N (50 Ω)	DC to 18 GHz	Standard	2% – 0.3%	**85054B**	1A7, A6J, UK6
7-16	DC to 7.5 GHz	Standard	2%	**85038A**	UK6
7-16 (female)	DC to 7.5 GHz	Standard	2%	**85038F**	UK6
7-16 (male)	DC to 7.5 GHz	Standard	2%	**85038M**	UK6
7 mm	DC to 6 GHz	Economy	2% – 0.3%	**85031B**	1A7, A6J, UK6
7 mm	DC to 18 GHz	Economy	5% – 1%	**85050D**	1A7, A6J, UK6
7 mm	DC to 18 GHz	Standard	2% – 0.05%	**85050B**	1A7, A6J, UK6
7 mm	DC to 18 GHz	Precision	0.3% – 0.05%	**85050C**	1A7, A6J, UK6
3.5 mm	DC to 9 GHz	Standard	5% – 1%	**85033E**	1A7, A6J, UK6, 100, 200, 300, 400, 500
3.5 mm	DC to 26.5 GHz	Economy	5% – 1%	**85052D**	1A7, A6J, UK6
3.5 mm	DC to 26.5 GHz	Standard	3% – 0.5%	**85052B**	1A7, A6J, UK6
3.5 mm	DC to 26.5 GHz	Precision	2% – 0.5%	**85052C**	1A7, A6J, UK6
2.92 mm	DC to 50 GHz	Economy	11% – 4% (Option 001 65% – 3%)	**85056K**	1A7, A6J, UK6, 001
2.4 mm	DC to 50 GHz	Economy	5% – 1%	**85056D**	1A7, A6J, UK6
2.4 mm	DC to 50 GHz	Standard	4% – 0.5%	**85056A**	1A7, A6J, UK6
1.85 mm	DC to 67 GHz	Economy		**85058E**	1A7, A6J, UK6
1.85 mm	DC to 67 GHz	Standard		**85058B**	1A7, A6J, UK6
1 mm	DC to 110 GHz	Precision	5% – 1%	**85059A**	1A7, A6J, UK6

Option description:
1A7 ISO 17025 compliant calibration
A6J ANSI Z540 compliant calibration
UK6 Commercial calibration certificate with test data
00M Includes male standards & male-male adapter
00F Includes female standards and female-female adapter
MOF Includes male and female standards and 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

Waveguide mechanical calibrations kits

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

Coaxial electronic calibration kits (ECal)

Connector	Frequency range	Type	VNA calibration accuracy	Agilent model	Available options
Type-F (75 Ω)	300 kHz to 3 GHz	2-port	N/A	**85099C**	UK6, 00F, 00M, M0F, 00A
Type-N (75 Ω)	300 kHz to 3 GHz	2-port	N/A	**85096C**	UK6, 00F, 00M, M0F, 00A
Type-N (50 Ω)	300 kHz to 9 GHz	2-port	1% – 0.1%	**85092C**	1A7, A6J, UK6, 00F, 00M, M0F, 00A
Type-N (50 Ω)	300 kHz to 13.5 GHz	4-port	N/A	**N4431B Option 020**	1A7, A6J, UK6
Type-N (50 Ω)	300 kHz to 18 GHz	2-port	N/A	**N4690B**	1A7, A6J, UK6, 00F, 00M, M0F, 00A
Type-N (50 Ω)	300 kHz to 18 GHz	4-port	N/A	**N4432A**	N/A
7-16	300 kHz to 7.5 GHz	2-port	N/A	**85098C**	UK6, 00F, 00M, M0F, 00A [1]
7 mm	300 kHz to 9 GHz	2-port	1% – 0.1%	**85091C**	1A7, A6J, UK6
7 mm	300 kHz to 18 GHz	2-port	N/A	**N4696B**	1A7, A6J, UK6
3.5 mm	300 kHz to 9 GHz	2-port	2% – 0.2%	**85093C**	1A7, A6J, UK6, 00F, 00M, M0F, 00A [2]
3.5 mm	300 kHz to 13.5 GHz	4-port	N/A	**N4431B Option 010**	1A7, A6J, UK6
3.5 mm	300 kHz to 20 GHz	4-port	N/A	**N4433A**	N/A
3.5 mm	300 kHz to 26.5 GHz	2-port	N/A	**N4691B**	1A7, A6J, UK6, 00F, 00M, M0F, 00A [2]
2.92 mm	10 MHz to 40 GHz	2-port	N/A	**N4692A**	1A7, A6J, UK6, 00F, 00M, M0F, 00A [3]
2.4 mm	10 MHz to 50 GHz	2-port	N/A	**N4693A**	1A7, A6J, UK6, 00F, 00M, M0F, 00A [4]
1.85 mm	10 MHz to 67 GHz	2-port	N/A	**N4694A**	1A7, A6J, UK6, 00F, 00M, M0F, 00A [5]
VNA Interface kit	N/A	N/A	N/A	**85097B**	N/A

Option description:

1A7 ISO 17025 compliant calibration
A6J ANSI Z540 compliant calibration
UK6 Commercial calibration certificate with test data
00M Includes male standards & male-male adapter
00F Includes female standards and female-female adapter
MOF Includes male and female standards and 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 Agilent 8702 lightwave component analyzer

3

Mechanical verification kits

Connector	Frequency range	Type	VNA calibration accuracy	Agilent model	Available options
Type-N (50 Ω)	300 kHz to 18 GHz	Precision	N/A	**85055A**	1A7, A6J, UK6
7 mm	300 kHz to 6 GHz	Precision	N/A	**85029B**	1A7, A6J, UK6, 001
7 mm	300 kHz to 18 GHz	Precision	N/A	**85051B**	1A7, A6J, UK6
3.5 mm	300 kHz to 26.5 GHz	Precision	N/A	**85053B**	1A7, A6J, UK6
2.4 mm	0.045 to 50 GHz	Precision	N/A	**85057B**	1A7, A6J, UK6
1.85 mm	0.010 to 67 GHz	Precision	N/A	**85058V**	1A7, A6J, UK6
WR-28	26.5 to 40 GHz	Precision	N/A	**R11645A**	1A7, A6J, UK6
WR-22	33 to 50 GHz	Precision	N/A	**Q11645A**	1A7, A6J, UK6
WR-19	40 to 60 GHz	Precision	N/A	**U11645A**	1A7, A6J, UK6
WR-15	50 to 75 GHz	Precision	N/A	**V11645A**	1A7, A6J, UK6
WR-10	75 to 110 GHz	Precision	N/A	**W11645A**	1A7, A6J, UK6

Option description:
1A7 ISO 17025 compliant calibration
A6J ANSI Z540 compliant calibration
UK6 Commercial calibration certificate with test data
00M Includes male standards & male-male adapter
00F Includes female standards and female-female adapter
MOF Includes male and female standards and 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 Agilent 8702 lightwave component analyzer

4

Agilent 83020A

Agilent 83018A

Agilent 83017A

Agilent 83006A

Agilent 83050/51A

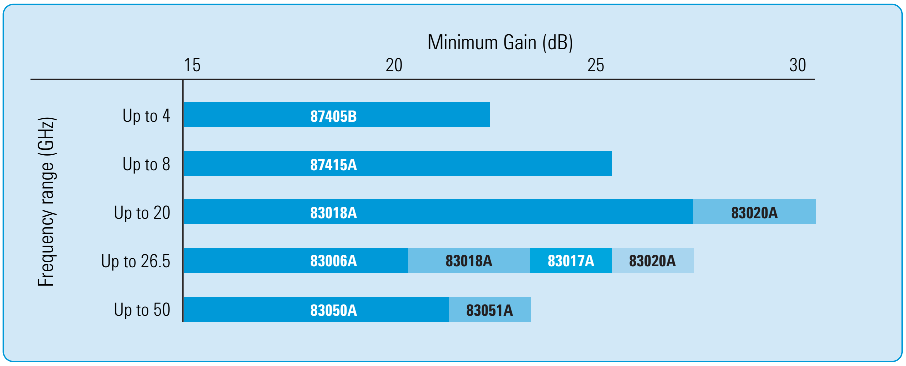
The Agilent 83006/017/018/020/050/051A test system amplifiers offer ultra broadband performance up to 50 GHz. With excellent noise figure relative to their broad bandwidth and high gain, these products can be used to significantly reduce test system noise figure. By replacing several amplifiers with a single broadband product, test setups can be greatly simplified. You can place this amplification power where you need it, by using remotely-locatable Agilent power supplies. In addition, the Agilent 87415A provides octave band performance from 2 to 8 GHz. The Agilent 87405B preamplifier is designed for input signal preamplification of low-level instruments such as the Agilent 859X series spectrum analyzers.

These amplifiers are supplied with a 2-meter bias cable that has a connector on one end and bare wires on the other (except for the Agilent 87405B). This bias cable can be used to interface with a power supply provided by the user. Or, for a complete solution, Agilent offers the Agilent 87421/422A remotely locatable power supplies. The Agilent 87421A power supply is furnished with one 2-meter cable (Agilent 87422A, two 2-meter cables) for direct connection to an Agilent amplifier as shown in the amplifier power cable cross reference on page 30.

Agilent 87415A

Agilent 87405B

Selection guide



Specifications (+20 to +30 °C)

Agilent model	Frequency range (GHz)	Output power at P_{sat} (dBm/mW)	Output power at P_{1dB} (dBm/mW) (min)	Gain (dB) (min)	Noise figure (dB) (typ)	Detector [1] output/DC connector	Bias (nom)	RF connectors (input/output)
83006A	0.01 to 26.5	+18/64 typ. to 10 GHz +16/40 typ. to 20 GHz +14/25 typ. to 26.5 GHz	+13/20 to 20 GHz +10/10 to 26.5 GHz	20	13 to 0.1 GHz 8 to 18 GHz 13 to 26.5 GHz	No	+12 V @ 450 mA –12 V @ 50 mA	3.5 mm (f)
83017A	0.5 to 26.5	+20/100 typ. to 20 GHz +15/32 typ. to 26.5 GHz	+18/64 to 20 GHz $(18 - 0.75\Delta f)$ dBm [2] $(64 - 7.8\Delta f)$ mw [2] $(20 \leq f \leq 26.5$ GHz)	25	8 to 20 GHz 13 to 26.5 GHz	Yes/BNC (f)	+12 V @ 700 mA –12 V @ 50 mA	3.5 mm (f)
83018A	2 to 26.5	+24/250 min to 20 GHz +21/125 min to 26.5 GHz	+22/160 to 20 GHz +17/50 to 26.5 GHz	27 to 20 GHz 23 to 26.5 GHz	10 to 20 GHz 13 to 26.5 GHz	Yes/BNC (f)	+12 V @ 2 A –12 V @ 50 mA	3.5 mm (f)
83020A	2 to 26.5	+30/1000 min to 20 GHz $(30 - 0.7\Delta f)$ dBm min [2] $(1000 - 65\Delta f)$ mw min [2] $(20 \leq f \leq 26.5$ GHz)	+27/500 to 20 GHz +23/200 to 26.5 GHz	30 to 20 GHz 27 to 26.5 GHz	10 to 20 GHz 13 to 26.5 GHz	Yes/BNC (f)	+15 V @ 3.2 A –15 V @ 50 mA	3.5 mm (f)
83050A	2 to 50	+20/100 min to 40 GHz $(19 - 0.2\Delta f)$ dBm [3] $(80 - 3.1\Delta f)$ mw [3] $(40 < f \leq 50$ GHz)	+15/32 to 40 GHz +13/20 to 50 GHz	21	6 to 26.5 GHz 10 to 50 GHz	No	+12 V @ 830 mA –12 V @ 50 mA	2.4 mm (f)
83051A	0.045 to 50	+12/16 min to 45 GHz min +10/10 min to 50 GHz min	+8/6 to 45 GHz +6/4 to 50 GHz	23	12 to 2 GHz 6 to 26.5 GHz 10 to 50 GHz	No	+12 V @ 425 mA –12 V @ 50 mA	2.4 mm (f)
87405B	0.01 to 4	+7/5 typ.	+8/6	22 min 27 max	5 to 4 GHz	No	+15 V @ 105 mA	N (f) N (m)
87415A	2 to 8	+26/400 typ.	+23/200	25	13	No	+12 V @ 900 mA	SMA (f)

[1] *Detector output can be utilized for leveling output power at the test port.*
[2] *$\Delta f = f(GHz) - 20$.*
[3] *$\Delta f = f(GHz) - 40$.*

Weight: Agilent 83006A, 83017A, 83050A, 83051A, 87415A: 0.64 kg (1.4 lb), Agilent 83018A: 1.8 kg (4 lb), Agilent 83020A: 3.9 kg (8.5 lb), Agilent 87405B: 0.23 kg (0.5 lb)

Power cable (shipped with amplifiers): 2-meter cable with a connector on one end and bare wires on the other. See amplifier power cable cross reference on page 30.

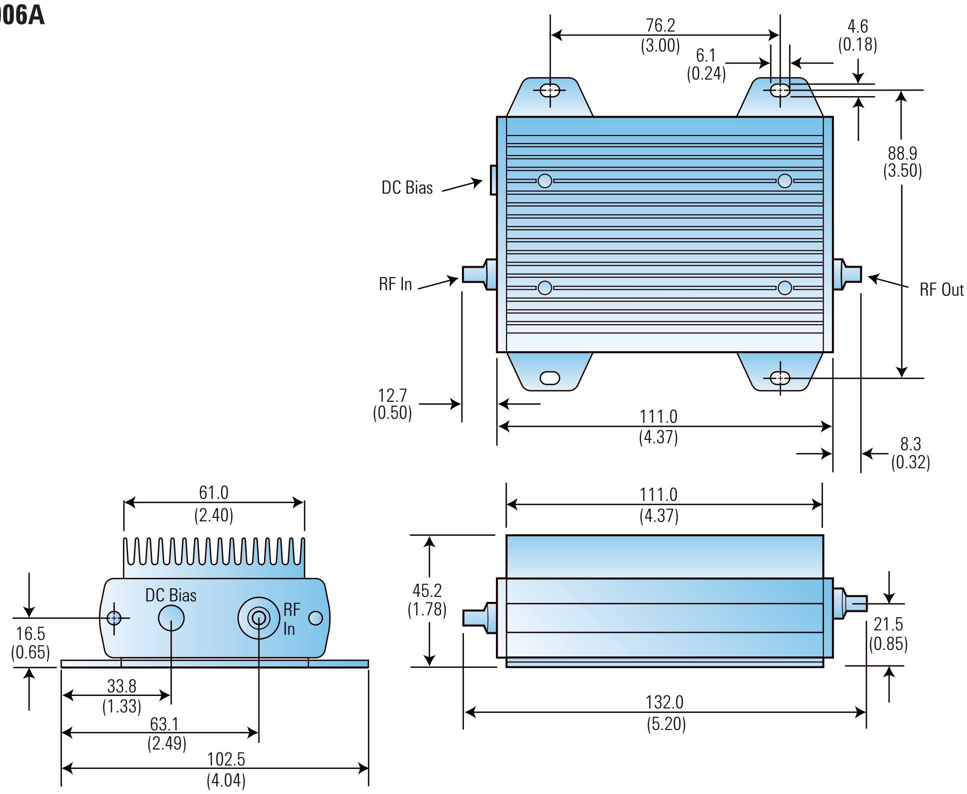
Power supply specifications

Agilent model	ac Input voltage	DC Output (nom)	Output power	Size (H, W, D)
87421A	100 to 240 VAC 50/60 Hz	+12 V @ 2.0 A, –12 V @ 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 @ 3.3 A, –15 V @ 50 mA +12 V @ 2.0 A, –12 V @ 200 mA	70 W max	86, 202, 276 mm 3.4, 8.0, 10.9 in

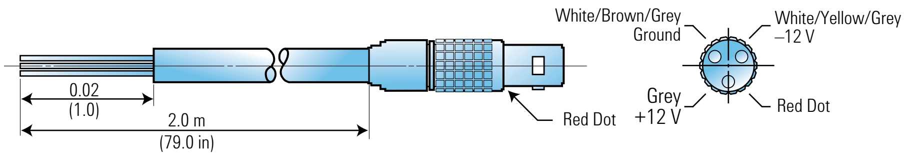
[1] *The ±15 V output is designed to power the Agilent 83020A; the ±12 V output can be used to power an additional amplifier.*

Power cable (shipped with power supplies): 2-meter cables to connect between amplifier and power supplies. See amplifier power cable cross reference on page 30.

Agilent 83006A

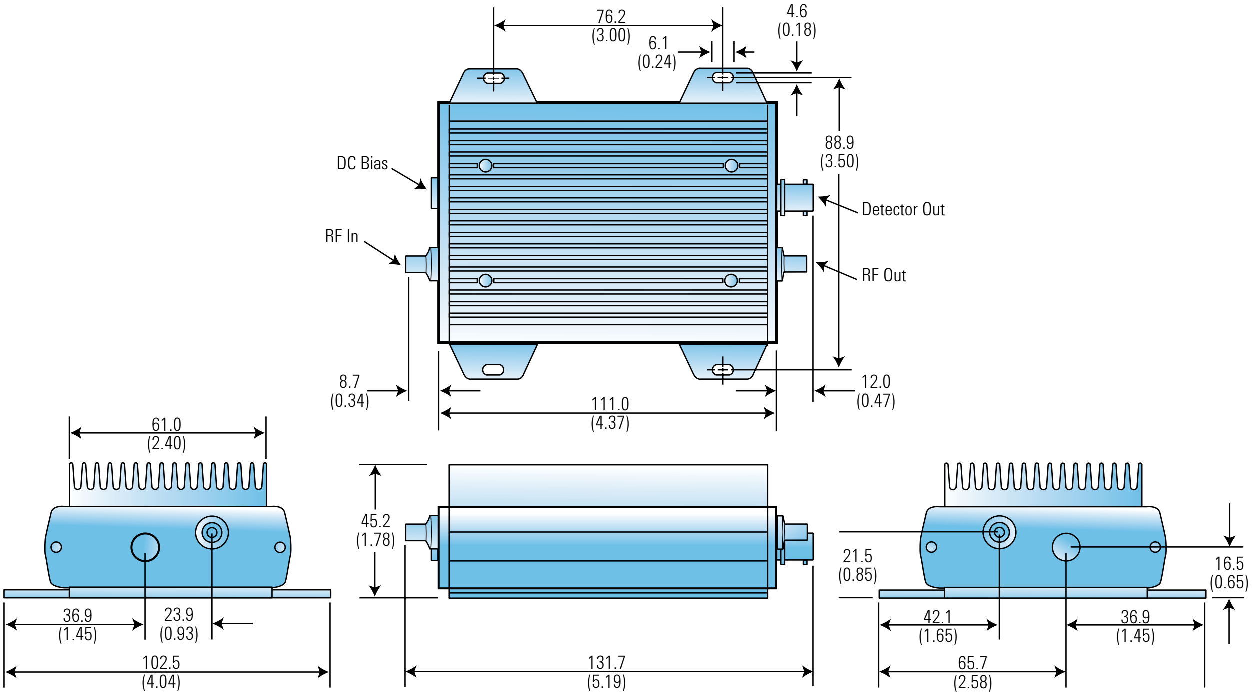


Agilent 83006-60004 cable (Shipped with Agilent 83006A, 83017A, 83018A, 83050A, 83051A, 87415A)

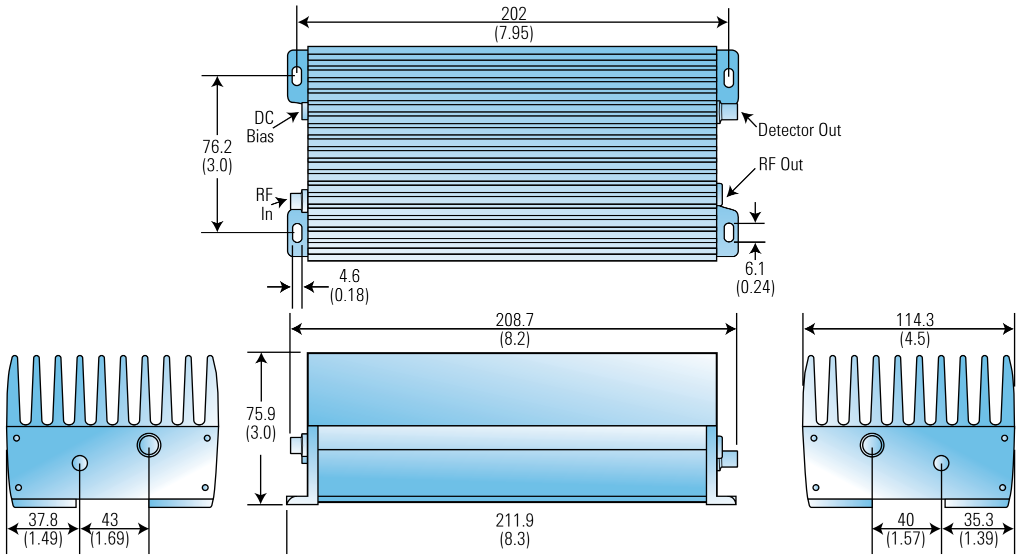


Dimensions are in mm (inches) nominal, unless otherwise specified.

Agilent 83017A

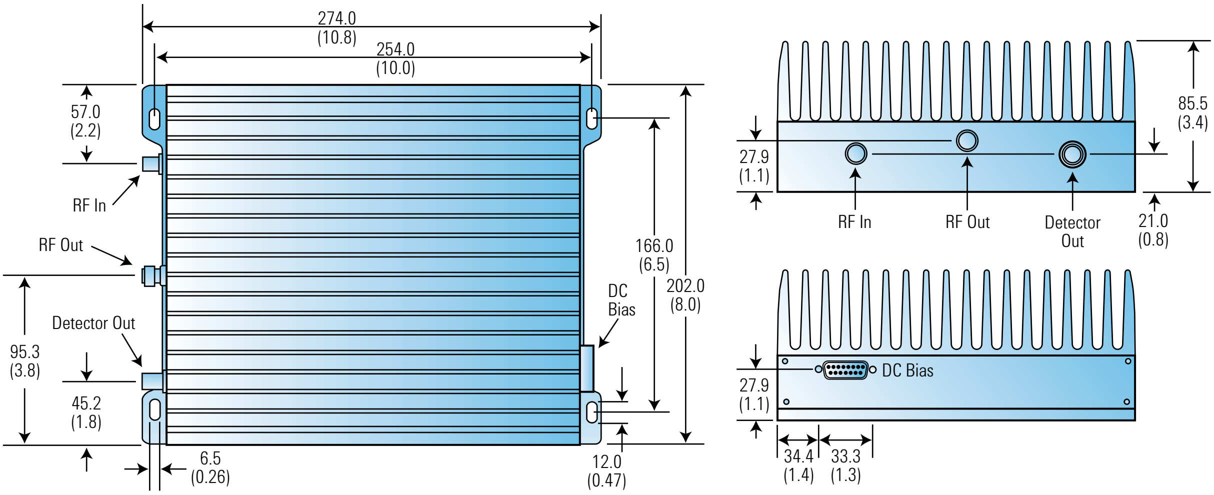


Agilent 83018A

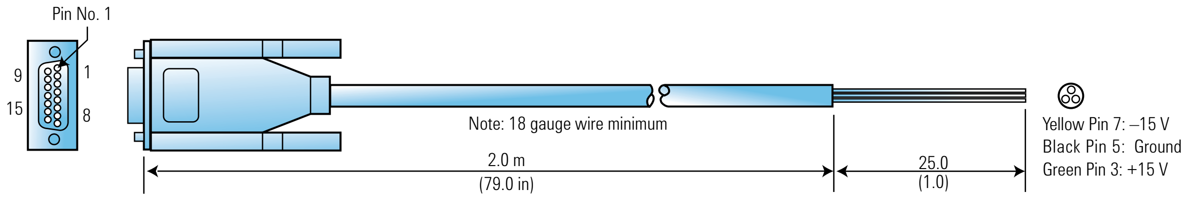


Dimensions are in mm (inches) nominal, unless otherwise specified.

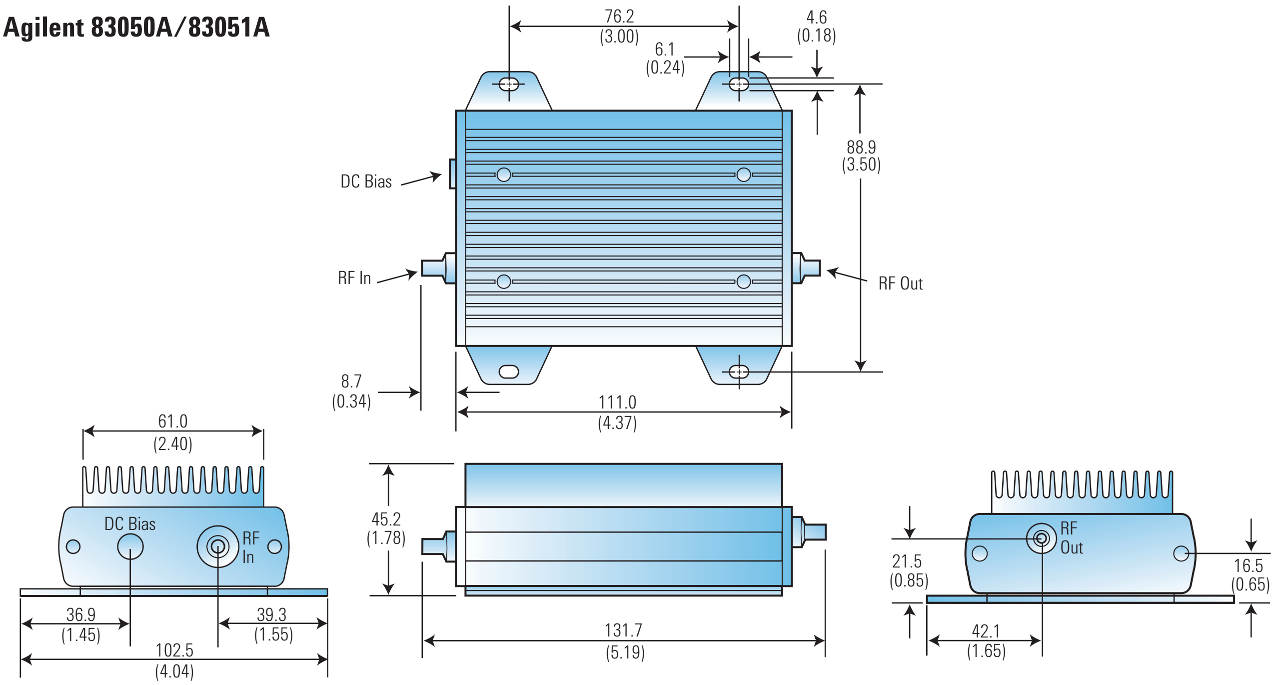
Agilent 83020A



Agilent 83020-60004 cable (Shipped with Agilent 83020A)

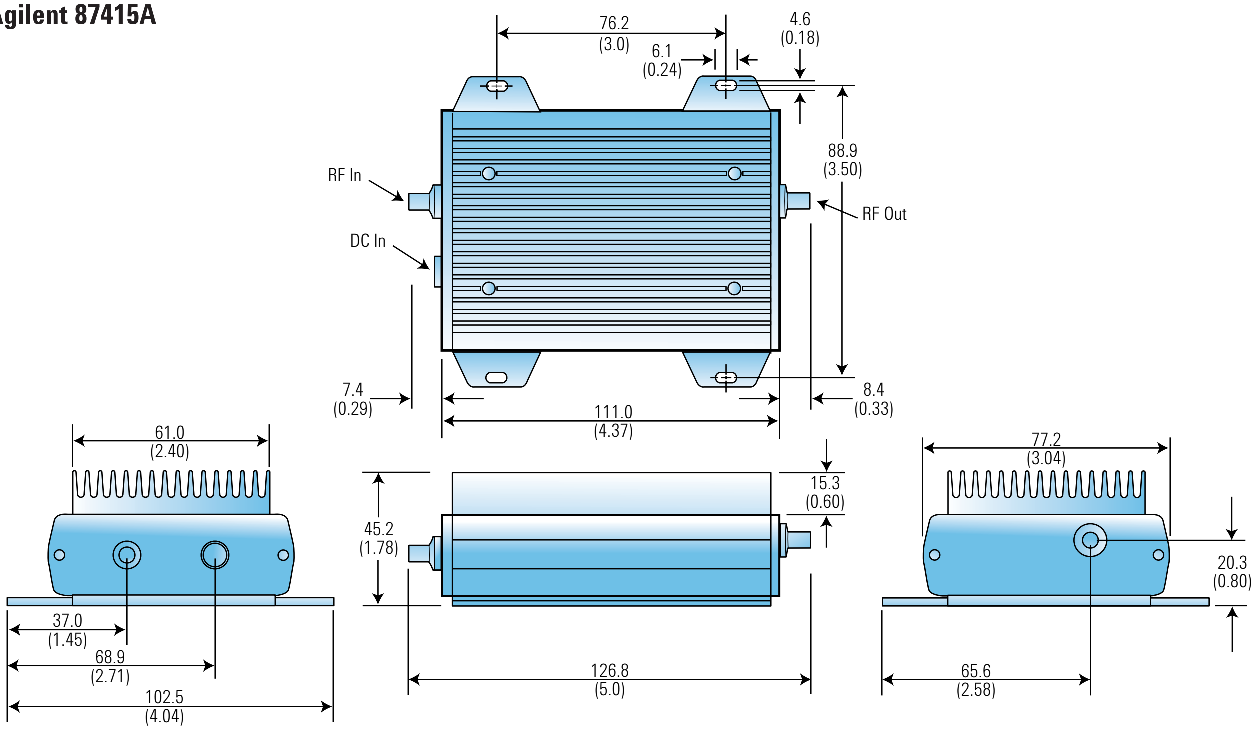


Agilent 83050A/83051A

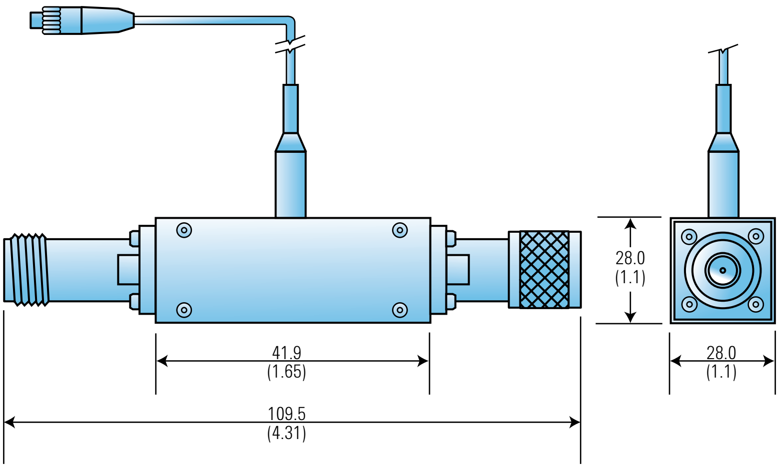


Dimensions are in mm (inches) nominal, unless otherwise specified.

Agilent 87415A

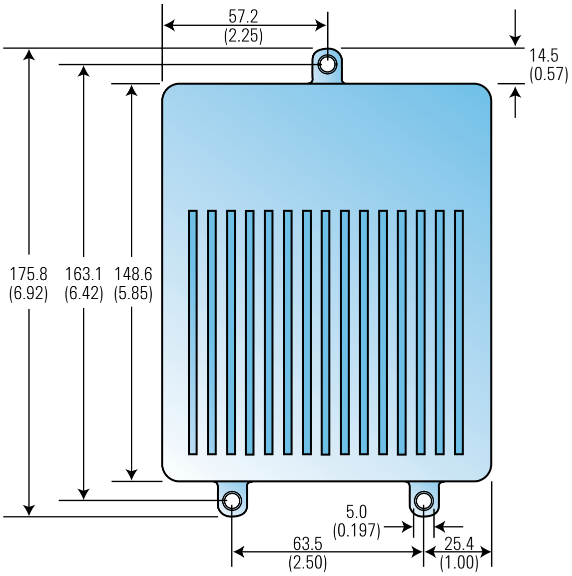


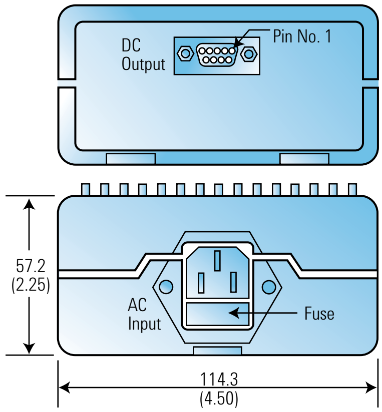
Agilent 87405B



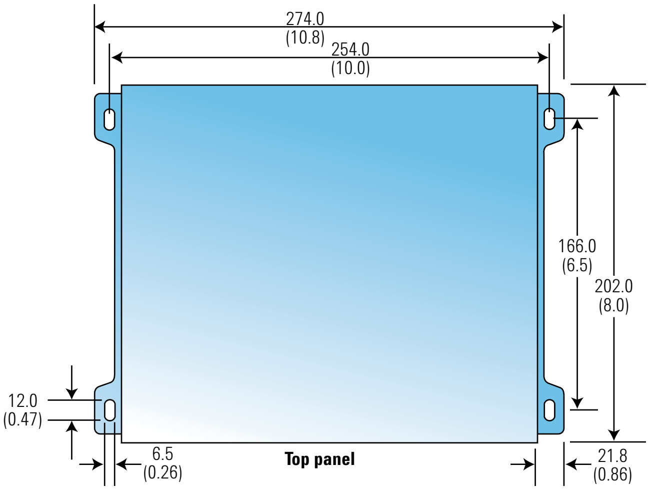
Dimensions are in mm (inches) nominal, unless otherwise specified.

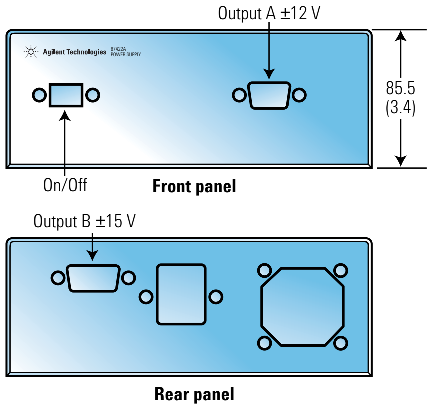
Agilent 87421A





Agilent 87422A

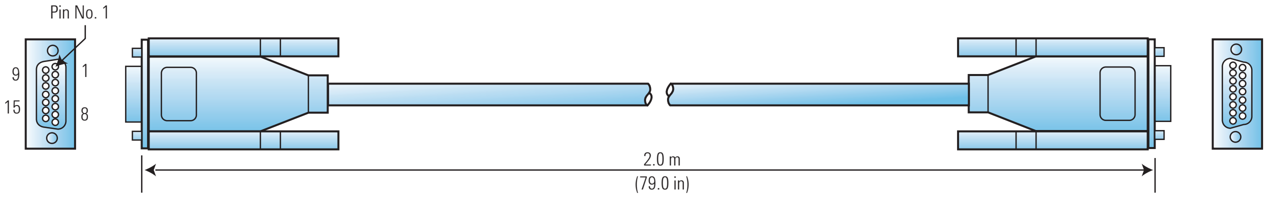


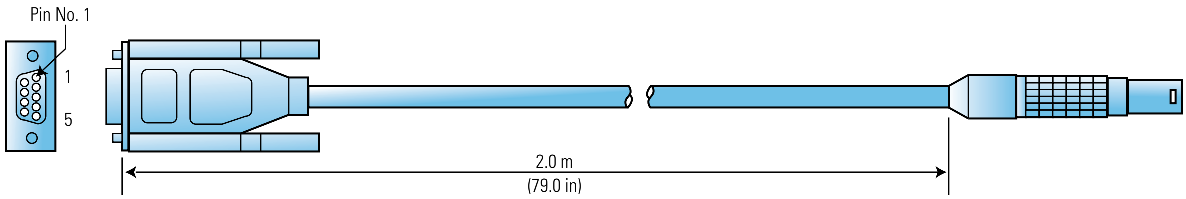


Dimensions are in mm (inches) nominal, unless otherwise specified.

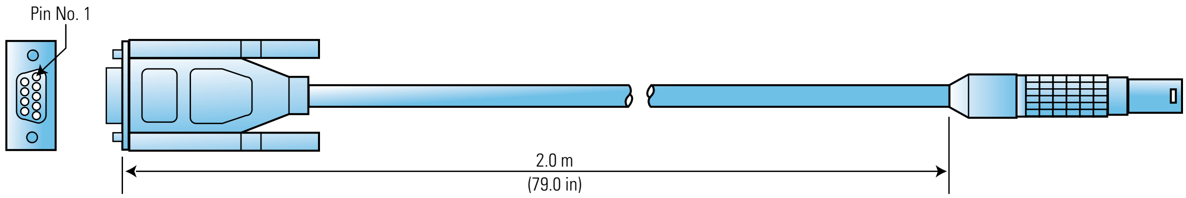
Amplifier Outline Drawings (continued)

Agilent 87422-60001 and 83006-60005 cable (Shipped with Agilent 87422A)





Agilent 83006-60005 cable (Shipped with Agilent 87421A)



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

Power cable cross reference [1]

Agilent model number	Agilent cable part number [2] (supplied with amplifier)	Agilent power supply recommended	Agilent 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
87405A	Integral cable	Agilent 11899A power supply or spectrum analyzer	

[1] *See outline drawings for connector types.*
[2] *For use with available power supply.*
[3] *For use with power supply for direct connection.*

Attenuators

5

Applications

Agilent fixed and step attenuators find use in a wide variety of applications for signal conditioning and level control.

- Reducing signal levels
- Matching impedances of sources and loads
- Measuring gain or loss of a two-port device

Key specifications

- SWR
- Accuracy
- Repeatability
- Life

SWR

Most attenuators use some form of distributed thin-film attenuating element, designed to operate over multi-octave ranges and for low SWR match at input and output. The SWR characteristic is controlled with careful design of the element as well as the transition from RF connector to the element's planar geometry.

When an attenuator is inserted into a test network, the interaction of its SWR and the network SWR results in frequency-varying mismatch, which degrades the accuracy of the measurement. The amount of variation often exceeds the flatness specification of the attenuator. As an example, if at a given frequency, a 3 dB attenuator with SWR of 1.22 at each port is inserted into a microwave network that has a source and load SWR of 1.35, the variation from the expected 3 dB change could be as great as ±0.5 dB. This change is due to SWR alone and points out the importance of the SWR specification in a precision attenuator.

Accuracy

The accuracy of an attenuator directly affects the uncertainty of the measurement where the attenuator is used. In many measurement and metrology applications, attenuators are the basic standard against which other components and instruments are calibrated.

Agilent attenuator accuracy specifications always include the effect of frequency response. And, Agilent attenuators use "edgeline" coaxial structure technology to achieve low-insertion loss and SWR resulting in better accuracy.

Agilent attenuators achieve flat-frequency response and high accuracy through the use of thin-film attenuator cards. These cards are composed of high-stability tantalum nitride resistive film, deposited on sapphire or alumina substrates. Advanced design and state-of-the-art processes in the deposition stages allow precise control of the geometry and thus the attenuation value. The result is very flat frequency response and greater accuracy.

Ultimate specified accuracy of RF/microwave attenuators is limited by the accuracy to which National Institute of Standards and Technology (NIST) can measure, plus the uncertainty of the measurement transfer process which calibrates the production test equipment. See Figure 1, on the next page, for an accuracy traceability example. At Agilent, performance to specifications is verified by fully testing each attenuator with an ATE system including an automatic network analyzer (ANA). In turn, the ANA is periodically calibrated using standards traceable to NIST.

Each published specification has been established using a "specification budget" process. This process provides for "guardbands" to account for transfer uncertainties between NIST, Agilent Metrology Labs, and the Agilent production test systems. Figure 2, on the next page, shows how the specification budget is allocated.

Repeatability

Fixed attenuators are often used as standards of reference in microwave measurements. Therefore, the accuracy of the measurement depends not only on the reference accuracy but on the repeatability of the insertion processes. Typical production test situations might require hundreds of connects/disconnects per day. So, measurement repeatability depends strongly on the connectors used. Agilent attenuators use precision type-N and APC-7 connectors, with repeatability that exceeds the International Electrotechnical Commission (IEC) standard for 7 mm connectors. For higher frequencies, Agilent uses 3.5 mm connectors that are fully SMA compatible, but are more rugged and repeatable than SMA. For applications to 50 GHz, Agilent uses 2.4 mm connectors that also have larger mating surfaces for rugged and repeatable connections. Design verification testing of 3.5 mm connectors showed virtually no test deterioration even after 1000 connections. For step attenuators, the repeatability of the internal RF connections is also of concern. Agilent uses an "edgeline" transmission line structure in which the outer conductor is a continuous ground plane and only the center conductor is switched to insert or remove an attenuation step. Keys to achieving long-term repeatability include precision control of all dimensions that affect contact pressure, careful selection and control of plating processes, and careful monitoring and control of the assembly process. The result is a step attenuator with repeatability specified at 0.03 dB maximum over 5 million cycles per section.

Life

The life of step attenuators is usually specified in cycles; i.e., the number of times a given attenuator section switches from one position to another and back. Agilent determines life by cycling attenuators to the point of degradation. Typically, Agilent attenuators in life cycle tests perform to specification for at least twice as many cycles as warranted. Agilent step attenuator families have a specified life of 5 million cycles per section. This long life results in lower cost of ownership by reducing periodic maintenance, downtime, and repairs.

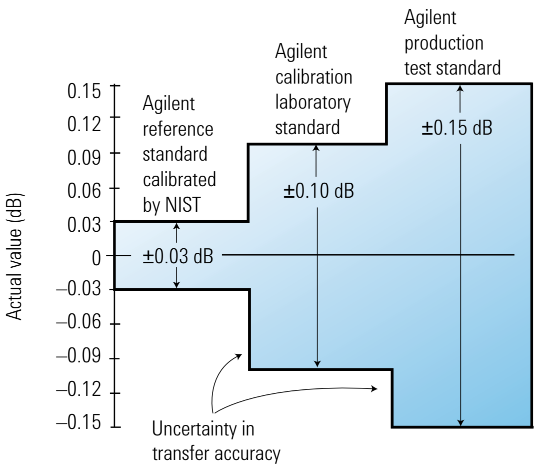


Figure 1. Accuracy traceability example.

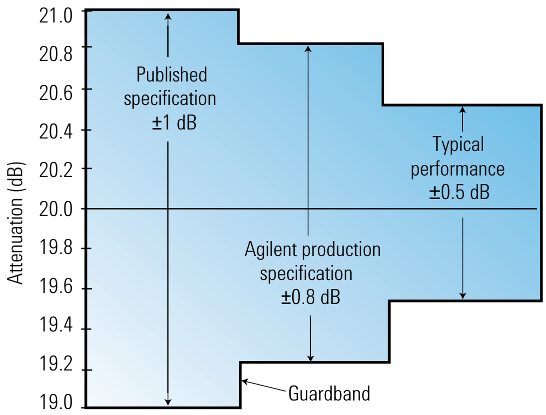


Figure 2. Guardband example.

5

Agilent 8491A/B

Agilent 8493A

Agilent 8498A

Agilent 8490D

Agilent 8491A/B, 8493A/B/C

Agilent Technologies 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.

Agilent 8498A high-power attenuator

The Agilent 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 fins keep the unit cool even under continuous maximum input power conditions.

Agilent 8490D 50 GHz fixed attenuator

Agilent Technologies coaxial fixed attenuators have been the standard for accurate flat response and low SWR. The Agilent 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.

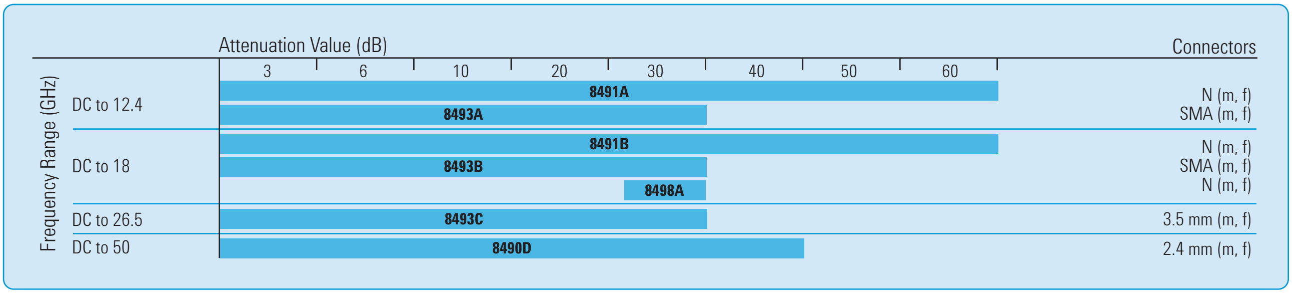
Agilent 11581A, 11582A, 11583C attenuator sets

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

Agilent 86213A attenuator set

Provides a set of four 75 ohm type-N attenuators (3, 6, 10 and 20 dB) in a walnut accessory case (Agilent 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.

Fixed attenuator selection guide



Specifications

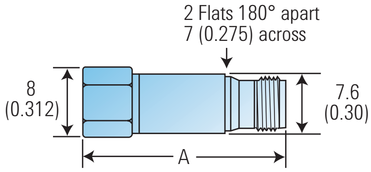
Agilent model	Frequency range (GHz)	Maximum input power			Atten.	3 dB	6 dB	10 dB	20 dB	30 dB	40 dB	Connectors
8490D	DC to 50	1 W avg.	**Attenuation: (dB)**	**Min:** DC to 50 GHz		2.5	5.4	9.4	19.2	29.2	38.2	2.4 mm (m, f)
				Max: DC to 26.5 GHz		3.9	6.9	10.9	21.3	31.3	42.5	
				Max: 26.5 to 50 GHz		4.8	7.8	11.3	21.7	31.7	42.5	
			SWR:	**Max:** DC to 26.5 GHz		1.15	1.15	1.15	1.15	1.15	1.08	
				Max: 26.5 to 40 GHz		1.25	1.25	1.25	1.25	1.25	1.15	
				Max: 40 to 50 GHz		1.45	1.45	1.45	1.45	1.45	1.25	

Specifications

Agilent model	Frequency range (GHz)	Maximum SWR	Maximum input power	Attenuation accuracy (± dB) 3 dB	6 dB	10 dB	20 dB	30 dB	40 dB	50 dB	60 dB	Connectors
8491A 3 to 30 dB 40 to 60 dB	DC to 12.4	1.2 to 8 GHz 1.3 to 12.4 GHz	2 W avg. 100 W peak	0.3	0.3	0.5	0.5	1.0	1.5	1.5	2	N (m, f)
8491B 3 to 30 dB 40 to 60 dB	DC to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz	2 W avg. 100 W peak	0.3	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	1.5	1.5	2	N (m, f)
8493A 3 to 20 dB 30 dB	DC to 12.4	1.2 to 8 GHz 1.3 to 12.4 GHz	2 W avg. 100 W peak	0.3	0.3	0.5	0.5	1.0	N/A	N/A	N/A	SMA (m, f)
8493B 3 to 20 dB 30 dB	DC to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz	2 W avg. 100 W peak	0.3	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	N/A	N/A	N/A	SMA (m, f)
8493C 3 to 30 dB	DC to 26.5	1.1 to 8 GHz 1.15 to 12.4 GHz 1.25 to 26.5 GHz [1]	2 W avg. 100 W peak	0.5 to 18 GHz 1.0 to 26.5 GHz	0.6	0.3	0.5	0.7	1.0	N/A	N/A	3.5 mm (m, f)
40 dB					0.6	0.5	0.6	1.0	1.3			
8498A 30 dB	DC to 18	1.15 to 8 GHz 1.25 to 12.4 GHz 1.30 to 18 GHz	25 W avg. 500 W peak (DC to 5.8 GHz) 125 W peak 500 W/ms max. per pulse (5.8 to 18 GHz)	N/A	N/A	N/A	N/A	1.0	N/A	N/A	N/A	N (m, f)

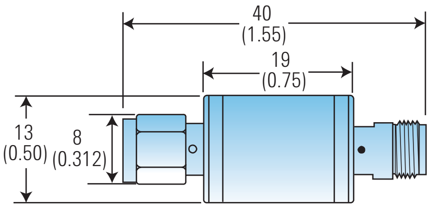
[1] *1.27 for 6 dB attenuation.*

Agilent 8490D

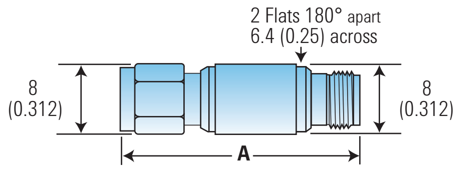


Dimension A
3, 6, 10, 20 dB: 27 (1.06)
30, 40 dB: 29 (1.14)

Agilent 8493A, B



Agilent 8493C



Dimension A
3, 6, 10, 20 dB: 33.8 (1.330)
30, 40 dB: 36.8 (1.450)

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

Fixed attenuator ordering information

Agilent 8490/91/92/93/98 series ordering example [1]

Agilent 849 **3 C** Option **010** Option **UK6**

Frequency range
0D: DC to 50 GHz
1A: DC to 12.4 GHz
1B: DC to 18 GHz
3A: DC to 12.4 GHz
3B: DC to 18 GHz
3C: DC to 26.5 GHz
8A: DC to 18 GHz

Attenuation
003: 3 dB
006: 6 dB
010: 10 dB
020: 20 dB
030: 30 dB
040: 40 dB [2]
050: 50 dB [2]
060: 60 dB [2]

Calibration documentation
UK6: Commercial calibration test data with certificate

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

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**
Manual	1 dB	0 to 11 dB	8494A	8494B			84904M
	10 dB	0 to 70 dB	8495A	8495B	8495D		
		0 to 110 dB	8496A	8496B			
Programmable	1 dB	0 to 11 dB	8494G	8494H	84904K	84904L	
	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			

Agilent 84904/906/907 series

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.

Agilent 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 Agilent: attenuation ranges of 11, 70, or 90 dB, 1 dB, and 10 dB step sizes, 5 million cycles per section and better than 0.03 dB repeatability. RF connector choices include precision 3.5 mm on the 26.5 GHz K models, and precision 2.4 mm or 2.92 mm on the L models. While the 2.92-mm connector format is compatible with both 3.5-mm and SMA connectors, Agilent Technologies recommends the more rugged 2.4-mm connectors.

Agilent programmable step attenuators feature electro-mechanical 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.

Agilent 84904L

Agilent 8494/95/96A/B/D

Agilent 8494/95/96G/H/K

Agilent 84904M

Agilent 8494/95/96/97 series

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.

Programmable models

Miniature drive solenoids in the programmable models keep switching time, including settling, down to less than 20 milli-seconds. Once switched, strong permanent magnets hold the solenoids (and attenuation value) in place. Current interrupts automatically disconnect solenoid current, simplifying driver circuit design, and minimizing heat dissipation. Programming is done through a 12-pin Viking socket or optional ribbon cables with DIP plugs. Automatic drive control is easy using the GPIB compatible Agilent 11713A or 87130A attenuator/switch driver and an external controller.

Programmable driver instruments

Programmable drive options for step attenuators include the Agilent 11713A attenuator/switch driver, which permits users to easily integrate the attenuator into GPIB compatible automatic test systems.

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

Manual models

These models provide excellent performance with the simplicity and convenience of positive manual switching. A low-torque camshaft activates the insertion and removal of the attenuation sections. Positive detents and an attenuation-level indicator ensures quick and accurate control.

Attenuator interconnecting kits

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

Specifications

Agilent model (switching model)	Frequency range (GHz)	Attenuation range	Insertion loss @ 0 dB	Maximum SWR	Repeatability life [1]	Maximum RF input power	Shipping weight
8494A (Manual) **8494G** (Programmable)	DC to 4	0 to 11 dB 1 dB steps	0.6 dB + 0.09 dB/GHz	1.5			
8494B (Manual) **8494H** (Programmable)	DC to 18	0 to 11 dB 1 dB steps		1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	0.01 dB typical 5 million cycles per section		
8495A (Manual) **8495G** (Programmable)	DC to 4	0 to 70 dB 10 dB steps	0.4 dB + 0.07 dB/GHz	1.35			
8495B (Manual) **8495H** (Programmable)	DC to 18	0 to 70 dB 10 dB steps		1.35 to 8 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz			
8495D (Manual) **8495K** (Programmable)	DC to 26.5	0 to 70 dB 10 dB steps	0.5 dB + 0.13 dB/GHz	1.25 to 6 GHz 1.45 to 12.4 GHz 1.9 to 18 GHz 2.2 to 26.5 GHz	0.01 dB typical to 18 GHz 0.05 dB typical to 26.5 GHz 5 million cycles per section	1 W avg. 100 W peak [2] (10 us max.)	0.9 kg (2 lb)
8496A (Manual) **8496G** (Programmable)	DC to 4	0 to 110 dB 10 dB steps	0.6 dB + 0.09 dB/GHz	1.5	0.01 dB typical 5 million cycles per section		
8496B (Manual) **8496H** (Programmable)	DC to 18	0 to 110 dB 10 dB steps		1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz			
8497K (Programmable)	DC to 26.5	0 to 90 dB 10 dB steps	0.4 dB + 0.09 dB/GHz	1.25 to 6 GHz 1.45 to 12.4 GHz 1.6 to 18 GHz 1.8 to 26.5 GHz	0.01 dB typical to 18 GHz 0.05 dB typical to 26.5 GHz 5 million cycles per section		

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

Agilent 8494/95/96/97 series options

	Option 024	Option 011	Option 015
Supply voltage			
Supply voltage range	20 to 30 Vdc	4.5 to 7 Vdc	13 to 22 Vdc
Supply voltage (nom)	24 Vdc	5 Vdc	15 Vdc
Current drawn	125 mA	300 mA	187 mA
RF connectors			
A, B, G, H models	**Option 001:** N (f)	**Option 002:** SMA (f)	**Option 003:** APC-7
D, K models	**Option 004:** 3.5 mm (f)		
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		

Specifications

Agilent model (switching mode)	Frequency range (GHz)	Attenuation range	Insertion loss @ 0 dB	Maximum SWR Option 101. (Option 106)	Repeatability [1] life	Maximum RF input power	Shipping weight
84904K (Programmable)	DC to 26.5	0 to 11 dB 1 dB steps	0.8 dB + 0.04 dB/GHz	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 typical. 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						
84906K (Programmable)	DC to 26.5	0 to 90 dB 10 dB steps	0.8 dB + 0.04 dB/GHz	1.3 (1.5) to 12.4 GHz 1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz			0.29 kg (10.32 oz)
84906L (Programmable)	DC to 40						
84907K (Programmable)	DC to 26.5	0 to 70 dB 10 dB steps	0.6 dB + 0.03 dB/GHz	1.25 (1.4) to 12.4 GHz 1.5 (1.7) to 34 GHz 1.7 (1.9) to 40 GHz			0.23 kg (8.1 oz)
84907L (Programmable)	DC to 40						

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

Agilent 84904/906/907 series options

	Option 024	Option 011	Option 015	
Supply voltage				
Supply voltage range	20 to 30 Vdc	4.5 to 7 Vdc	13 to 22 Vdc	
Supply voltage (nom)	24 Vdc	5 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			

Specifications

Agilent model (switching model)	Frequency range (GHz)	Attenuation range	Insertion loss @ 0 dB	Maximum SWR	Repeatability [3] life	Maximum RF input power	Shipping weight
84904M (Programmable)	DC to 50	0 to 11 dB 1 dB steps	0.8 dB + 0.04 dB/GHz to 40 GHz 3 dB to 50 GHz	1.3 to 12.4 GHz 1.7 to 34 GHz 1.8 to 40 GHz 3 to 50 GHz	0.03 dB typical 2 million cycles per section	1 W avg. 50 W peak [4] (10 µs max)	0.291 kg (10.3 oz)
84905M (Programmable)	DC to 50	0 to 60 dB 10 dB steps	0.6 dB + 0.03 dB/GHz to 40 GHz 2.6 dB to 50 GHz	1.25 to 12.4 GHz 1.5 to 34 GHz 1.7 to 40 GHz 2.6 to 40 GHz	0.03 dB typical 2 million cycles per section	1 W avg. 50 W peak [4] (10 µs max)	0.229 kg (8.1 oz)
84908M (Programmable)	DC to 50	0 to 65 dB 5 dB steps	0.8 dB + 0.04 dB/GHz to 40 GHz 3 dB to 50 GHz	1.3 to 12.4 GHz 1.7 to 34 GHz 1.8 to 40 GHz 3 to 50 GHz	0.03 dB typical 2 million cycles per section	1 W avg. 50 W peak [4] (10 µs max)	0.291 kg (10.3 oz)

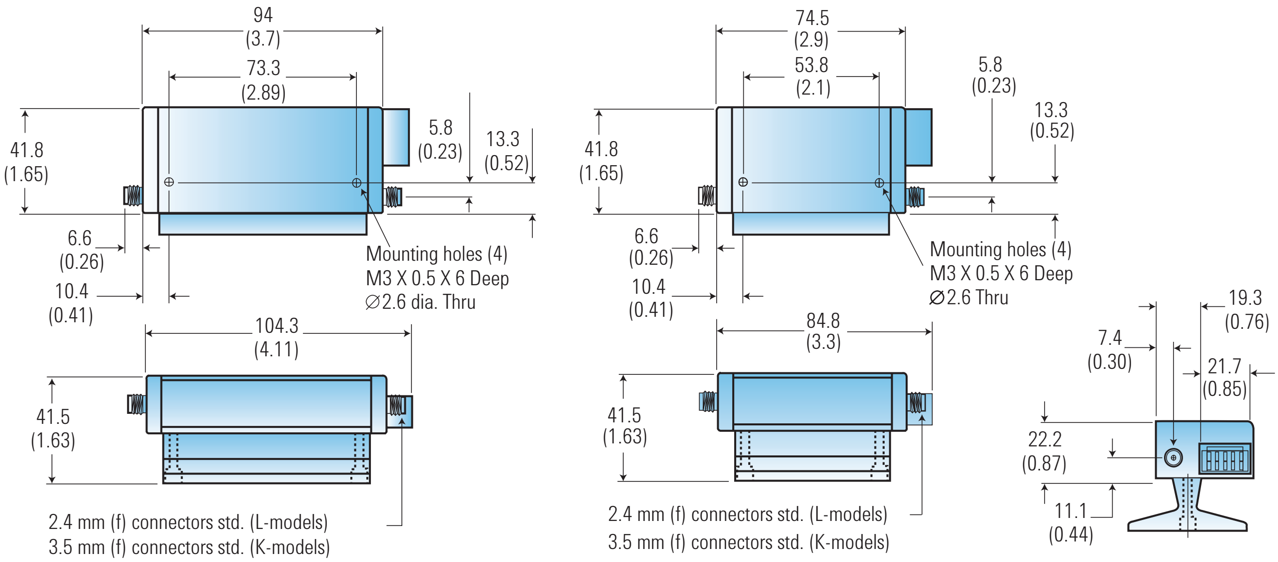
Agilent 84904/905/908M series options

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

[1] *Drive cable end.*
[2] *End opposite to drive cable.*
[3] *Measured at 25 °C.*
[4] *Not to exceed average power.*

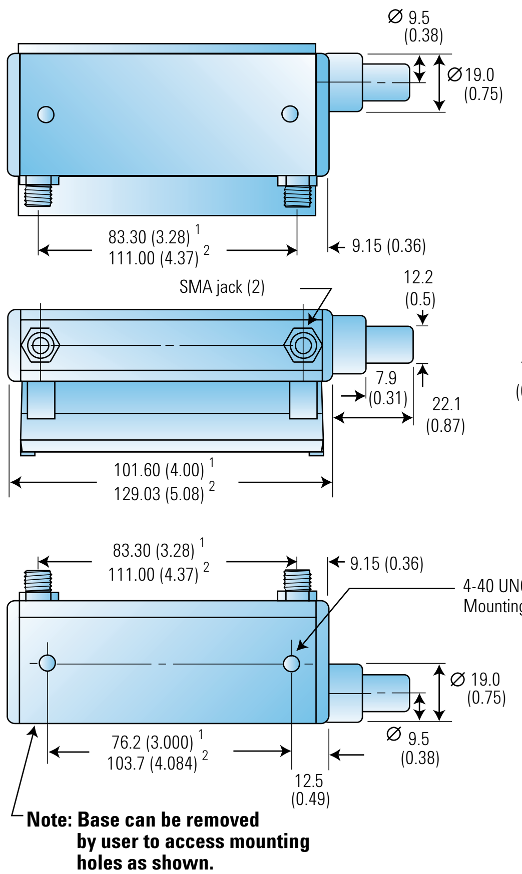
Outline Drawings

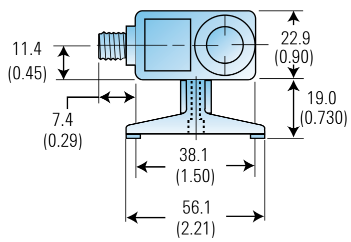
Agilent 84904/906/907 series – programmable



See ordering example for connector options

Agilent 8494/95/96/97 series – manual

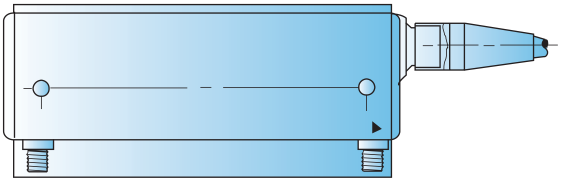




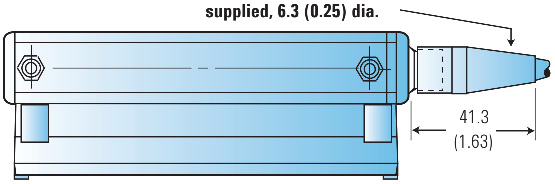
[1] Agilent 8495A, B.
[2] Agilent 8494A, B, 8495D, 8496A, B.

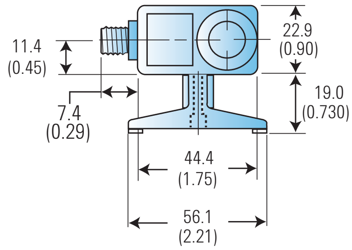
Dimensions are in mm (inches) nominal, unless otherwise specified.

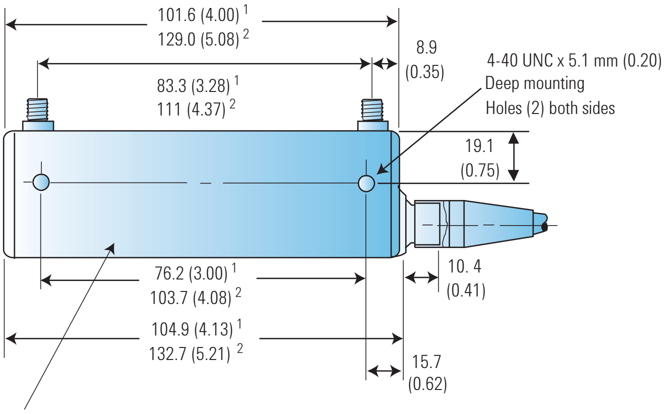
Agilent 8494/95/96/97 series – programmable



Solenoid drive plug and 5 ft. cable supplied, 6.3 (0.25) dia.

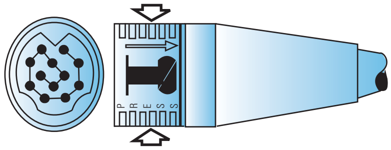






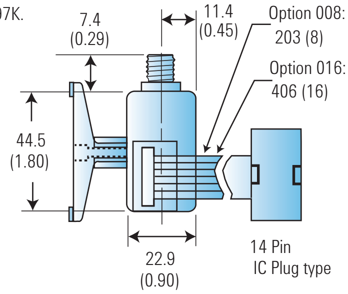
Note: Base can be removed by user to access mounting holes as shown above.

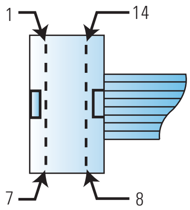
Solenoid drive plug detail



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

[1] Agilent 8495G, H.
[2] Agilent 8494G, H, 8495K, 8496G, H, 8497K.





Plug top view
(pins on oher side)

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

Step attenuator ordering information

Agilent 8494/95/96/97 series ordering example

Agilent 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 [6]
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	A: Manual, DC to 4 GHz B: Manual, DC to 18 GHz D: Manual, DC to 26.5 GHz [2] G: Programmable, DC to 4 GHz H: Programmable, DC to 18 GHz K: Programmable, DC to 26.5 GHz [3]	**A, B, G, H models:** 001: N (f) 002: SMA (f) 003: APC-7 [4] **D, K models:** 004: 3.5 mm (f) [3]	024: 24 Vdc 011: 5 Vdc	**G, H, K models** 060: 12-pin Viking connector 016: 16-inch ribbon cable with 14-pin DIP plug	UK6: Commercial calibration test data with certificate

Agilent 84904/905/906/907/908 series ordering example [5]

Agilent 8490 4 K   Option 011   Option 006   Option UK6

Attenuation range	Frequency range	Supply voltage	RF connector	Calibration documentation [6]
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 [7] L: DC to 40 GHz [7] M: DC to 50 GHz [8]	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 Agilent 8495 only.*
3 *Available with Agilent 8495/97 only.*
4 *Available with Agilent 8494/96/G/H and 8495H only.*
5 *Drive cable not included.*
6 *Option UK6 not available with Option 106.*
7 *Available with 84904/906/907 only.*
8 *Available with 84904/905/908 only.*

Agilent 11713A

Agilent 11716A

Agilent 11713A attenuator/switch driver

This driver provides GPIB or "local" front panel drive control for programmable attenuators and electromechanical switches. Concurrently, drive up to two Agilent 8494/95/96 and Agilent 87904/906/907 programmable attenuators and two electromechanical switches (Agilent 8761, 8762, or 8765 series). The Agilent 11713A can also be used to supply +24 V common and ten pairs of current sinking contacts (total current draw <1.25 A peak for 1 second, 0.65 A steady state) to independently control up to 10 relays. An integral power supply (with short circuit protection) eliminates the need for an external power source. Each Agilent 11713A is supplied with two plug-in drive cables to simplify connection to programmable attenuators. Switching time is less than 10 milliseconds.

Attenuator accessories

Agilent 11716 series attenuator interconnect kits

These kits can be utilized to connect any two of the Agilent 8494/95/96 attenuators in series. The rigid interconnect cable is available in type-N, and SMA connectors as described below.

Agilent 11716A Attenuator Interconnect Kit (type-N)
Agilent 11716C Attenuator Interconnect Kit (SMA)

Attenuator/Switch Driver

6

Agilent 11713A attenuator/switch driver

The Agilent 11713A attenuator/switch driver provides simple GPIB control of up to ten 24 Vdc solenoid activated switch or attenuator sections. The Agilent 11713A supplies 24 Vdc common and ten pairs of current sinking contacts to control up to 10 relays. The internal 24 Vdc power supply can deliver control signals totaling 0.65 Amps continuously or 1.3 Amps for one second. Each Agilent 11713A comes equipped with two plug-in drive cables for driving attenuators. The convenient front panel controls allow manual control of individual attenuator sections and/or switches.

Compatible Agilent switches and attenuators

The Agilent 11713A attenuator/switch driver is designed to control the following Agilent attenuators and switches.

Product	Agilent part number
Programmable attenuator	8494G, H 8495G, H, K 8496G, H 8497K 84904K, L 84906K, L 84907K, L
Bypass switch	8763A, B, C 8764A, B, C N1811TL, N1812UL
Matrix switch	87406B 87606B
Multiport switch	87104A, B, C 87106A, B, C 87204A, B, C 87206A, B, C 8766K 8767K 8768K 8769K 8769M 8767M 8768M
SPDT switch	8761B 8762A, B, C, F 8765A, B, C, D, F N1810UL, N1810TL
Transfer switch	87222C, D, E

Agilent 11713A

Supplemental characteristic

Power	100 or 120 Vac, +5%, –10% at 48 to 440 Hz 200 or 240 Vac, +5%, –10% at 48 to 66 Hz 80 VA maximum
Response time	10 µs maximum for contact pairs 1 through 20 µs maximum for contact pairs 9 and 0
Driver life	>2,000,000 switchings at maximum current for contact pairs 9 and 0
Maximum load inductance	500 mH
Maximum load capacitance	<0.01 mF for contact pairs 9 and 0
Net weight	4.1 kg (9 lbs)
Dimensions	Height: 102 mm (4 inches including feet) Rack height: 89 mm (3.5 inches, half-width module Width: 213 mm (8.4 inches) Depth: 295 mm (11.6 inches)

Ordering information

Option 101 – Viking to viking drive cables; quantity (2)
Option 001 – Viking connector to 10-pin DIP plug; quantity (2)

7

DC Block

Overview

The Agilent 11742A DC block offers a new level of performance in coaxial blocking capacitors. The device is broadband with a frequency range of 0.045 to 26.5 GHz, has low SWR (<1.11 to 12.4 GHz and <1.23 to 26.5 GHz) and low insertion loss.

Agilent 11742A specifications

Frequency range	0.045 to 26.5 GHz
Connector type	APC-3.5 mm (m-f)
Insertion loss	
0.045 to 12.4 GHz	0.35 dB maximum
12.4 to 26.5 GHz	0.70 dB maximum
Reflection coefficient	
0.045 to 8.0 GHz	0.052 maximum (1.11 SWR)
8.0 to 12.4 GHz	0.062 maximum (1.13 SWR)
12.4 to 26.5 GHz	0.102 maximum (1.23 SWR)
DC working voltage	50 V maximum

Environmental specifications

Temperature	
Non-operating	–55 °C to +75 °C
Operating	–5 °C to +60 °C
Altitude	
Non-operating	50,000 ft
Operating	15,000 ft
Humidity	Cycling 5 days, +40 °C @ 95% RH
Vibration	0.015 in, 5-55-5 Hz 15 minutes 3 axes
Shock	100 g, 1 to 2 mS, 3 times 3 planes
EMC	Radiation interference is within the requirements of MIL-STD-461, method RE02, VDE 0871, CISPR Publication 11

7

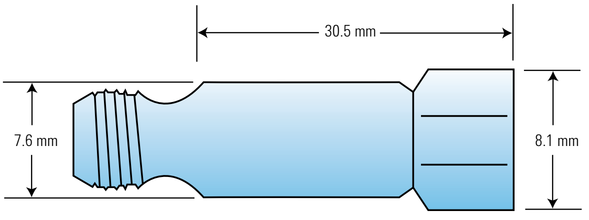
Agilent 11742A

Agilent 11742A DC Block

The 11742A is used in biased microwave circuits such as a DC block, to suppress low frequency signals which may affect the accuracy of your microwave and RF measurements.

The 11742A is an INSIDE block which places the capacitance in series with the center conductor, preventing low frequency signals from flowing along the center conductor. The male and female APC-3.5 mm connectors allow for excellent operation between 0.045 GHz and 26.5 GHz

Outline drawing



Detectors

8

Applications

Agilent 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

Agilent 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. All of Agilent's 8474 family of coaxial detectors are available in both octave band and broadband versions. The guaranteed performance of the octave band models are characterized for frequency response flatness and SWR.

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. Agilent typically uses –30 dBm to measure frequency response. Agilent 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 Agilent 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 Agilent 8474E, representative of PDBD detectors, is exceptionally flat beyond 26.5 GHz.

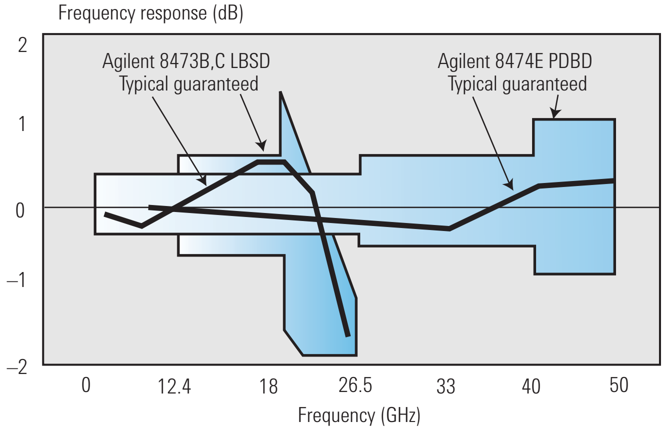


Figure 1. Detector frequency response characteristics.

[1] *See Waveguide chapter for additional products.*

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/mW. 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 ohms 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 R_V. Figure of Merit equals $K/\sqrt{R_V}$, where R_V = internal video resistance.

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. Agilent detectors are designed for optimal flatness and SWR. Figure 2 shows typical tangential sensitivity.

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.

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.

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

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/mW)

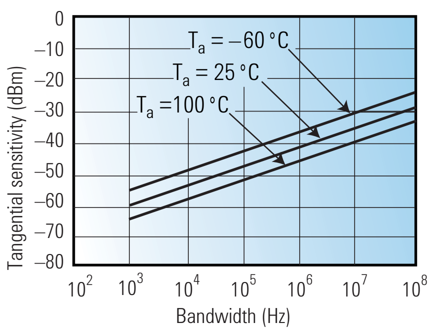


Figure 2. Typical tangential sensitivity performance.

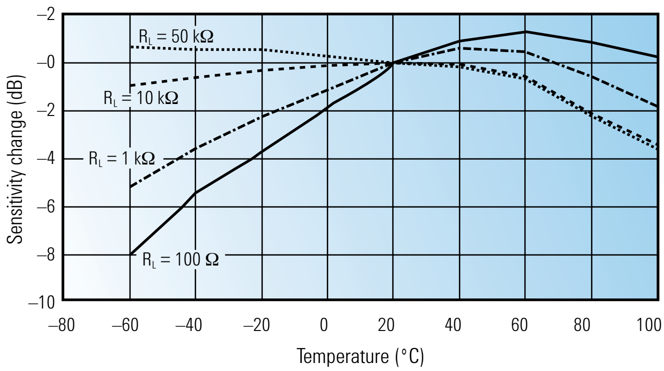


Figure 3. Typical output response with temperature (Pin <–20 dBm) (Schottky diode).

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.

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

Where		**Determined by**
$\mathbf{R_L}$ = Load impedance	$\mathbf{C_L}$ = Load capacitance	Measuring equipment Detector
$\mathbf{R_V}$ = Video impedance	$\mathbf{C_b}$ = Bypass capacitance	Measuring equipment Detector

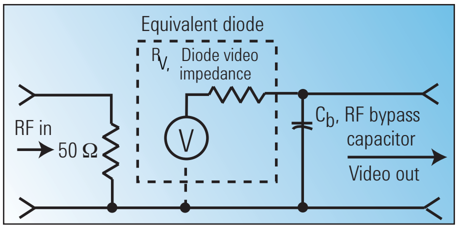


Figure 4. Detector model.

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.*

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 Agilent 8473B,C LBSD detector and the Agilent 8473D PDBD detector.

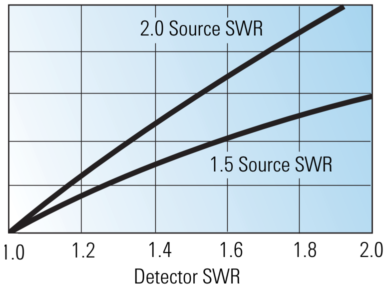


Figure 5. Mismatch error from detector and source mismatch.

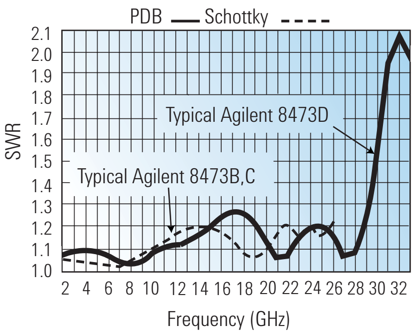


Figure 6. Typical SWR of detectors.

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).

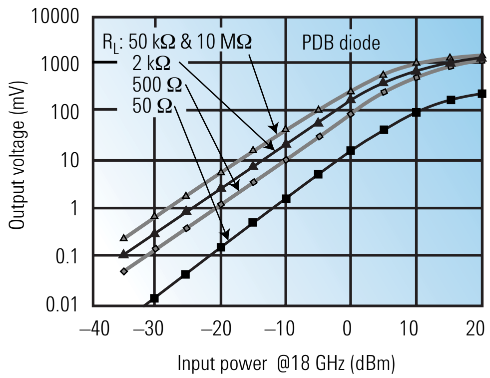


Figure 7. Typical detector square law response (mV).

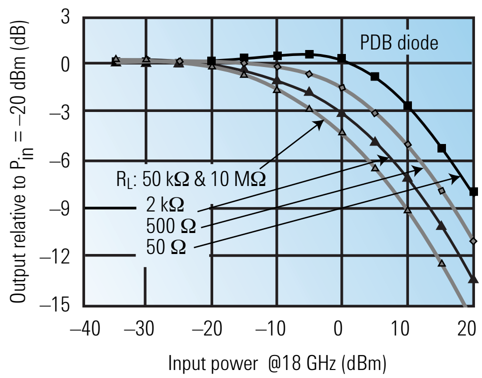


Figure 8. Typical detector square law response (dB).

8

Low-barrier Schottky diode detectors

Agilent 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).

Planar-doped barrier detectors

Agilent 8471D, E detectors are planar-doped barrier detectors offering excellent performance to 2 and 12 GHz. The Agilent 8471D covers 100 kHz to 2 GHz with a BNC (m) input connector and the Agilent 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 as Option 103.

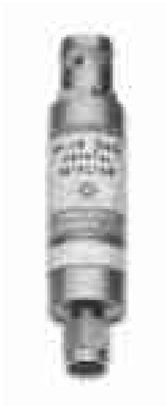
High performance planar-doped barrier detectors

Agilent 8474B, C and E detectors are the newest additions to the Agilent 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, Agilent 8474B, C, E detectors are available with frequency band options that feature lower SWR and flatter frequency response.

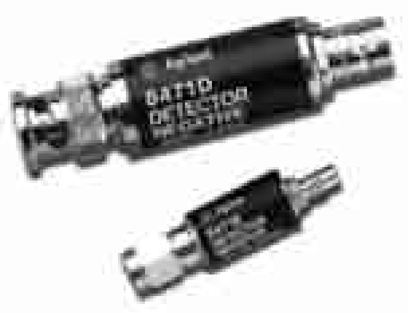
Agilent 8472B



Agilent 8473D

Agilent 423B

Agilent 8471D, E



Agilent 8474 family

8

Selection guide

	Operating frequency					
Input connector type	**Up to 2 GHz**	**Up to 12 GHz**	**Up to 18 GHz**	**Up to 26.5 GHz**	**Up to 33 GHz**	**Up to 50 GHz**
BNC	8471D					
Type-N		423B	8474B			
APC-7	8470B					
SMA		8471E	8472B		8473D, 8474C	
3.5 mm			33330B, 8473B	8473C		
2.4 mm				33330C		8474E

Specifications

Agilent 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	±0.4 to 26.5 GHz ±0.7 to 33 GHz	±0.3 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)

Options

Agilent 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		

PDBD frequency band options

Agilent 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
Agilent 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

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

Low-Barrier Schottky Diode Detector

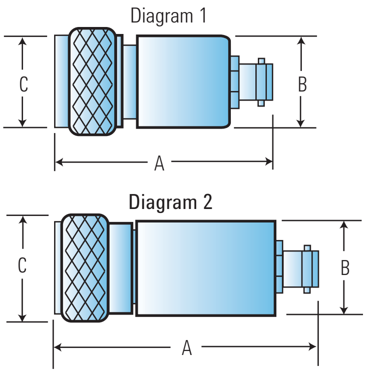
Specifications

Agilent 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

Agilent 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				
Field replaceable detector elements standard:	00423-60003	08470-60012	08470-60012	08473-80001	33330-80003	08473-80004	33330-80006
Option 001	00423-60007		08470-60016	08473-80002	33330-80004	08473-80005	33330-80007
Option 002	00423-60005	08470-60014					
Option 003	00423-60004	08470-60013	08470-60013	08473-80003	33330-80005	08473-80006	33330-80008

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



Outline drawings

Agilent 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)
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					
8470B	62 mm (2.50 in)	19 mm (0.75 in)	22 mm (0.87 in)	114 g (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)	227 g (8 oz)
8474C	41 mm (1.62 in)	9.7 mm (0.38 in)	7.9 mm (0.31 in)	14 g (0.5 oz)	227 g (8 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)
8473D	48 mm (1.89 in)	10 mm (0.39 in)	7.9 mm (0.31 in)	57 g (2 oz)	227 g (8 oz)
Diagram 5					
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)

Environmental specifications

Agilent 423B, 8470B, 8472B, 8473B, C, 33330B, C (LBSD)

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

Agilent 8471D, E, 8473D, 8474B, C, E (PDBD)

Operating temperature:	–65 °C to +100 °C (Except Agilent 8474B: 0 °C to +75 °C)
Temperature cycling: (non-operating)	–65 °C to +100 °C; MIL-STD 883, Method 1010
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

Agilent 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.

Agilent 83036C

With a 10 MHz to 26.5 GHz frequency range, a single Agilent 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.

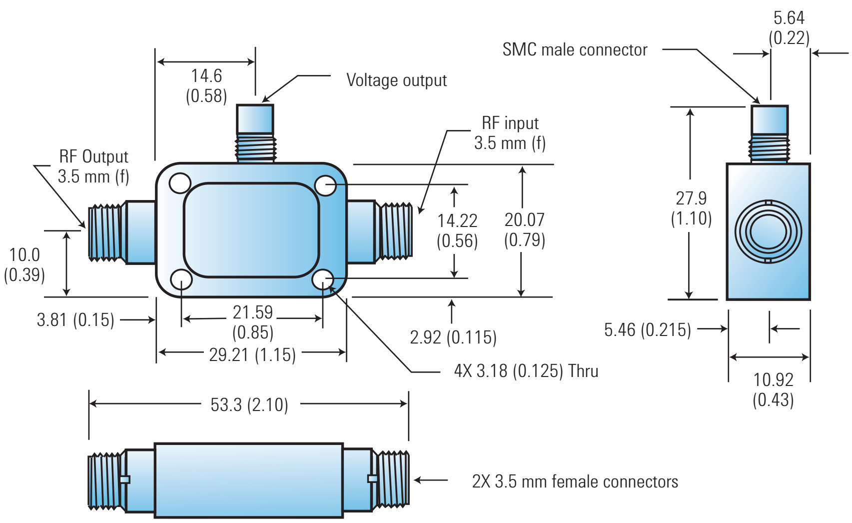
The Agilent 83036C has been used with great success as the sampling element for external leveling of broadband swept frequency sources. The detector's extended frequency range increases the usable band to 100 MHz to 26 GHz, giving the user full use of a broadband source with external leveling. Other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

8

Specifications [1]

Agilent 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.*



Environmental specifications

Non-operating temperature:
–65 to +150 °C

Random vibration: In accordance with MIL-STD-883, Method 2026, Condition IIA: 5.9 g, 50 to 2000 Hz.

Shock: In accordance with MIL-STD-883, Method 2002, Condition B: 1500 g for 0.5 ms.

Moisture resistance: In accordance with MIL-STD-883, Method 1004: 10 cycles, –10 to +65 °C at 90 to 100% RH.

Altitude: In accordance with MIL-STD-883, Method 1001, Condition C: 50,000 ft. operating altitude.

Directional Couplers and Bridges

9

Applications

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.

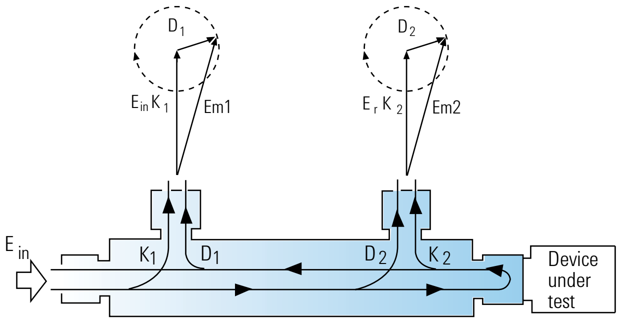
- Directivity
- SWR
- Coupling coefficient
- Transmission loss
- Input power

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, Em_1, is less important because the desired signal is usually a large value. When Agilent 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.

Agilent 87300/301 series, 87310B

Agilent 772/3D

Agilent 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 Agilent 8474 series coaxial detectors are recommended if output detection is desired. A broad offering of products is available with frequencies up to 50 GHz.

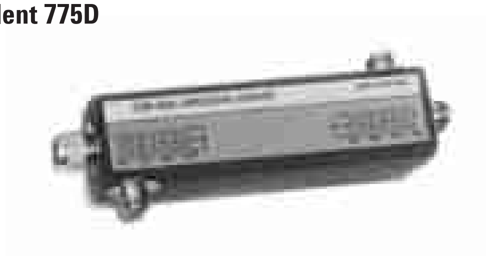
Agilent 87310B hybrid coupler

The Agilent 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.

Agilent 773D directional coupler
Agilent 772D dual-directional coupler

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

Agilent 775D



Agilent 776D

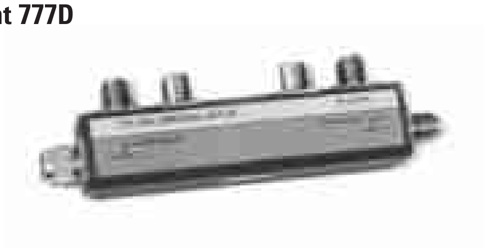
Agilent 775/6/7/8D dual-directional couplers

These couplers cover a frequency spread of more than 2:1, each centered on one of the important VHF/UHF bands. Agilent 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.

Agilent 11691D and 11692D directional couplers

Agilent 11691D is a single coupler for 2 to 18 GHz with a 20 dB coupling factor. With 30 dB directivity to 8 GHz and 26 dB to 18 GHz, it is useful for broadband reflectometry. It features many connector options to match test device requirements. Agilent 11692D is a dual-directional coupler with the same performance specifications as the Agilent 11691D. Dual couplers make it possible to measure both reflection and transmission parameters of a device under test at the same time.

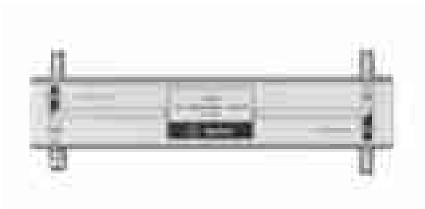
Agilent 777D



Agilent 11691D

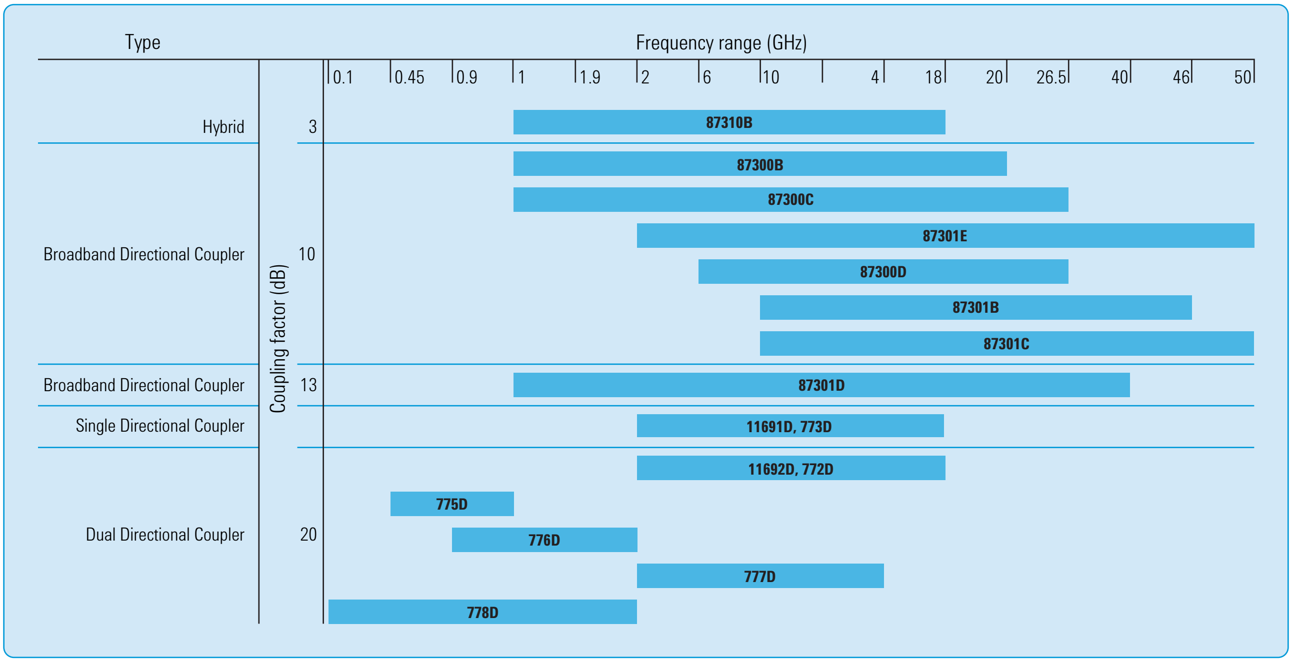
Agilent 778D

Agilent 11692D



Single- and Dual-Directional Couplers, 90° Hybrid Coupler (continued)

Directional coupler selection guide



Specifications

Agilent model	Frequency range (GHz)	Nominal coupling & variation (dB)	Directivity (dB)	Maximum SWR	Insertion loss (dB)	Power rating average, peak
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
87300C Option 020	1 to 26.5	20±1.0	>14	1.4	<1.2	20 W, 3 kW
87300D	6 to 26.5	10±0.5	>13	1.40	<1.3	20 W, 3 kW
87301B	10 to 46	10±0.7	>10	1.80	<1.9	20 W, 3 kW
87301C	10 to 50	10±0.7	>10	1.80	<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
772D [2]	2 to 18	20±0.9	>30 to 12.4 GHz >27 to 18 GHz	1.28 to12.4 GHz 1.4 to 18 GHz	<1.5	50 W, 250 W
773D [2]	2 to 18	20±0.9	>30 to 12.4 GHz >27 to 18 GHz	1.2	<0.9	50 W, 250 W
775D [3]	0.45 to 0.94	20±1	>40	1.15	<0.40	50 W, 500 W
776D [3]	0.94 to 1.9	20±1	>40	1.15	<0.35	50 W, 500 W
777D [3]	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 [4] >32 to 2 GHz [4]	1.1	<0.60	50 W, 500 W
11691D	2 to 18	20±1.0	>30 to 8 GHz >26 to 18 GHz [6]	1.4 1.3	<2.0	50 W, 250 W
11692D	2 to 18	20±1 incident to test port	>30 to 8 GHz >26 to 18 GHz [6]	1.3 to 12.4 GHz 1.4 to 18 GHz	<1.5	50 W, 250 W

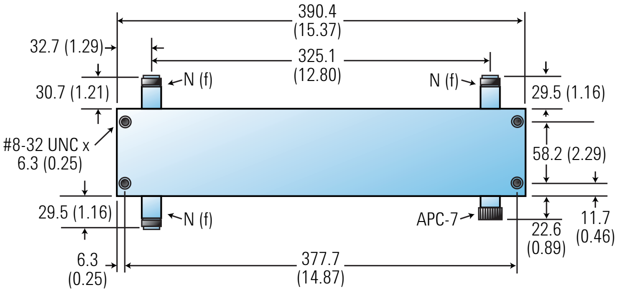
[1] *See page 72 for connector types.*
[2] *See data sheet for typical out of band data from 0.1 to 2 GHz and 18 to 20 GHz.*
[3] *Maximum auxiliary arm tracking: 0.3 dB for Agilent 776D; 0.5 dB for Agilent 777D.*
[4] *30 dB to 2.0 GHz, input port.*
[5] *Apparent SWR at the output port of a coupler when used in a closed-loop leveling system.*
[6] *24 dB with Type-N connector on the test port.*

Agilent 87310B specifications

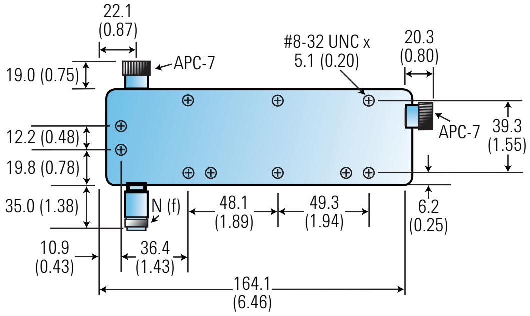
Frequency range	1 to 18 GHz
Coupling	3 dB
Amplitude imbalance	±0.5 dB at each port, centered at –3 dB
Phase imbalance	±10 Degrees
Isolation	>17 dB
Maximum SWR	1.35
Insertion loss	<2.0 dB
Power rating	
Average	20 W
Peak	3 kW
Connectors	SMA (f)
Weight in grams (oz)	148 (5.2)

Outline drawings

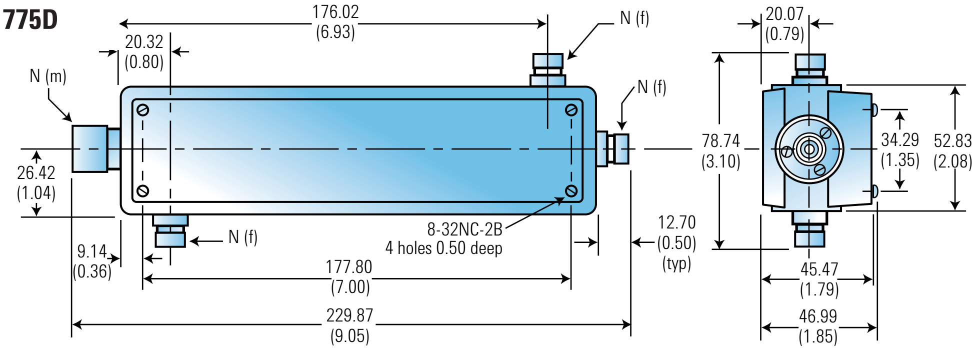
Agilent 772D



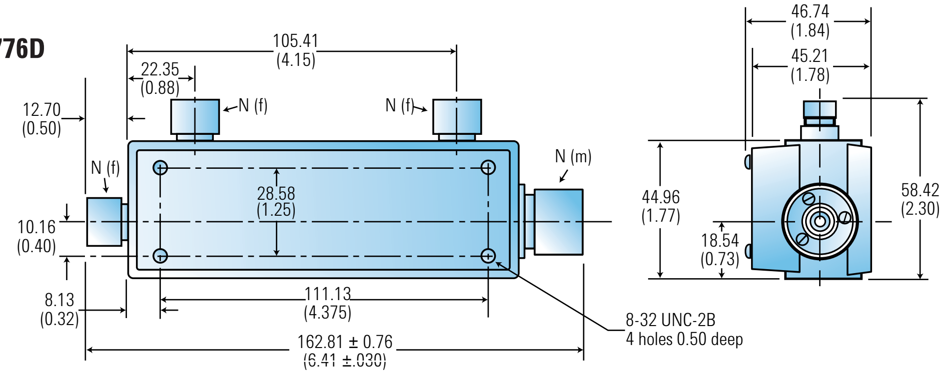
Agilent 773D



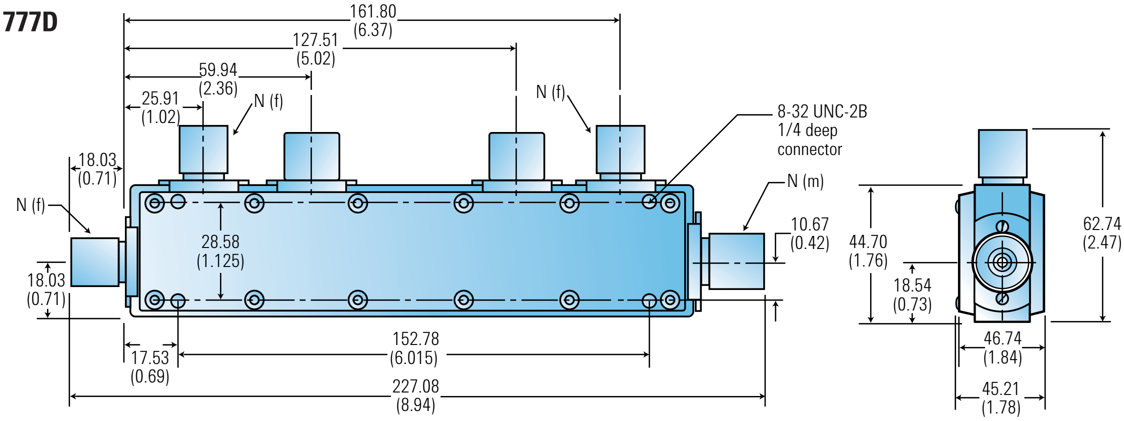
Agilent 775D



Agilent 776D

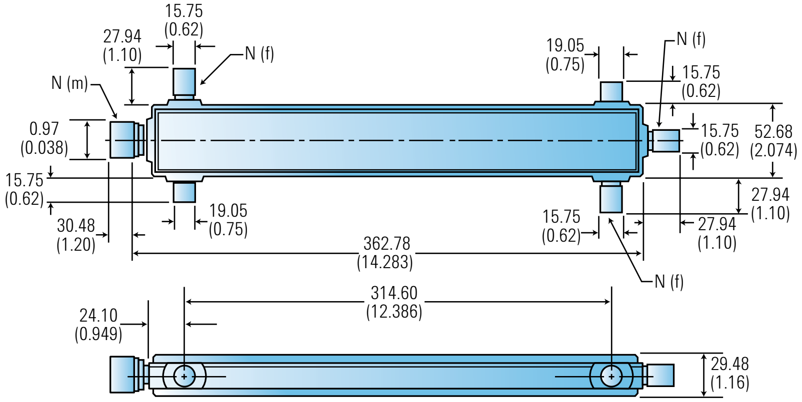


Agilent 777D

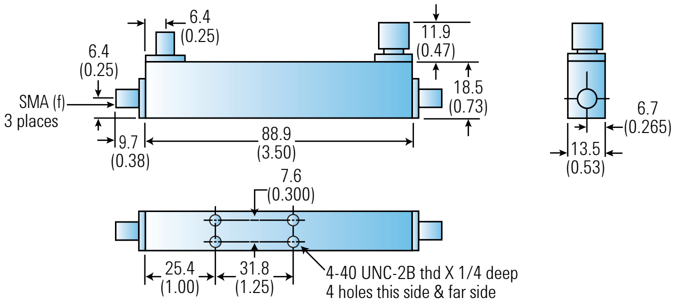


Dimensions are in mm (inches) nominal, unless otherwise specified.

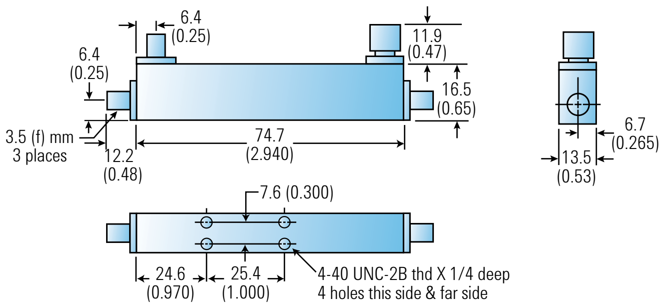
Agilent 778D



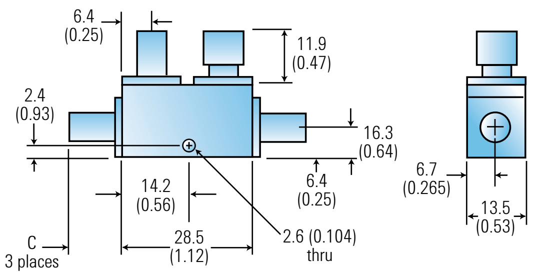
Agilent 87300B



Agilent 87300C



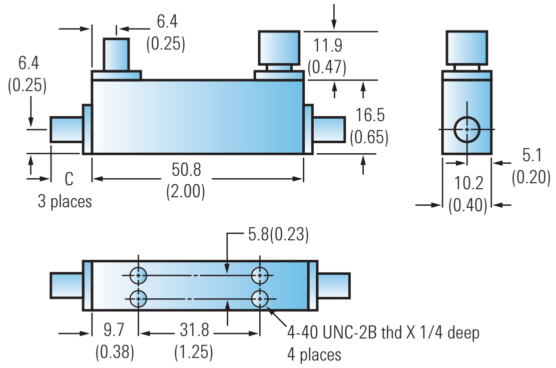
Agilent 87300D, 87301B, 87301C



Agilent model	Connector type	C 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)

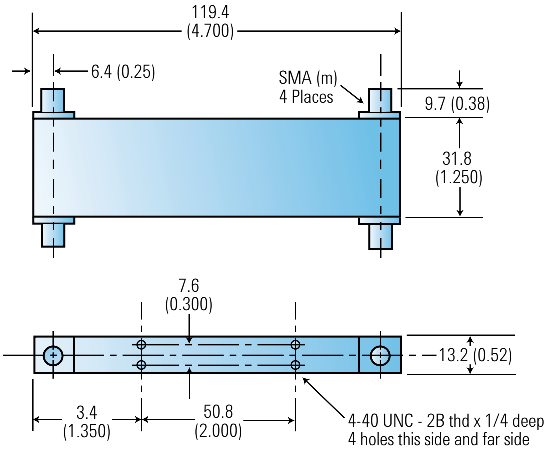
Dimensions are in mm (inches) nominal, unless otherwise specified.

Agilent 87301D, E



Connector Type	C Dimension
2.4 mm (f)	9.7 (0.38)
2.92 mm (f)	9.7 (0.38)

Agilent 87310B



Agilent model	Standard connector and options
772D	
STD	Primary Line: APC-7, APC-7 Auxiliary arm: N(f)
Option 001	Primary Line: N(f), N(f) Auxiliary arm: N(f)
773D	
STD/101	Primary Line: APC-7, APC-7 Auxiliary arm: N(f)
Option 001	Primary Line: N(f), N(f) Auxiliary arm: N(f)
Option 010	Primary Line: N(m), N(f) Auxiliary arm: N(f)
Option 002	Primary Line: N(f), N(m) Auxiliary arm: N(f)
775D – 777D	
STD	Primary Line: N(m), N(f) Auxiliary arm: N(f), N(f)
778D	
STD	Primary Line: N(f), N(m) Auxiliary arm: N(f), N(f)
Option 011	Primary Line: APC-7, N(f) Auxiliary arm: N(f), N(f)
Option 011	Primary Line: N(m), N(f) Auxiliary arm: N(f), N(f)
11691D	
STD	Primary Line: APC-7, APC-7 Auxiliary arm: N(f)
11692D	
STD	Primary Line: N(f), APC-7 Auxiliary arm: N(f), N(f)
Option 001	Primary Line: N(f), N(f) Auxiliary arm: N(f), N(f)
Option 002	Primary Line: N(f), N(m) Auxiliary arm: N(f), N(f)
Option 003	Primary Line: N(f), APC-7 Auxiliary arm: APC-7, APC-7
Option 004	Primary Line: APC-7, APC-7 Auxiliary arm: APC-7, APC-7
87300B	Primary Line: SMA(f), SMA (f) Auxiliary arm: SMA(f)
87300C	Primary Line: 3.5 mm(f), 3.5 mm(f) Auxiliary arm: 3.5 mm(f)
87300D	Primary Line: 3.5 mm(f), 3.5 mm(f) Auxiliary arm: 3.5 mm(f)
87301B	Primary Line: 2.92 mm(f), 2.92 mm(f) Auxiliary arm: 2.92 mm(f)
87301C	Primary Line: 2.4 mm(f), 2.4 mm(f) Auxiliary arm: 2.4 mm(f)
87301D	
Option 240	Primary Line: 2.4 mm(f), 2.4 mm(f) Auxiliary arm: 2.4 mm(f)
Option 292	Primary Line: 2.92 mm(f), 2.92 mm(f) Auxiliary arm: 2.92 mm(f)
87301E	Primary Line: 2.4 mm(f), 2.4 mm(f) Auxiliary arm: 2.4 mm(f)
87310B	Primary Line: SMA(m), SMA(m) Auxiliary arm: SMA(m)

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 Agilent 8711A RF scalar network analyzer, the Agilent 8753 family of RF vector analyzers as well as Agilent spectrum analyzers.

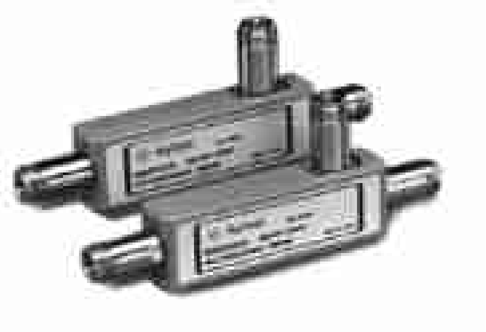
Agilent 86205A

This 50 ohm 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).

Agilent 86207A

This 75 ohm 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).

Agilent 86205/207A



Agilent model	Agilent 86205A	Agilent 86207A
Frequency range	300 kHz to 6 GHz	300 kHz to 3 GHz
Impedance	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)	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)	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	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	(<3 GHz) 16.0 dB, +0.15 dB/GHz

Frequency Meter

10

Overview

Passive frequency meters are intended for moderate (+0.05%) accuracy applications in microwave measurement setups. Reaction cavity types are usually best for this purpose since they permit full power flow down the transmission line except at the precise tuned frequency. At the tuned frequency, a slight amount of power (1.5 dB dip) is absorbed by the cavity which is visible on an oscilloscope or SWR meter display.

Key specifications

- SWR
- Insertion loss
- Accuracy
- Turning dip
- Spurious response

Low SWR and insertion loss are important to provide flat power transmission off-frequency. The Agilent frequency meter features broadband coupling loops that are very flat versus frequency. Accurate calibration is maintained by attention to thermal considerations and metal selection in design. Long effective scales are provided with a highly-readable spiral dial.

A constant tuning dip ensures readable indications at all frequencies in the band. The Agilent frequency meter is carefully designed and tested for uniformity of tuning dip. Likewise, spurious responses are undesirable since two responses near the same input frequency cause confusion. Although this meter covers more than 1 octave, the design uses a loaded coaxial cavity that prevents resonance at 3/4 λ tuned frequencies providing low-error operation.

Agilent 537A

Agilent 537A frequency meter

This direct-reading frequency meter measures frequencies from 3.7 to 12.4 GHz quickly and accurately. Its long scale length and numerous calibration marks provide high resolution. This is particularly useful when measuring frequency differences or small frequency changes. Frequency is read directly in GHz so interpolation or charts are not required.

The instrument comprises a special transmission section with a high-Q resonant cavity tuned by a choke plunger. A 1-dB or greater dip in output indicates resonance; virtually full power is transmitted off resonance. Tuning is by a precision lead screw, spring-loaded to eliminate backlash.

Resolution is enhanced by a long, spiral-scale calibrated in small frequency increments. Resettability is extremely good, and all frequency calibrations are visible so that the measurement point is directly indicated. Overall accuracy of the frequency meter includes allowance for 0 to 100 percent relative humidity and temperature variation from 13 to 33°C. There are no spurious modes or resonances.

Specifications

Model	Frequency range	Reflection coefficient off resonance	Dial accuracy	Overall accuracy	Minimum dip at resonance	Calibration increment	Connector	Dimensions mm (in)	Shipping weight kg (lb)
537A	3.7 to 12.4 GHz	0.33 (2.0 SWR, 9.5 dB return loss)	0.100%	0.170%	1 dB	10 MHz	Type-N (f)	118 x 146 x 89 (4.6 x 5.8 x 3.5)	2.3 (5)

High Frequency Probe

11

Agilent 85024A high frequency probe

The Agilent 85024A high frequency probe offers excellent performance. The probe employs a GaAs IC to obtain extremely low input capacitance of only 0.7 pF shunted by 1 MΩ of resistance. Because of this low input capacitance, high frequency probing is possible without adversely loading the circuit under test. Also, the 1 MΩ shunt resistance guarantees minimal circuit loading a lower frequencies. Since the probe has excellent sensitivity, it is well-suited for use with analyzers offering exceptional dynamic range. The 85024A is an excellent accessory for high frequency test equipment, especially Agilent RF network or spectrum analyzers which supply probe power from the front panel.

Spectrum analysis

Troubleshooting RF and IF signal paths to identify problem areas in a system is convenient and accurate with an 85024A and a spectrum analyzer. Measurements of frequency, power, modulation, distortion, conversion loss, and spectral purity are possible within a circuit. High sensitivity and low distortion levels ensure the probe's ability to detect small signals or search for spurious responses. In fact, the sensitivity of most 85024A applications is limited only by the noise floor of the spectrum analyzer itself. Add a tracking generator to easily perform swept in-circuit measurements.

Network analysis

When used with a network analyzer, this versatile probe makes it easy to measure the gain, attenuation, phase linearity, or group delay of individual circuit stages. Also, investigate multi-stage circuits to rapidly determine the location of faults in a system. Low input capacitance and high shunt resistance minimizes the loading to the circuit under test. Excellent frequency response and unity gain of the Agilent 85024A guarantee high accuracy in swept measurements.

Specifications

Performance parameter	Value	Code [1, 2]
Input capacitance	<0.7 pF	N
Input resistance	1 MΩ	N
Bandwidth	300 kHz to 3 GHz (usable to 100 kHz)	N
Median gain (mid-point between max and min gains, 300 kHz to 1 GHz)	0 dB ±1.25 dB	S
Frequency response flatness [3] 300 kHz to 1.0 GHz 1.0 GHz to 3.0 GHz	 ±1.25 dB ±2.5 dB	 S S
Average noise level 10 MHz Bandwidth 3 GHz Bandwidth	 <1 mV rms RTI [4] (or –47 dBm) <17 mV rms RTI [4] (or –23 dBm)	 N S
Noise figure <100 MHz 100 MHz to 3.0 GHz	 <50 dB <25 dB	 N N
Gain compression at 0.3 V peak input voltage	<1.0 dB	S
Pulse transition time	200 ps	N
Distortion at 0.3 V peak input voltage	<–30 dBc	N
Maximum safe RF input voltage Without 10:1 Divider With 10:1 Divider	 1.5 V peak 15 V peak	 S S
Maximum safe DC input voltage Without 10:1 Divider With 10:1 Divider	 ±50 V ±200 V	 N N

1 N = Nominal value: not warranted
S = Specification value: warranted
2 Specifications apply at 25 °C ±5 °C.
3 Relative to the median gain.
4 Referred to input.

Impedance Matching Adapters

12

Impedance Matching Adapters

Overview

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

Agilent 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 Agilent 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.

Agilent 11852B

11852B specifications

Agilent 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)		50 Ω side (75 Ω side terminated): 1.09		

Power Limiters

13

Agilent 11930A/B

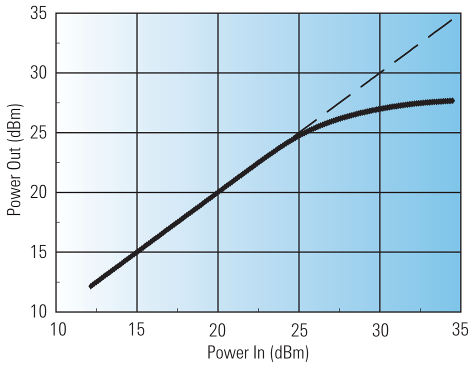


Figure 1. Agilent 11930A/B typical output power versus input power.

Agilent 11930A/B power limiters

The Agilent 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 Agilent 11930A. The Agilent 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.

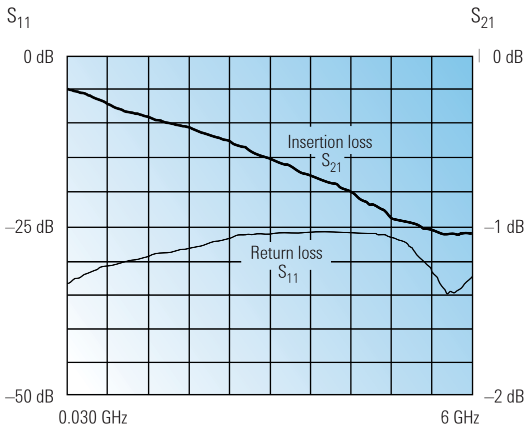


Figure 2. Agilent 11930A typical insertion and return loss versus frequency.

Features

The Agilent 11930A is furnished with an APC-7 connector and the Agilent 11930B has a type-N connector. The limiters offer low insertion loss and linear operation at low input levels while providing protection against transients or short duration overloads. In Figure 1 typical data for output power versus input power is shown for Agilent 11930A/B. Figures 2 and 3 illustrate typical insertion loss and return loss.

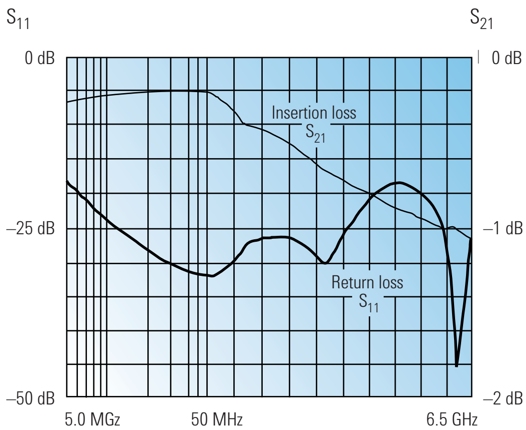


Figure 3. Agilent 11930B typical insertion and return loss versus frequency.

Agilent N9355/6 series power limiters

The N9355/6 series power limiters are designed for input protection of electronic components within the fields of communications, telemetry, radar systems and high frequency instrumentation. These 4 models provide customers with a choice of operating frequency range and limiting threshold to suit their applications. Combining with excellent insertion loss and return loss, these limiters will safe-guard your investments from damage due to excess RF power, DC transients or Electro-Static-Discharge (ESD).

Features

The N9355/6 series limiters also include a DC block integrated into both input and output ports that will filter signals below 10 MHz and pass signals up to 26.5 GHz.

Specifications

Agilent model	11867A	11930A	11930B	N9355B	N9356B	N9355C	N9356C
Impedance	50 Ω nominal						
Frequency range	DC to 1.8 GHz	DC to 6 GHz	5 MHz to 6.5 GHz [1]	10 MHz to 18 GHz		10 MHz to 26.5 GHz	
Frequency response Insertion loss	<0.75 dB	<1.0 dB DC to 3 GHz <1.5 dB 3 to 6 GHz	<1.0 dB 16 MHz to 3 GHz [2] <1.5 dB 3 to 6.5 GHz	<1.5 dB 10 MHz to 7 GHz <1.8 dB 7 to 18 GHz		<1.5 dB 10 MHz to 7 GHz <1.8 dB 7 to 18 GHz <2.0 dB 18 to 22 GHz <2.5 dB 22 to 26.5 GHz	
Return loss	>20 dB	>22 dB 30 kHz to 3 GHz >20 dB 3 to 6 GHz	>21 dB 16 MHz to 3 GHz [2] >17 dB 3 to 6.5 GHz	>15 dB 30 to 100 MHz [3] >20 dB 100 MHz to 10 GHz >15 dB 10 to 18 GHz		>15 dB 30 to 100 MHz [3] >20 dB 100 MHz to 10 GHz >15 dB 10 to 18 GHz	
Maximum continuous RF input power	10 Watts	3 Watts	3 Watts	1 Watt	6 Watts	1 Watt	4 Watts
Limiting threshold	0 dBm	30 dBm typical	30 dBm typical	10 dBm typical	25 dBm typical	10 dBm typical	25 dBm typical
Maximum DC voltage	N/A	30 V	30 V	30 V	30 V	30 V	30 V
Maximum DC current	N/A	350 mA	N/A	N/A	N/A	N/A	N/A
Input/output connectors	Type-N	APC-7 (7 mm)	Type-N	Type-N	Type-N	3.5 mm	3.5 mm

Notes:
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 6 to 6.5 GHz, typical.
2 5 to 16 MHz insertion and return loss limited by internal blocking capacitor.
3 10 to 30 MHz return loss specification is 8.5 dB.

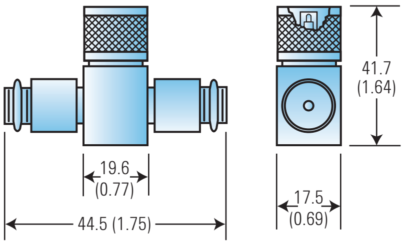
Power Dividers and Splitters

14

Agilent 11636A, B power dividers

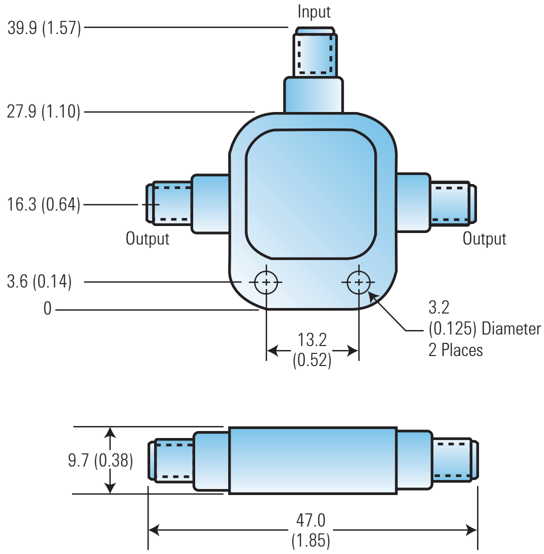
These power dividers provide good match and excellent tracking characteristics from DC to 26.5 GHz. Power dividers are recommended for applications such as transmission line fault testing, and power combining. They are not recommended for ratio and leveling applications.

Agilent 11636A



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

Agilent 11636B



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

Agilent 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.

Agilent 87302C

Power divider selection guide

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

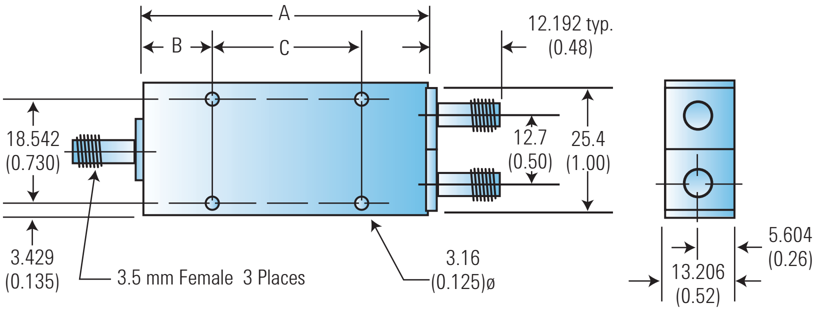
Specifications

Agilent model	Frequency range (GHz)	Max. SWR	Maximum insertion loss (dB)	Minimum isolation (dB)	Maximum amplitude tracking (dB) [1]	Maximum phase tracking (deg) [1]
11636A	DC to 18	1.35	6.0 typ. [2]		0.5 [3]	±2° typ.
11636B	DC to 26.5	1.29	7.5		0.25 [3]	±2° typ.
87302C	0.5 ST	1.45	1.5	19	0.3	6
	26.5 ST	1.60	1.9	19	0.5	10
87303C	1.0 to 18	1.45	1.2	19	0.3	6
	18 to 26.5	1.60	1.6	21	0.5	10
87304C	2.0 to 18	1.45	1.1	19	0.3	6
	18 to 26.5	1.60	1.4	18	0.5	10

Power Rating: 10 watts 87302C/3C/4C, 1 watt CW 11636A/B, (2:1 maximum load SWR)
Connectors: 3.5 mm (f), (SMA compatible)
Weight: 170 g (6 oz) net, 340 g (12 oz) shipping

1 Amplitude and phase tracking are the ratio of one output to the other in dB or degrees, respectively.
2 5.8 to 7.2 dB up to 10 GHz; 5.8 to 7.5 dB up to18 GHz.
3 at 18 GHz.

Agilent 87302/303/304C



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

Agilent 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)	2.10 (53.34)
87304C	57.15 (2.25)	28.702 (1.13)	0.00 (0.00)

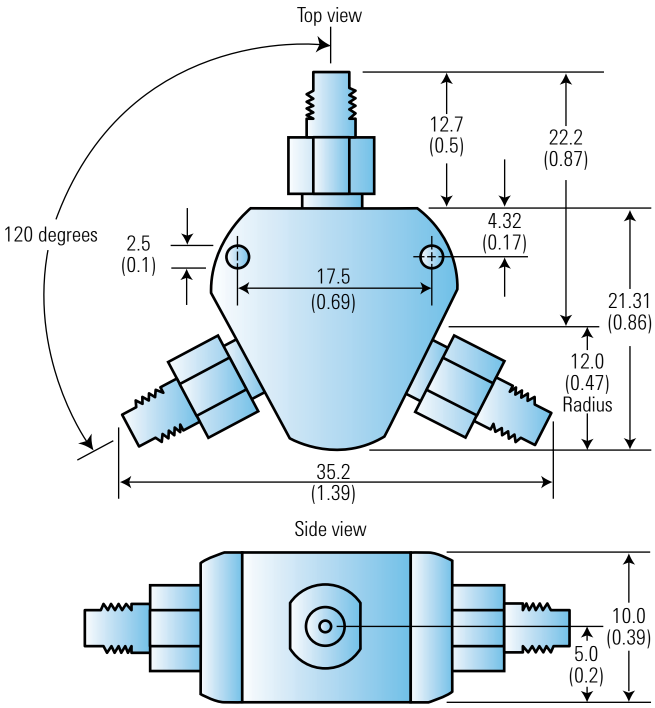
Dimensions are in mm (inches)
nominal, unless otherwise specified.

Agilent 11667A

Agilent 11667B

Agilent 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.



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

Agilent 11667C

Agilent 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 use of 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.

14

Power Dividers and Splitters (continued)

Power splitter selection guide

Connector type		Frequency range		
Input	Output	DC to 18 GHz	DC to 26.5 GHz	DC to 50 GHz
N-Type (f)	N-Type (f)	11667A		
N-Type (m)	N-Type (f)	11667A Option 001		
N-Type (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

Agilent model	Frequency range	Equivalent output SWR (nominal 50 Ω)	Maximum input power	Nominal insertion loss (input to either output)	Tracking between any two ports	Connectors	Shipping weight (kg) lb
11667A Option 001 Option 002	DC to 18.0 GHz	1.10: DC to 4 GHz 1.20: DC to 8 GHz 1.33: DC to 18 GHz	0.5 W	7 dB	0.20 dB to 8 GHz 0.25 dB to 18 GHz	N (f) all ports Option 001: N (m) in, N (f) out Option 002: N (f) in, APC-7 out	0.2 (0.5)
11667B	DC to 26.5 GHz	1.22	0.5 W	7 dB	<0.25 dB	3.5 mm (f) all ports	0.14 (0.3)
11667C	DC to 50 GHz	1.65	0.5 W	8.5 dB	<0.40 dB	2.4 mm (f) all ports	0.14 (0.3)

14

15

Applications

RF/microwave switches find use in a wide variety of signal routing applications for test and measurement systems. Typical applications include:

- Selection of multiple signal sources to one output
- Selection of multiple input signals to one measurement instrument
- Transfer switching to insert or remove a device in a signal path
- Matrix switching of multiple inputs and outputs

Technology

Agilent electromechanical coaxial switches feature low insertion loss, high isolation, broadband performance, long life and exceptional repeatability. Agilent 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.

The Agilent 87104/106 and 87204/206 series of switches use optoelectronic sensing to provide the coil current interrupt function. Since no mechanical contacts are involved in this function, the switch reliability is improved.

Key specifications

- Frequency range
- Input power
- Insertion loss
- Isolation
- SWR
- Repeatability
- Life

Frequency range

One of the main advantages of electromechanical switches is that they transmit signals all the way down to DC. The top frequency limits are set by the size of the coaxial structure and connectors. Various Agilent models are available up to 50 GHz. Parameters such as insertion loss, isolation and SWR behave in a predictable manner. Typically, these parameters will linearly degrade at higher frequencies.

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.

Insertion loss

Insertion loss for electromechanical switches is very low, ranging from 0.1 dB at low frequencies to 1.5 dB at high frequencies. This performance distinguishes them from solid-state switches which range from 0.5 dB to 6 dB. Factors that influence loss are: path length, types of material used on signal carrying surfaces, contact wear, corrosion or other contamination. Insertion loss can play an important role whether high or low power is present. In high-power systems, this additional loss may require that the source power be increased to compensate. In receiver applications, the effective sensitivity of the system is reduced by the amount of insertion loss. In other systems, additional power may not be available, due to the prohibitive cost of supplying more power.

Isolation

High isolation in switches is important to almost every measurement application, because it prevents unwanted signals from interfering with the desired signal. Isolation is the amount that the unwanted signal is attenuated before it is detected at the port of interest. Agilent switches have high isolation, with typical values >90 dB to 18 GHz and >50 dB to 26.5 GHz. High isolation can be particularly important in measurement systems where signals from sources are being routed. If too much power from an unselected source is allowed to flow through a device under test, measurement results will not be accurate.

SWR

The standing wave ratio (SWR) of a switch specifies how well the connectors and switching signal path are matched to an ideal 50 ohm transmission line. Low SWR is crucial in test set design when signal routing configurations involve multiple components in series, thereby adding to measurement uncertainty. SWRs of 1.1 to 1.5 are typical in Agilent switches.

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. Agilent 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 a 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 Agilent switches, as this tends to be the specification most sensitive to changes in switch performance.

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. Agilent 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.

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. Agilent determines life by cycling switches to the point of degradation. Typically, Agilent switches, in life cycle tests, perform to specifications for at least twice as many cycles as warranted.

Four Agilent 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.

Agilent offers a broad line of coaxial switches, covering up to 50 GHz, for use in test and measurement applications. All switches use magnetically-latched solenoids and are primarily designed with break-before-make RF contacts for test simplicity.

Agilent 8761A

Agilent 8762/63/64 series

Agilent 8765 series

Coaxial – flexible, high performance

The Agilent N181x series of coaxial latching switches combines unmatched flexibility of configuration with excellent repeatability, long life, and reliability. 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 Agilent N1810UL is a three-port single pole double throw (SPDT) switch. The Agilent N1810TL is a single pole double throw switch with two 50 ohm terminations, making it ideal for applications where port matching is required. 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 5-port switch that can be used in transfer switch applications and for signal path reversal.

SPDT – configurable connectors

Agilent 8761A, B SPDT switches operate up to 18 GHz. Each port features six connector options plus 50 ohm termination for design flexibility.

SPDT – high performance

Agilent 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 ohm 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, Agilent 8762F, is designed for 75 ohm transmission lines, making it valuable for communication applications up to 4 GHz.

SPDT – high reliability

Agilent 8765A, B, C, D, F 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, as well as a 75 ohm model to 4 GHz. Unlike the Agilent 8762 switches, they do not have internal, switched 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 Agilent 8765 switch comes with ribbon cables and standard printed circuit board with a 0.025-inch connector for convenient assembly. Optional solder terminals are available.

Coaxial – high performance

Agilent 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.

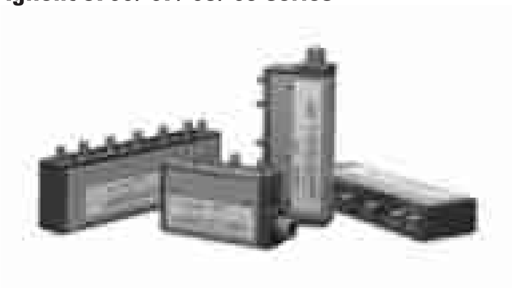
Agilent 8764A, B, C switches operate up to 26.5 GHz, similar to the Agilent 8763, but with the internal termination replaced by a fifth port. The fifth port can be utilized for signal path reversal or as a calibration port. Options T15 and T24 offer TTL/5V CMOS compatibility.

Multiport – low profile

Agilent 8766/67/68/69K series switches are modified versions of the Agilent 8494/95/96/97 series step attenuators (DC to 26.5 GHz) for applications requiring a single-pole, 3-throw, 4-throw, 5-throw or 6-throw coaxial switch. 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.

Agilent 8766/67/68/69 series



Agilent 87104/106 series

Agilent 87204/206 series

Multiport – high performance

Agilent 87104A, B, C and 87106A, B, C multiport switches operate up to 26.5 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 port-to-port isolation of better than 100 dB at 4 GHz, 70 dB at 20 GHz, and 65 dB at 26.5 GHz. When used in switching trees or in full access matrixes, isolation and insertion loss repeatability is crucial to measurement confidence.

Agilent 87104 is a single-pole-4-throw (SP4T) and the Agilent 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 ohm load for eliminating unwanted reflections in unused signal lines.

The Agilent 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 ohms, and then returns to the nominal 50 ohm match.

The standard Agilent 87204/206 provides a 16-pin drive connector while Option 100 provides solder terminals. The Agilent 87204/206 can perform make-before-break or break-before-make switching.

Transfer

The Agilent 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.

Matrix

The 87406B matrix switch consists 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.

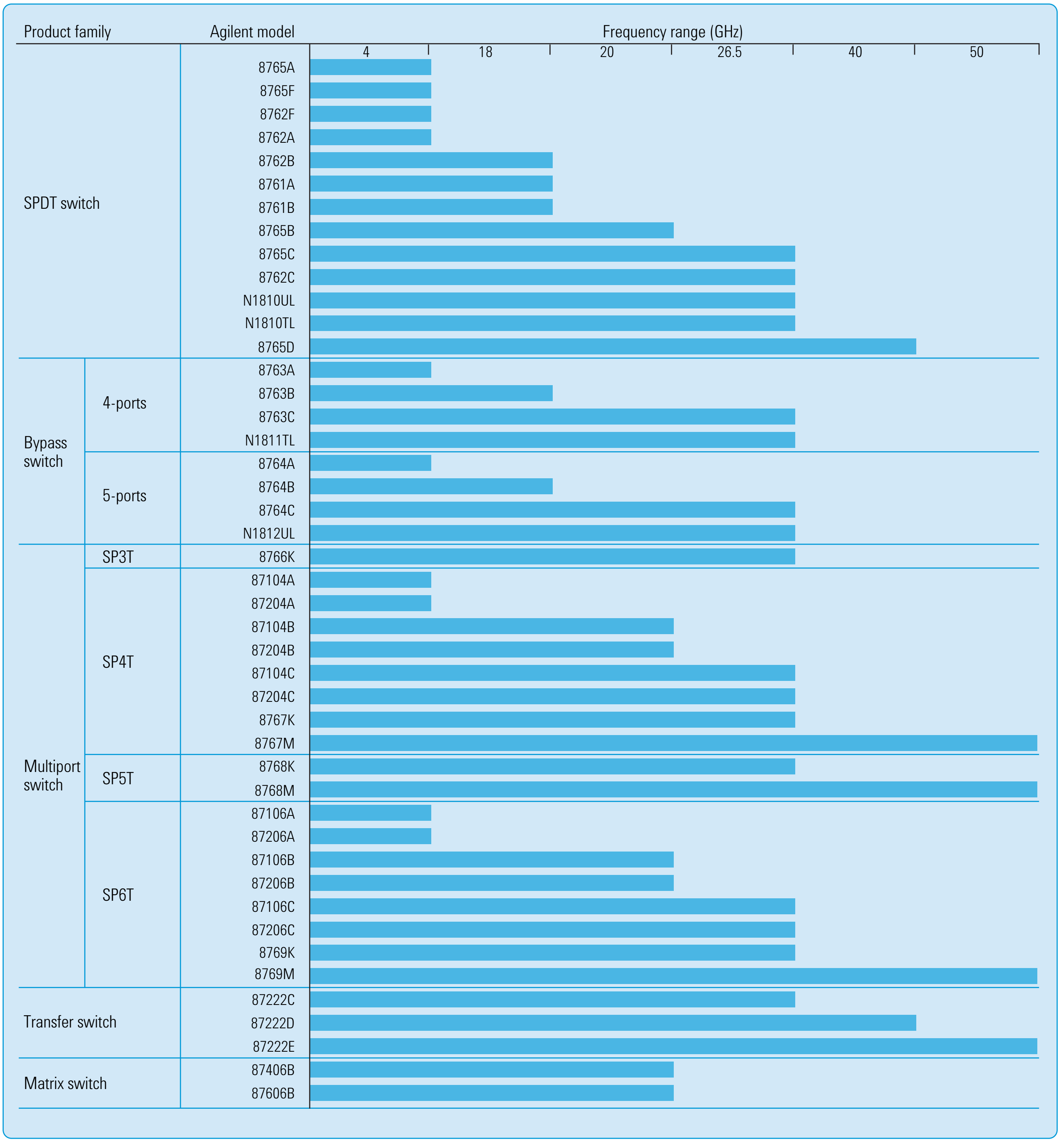
GPIB compatibility

All of the Agilent switch families can be remotely and automatically controlled from switch driver instruments such as the Agilent 11713A or 3488A. These drivers are all GPIB (IEEE 488) compatible. Drivers are also available for Agilent VXI and Agilent VEE systems.

Switch driver cables

For complete cable configuration information, request publication number 5989-3703EN, Agilent 11713A Switch and Attenuator Driver Configuration Guide.

Switch selection guide



Switch specifications

Agilent model	8761A, 8761B	8765A, 8765B, 8765C	8765D	8765F	N1810UL	8762A, 8762B	8762C	8762F	N1810TL
Features	Break-before-make								
	Unterminated					Terminated			
	Configurable RF connectors				Current Interrupts				
Impedance	50 Ω	50 Ω	50 Ω	75 Ω	50 Ω	50 Ω	50 Ω	75 Ω	50 Ω
Frequency range	DC to 18 GHz	A: DC to 4 GHz B: DC to 20 GHz C: DC to 26.5 GHz	DC to 40 GHz	DC to 4 GHz	DC to 26.5 GHz	A: DC to 4 GHz B: DC to 18 GHz	DC to 26.5 GHz	DC to 4 GHz	DC to 26.5 GHz
Insertion loss (dB)	<0.5 to 12.4 GHz <0.8 to 18 GHz	**A & B:** 0.2 + 0.025f [1] max **C:** 0.25 + 0.027f [1] max	0.2 + 0.023f [1] max 0.75 + 0.023 Δf [2] max (26.5 ≤ f ≤ 40)	<0.18 to 1 GHz <0.24 to 2 GHz <0.4 to 4 GHz	0.35 + (0.45/26.5)f [1] **Option 302:** 0.20 + (0.45/26.5)f [1]	**A:** <0.20 to 2 GHz <0.25 to 4 GHz **B:** <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	0.35 + (0.45/26.5)f [1] **Option 302:** 0.20 + (0.45/26.5)f [1]
SWR (through line)	See connector code Option data on page 100	**A & B:** <1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz **C:** <1.25 to 4 GHz <1.45 to 18 GHz <1.7 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	<1.15 to 4 GHz <1.25 to 12.4 GHz <1.30 to 20 GHz <1.60 to 26.5 GHz **Option 302:** <1.10 to 4 GHz <1.20 to 12.4 GHz <1.23 to 20 GHz <1.45 to 26.5 GHz	**A:** <1.1 to 2 GHz <1.2 to 4 GHz **B:** <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	<1.15 to 4 GHz <1.25 to 12.4 GHz <1.30 to 20 GHz <1.60 to 26.5 GHz **Option 302:** <1.10 to 4 GHz <1.20 to 12.4 GHz <1.23 to 20 GHz <1.45 to 26.5 GHz
SWR (into termination)	Add 0.05 to SWR (Through Line) of connector selected	N/A		N/A		**A:** <1.1 to 2 GHz <1.2 to 4 GHz **B:** <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 <1.3 to 18 GHz <1.8 to 26.5 GHz	<1.3	<1.15 to 4 GHz <1.25 to 12.4 GHz <1.30 to 20 GHz <1.60 to 26.5 GHz **Option 302:** <1.10 to 4 GHz <1.20 to 12.4 GHz <1.23 to 20 GHz <1.45 to 26.5 GHz
Isolation (dB)	>50 to 12.4 GHz >45 to 18 GHz	110 – 2.25f [1] min	110 – 2.25f [1] min	>100 to 1 GHz >90 to 4 GHz	90 – (30/26.5)f [1] **Option 301:** 125 – (35/26.5)f [1]	>100 to 4 GHz >90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz	>100	90 – (30/26.5)f [1] **Option 301:** 125 – (35/26.5)f [1]
Input power Average Peak [3]	10 W 5 kW [4]	2 W 100 W (10 µs max)			1 W 50 W (10 µs max)	1 W 100 W (10 µs max)			1 W 50 W (10 µs max)
Switching time (max)	50 ms	15 ms				30 ms			15 ms
Repeatability (max) [5]	0.03 dB						0.03 dB to 18 GHz 0.5 dB to 26.5 GHz	0.03 dB	
Life (min)	1 million cycles	5 million cycles				1 million cycles			5 million cycles
RF connectors	See connector options in ordering example	**A & B:** SMA (f) **C:** 3.5 mm (f)	2.4 mm (f) See Options	Mini SMB (m) [6] (75 Ω)	SMA (f)	SMA (f)	3.5 mm (f)	Mini SMB (m) [6] (75 Ω)	SMA (f)
DC connectors	Solder terminals	Ribbon cable			D-subminì 9 pin or solder terminals	Solder terminals			D-subminì 9 pin or solder terminals

1 *f is frequency in GHz.*
2 *Δf = f (GHz) – 26.5.*
3 *Not to exceed average power (non-switching).*
4 *Option 7: 2 W average, 100 W peak (10 µs max)*
5 *Measured at 25°C.*
6 *75 Ω Mini SMB does not mate with 75 Ω SMB. See data sheet for more information.*

Options (8761/2/5 series)

Agilent model	8761A	8761B	8762A, B, C, F			8765A, B, C, D, F			
Supply voltage, current and impedance [1]			Option 024/T24	Option 011	Option 015/T15	Option 005/305	Option 010/310	Option 015/315	Option 024/324
Supply voltage Range	12 to 15 Vdc	24 to 30 Vdc	20 to 32 Vdc	4.5 to 7 Vdc	12 to 20 Vdc	4.5 to 7 Vdc	7 to 12 Vdc	12 to 20 Vdc	20 to 32 Vdc
Supply voltage (nom)	12 Vdc	24 Vdc	24 Vdc	5 Vdc	15 Vdc	5 Vdc	10 Vdc	15 Vdc	24 Vdc
Current (nom)	80 mA	65 mA	120 mA	400 mA	182 mA	385 mA	300 mA	200 mA	120 mA
Impedance (nom)	150 Ω, 90 mH	400 Ω, 300 mH	200 Ω, 127 mH	13 Ω, 8 mH	82 Ω, 57 mH	13 Ω, 8 mH	33 Ω, 25 mH	75 Ω, 55 mH	200 Ω, 135 mH
Control logic	N/A		**Option T15:** TTL/5V CMOS compatible logic with 15 Vdc supply [2] **Option T24:** TTL/5V CMOS compatible logic with 24 Vdc supply [2]			N/A			
RF connector	See ordering information		N/A			**D (Option 292):** 2.92 mm (f)			
DC connectors	N/A					**Option 108:** 8-inch ribbon cable extension **Option 116:** 16-inch ribbon cable extension			
Calibration documentation	See ordering information								

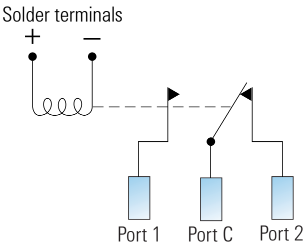
Options (N1810TL/UL)

Frequency range	Coil voltage	DC connector	Performance	Drive
002 DC to 2 GHz	**105** [3] 5 Vdc	**201** D-subminí 9 pin (f)	**301** High isolation	**401** TTL/5V CMOS compatible
004 DC to 4 GHz	**115** 15 Vdc	**202** Solder lugs	**302** Low SWR & insertion loss	**402** Position indicators
020 DC to 20 GHz	**124** 24 Vdc		**UK6** Calibration certificate with test data	**403** Current interrupts
026 DC to 26.5 GHz				

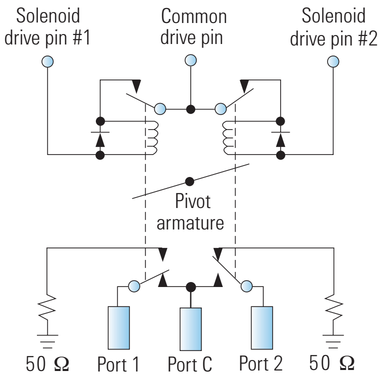
[1] *Must specify option for Agilent 8765 series products.*
[2] *Not available with Agilent 8762F.*
[3] *Option 105 includes Option 402 and Option 403.*

Schematics

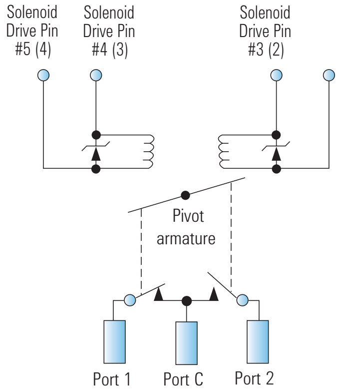
Agilent 8761 series



Agilent 8762 series



Agilent 8765 series [1]



[1] Option 100 Solder terminal numbers in parenthesis

Signal path control data

The tables shown here can be used to better understand how to select a signal path for each switch. For example, the Agilent 8762 switch has two drive control alternatives i.e. a standard drive scheme and a TTL/5V CMOS drive scheme. For TTL/5V CMOS drive, it is required that the supply voltage be applied to pin C and that pin 1 is grounded. To close the path from port 1 to port C, apply a TTL "low" to pin 2. Additional information related to signal path control can be found in the product data sheet.

Agilent 8761 series

	DC drive control voltage	
RF path	**Pin "+"**	**Pin "–"**
1 to C	Negative	Positive
2 to C	Positive	Negative

Agilent 8762 series

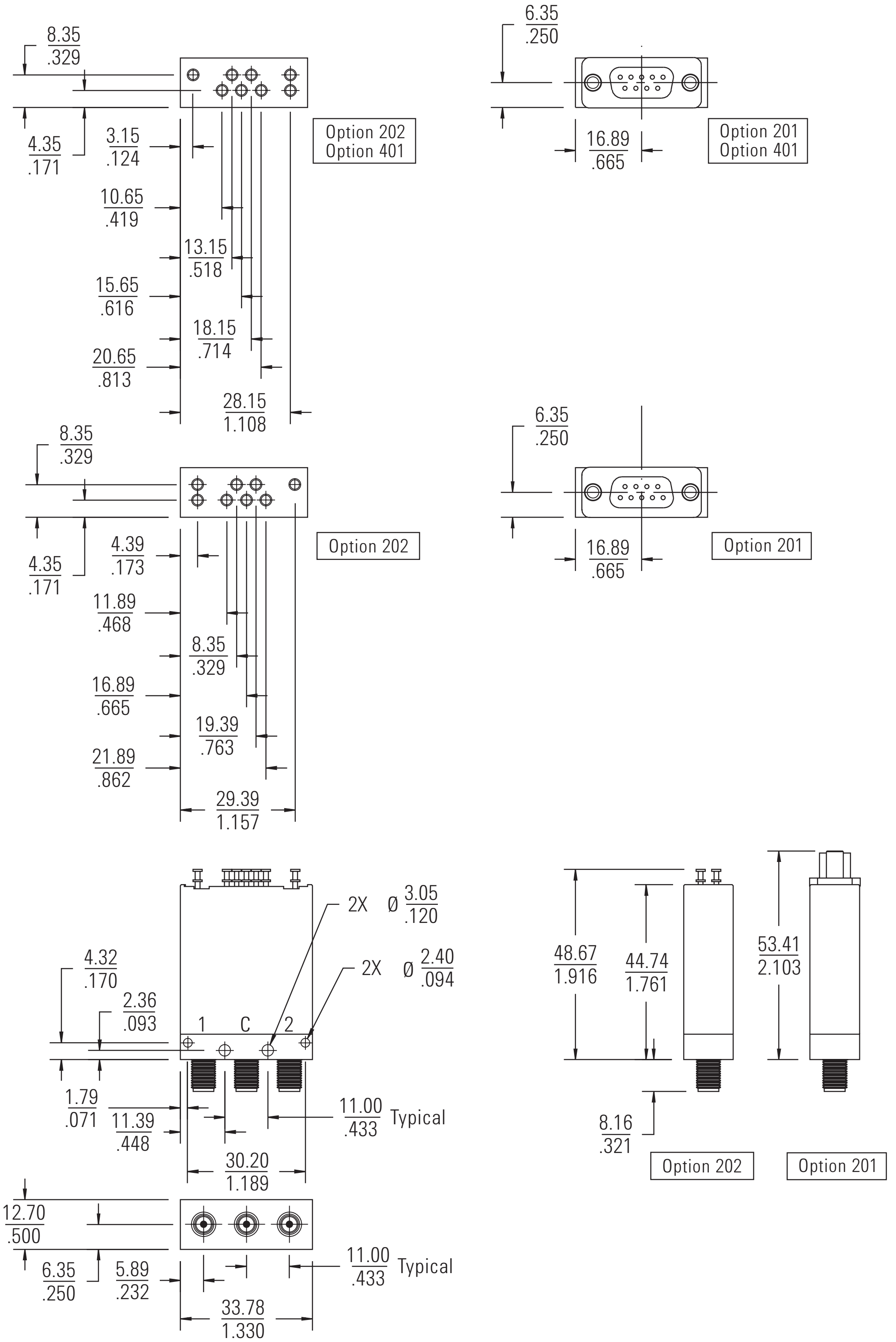
	Drive control alternatives			
	Standard drive voltage [2]		TTL/5V CMOS drive voltage [2, 3]	
RF path	**Pin 1**	**Pin 2**	**Pin 1**	**Pin 2**
1 to C	Ground	Open	Ground	"High"
2 to C	Open	Ground	Ground	"Low"

Agilent 8765 series

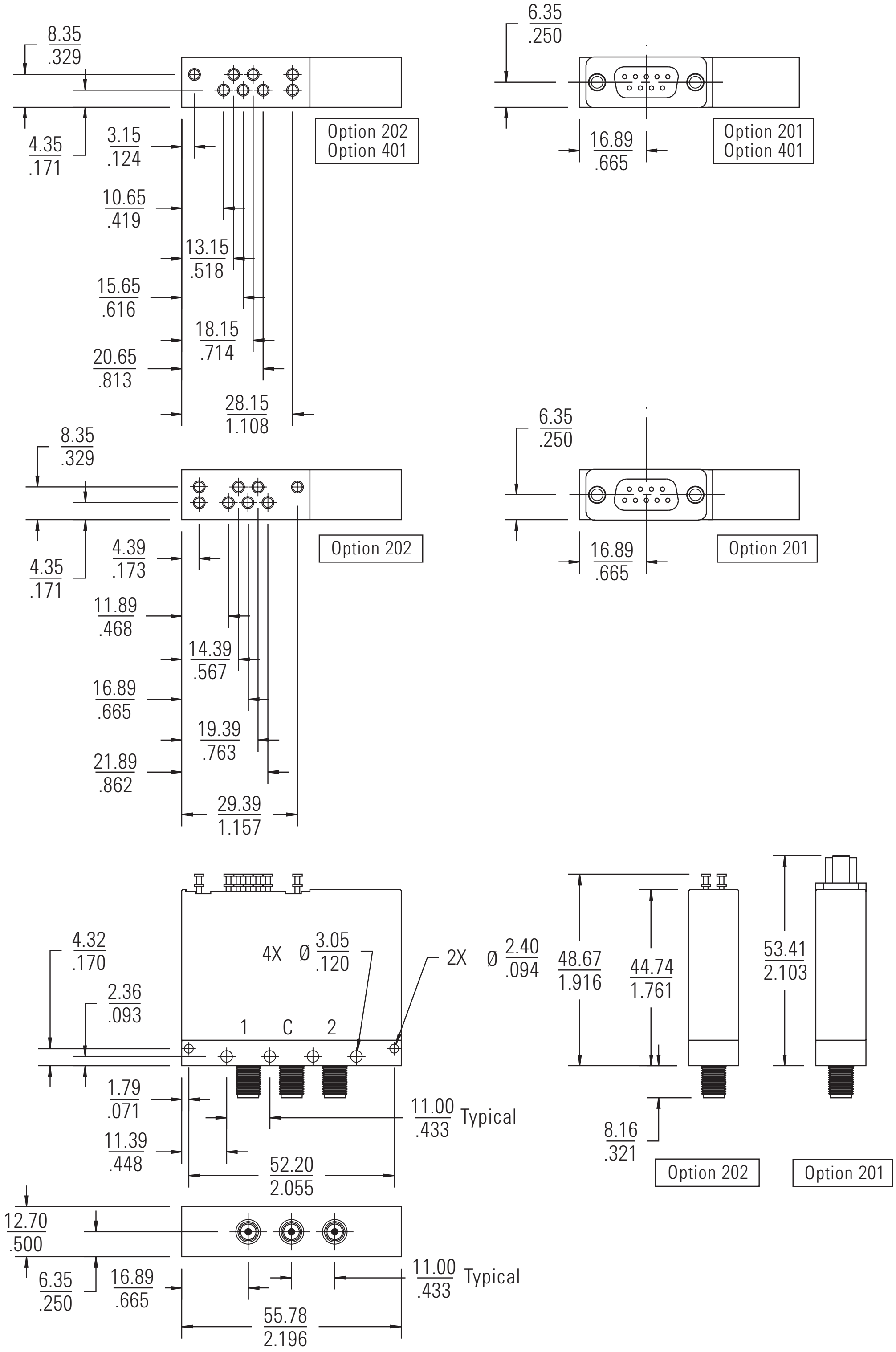
		Drive control alternatives [4]								
		Common positive drive voltage			Common negative drive voltage			Polarity reversal drive voltage		
RF path	**Std. (Option 100)**	**Pin 1 (1)**	**Pin 3/4 (2/3)**	**Pin 5 (4)**	**Pin 3 (2)**	**Pin 1/5 (1/4)**	**Pin 4 (3)**	**Pin 1 (1)**	**Pin 3/4 (2/3)**	**Pin 5 (4)**
1 to C		Open	Supply voltage	Ground	Open	Ground	Supply voltage	Ground	Connected	Supply voltage
2 to C		Ground	Supply voltage	Open	Supply voltage	Ground	Open	Supply voltage	Connected	Ground

[1] *Option 100 solder terminal numbers in parenthesis.*
[2] *Drive pin C is supply voltage.*
[3] *Not available on Agilent 8762F.*
[4] *See data sheet for additional information on these drive control alternatives.*

Agilent N1810UL



Agilent N1810TL



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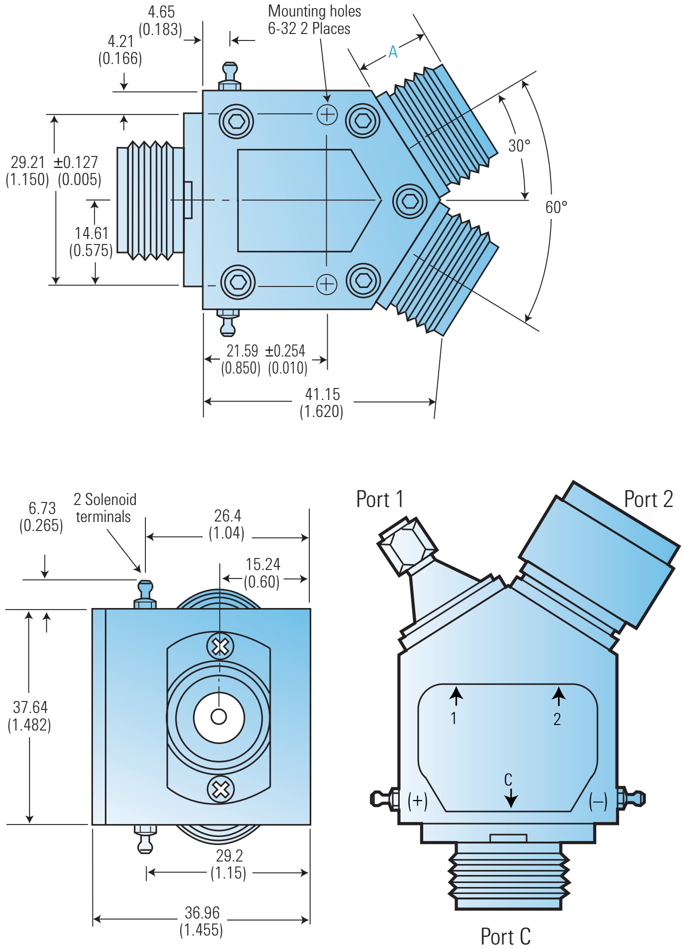
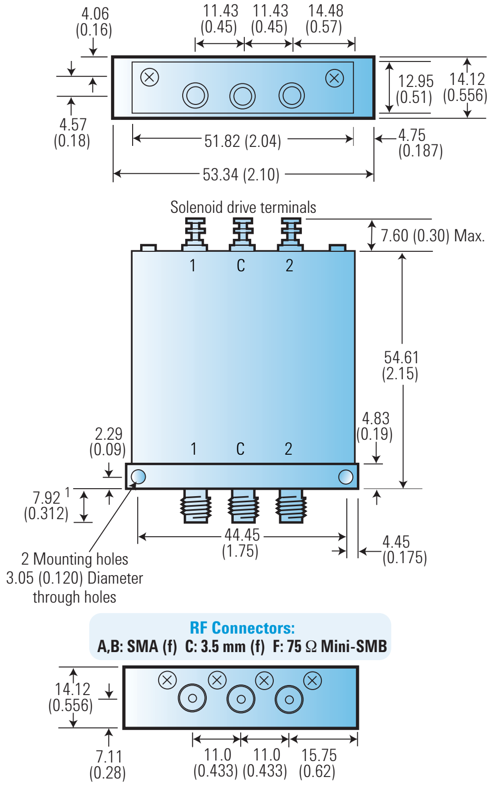
Agilent 8761 series



Agilent 8762 series



[1] *10.0 (0.393) for F version.*

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See ordering example for Agilent 8761 options on page 102.

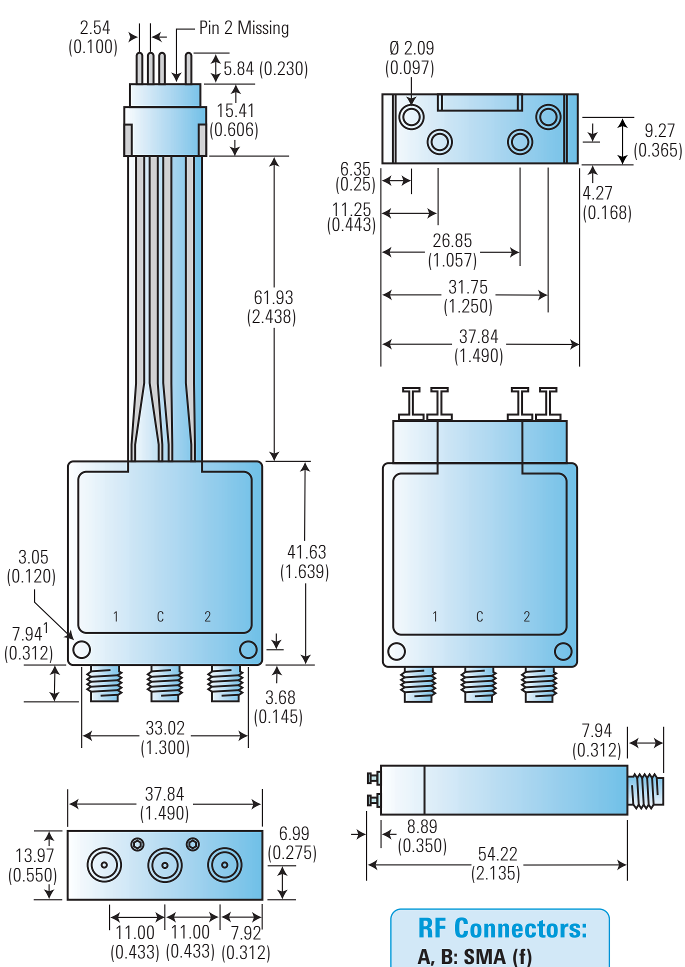
Dimensions are in millimeters (inches) nominal, unless otherwise specified.

Agilent 8761 series connector dimensions

Connector code option	Connector type	Dimension "A" mm	(inch)	SWR (through line)
0	Type-N (f)	13.72	(0.540)	<1.25 to 18 GHz
1	Type-N (m)	19.79	(0.775)	<1.25 to 18 GHz
2	APC-7 threaded sleeve	9.27	(0.365)	<1.2 to 18 GHz
3	APC-7 coupling nut	11.94	(0.470)	<1.2 to 18 GHz
4	UT-250 coax	9.27	(0.365)	<1.25 to 18 GHz
5	SMA (f)	16.13	(0.635)	<1.35 to 18 GHz
6	SMA (m)	17.15	(0.675)	<1.35 to 18 GHz
7	50 Ω termination	30.5	(1.20)	

Agilent 8765A, B, C, D

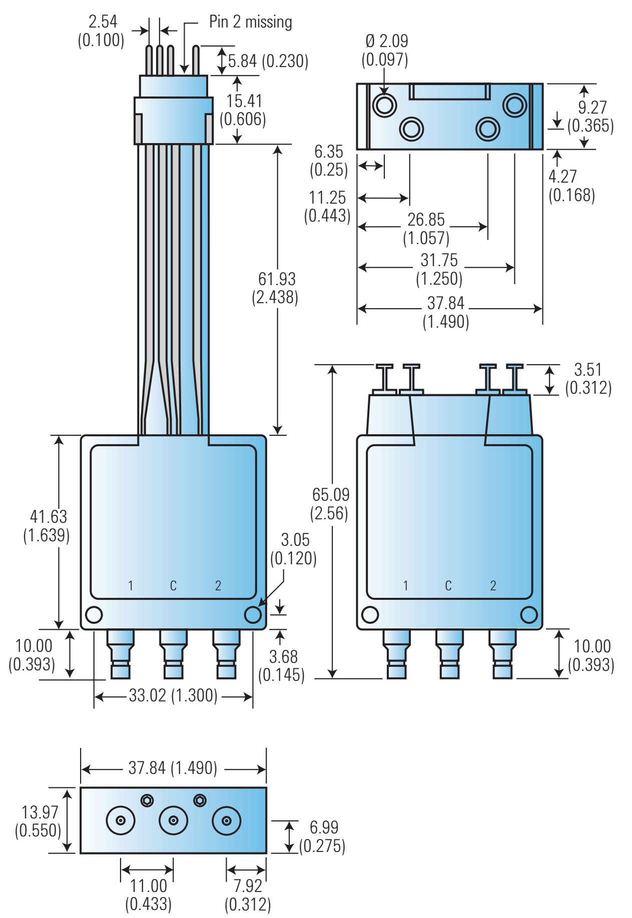
Standard | Option 100



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

Agilent 8765F

Standard | Option 100



RF Connectors:
75 Ω Mini-SMB (m) [2]

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[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 millimeters (inches) nominal, unless otherwise specified.

Ordering Information

Agilent 8761 series ordering example

Agilent 8761 **A** — Option **612** (Port 1, Port 2, Port C)

Option 612 shown on Page 100 in upper right diagram.

Solenoid voltage
- A: 12 to 15 Vdc
- B: 24 to 30 Vdc

Connector code [1]
- 0: N (f)
- 1: N (m)
- 2: APC-7 threaded sleeve
- 3: APC-7 coupling nut
- 4: 7 mm for UT-250 coax
- 5: SMA (f)
- 6: SMA (m)
- 7: 50 ohm termination [2]

Agilent 8762 series ordering example

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

Frequency range
- A: 4 GHz
- B: 18 GHz
- C: 26.5 GHz
- F: 4 GHz (75 ohm)

Supply voltage/control logic
- 024: 24 Vdc
- 011: 5 Vdc
- 015: 15 Vdc
- T15: TTL/5V CMOS compatible with 15 Vdc supply [3]
- T24: TTL/5V CMOS compatible with 24 Vdc supply [3]

Calibration documentation [4]
- UK6: Commercial calibration test data with certificate

Agilent 8765 series ordering example

Agilent 8765 **B** — Option **005** — Option **292** — Option **108** — Option **UK6**

Frequency range
- A: 4 GHz
- B: 20 GHz
- C: 26.5 GHz
- D: 40 GHz
- F: 4 GHz (75 ohm)

Supply voltage and DC connector [1]
- 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

RF connector [5]
- 241: 2.4 mm (f)
- 292: 2.92 mm (f)

DC connector accessories
- 108: 8-inch ribbon cable extension
- 116: 16-inch ribbon cable extension

Calibration documentation [4]
- UK6: Commercial calibration test data with certificate

Agilent N1810UL/TL ordering example

Agilent N1810UL/TL — Option **002** — Option **105** — Option **201** — Option **301** — Option **401**

Frequency range
- 002: DC to 2 GHz
- 004: DC to 4 GHz
- 020: DC to 20 GHz
- 026: DC to 26.5 GHz

Coil voltage
- 105: 5 Vdc
- 115: 15 Vdc
- 124: 24 Vdc

DC connector
- 201: D-submini 9 pin (f)
- 202: Solder lug

Performance
- 301: High Isolation
- 302: Low SWR & insertion loss
- UK6: Commercial calibration certificate with test data

Drive
- 401: TTL/5V CMOS compatible
- 402: Position indicators
- 403: Current interrupts

[1] This option must be specified when ordering this product.
[2] Port 1 or port 2 only.
[3] Not available with Agilent 8762F.
[4] Not available for Agilent 8762F, 8765D Option 292, or 8765F.
[5] Available with Agilent 8765D only.

Specifications

Agilent model	8764A	8764B	8764C	N1812UL	8763A	8763B	8763C	N1811TL
Configuration	5-port				4-port			
Features	Break-before-make Current Interrupts							
	Unterminated				Terminated			
Impedance	50 Ω				50 Ω			
Frequency range	DC to 4 GHz	DC to 18 GHz	DC to 26.5 GHz	DC to 26.5 GHz	DC to 4 GHz	DC to 18 GHz	DC to 26.5 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	<0.25 to 2 GHz <0.50 to 18 GHz <1.25 to 26.5 GHz	0.35 + (0.45/26.5)f [1] **Option 302:** 0.20 + (0.45/26.5)f [1]	<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	0.35 + (0.45/26.5)f [1] **Option 302:** 0.20 + (0.45/26.5)f [1]
SWR (through line)	<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	<1.15 to 4 GHz <1.25 to 12.4 GHz <1.30 to 20 GHz <1.60 to 26.5 GHz **Option 302:** <1.10 to 4 GHz <1.20 to 12.4 GHz <1.23 to 20 GHz <1.45 to 26.5 GHz	<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	<1.15 to 4 GHz <1.25 to 12.4 GHz <1.30 to 20 GHz <1.60 to 26.5 GHz **Option 302:** <1.10 to 4 GHz <1.20 to 12.4 GHz <1.23 to 20 GHz <1.45 to 26.5 GHz
SWR (into termination)	N/A	N/A	N/A	N/A	<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 <1.3 to 18 GHz <1.8 to 26.5 GHz	<1.15 to 4 GHz <1.25 to 12.4 GHz <1.30 to 20 GHz <1.60 to 26.5 GHz **Option 302:** <1.10 to 4 GHz <1.20 to 12.4 GHz <1.23 to 20 GHz <1.45 to 26.5 GHz
Isolation (dB)	>100 to 4 GHz	>90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz	90 – (30/26.5)f [1] **Option 301:** 125 – (35/26.5)f [1]	>100 to 4 GHz	>90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz	90 – (30/26.5)f [1] **Option 301:** 125 – (35/26.5)f [1]
Input power Average Peak [2]	 1 W 100 W (10 µs max)	 1 W 100 W (10 µs max)	 1 W 100 W (10 µs max)	 1 W 50 W (10 µs max)	 1 W 100 W (10 µs max)	 1 W 100 W (10 µs max)	 1 W 100 W (10 µs max)	 1 W 50 W (10 µs max)
Switching time (max)	30 ms	30 ms	30 ms	15 ms	30 ms	30 ms	30 ms	15 ms
Repeatability (max) [3]	0.03 dB	0.03 dB	0.03 dB to 18 GHz 0.5 dB to 26.5 GHz	0.03 dB	0.03 dB	0.03 dB	0.03 dB to 18 GHz 0.5 dB to 26.5 GHz	0.03 dB
Life (min)	1 million cycles	1 million cycles	1 million cycles	5 million cycles	1 million cycles	1 million cycles	1 million cycles	5 million cycles
RF connectors	SMA (f)	SMA (f)	3.5 mm (f)	SMA (f)	SMA (f)	SMA (f)	3.5 mm (f)	SMA (f)
DC connectors	Solder terminals	Solder terminals	Solder terminals	D-subminі 9 pin or solder terminals	Solder terminals	Solder terminals	Solder terminals	D-subminі 9 pin or solder terminals

1 *f is frequency in GHz.*
2 *Not to exceed 1 W average (non-switching).*
3 *Measured at 25 °C.*

Bypass Switch (continued)

Options (8763/4 series)

Control logic	**Option T15:** TTL/5V CMOS compatible logic with 15 Vdc supply **Option T24:** TTL/5V CMOS compatible logic with 24 Vdc supply		
Supply voltage, current and impedance	**Option 024/T24**	**Option 011**	**Option 015/T15**
Supply voltage range	20 to 32 Vdc	4.5 to 7 Vdc	12 to 20 Vdc
Supply voltage (nom)	24 Vdc	5 Vdc	15 Vdc
Current (nom)	120 mA	400 mA	182 mA
Impedance (nom)	200 Ω, 127 mH	13 Ω, 8 mH	82 Ω, 57 mH
Calibration documentation	See ordering information		

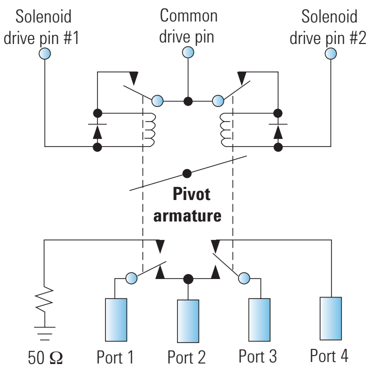
Options – N1811TL, N1812UL

Frequency range		Coil voltage		DC connector		Performance		Drive	
002	DC to 2 GHz	**105** [2]	5 Vdc	**201**	D-subminі 9 pin (f)	**301**	High isolation	**401**	TTL/5V CMOS compatible
004	DC to 4 GHz	**115**	15 Vdc	**202**	Solder lugs	**302**	Low SWR & insertion loss	**402**	Position indicators
020	DC to 20 GHz	**124**	24 Vdc			**UK6**	Calibration certificate with test data	**403**	Current interrupts
026	DC to 26.5 GHz								

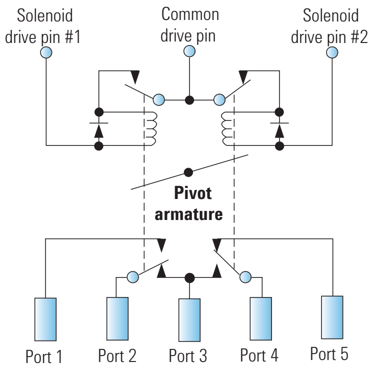
[1] *Specifications include margins for measurement uncertainties.*
[2] *Option 105 includes Option 402 and Option 403.*

Schematics

Agilent 8763 series



Agilent 8764 series



Signal path control data

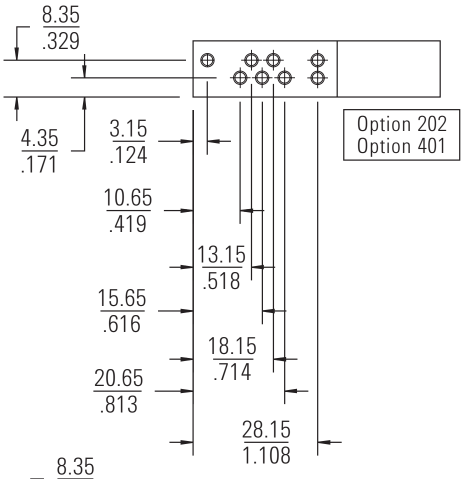
The table at right can be used to better understand how to select a signal path for each switch. For example, the Agilent 8763 switch has two drive control alternatives i.e. a standard drive scheme and a TTL/5V CMOS drive scheme. For standard drive, it is required that the supply voltage be applied to pin C. The path from port 1 to port 2 and port 3 to port 4 can be closed by grounding pin 1 and opening pin 2. Additional information related to signal path control can be found in the product data sheet for each of the products shown here.

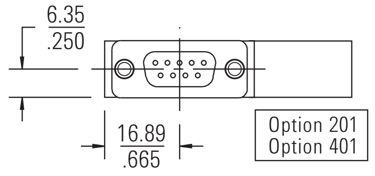
Agilent 8763/64 series

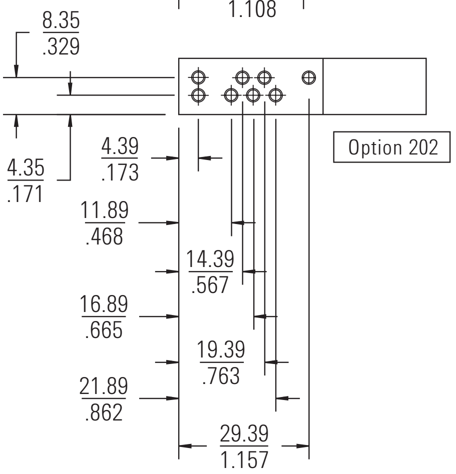
Agilent model	Drive control alternatives				
		Standard drive voltage [1]		TTL/5V CMOS drive voltage [1]	
	RF Path	Pin 1	Pin 2	Pin 1	Pin 2
8763A, B, C	1 to 2 3 to 4	Ground	Open	Ground	"Low"
	2 to 3 1 terminated 4 open	Open	Ground	Ground	"High"
8764A, B, C	2 to 3 4 to 5 1 open	Ground	Open	Ground	"Low"
	1 to 2 3 to 4 5 open	Open	Ground	Ground	"High"

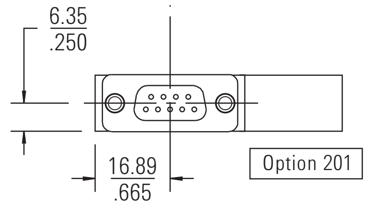
[1] *Drive pin C is supply voltage.*

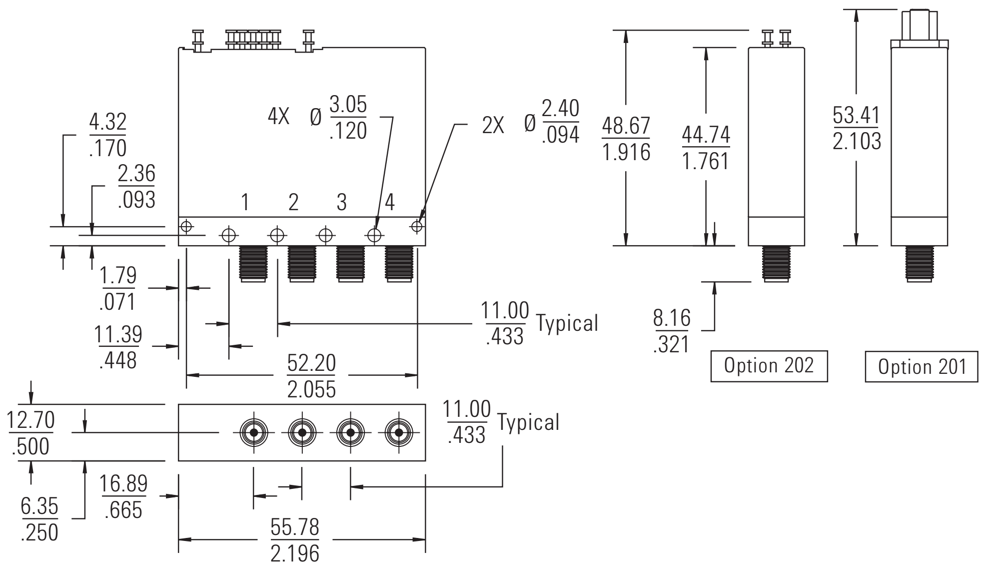
Agilent N1811TL



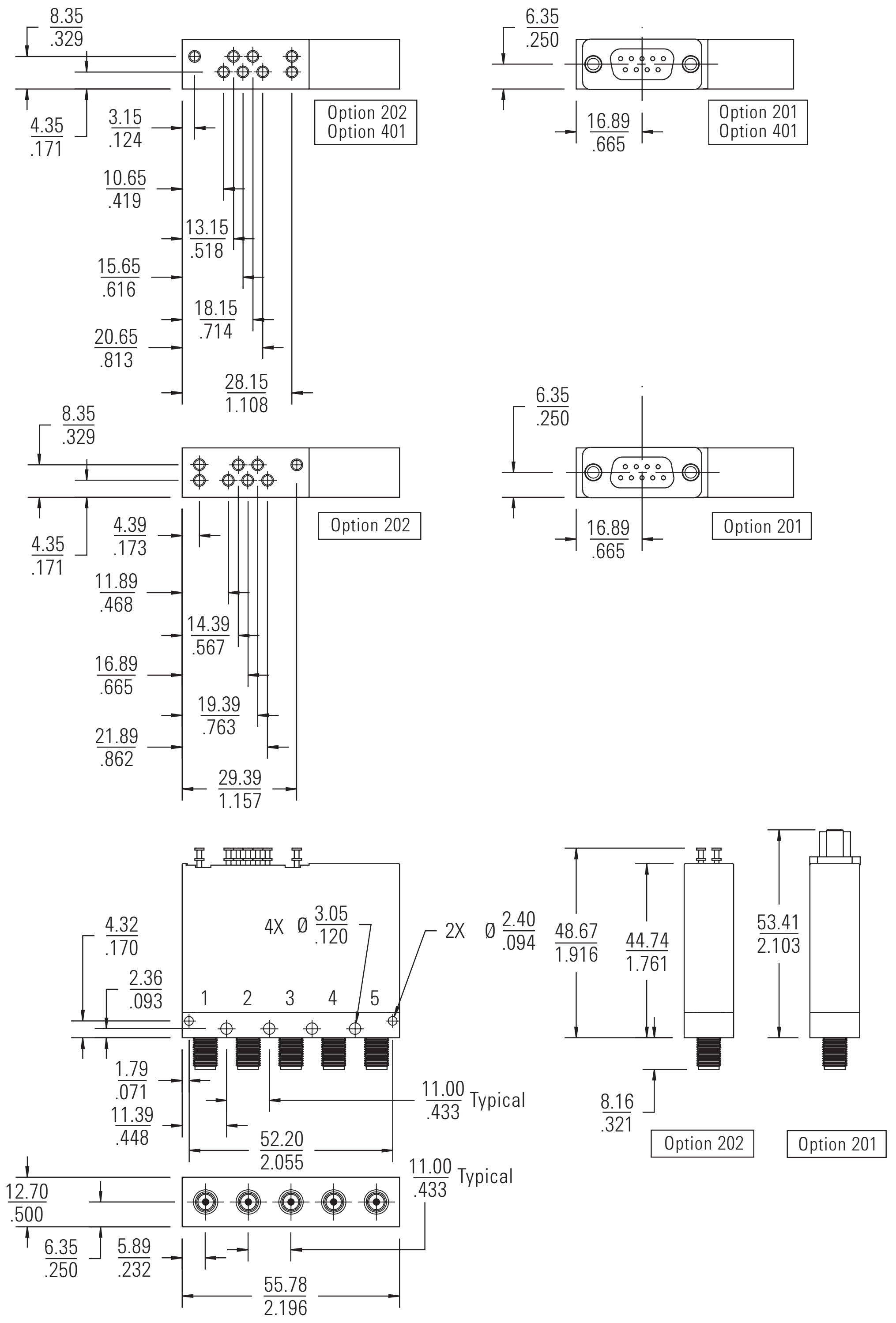






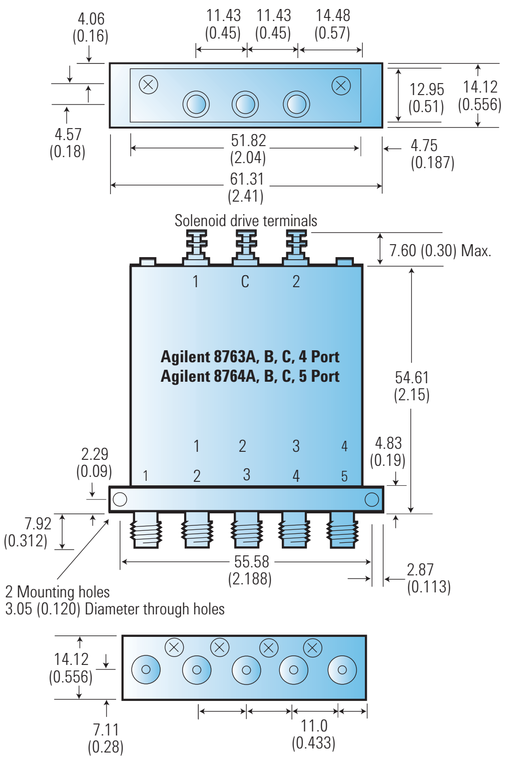


Agilent N1812UL



Outline drawing

Agilent 8763/64 series



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

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

Ordering information

Agilent 8763/64 series ordering example

Agilent 876 3 B Option 015 Option UK6

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

Agilent N1811TL/12UL ordering example

Agilent N1811TL/12UL Option 002 Option 105 Option 201 Option 301 Option 401

Frequency range	Coil voltage	DC connector	Performance	Drive
002: DC to 2 GHz	105: 5 Vdc	201: D-subminі 9 pin (f)	301: High isolation	401: TTL/5V CMOS compatible
004: DC to 4 GHz	115: 15 Vdc	202: Solder lug	302: Low SWR & insertion loss	402: Position indicators
020: DC to 20 GHz	124: 24 Vdc		UK6: Commercial Calibration certificate with test data	403: Current interrupts
026: DC to 26.5 GHz				

Specifications

Agilent model	8766K	8767K	8768K	8769K
Configuration	SP3T	SP4T	SP5T	SP6T
Features	Unterminated Break-before-make Current interrupts Position indication capability [1]		Unterminated Break-before-make Current interrupts Position indication capability [1]	
Impedance	50 Ω		50 Ω	
Frequency range	DC to 26.5 GHz		DC to 26.5 GHz	
Insertion loss (dB)	**Signal path** Common to Port 1: 0.2 dB + 0.05 dB x freq (GHz) Common to Port 2: 0.2 dB + 0.06 dB x freq (GHz) Common to Port 3: 0.2 dB + 0.08 dB x freq (GHz) Common to Port 4: 0.25 dB + 0.095 dB x freq (GHz) Common to Port 5: 0.25 dB + 0.108 dB x freq (GHz) Common to Port 6: 0.25 dB + 0.12 dB x freq (GHz)		**Signal path** Common to Port 1: 0.2 dB + 0.05 dB x freq (GHz) Common to Port 2: 0.2 dB + 0.06 dB x freq (GHz) Common to Port 3: 0.2 dB + 0.08 dB x freq (GHz) Common to Port 4: 0.25 dB + 0.095 dB x freq (GHz) Common to Port 5: 0.25 dB + 0.108 dB x freq (GHz) Common to Port 6: 0.25 dB + 0.12 dB x freq (GHz)	
SWR (through line)	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz		<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz	<1.3 to 8 GHz <1.55 to 12.4 GHz <1.8 to 18 GHz <2.05 to 26.5 GHz
Isolation (dB)	See chart on page 113		See chart on page 113	
Input power Average Peak [2]	 1 W 100 W (10 μs max)		 1 W 100 W (10 μs max)	
Switching time (max)	20 ms		20 ms	
Repeatability (typ)	0.01 dB to 18 GHz 0.05 dB to 26.5 GHz		0.01 dB to 18 GHz 0.05 dB to 26.5 GHz	
Life (min)	5 million cycles		5 million cycles	
RF connectors	3.5 mm (f)		3.5 mm (f)	
DC connectors	Viking cable connector		Viking cable connector	

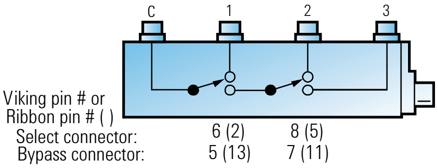
Options

	Option 024	Option 011	Option 015
Supply voltage, current, and impedance			
Supply voltage range	20 to 30 Vdc	4.5 to 7 Vdc	13 to 22 Vdc
Supply voltage (nom)	24 Vdc	5 Vdc	15 Vdc
Current (nom)	130 mA	332 mA	187 mA
Impedance (nom)	185 Ω, 65 mH	17 Ω, 5.5 mH	80 Ω, 30 mH
RF connectors	**Option 002:** SMA (f) [4] **Option 004:** 3.5 mm (f)		
DC connectors	**Option 060:** 5 feet DC control cable; 12 pin viking **Option 016:** 16-inch ribbon cable		
Calibration documentation	See ordering information on page 115		

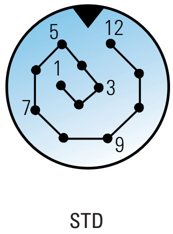
[1] *Provides position sensing when used with Agilent 87130A/70611A switch driver or customer supplied external circuitry.*
[2] *Not to exceed 1 W average (non-switching).*
[3] *Measured at 25 °C.*
[4] *Use to 18 GHz only.*

Simplified schematics

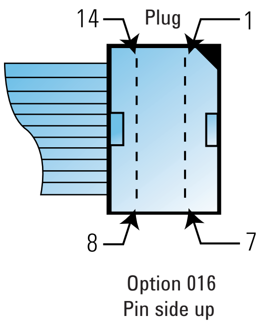
Agilent 8766K



Viking plug detail [1, 2]

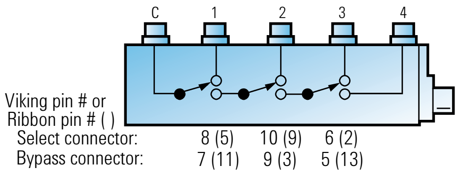


DIP plug [3]

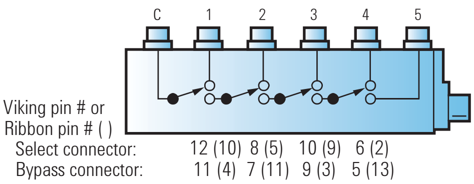


[1] *DC drive interface cable has color coded tinned leads at opposite end.*
[2] *Supply voltage is Pin 1 (red wire).*
[3] *Supply voltage is Pin 6.*

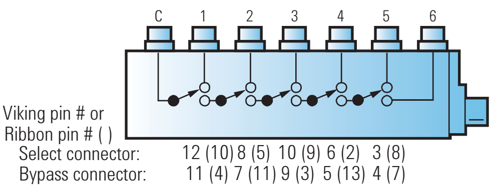
Agilent 8767K



Agilent 8768K



Agilent 8769K



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

Low Profile Multiport Switch (continued)

Signal path control data

The tables below can be used to better understand how to select a signal path for each switch. The standard drive connector for each switch is a Viking connector with a 5 ft. cable. Alternately, a flat ribbon cable with a 14-pin DIP plug is available as an option. As an example, to connect the path from port C to port 2 of the standard 8767K, it is required that the supply voltage be applied to pin 1 (red lead) and that pin 10 (blue lead) and pin 7 (black lead) are grounded. This will "bypass" port 1 and "select" port 2. Note that section 3 can be selected or bypassed; however, isolation performance will be affected (see next page for further information). Additional information related to signal path control can be found in the product data sheet.

Agilent 8766K SP3T switch

Switching section	1		2	
Section state	Select	Bypass	Select	Bypass
Std. Viking pin	6	5	8	7
Std. Viking wire color	Yellow	Violet	Green	Black
Option 016 Dual inline Pin connector	2	13	5	11
Common to Port 1	X			
Common to Port 2		X	X	
Common to Port 3		X		X

Agilent 8767K SP4T switch

Switching section	1		2		3	
Section state	Select	Bypass	Select	Bypass	Select	Bypass
Std. Viking pin	8	7	10	9	6	5
Std. Viking wire color	Green	Black	Blue	Orange	Yellow	Violet
Option 016	5	11	9	3	2	13
Dual inline pin connector						
Common to Port 1	X					
Common to Port 2		X	X			
Common to Port 3		X		X	X	
Common to Port 4		X		X		X

Agilent 8768K SP5T switch

Switching section	1		2		3		4	
Section state	Select	Bypass	Select	Bypass	Select	Bypass	Select	Bypass
Std. Viking pin	12	11	8	7	10	9	6	5
Std. Viking wire color	White	Brown	Green	Black	Blue	Orange	Yellow	Violet
Option 016 Dual inline Pin connector	10	4	5	11	9	3	2	13
Common to Port 1	X							
Common to Port 2		X	X					
Common to Port 3		X		X	X			
Common to Port 4		X		X		X	X	
Common to Port 5		X		X		X		X

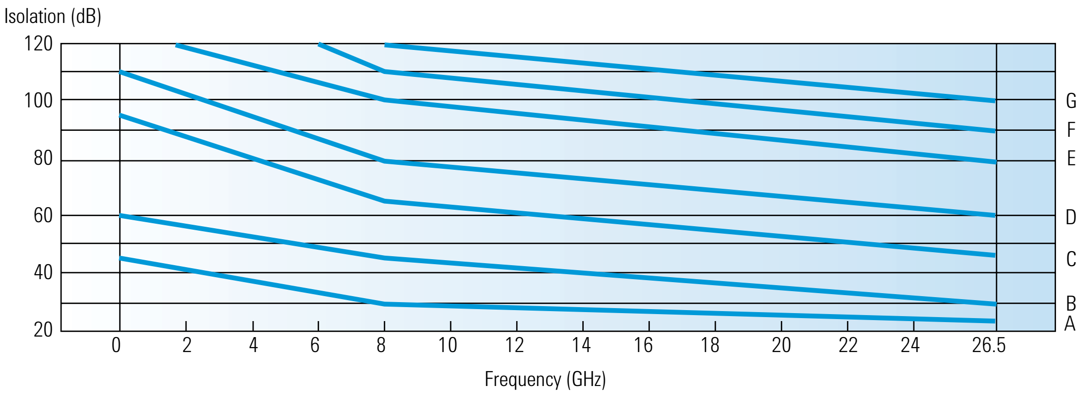
Agilent 8769K SP6T switch

Switching section	1		2		3		4		5	
Section state	Select	Bypass	Select	Bypass	Select	Bypass	Select	Bypass	Select	Bypass
Std. Viking pin	12	11	8	7	10	9	6	5	3	4
Std. Viking wire color	White	Brown	Green	Black	Blue	Orange	Yellow	Violet	Gray	White/Red
Option 016 Dual inline Pin connector	10	4	5	11	9	3	2	13	8	7
Common to Port 1	X									
Common to Port 2		X	X							
Common to Port 3		X		X	X					
Common to Port 4		X		X		X	X			
Common to Port 5		X		X		X		X	X	
Common to Port 6		X		X		X		X		X

Sections identified by this cross-hatch symbol can be selected or bypassed; however, isolation performance will be affected (see next page for further information).

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 Agilent 8768K is being used, use the Agilent 8768K table to determine the isolation to each port. If port three (the third connector from the input) is selected, the isolation to ports 1and 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.



Agilent 8766K SP3T switch

Section	Section status		Isolation curve for Port ( )		
	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	—

15

Agilent 8767K SP4T switch

Section	Section status			Isolation curve for Port ( )			
	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	—

Isolation calculation characteristics

Agilent 8768K SP5T switch

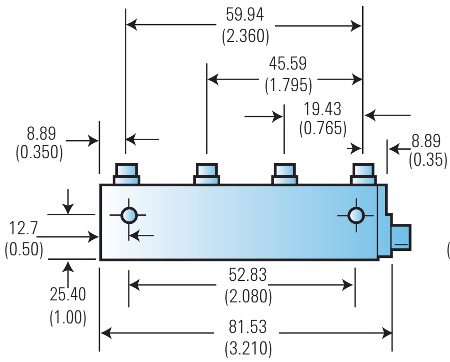
	Section status				Isolation curve for Port ( )				
Section	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**
Common to Port 1	Select	Select	Select	Select	—	B	D	E	F
Common to Port 1	Select	Select	Bypass	Select	—	B	E	D	E
Common to Port 1	Select	Bypass	Select	Select	—	C	B	D	E
Common to Port 1	Select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

Agilent 8769K SP6T switch

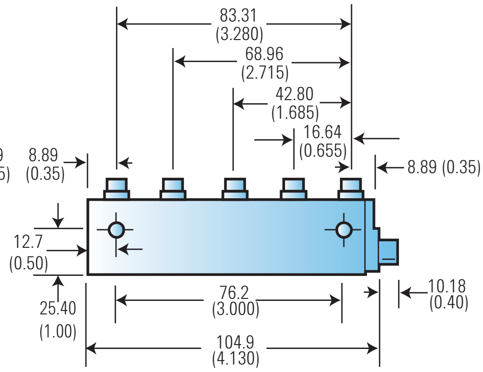
	Section status					Isolation curve for Port ( )					
Section	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**
Common to Port 1	Select	Select	Select	Select	Select	—	B	D	E	F	G
Common to Port 1	Select	Select	Select	Bypass	Select	—	B	D	F	E	F
Common to Port 1	Select	Select	Bypass	Select	Select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

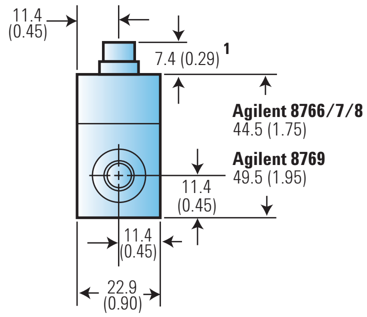
Outline drawings

Agilent 8766K



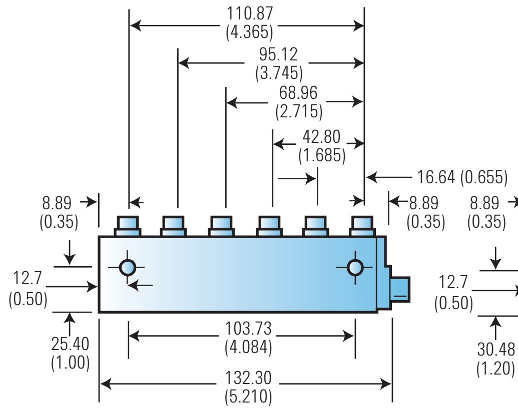
Agilent 8767K



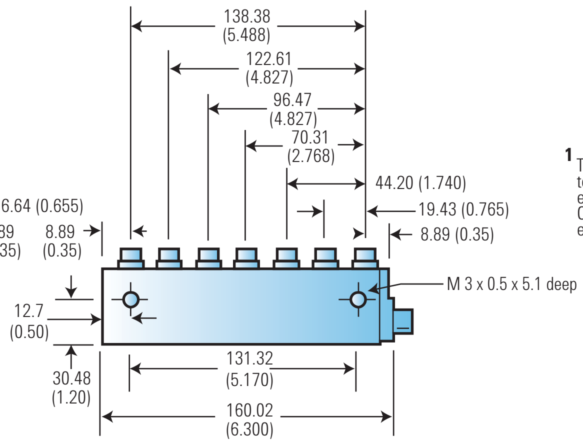


[1] This dimension applies to connectors on each end of the switch. Connectors between the ends are 0.05 inches taller.

Agilent 8768K



Agilent 8769K



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

Ordering Information

Agilent 8766/67/68/69 series ordering example

Agilent 876 7 K	Option 011	Option 002	Option 060	Option UK6
Type	**Supply voltage**	**RF connector**	**DC connector**	**Calibration documentation**
6: SP3T	024: 24 Vdc	004: 3.5 mm (f)	060: Viking cable connector	UK6: Commercial calibration test data with certificate
7: SP4T	011: 5 Vdc	002: SMA (f)	016: 16-inch ribbon cable	
8: SP5T	015: 15 Vdc			
9: SP6T				

Specifications

Agilent model	87104A 87104B 87104C	87106A 87106B 87106C	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	
Frequency range	A: DC to 4 GHz B: DC to 20 GHz C: DC to 26.5 GHz		A: DC to 4 GHz B: DC to 20 GHz C: DC to 26.5 GHz	
Insertion loss (dB)	0.3 + 0.015 x freq (GHz)		0.3 + 0.015 x freq (GHz)	
SWR	<1.2: DC to 4 GHz <1.35: 4 to 12.4 GHz <1.45: 12.4 to 18 GHz <1.7: 18 to 26.5 GHz		<1.2: DC to 4 GHz <1.35: 4 to 12.4 GHz <1.45: 12.4 to 18 GHz <1.7: 18 to 26.5 GHz	
Isolation (dB)	>100 dB: DC to 4 GHz >80 dB: 12 to 15 GHz >70 dB: 15 to 20 GHz >65 dB: 20 to 26.5 GHz		>100 dB: DC to 4 GHz >80 dB: 12 to 15 GHz >70 dB: 15 to 20 GHz >65 dB: 20 to 26.5 GHz	
Input power Average Peak [2]	 1 W 50 W (10 µs max)		 1 W 50 W (10 µs max)	
Switching time (ms)	<15		<15	
Repeatability (max) [3]	0.03 dB		0.03 dB	
Life (min)	5 million cycles		5 million cycles	
Supply voltage and current Supply voltage range Supply voltage (nom) Current (nom) [4]	 20 to 32 Vdc 24 Vdc 200 mA		 20 to 32 Vdc 24 Vdc 200 mA	
RF connectors	SMA (f)		SMA (f)	
DC connectors	Ribbon cable receptacle		Ribbon cable receptacle	

15

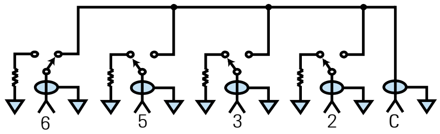
Options

	87104A, B, C	87106A, B, C	87204A, B, C	87206A, B, C
Control logic	**Option T24:** TTL/5V CMOS compatible logic with 24 Vdc supply		N/A	
DC connectors	**Option 100:** Solder terminals		**Option 100:** Solder terminals	
Calibration Documentation	UK: Commercial calibration test data with certificate		UK: Commercial calibration test data with certificate	

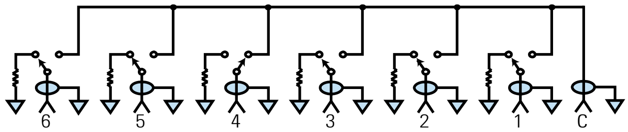
[1] *Position sensing when used with customer supplied external circuitry only.*
[2] *Not to exceed average power (non-switching).*
[3] *Measured at 25 °C.*
[4] *Closing one RF path requires 200 mA. Add 200 mA for each additional RF path closed or opened.*

Simplified schematics

Agilent 87104/204A, B, C



Agilent 87106/206A, B, C



Signal path control data

The table shown here can be used to better understand how to select a signal path for Agilent 87104/106 multiport switches. For example, there are two drive control alternatives, i.e. a standard drive scheme and a TTL/5V CMOS drive scheme. For standard drive, it is required that the supply voltage be applied to pin 1 and that pin 15 is grounded. The path from port C to port 2 can be closed by grounding pin 5. Note that all other RF paths are simultaneously opened by internal logic. Further, the Agilent 87104/106 permits closing 1 or more RF paths simultaneously, allowing make-before-break RF switching transitions. See product data sheet for more information.

Agilent 87104/106 series signal path control data [1]

		Drive control voltages [2]	
RF Path	**Pin No.** [2]	**Standard**	**TTL/5V CMOS**
1 to C [3]	3	Ground	"High"
2 to C	5	Ground	"High"
3 to C	7	Ground	"High"
4 to C [3]	9	Ground	"High"
5 to C	11	Ground	"High"
6 to C	13	Ground	"High"
Open all paths	16 [4]	Ground	"High"

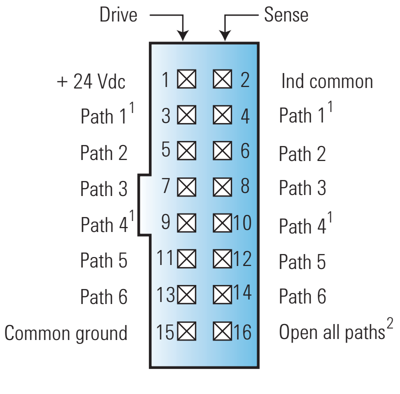
[1] Agilent recommends the Agilent 87130A/70611A switch driver for Agilent 87204/206 series products. See data sheet for additional information related to driving these switches.
[2] Pin 1 is supply voltage. Pin 15 is common ground.
[3] Paths 1 and 4 are not available for Agilent 87104A, B, C.
[4] Not available on Option 100.

15

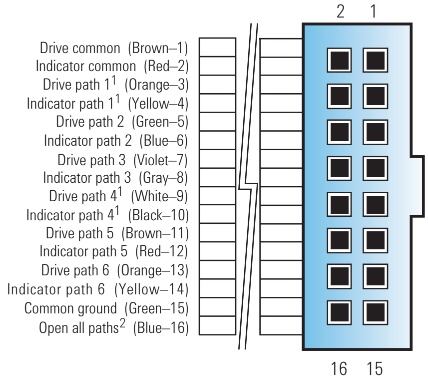
Drive connection diagrams

Agilent 87104/106 series

Standard/Option T24

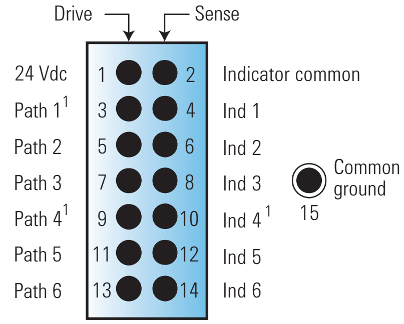


Switch connector



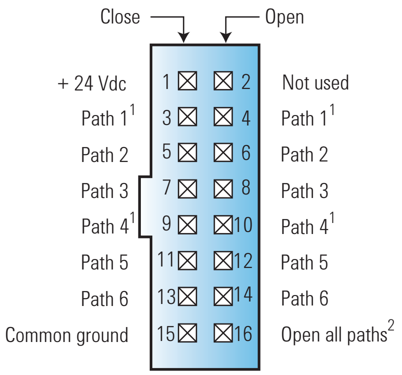
Mating cable connector

Option 100 (solder terminals)

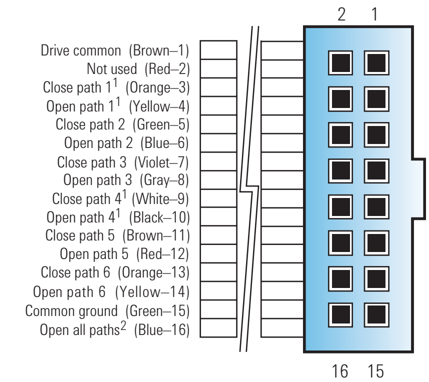


Agilent 87204/206 series

Standard

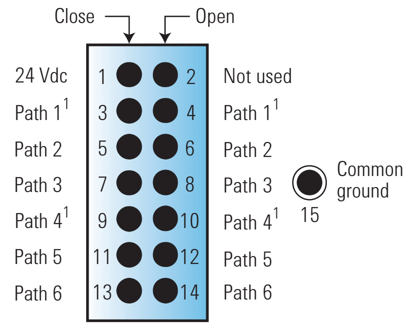


Switch connector



Mating cable connector

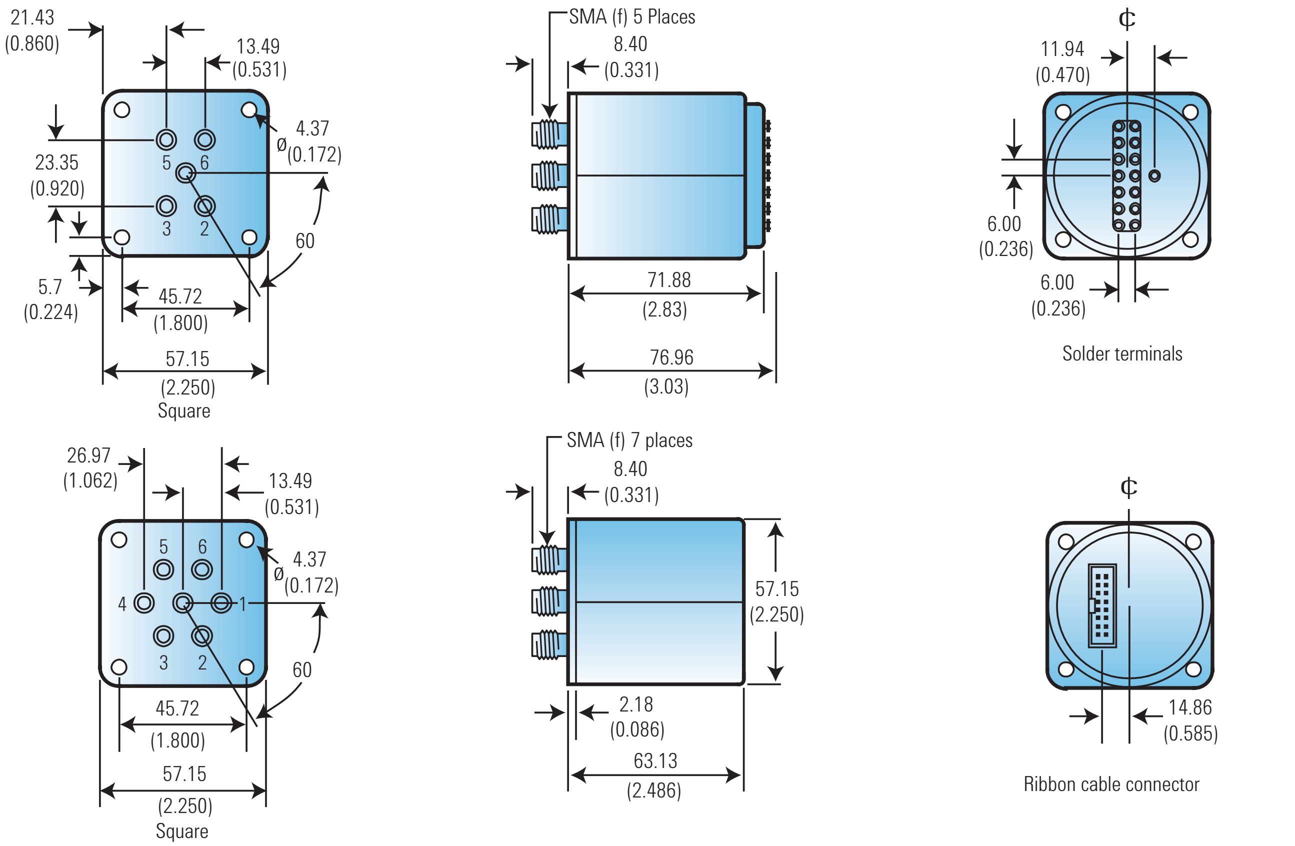
Option 100 (solder terminals)



[1] Paths 1 and 4 are not connected for Agilent 87104/204 series.
[2] This function is not available on Option 100.

Outline drawings

Agilent 87104/106, 87204/206 series



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

Ordering information

Agilent 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 Agilent 87130A/70611A driver or customer supplied external circuitry.

Agilent 87 2 0 4 B — Option 100 — Option T24 — Option UK6

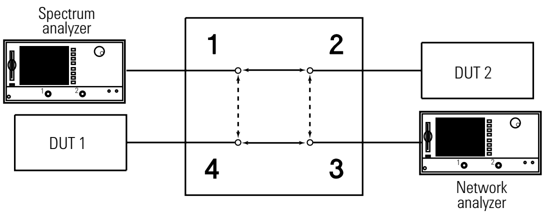
Switch type	Frequency range	DC connector	Control logic [1]	Calibration documentation
4: SP4T	A: 4 GHz	161: Ribbon receptacle	024: 24 Vdc drive	UK6: Commercial calibration test data with certificate
6: SP6T	B: 20 GHz	100: Solder terminals	T24: TTL/5V CMOS compatible logic with 24 Vdc supply	
	C: 26.5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

[1] *Option T24 not available with Agilent 87204/206 series products.*

Applications

The Agilent 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.

The Agilent 87222C/D/E transfer switches have the ability to exchange two signals between two inputs and two outputs. The transfer switches can connect two different instruments with two devices under test (DUT). Once switched, the signals are exchanged between the two instruments and the two DUTs. The exchanged signals allow complete network and spectrum analysis on two devices with a single switch and one test setup. See Figure 1 for an example of this application.



	DUT 1	DUT 2
Network analyzer	Position A	Position B
Spectrum analyzer	Position B	Position A

Figure 1. Switching two instruments and two DUTs

In the signal reverse configuration, a device can be connected across two diagonal ports of the Agilent 87222C/D/E transfer switch. This will allow the signal direction through the device to be reversed. See Figure 2.

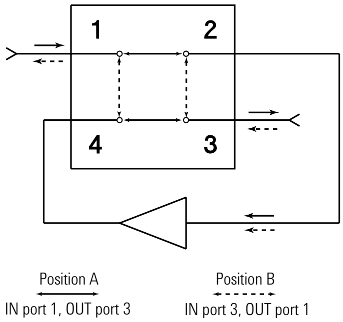


Figure 2. Signal reversal

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The Agilent 8782C/D/E can be used as a simple drop-out switch where a signal is either run through the device under test or straight through the switch, bypassing the device. See Figure 3.

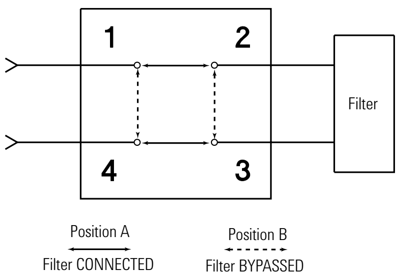


Figure 3. Drop-out switch

By attaching an external termination, the designer can use the Agilent 87222C/D/E in a SPDT terminated switch configuration. See Figure 4.

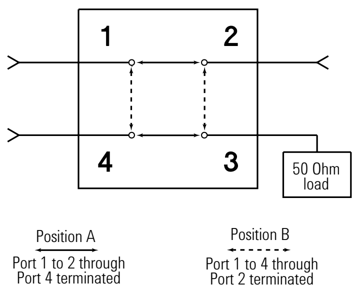
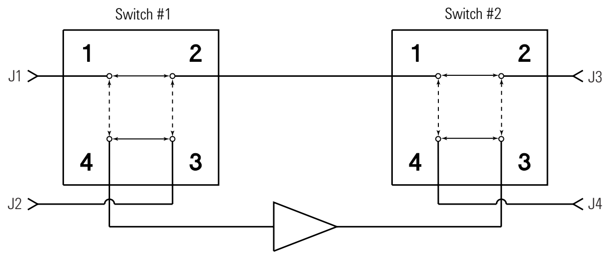


Figure 4. SPDT terminated

In Figure 5, an active device, such as an amplifier, is inserted into a signal path presenting a unique problem. A single transfer switch has the undesirable characteristic of shunting the output of the amplifier to its input when the signal is bypassing the amplifier. The advantage of using two transfer switches is that an additional signal path is available, however two SPDT switches can also be used. This additional path can utilize the same amplifier when the original path is bypassed.



Switch states		Signal paths	
Switch #1	Switch #2		
Position A	Position A	J1 — J3	J2 —▷— J4
Position B	Position A	J2 — J3	J1 —▷— J4
Position A	Position B	J2 —▷— J3	J1 — J4
Position B	Position B	J1 —▷— J3	J2 — J4

Figure 5. Bypassing an active device

Driving the switch

There are two positions for the Agilent 87222C/D/E transfer switch. See Table A on page 123. Position A has RF Port 1 connected to RF Port 2 and RF Port 3 connected to RF Port 4. Position B has RF Port 2 connected to RF Port 3 and RF Port 1 connected to RF Port 4. The switch can be driven with a standard grounding drive control with or without a separate ground. Single line or dual line TTL control are also available. The switch operates in a break-before-make mode.

Caution 11713A switch driver users: Do not drive the 87222C/D/E using the S9 or S0 outputs from either the banana-plug outputs or the Viking connectors located on the rear panel of the 11713A.

(I) Standard drive:

See Figure 6 on page 123 for drive connection diagrams.

- Connect Pin 1 to supply (+20 VDC to +32 VDC)
- Connect Pin 9 to ground (see note 1)
- Select position "A" by applying ground to Pin 3 (see note 3)
- Select position "B" by applying ground to pin 5 (see note 3)

(II) Single line TTL drive:

See Figure 6 on page 123 for drive connection diagrams.
See Figure 7 on page 123 for TTL voltage states.

- Connect Pin 1 to supply (+20 VDC to +32 VDC)
- Connect Pin 9 to ground (see notes 2, 4)
- Connect Pin 8 to TTL "High"
- Select position "A" by applying TTL "High" to pin 7 (see note 3)
- Select position "B" by applying TTL "Low" to pin 7 (see note 3)

(III) Dual line TTL drive:

See Figure 6 on page 123 for drive connection diagrams.
See Figure 7 on page 123 for TTL voltage states.

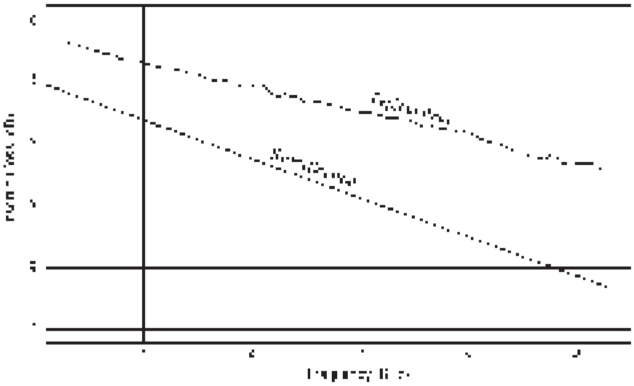
- Connect Pin 1 to supply (+20 VDC to +32 VDC)
- Connect Pin 9 to ground (see notes 2, 4)
- Select position "A" by applying TTL "High" to pin 7 and TTL "Low" to pin 8 (see note 3)
- Select Position "B" by applying TTL "Low" to pin 7 and TTL "High" to pin 8 (see note 3)

Notes:

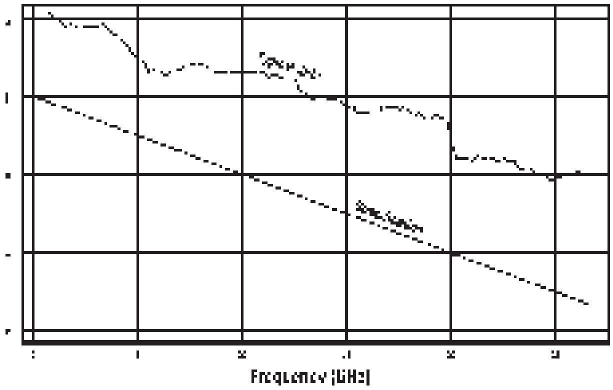
1. Pin 9 does not need to be grounded for the switch to operate in standard drive mode. If pin 9 is not grounded, the position indicators will only function while the appropriate drive has ground applied. Therefore, if a pulse drive is used and continuous indicator operation is required, pin 9 must be grounded.
2. For TTL drive, pin 9 must be grounded.
3. After the RF path is switched and latched, the drive current is interrupted by the electronic position-sensing circuitry. Pulsed control is not necessary, but if implemented, the pulse width must be 15 ms minimum to ensure that the switch is fully latched.
4. In addition to the quiescent current supplying the electronic position-sensing circuitry, the drive current flows out of pin 9 (during switching) when using TTL drive.

High Performance Transfer Switch (continued)

Agilent 87222C/D/E insertions loss versus frequency



Agilent 87222C/D/E isolation versus frequency



Specifications

Agilent model	87222C	87222D	87222E
Features	Opto-electronic indicators and interrupts TTL/5V CMOS compatible Unterminated		
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 dB + 0.025 freq (GHz)	0.2 dB + 0.025 freq (GHz)	0.15 dB + 0.02 freq (GHz)
SWR	<1.10 DC to 2 GHz <1.15 2 to 4 GHz <1.25 4 to 12.4 GHz <1.40 12.4 to 20 GHz <1.65 20 to 26.5 GHz	<1.30 DC to 12.4 GHz <1.40 12.4 to 25 GHz <1.70 25 to 40 GHz	<1.30 DC to 12.4 GHz <1.40 12.4 to 20 GHz <1.50 20 to 30 GHz <1.60 30 to 40 GHz <1.70 40 to 50 GHz
Isolation (dB)	120 dB –2.0 x frequency (GHz)	DC to 26.5 GHz: 120 dB –2.0 x frequency (GHz) 26.5 to 40 GHz: 60 dB	DC to 26.5 GHz: 120 dB –2.0 x frequency (GHz) 26.5 to 50 GHz: 60 dB
Input power Average Peak [1]	 1 W 50 W	 1 W 50 W	 1 W 50 W
Switching speed (max)	15 ms	15 ms	15 ms
Repeatability (max) [2]	0.03 dB	0.03 dB	0.03 dB DC to 40 GHz <0.05 dB typical 40 to 50 GHz
Life (min)	5 million cycles	5 million cycles	5 million cycles
RF connectors	SMA (f)	2.92 mm (f)	2.4 mm (f)

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

[1] *Not to exceed 1 W average.*
[2] *Measured at 25° C.*

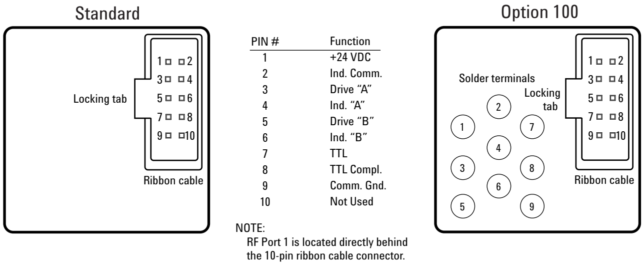


Figure 6. Drive connections

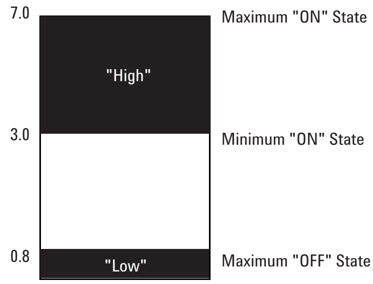


Figure 7. TTL control voltage states

Table A. Drive control alternatives

RF path	(I) Standard drive voltage		(II) Single line TTL/5V CMOS drive voltage		(III) Dual line TTL/5V CMOS drive voltage	
	Drive A Pin 3	**Drive B Pin 5**	**TTL Drive A Pin 7**	**TTL Drive B Pin 8**	**TTL Drive A Pin 7**	**TTL Drive B Pin 8**
Position A 1 to 2, 3 to 4	Ground	Open	High	High	High	Low
Position B 2 to 3, 1 to 4	Open	Ground	Low	High	Low	High

Specifications

Specifications describe the instrument's warranted performance. Supplemental and typical characteristics are intended to provide information useful in applying the instrument by giving typical, but not warranted performance parameters.

Table B. Standard switch drive specifications

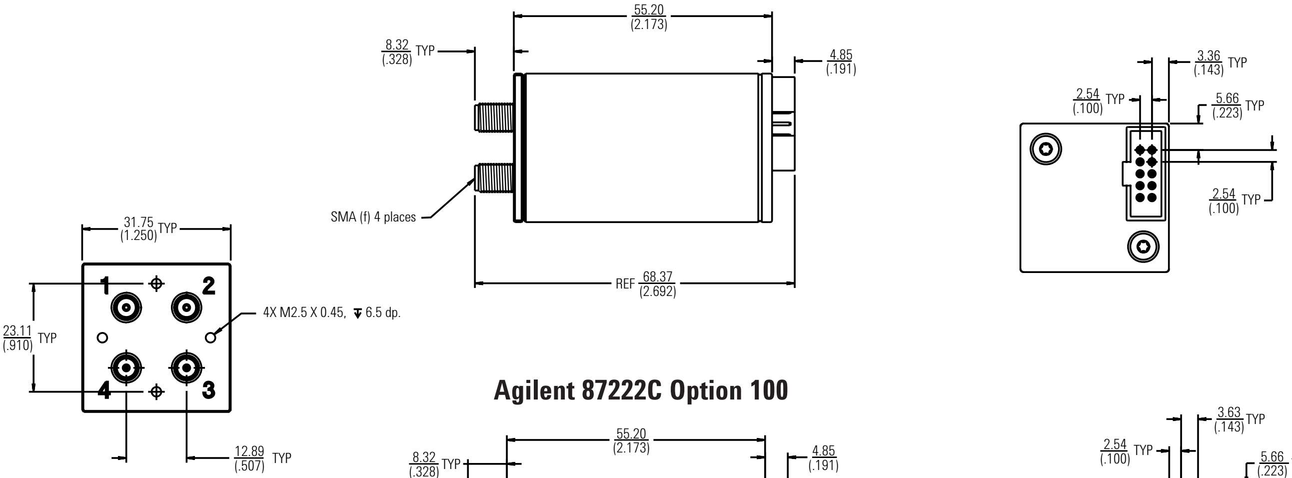
Parameter	Conditions	Min	Nom	Max	Units
Supply voltage		20	24	32	V
Supply current, Icc	Switching: Pulse width >15 ms: Vcc = 24 VDC		200		mA
Supply current (Quiescent)		25		50	mA

Table C. TTL Specific drive specifications

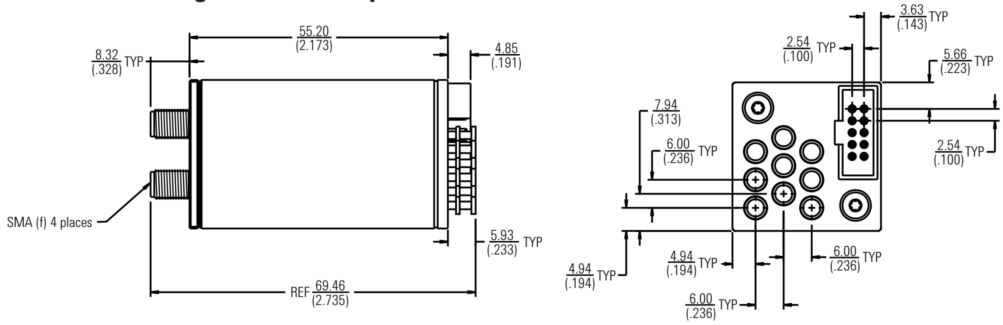
Parameter	Conditions	Min	Nom	Max	Units
High level input		3		7	V
Low level input				0.8	V
Max high input current	Vcc = Max V input = 3.85 VDC		1	1.4	mA

Product outlines

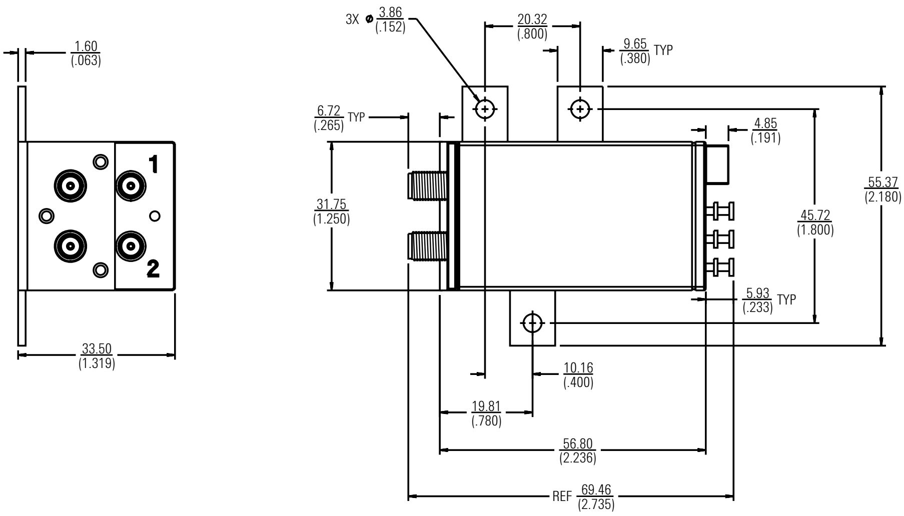
Agilent 87222C standard



Agilent 87222C Option 100



Agilent 87222C Option 100 and 201



Dimensions are in millimeters and (inches) nominal unless otherwise specified. For further information see publication 5968-2216E.

Applications

Figures 8 and 9 show the Agilent 87406B and 87606B configured for blocking 2 x 4 and 3 x 3 applications. With outstanding repeatability and life greater than 5 million cycles, these switches enhance measurement confidence and reduce cost of ownership. In addition, the matrix switch has the versatility to provide single pole multiple throw signal routing up to 1 x 5 (SP5T).

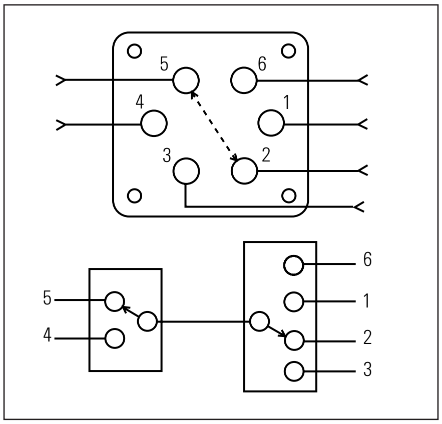


Figure 8. Matrix switch configured for a 2 x 4 blocking application (RF Path 5 to 2 shown)

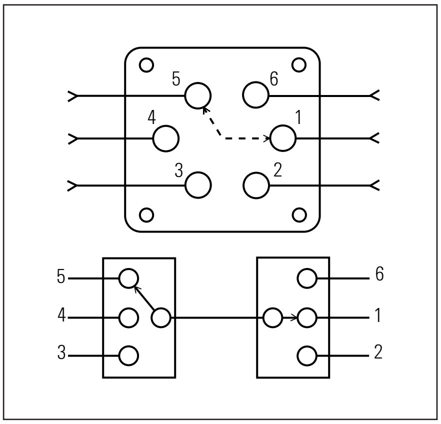


Figure 9. Matrix switch configured for a 3 x 3 blocking application (RF Path 5 to 1 shown)

Driving the switch

DC power connection

- Connect pin 1 to supply (+20 V DC to +32 V DC)
- Connect pin 15 to chassis ground to enable the electronic position-indicating circuitry and drive logic circuitry.
  WARNING: DAMAGE TO SWITCH WILL OCCUR IF PIN 15 IS NOT GROUNDED

RF path selection

To connect any two RF ports, apply control signals to the corresponding drive pins as shown below:

Table 1. Agilent 87406B RF port drive pin control data

RF port	6	5	4	3	2
1	3, 13	3, 11	3, 9	3, 7	3, 5
2	5, 13	5, 11	5, 9	5, 7	
3	7, 13	7, 11	7, 9		
4	9, 13	9, 11			
5	11, 13				

Using this table, **select** (close) the desired RF path by connecting ground (standard and Option 100) or applying TTL "High" (Option T24 or Option T00) to the corresponding "drive" pins.

Unselect (open) RF paths by disconnecting ground (standard and Option 100) or applying TTL "Low" (Option T24 or Option T00) to the corresponding "drive" pins.

Example: Configure the RF path from port 2 to port 5
Using the data in Table 1, select pins 5 and 11 while ensuring no other pins are selected:

RF port	1	2	3	4	5	6	Open All*
Drive pin	3	5	7	9	11	13	16
Standard, Option 100	U	G	U	U	G	U	X**
Options T24, T00	L	H	L	L	H	L	X**

U = Ungrounded, G = Grounded, L = TTL "Low", H = TTL "High", X = Don't care

** "Open All Ports" is not available with Option 100 and Option T00.*
*** "Open all RF Ports" feature is overridden by port selection.*

Selected ports will be closed and unselected ports will be automatically opened by the internal logic circuits when new port selections are made. After the RF port is switched and magnetically latched, the solenoid current is interrupted by the solid-state position sensing circuitry. The drive voltage must be maintained to avoid RF path disconnection by the internal logic. For this reason, pulsed drive is NOT recommended.

Open all RF ports

Unselecting all RF ports and selecting Pin 16 on standard and Option T24 opens all RF ports:

Drive pin	3	5	7	9	11	13	16
Standard	U	U	U	U	U	U	G
Option T24	L	L	L	L	L	L	H

U = Ungrounded, G = Ground, L = TTL "Low", H = TTL "High"

Selecting an RF port will override the "open all RF ports" for each selected port. If desired, pin 16 can be wired directly to ground (Option 024) or TTL "High" (Option T24) to open all RF ports at power-up.

Break-before-make

Remove the control inputs from the undesired port, then select the desired port. The internal logic will unselect the old port automatically upon application of the new port selection.

Make-before-break

Select the new RF port while maintaining the control input on the original ports. Allows 15 ms for the switching action to be completed, then unselect the original port; the original port will be automatically disconnected by the internal logic.

RF path selection

Close an RF port

To connect any two RF ports, apply control signals to the corresponding drive pins as shown below:

Table 2. Agilent 87606B "Close" RF port control data

RF port	6	5	4	3	2
1	3, 13	3, 11	3, 9	3, 7	3, 5
2	5, 13	5, 11	5, 9	5, 7	
3	7, 13	7, 11	7, 9		
4	9, 13	9, 11			
5	11, 13				

Using Table 2, **select** (close) the desired RF path by connecting ground to the corresponding "drive" pins.

Open an RF port

To open RF ports, apply control signal to the corresponding drive pins as shown below:

Table 3. Agilent 87606B "Open" RF port control data

RF port	1	2	3	4	5	6
Drive pin	3	5	7	9	11	13

Using Table 3, **unselect** (open) the desired RF path by connecting ground to the corresponding "drive" pins.

Example: Configure the RF path from port 2 to port 5:

Using the data in Tables 1 and 2, close ports 2 and 5 while opening all other ports (1, 3, 4, 6); ground pins 5, 11, 4, 8, 10, 14; all other drive pins must be removed from ground. Another method is to first apply ground to pin 16, with all other drive pins (3 – 14) ungrounded, for 15 milliseconds. This will open all paths. Next, apply ground to pins 5 and 11, to close ports 2 and 5.

RF port	1		2		3		4		5		6	
Drive pin	3	4	5	6	7	8	9	10	11	12	13	4
Standard, Option 100	U	G	G	U	U	G	U	G	G	U	U	G

U = Ungrounded, G =Grounded

Removing all drive pins (3 – 14) from ground, and grounding pin 16 will open all RF paths. Simultaneously grounding any "RF port close" pin and pin 16 will cause rapid cycling and premature failure of the switch.

Break-before-make

Open the undesired RF path. After 15 ms (minimum), close the new RF port(s).

Make-before-break

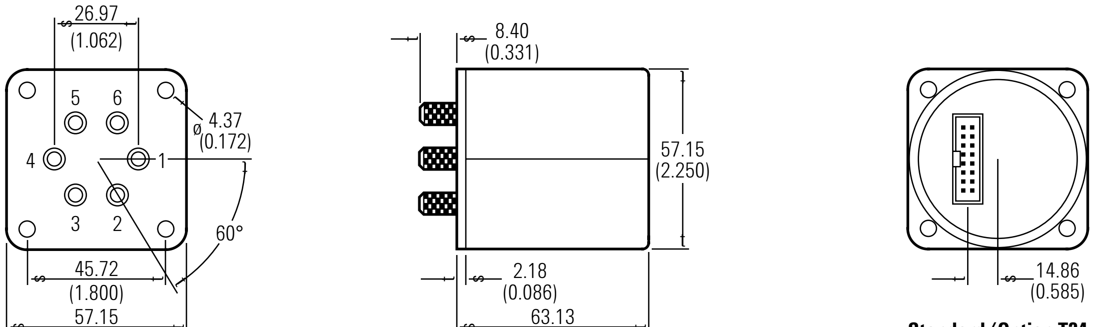
Close the new RF port(s). After 15 ms (minimum), open the undesired RF port(s).

Switch drive specifications

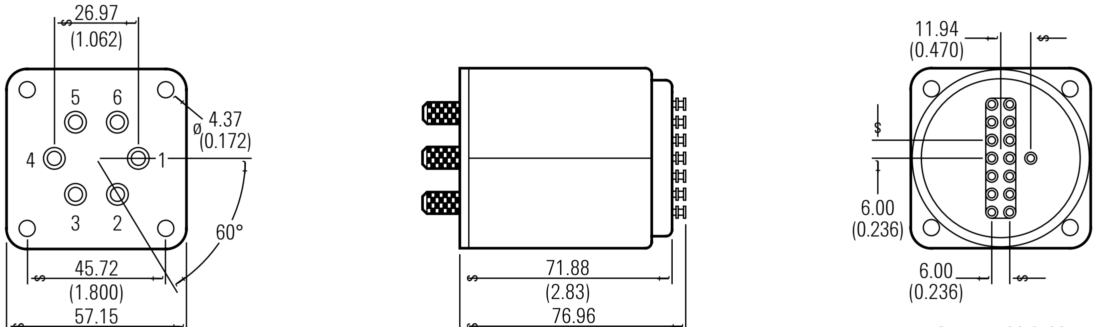
Parameter	Conditions	Min	Nom	Max	Units
Supply voltage, Vcc		20	24	32	V
Switching current	Vcc = 24 VDC		200 [1]		mA
Standby current (quiescent)		25		50	mA
Options T24/T00					
High level input		3		7	V
Low level input				0.8	V
Max high input current	Vcc = Max ; Vinput = 3.85 VDC		1	1.4	mA

[1] 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 times 200 mA each). See General Operation Section.

Product outline



Standard/Option T24 ribbon cable connector



Option 100/T00 solder terminals

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

15

Matrix

Agilent model	87406B	87606B
Features	3 x 3, 2 x 4 and 1 x 5 blocking matrix configurations Make-before-break or break-before-make operation Terminated Ports	
	Opto electronic indicators and interrupts [1]	Self interrupting drive circuit
Impedance	50 Ω	
Frequency range	DC to 20 GHz	
Insertion loss (dB)	0.34 dB + 0.033 x freq (GHz) maximum	
SWR	<1.21 from DC to 4 GHz <1.35 from 4 to 10 GHz <1.5 from 10 to 15 GHz <1.7 from 15 to 18 GHz <1.9 from 18 to 20 GHz	
Isolation (dB)	>100 dB to 12 GHz >80 dB from 12 to 15 GHz >70 dB from 15 to 20 GHz	
Input power		
Average	1 W	
Peak [2]	50 W (10 μs max)	
Switching time (max)	15 ms	
Repeatability (max) [3]	0.03 dB	
Life (min)	5 million cycles	
RF connectors	SMA (f)	

Agilent model number	Options
Agilent 87406B	**100:** Solder terminals to replace ribbon cable **T24:** TTL/5V CMOS compatibility (requires 24 VDC power supply)
Agilent 87606B	**100:** Solder terminals to replace ribbon cable

[1] Provides position sensing when used with Agilent 87130A/70611A switch driver or customer supplied external circuitry.
[2] Not to exceed 1 W average.
[3] Measured at 25° C.

Terminations (Loads)

16

Agilent 909 series fixed loads

The Agilent 909 series are fixed low-reflection loads for terminating a 50 Ω (75 Ω for Agilent 909E) coaxial system in its characteristic impedance. Whereas the Agilent 909A is designed for general purpose applications, the Agilent 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.

Agilent 909A

Agilent 909C

Agilent 909D

Agilent 909E

Agilent 909F

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				
	DC to 18 GHz	909A 909F	909A Option 012 909F Option 012	909A Option 013 909F Option 013				
	DC to 26.5 GHz				909D 909D Option 040	909D Option 011		
	DC to 50 GHz						85138A	85138B
75 Ω	DC to 3 GHz		909E	909E Option 011				

Specifications

Agilent 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	51 (2)	23 (0.9)	0.2 (0.5)
909A Option 012	50 Ω		DC to 4 GHz: 1.06 4 to 12.4 GHz: 1.11 12.4 to 18 GHz: 1.30		N (m)	51 (2)	21 (0.8)	
909A Option 013	50 Ω				N (f)	51 (2)	16 (0.63)	
909C	50 Ω	DC to 2	1.005	1/2 W avg. 100 W peak	APC-7	51 (2)	22 (0.9)	
909C Option 012	50 Ω		1.01		N (m)	51 (2)	21 (0.8)	
909C Option 013	50 Ω		1.01		N (f)	51 (2)	17 (0.7)	
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)	
909D Option 011	50 Ω				3.5 mm (f)	23 (0.9)	8 (0.3)	
909D Option 040	50 Ω		DC to 4 GHz: 1.02 4 to 6 GHz: 1.036 6 to 26.5 GHz: 1.12		3.5 mm (m)	23 (0.9)	8 (0.3)	
909E	75 Ω	DC to 3	DC to 2 GHz: 1.01	1/2 W avg. 100 W peak	N (m)	51 (2)	21 (0.8)	
909E Option 011	75 Ω		2 to 3 GHz: 1.02		N (f)	51 (2)	16 (0.6)	
909F	50 Ω	DC to 18	DC to 5 GHz: 1.005 5 to 6 GHz: 1.01 6 to 18 GHz: 1.15		APC-7	51 (2)	22 (0.9)	
909F Option 012	50 Ω		DC to 2 GHz: 1.007 2 to 3 GHz: 1.01 3 to 6 GHz: 1.02 6 to 18 GHz: 1.15		N (m)	51 (2)	21 (0.8)	
909F Option 013	50 Ω				N (f)	51 (2)	17 (0.7)	
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		2.4 mm (m)	—	—	—
85138B					2.4 mm (f)	—	—	—

16

Impedance Test Accessories

17

Overview

Impedance Test Accessories are designed to make measurements of passive components simple and reliable when using the Agilent RF LCR meters or impedance analyzers. Agilent Technologies 16191A, 16192A, 16194A, 16196A/B/C and 16197A series of test fixtures allow impedance measurements of SMD passive components up to 3 GHz.

Agilent 16191A bottom electrode SMD test fixture

This test fixture is designed for impedance evaluations of bottom electrode SMD components. The minimum SMD size that this fixture is adapted to evaluate is 2 (L) [mm].

Agilent 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].

Agilent 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° (recommended to be used with Agilent 4291B's high temperature test head).

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

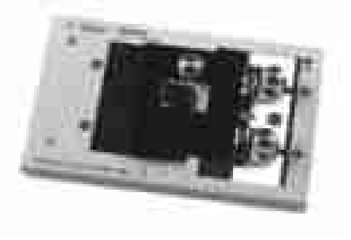
This test fixture is designed for impedance evaluations of parallel electrode SMD components. It accommodates small SMD sizes : 0603(inch)/1608(mm), 0402(inch)/1005(mm) or 0201(inch)/0603(mm). In addition, it provides highly repeatable measurements and achieves stable frequency characteristics at 3 GHz.

Agilent 16197A bottom electrode SMD test fixture

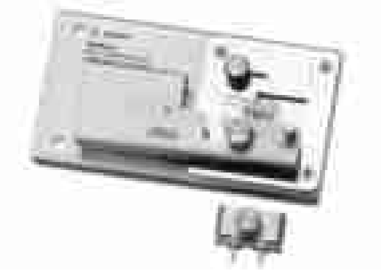
This test fixture is designed for impedance evaluations of bottom electrode SMD components up to 3 GHz. This test fixture accommodates various sizes of SMDs; as small as 1005(mm)/0402(inch) and as large as 3225(mm)/1210(inch). Accommodation of the 0603(mm)/0201(inch) SMD is available with Option 001.

Agilent 16191A

Agilent 16192A



Agilent 16194A



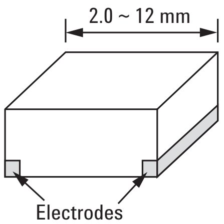
Agilent 16196A/B/C

Agilent 16197A

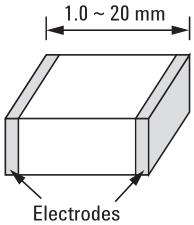
Specifications

Agilent model	Frequency range	Terminal connector	Maximum voltage peak max (AC + DC)	Operating temperature	Electrode configuration	Device under test size
16191A	DC to 2 GHz	7 mm	±40 V	–55 to +85°C	Bottom	2.0 to 12 mm (length)
16192A	DC to 2 GHz	7 mm	±40 V	–55 to +85°C	Parallel	1.0 to 20 mm (length)
16194A	DC to 2 GHz	7 mm	±40 V	–55 to +200°C	Bottom	See figure below
16196A	DC to 3 GHz	7 mm	±40 V	–55 to +85°C	Parallel	0603 (inch)/1608 (mm)
16196B	DC to 3 GHz	7 mm	±40 V	–55 to +85°C	Parallel	0402 (inch)/1005 (mm)
16196C	DC to 3 GHz	7 mm	±40 V	–55 to +85°C	Parallel	0201 (inch)/0603 (mm)
16197A	DC to 3 GHz	7 mm	±40 V	–55 to +85°C	Bottom	0.6 to 3.2 mm (length)

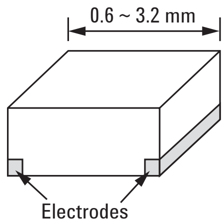
Agilent 16191A



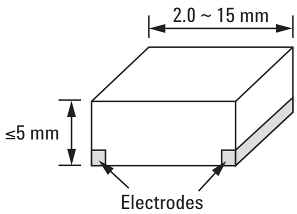
Agilent 16192A

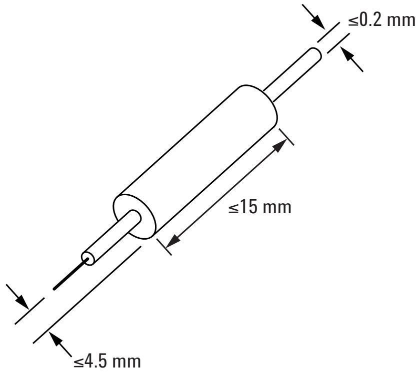


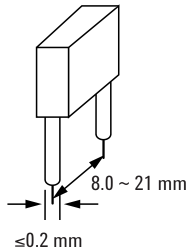
Agilent 16197A



Agilent 16194A



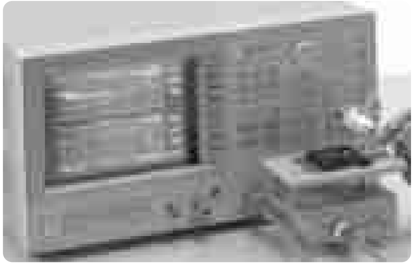




Agilent 4287A
RF LCR meter 1 MHz to 3 GHz

Agilent E4991A
RF impedance/material analyzer
1 MHz to 3 GHz

Agilent 4396B
network/spectrum/impedance analyzer
100 kHz to 1.8 GHz/2 Hz to 1.8 GHz/100 kHz to 1.8 GHz



17

18

Agilent 11974 series

Agilent 11970

Agilent 11974 series preselected millimeter mixers

Eliminate the need for signal identification at millimeter frequencies. The Agilent 11974 series mixers are preselected from 26.5 to 75 GHz for faster, easier testing of millimeter devices and systems. Preselection reduces mixer overload from broadband signals and reduces radiation of local oscillator harmonics back to the device under test. Equipment operators can quickly locate true signals. Also, software development for automated measurements is greatly simplified.

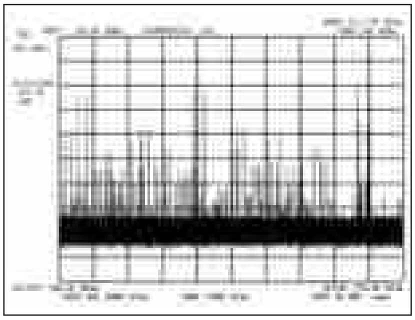
These mixers feature advanced barium-ferrite technology and come with a stand alone power supply. They are particularly useful for broadband millimeter signal analysis, millimeter electromagnetic-interference (EMI) measurements, and unattended monitoring of millimeter signals.

Compatibility

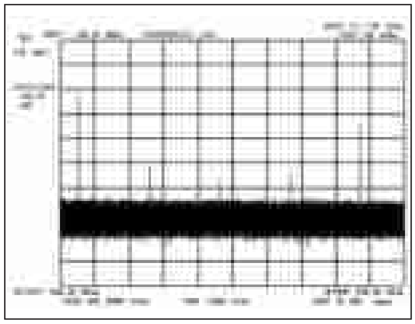
Agilent E4440A/46A/48A PSA series, E4407B ESA, 856xEC/E series spectrum analyzers, and Agilent 70907B external mixer interface modules are fully compatible with the Agilent 11974 series.

Agilent 11970 series harmonic mixers

These waveguide mixers are general purpose harmonic mixers. They employ a dual-diode design to achieve flat frequency response and low conversion loss. This is achieved without external DC bias or tuning stubs. Manual operation and computer controlled hardware operation are simplified because mixer bias and tuning adjustment are not required.



50 to 75 GHz sweep without preselection



50 to 75 GHz sweep using Agilent 11974 series mixer

Specifications

Agilent model [1]	Frequency range (GHz)	Sensitivity (displayed avg. noise level/10 Hz) (dBm)	Calibration accuracy (dB)	Image rejection (dBc)	1 dB Gain [2] compression (dBm)
11974A	26.5 to 40	–111 (–118, typ.)	<±2.3	–54	+6
11974Q	33 to 50	–106 (–116, typ.)	<±2.3	–50	0
11974U	40 to 60	–109 (–117, typ.)	<±2.6	–50	0
11974V	50 to 75	–100 (–109, typ.)	<±4.5	–50 (to 67 GHz) –40 (67 to 75 GHz)	+3

[1] *Specifications apply when connected to the Agilent PSA, 8566B or 70000 series spectrum analyzers.*
[2] *Typical characteristic.*

Specifications

Agilent model	Frequency range (GHz)	LO harmonic number	Maximum conversion loss (dB)	Noise level (dB) 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.

Features

- Preselected mixers to eliminate signal identification
- State-of-the-art technology
- Easier automated measurements
- Low conversion loss
- Individually amplitude calibrated
- No bias or tuning adjustments
- High 100 mW safe input level

Compatibility

The Agilent 11970 series mixers extend the frequency range of the Agilent E4440A/46A/48A PSA series high-performance spectrum analyzers, E4407B ESA and 856xEC/E portable spectrum analyzers up to 110 GHz. The Agilent 11970 series mixers are also compatible with the Agilent 8566B spectrum analyzer (used with the Agilent 11975A amplifier); and the Agilent 70000 modular measurement system (used with the Agilent 70907A, B external mixer interface module, or the Agilent 70909A and 70910A RF sections).

Agilent 11970 and 11974 series specifications

IF range: DC to 1.3 GHz
LO amplitude range: +14 to +16 dB; +16 optimum
Calibration accuracy: ±2.0 dB for Agilent 11970 series with optimum LO amplitude
Typical RF input SWR: <2.2:1, <3.0:1 for Agilent 11974 series
Bias requirements: none
Typical odd-order harmonic suppression: >20 dB (does not apply to Agilent 11974 series)
Maximum CW RF input level: +20 dBm (100 mW), +25 dBm for Agilent 11974 series
Maximum peak pulse power: 24 dBm (250 mW) with <1 µs pulse (avg. power = +20 dBm)
Bandwidth: 100 MHz minimum (Agilent 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

Ordering information

Agilent 11974A: 26.5 to 40 GHz preselected mixer
Agilent 11974Q: 33 to 50 GHz preselected mixer
Agilent 11974U: 40 to 60 GHz preselected mixer
Agilent 11974V: 50 to 75 GHz preselected mixer
  Option 003: Delete power supply (Agilent 11974 series only)
Agilent 11970K: 18 to 26.5 GHz mixer
Agilent 11970A: 26.5 to 40 GHz mixer
Agilent 11970Q: 33 to 50 GHz mixer
Agilent 11970U: 40 to 60 GHz mixers
Agilent 11970V: 50 to 75 GHz mixers
Agilent 11970W: 75 to 110 GHz mixers
Agilent 11970
  Option 009: Mixer connection set adds three-1 meter low-loss SMA cables, wrench, allen driver for any Agilent 11970 series mixer. Carrying case with storage space for cables and tools included.
Agilent 11975A: 2 to 8 GHz amplifier
Agilent 281A, B: Coaxial to waveguide adapters
R281A: 26.5 to 40 GHz, 2.4 mm (f)
R281B: 26.5 to 40 GHz, 2.4 mm (m)
Q281A: 33 to 50 GHz, 2.4 mm (f)
Q281B: 33 to 50 GHz, 2.4 mm (m)
U281A: 40 to 60 GHz, 1.85 mm (f)
U281B: 40 to 60 GHz, 1.85 mm (m)
V281A: 50 to 64 GHz, 1.85 mm (f)
V281B: 50 to 64 GHz, 1.85 mm (m)

Network Analyzer Accessories and Cal Kits

19

Overview

Accessories for the Agilent ENA, ENA-L, PNA, and PNA-L 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. Agilent 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 ohm), 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. Agilent 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 Agilent ENA, ENA-L, PNA, and PNA-L series network analyzers via its USB port, and are controlled via the 85079B VNA interface kit when used with the Agilent 8753 network analyzers.

Mechanical calibration kits

All network analyzer coaxial mechanical calibration kits contain precision standard devices to characterize the systematic errors of the Agilent ENA, ENA-L, PNA, and PNA-L 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. Agilent offers verification kits that include precision airlines, mismatch airlines, and precision-fixed attenuators. Traceable measurement data is shipped with each kit on disk. Verification kits may be recertified by Agilent Technologies. This recertification includes a new measurement of all standards and new data with uncertainties.

Scalar network analyzer accessories

The basic components of any scalar system include a scalar analyzer, a swept source, a directional bridge or coupler, and detectors. Agilent scalar accessories, when used with the 8757D network analyzer, provide measurement coverage from 10 MHz to 50 GHz.

Coaxial mechanical calibration kits

Connector	Frequency range (GHz)	Type	VNA calibration accuracy	Agilent model	Available options	Page
Type-F (75 ohm)	DC to 3	Economy	5% – 1%	85039B	1A7, A6J, UK6, 00M, 00F, M0F	147
Type-N (75 ohm)	DC to 3	Economy	5% – 1%	85036E	UK6	148
Type-N (75 ohm)	DC to 3	Standard	5% – 1%	85036B	1A7, A6J, UK6	148
Type-N (50 ohm)	DC to 6	Economy	5% – 1%	85032E	1A7, A6J, UK6	149, 150
Type-N (50 ohm)	DC to 9	Standard	5% – 1%	85032F	1A7, A6J, UK6, 100, 200, 300, 500*	151
Type-N (50 ohm)	DC to 18	Economy	5% – 1%	85054D	1A7, A6J, UK6	153
Type-N (50 ohm)	DC to 18	Standard	2% – 0.3%	85054B	UK6	152
7-16	DC to 7.5	Standard	2%	85038A	N/A	154
7-16 (female)	DC to 7.5	Standard	2%	85038F	N/A	154
7-16 (male)	DC to 7.5	Standard	2%	85038M	N/A	154
7 mm	DC to 6	Economy	2% – 0.3%	85031B	1A7, A6J, UK6	155
7 mm	DC to 18	Economy	5% – 1%	85050D	N/A	155
7 mm	DC to 18	Standard	2% – 0.05%	85050B	N/A	156
7 mm	DC to 18	Precision	0.3% – 0.05%	85050C	UK6	157
3.5 mm	DC to 9	Standard	5% – 1%	85033E	1A7, A6J, UK6, 100, 200, 300, 400, 500	158
3.5 mm	DC to 26.5	Economy	5% – 1%	85052D	1A7, A6J, UK6	159
3.5 mm	DC to 26.5	Standard	3% – 0.5%	85052B	1A7, A6J, UK6	160
3.5 mm	DC to 26.5	Precision	2% – 0.5%	85052C	1A7, A6J, UK6	161
2.92 mm	DC to 50	Economy	11% – 4% (Option 001 65% – 3%)	85056K	UK6, 001	162, 163
2.4 mm	DC to 50	Economy	5% – 1%	85056D	UK6	164
2.4 mm	DC to 50	Standard	4% – 0.5%	85056A	A6J, UK6	165
1.85 mm	DC to 67	Economy		85058E	1A7, A6J, UK6	166
1.85 mm	DC to 67	Standard		85058B	1A7, A6J, UK6	167, 168
1 mm	DC to 110	Precision	5% – 1%	85059A	1A7, A6J, UK6	169, 170

Waveguide mechanical calibration kits

Connector	Frequency range (GHz)	Type	VNA calibration accuracy	Agilent model	Available options	Page
WR-90	8.2 to 12.4	Precision	0.3% – 0.05%	X11644A	1A7, A6J, UK6	171
WR-62	12.4 to 18	Precision	0.3% – 0.05%	P11644A	1A7, A6J, UK6	172
WR-42	18 to 26.5	Precision	0.3% – 0.05%	K11644A	1A7, A6J, UK6	173
WR-28	26.5 to 40	Precision	0.3% – 0.05%	R11644A	1A7, A6J, UK6	174
WR-22	33 to 50	Precision	0.3% – 0.05%	Q11644A	1A7, A6J, UK6	175
WR-19	40 to 60	Precision	0.3% – 0.05%	U11644A	1A7, A6J, UK6	176
WR-15	50 to 75	Precision	0.3% – 0.05%	V11644A	1A7, A6J, UK6	177
WR-10	75 to 110	Precision	0.3% – 0.05%	W11644A	1A7, A6J, UK6	178

Option descriptions

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

Coaxial electronic calibration kits (ECal)

Connector	Frequency range (GHz)	Type	VNA calibration accuracy	Agilent model	Available options	Page
Type-F (75 ohm)	300 kHz to 3 GHz	2-port	N/A	85099C	UK6, 00F, 00M, M0F, 00A	181
Type-N (75 ohm)	300 kHz to 3 GHz	2-port	N/A	85096C	UK6, 00F, 00M, M0F, 00A	182
Type-N (50 ohm)	300 kHz to 9 GHz	2-port	1% – 0.1%	85092C	1A7, A6J, UK6, 00F, 00M, M0F, 00A	182
Type-N (50 ohm)	300 kHz to 13.5 GHz	4-port		N4431B Option 020	1A7, A6J, UK6	184
Type-N (50 ohm)	300 kHz to 18 GHz	2-port		N4690B	1A7, A6J, UK6, 00F, 00M, M0F, 00A	182
Type-N (50 ohm)	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]	183
7 mm	300 kHz to 9 GHz	2-port	1% – 0.1%	85091C	1A7, A6J, UK6	183
7 mm	300 kHz to 18 GHz	2-port		N4696B	1A7, A6J, UK6	183
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]	182
3.5 mm	300 kHz to 13.5 GHz	4-port		N4431B Option 010	1A7, A6J, UK6	184
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]	182
2.92 mm	10 MHz to 40 GHz	2-port		N4692A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [3]	183
2.4 mm	10 MHz to 50 GHz	2-port		N4693A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [4]	183
1.85 mm	10 MHz to 67 GHz	2-port		N4694A	1A7, A6J, UK6, 00F, 00M, M0F, 00A [5]	184
VNA interface kit	N/A	N/A	N/A	85097B	N/A	180

Mechanical verification kits

Connector	Frequency range (GHz)	Type	VNA calibration accuracy	Agilent model	Available options	Page
Type-N (50 ohm)	300 kHz to 18 GHz	Precision	N/A	85055A	1A7, A6J, UK6	186
7 mm	300 kHz to 6 GHz	Precision	N/A	85029B	1A7, A6J, UK6, 001	186
7 mm	300 kHz to 18 GHz	Precision	N/A	85051B	1A7, A6J, UK6	187
3.5 mm	300 kHz to 26.5 GHz	Precision	N/A	85053B	1A7, A6J, UK6	187
2.4 mm	0.045 to 50 GHz	Precision	N/A	85057B	1A7, A6J, UK6	188
1.85 mm	0.010 to 67	Precision	N/A	85058V	1A7, A6J, UK6	188
WR-28	26.5 to 40	Precision	N/A	R11645A	1A7, A6J, UK6	189
WR-22	33 to 50	Precision	N/A	Q11645A	1A7, A6J, UK6	189
WR-19	40 to 60	Precision	N/A	U11645A	1A7, A6J, UK6	190
WR-15	50 to 75	Precision	N/A	V11645A	1A7, A6J, UK6	190
WR-10	75 to 110	Precision	N/A	W11645A	1A7, A6J, UK6	191

Option descriptions

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 Agilent 8702 lightwave component analyzer
010 Four 3.5 mm (f) connectors
020 Four Type-N, 50 ohm (f) connectors
030 Four 7 mm connectors

Agilent 85039B calibration kit, Type-F

The Agilent 85039B 75 Ω Type-F calibration kit is used to calibrate Agilent 8753, and Agilent ENA-L series network analyzers for measurements of components with 75 Ω Type-F connectors up to 3 GHz.

Electrical specifications

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

Adapters

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

Replaceable parts

Part Number	Description	85039B	Option 00M	Option 00F
85039-60007	75 ohm Type-F male load	X	X	
85039-60008	75 ohm Type-F male short	X	X	
85039-60009	75 ohm Type-F male open	X	X	
85039-60004	75 ohm Type-F female load	X		X
85039-60003	75 ohm Type-F female short	X		X
85039-60005	75 ohm Type-F female open	X		X
85039-60006	75 ohm Type-F male to male adapter	X	X	
85039-60002	75 ohm Type-F female to female adapter	X		X
85039-60013	75 ohm Type-F female to Type-N male adapter	X		
85039-60011	75 ohm Type-F male to Type-N female adapter	X		

Additional adapters available from Agilent but not included in the cal kit.	
85039-60010	75 ohm Type-F male to Type-N male
85039-60012	75 ohm Type-F male to Type-F female
85039-60014	75 ohm Type-F female to Type-N female

[1] *The specifications for the open and short are given as allowed deviation from the nominal model as defined in the standard definitions. See Table A-3 of the Service Guide for details.*

Accessories

Agilent 86211A 75 ohm 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 ohm Type-N test ports.

Adapter kit

86211A	75 ohm 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)

Agilent 85036E economy calibration kit, Type-N, 75 ohm

The Agilent 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.

Electrical specifications

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

Agilent 85036B calibration kit, Type-N, 75 ohm

The Agilent 85036B calibration kit contains precision Type-N standards used to calibrate Agilent network analyzers for measurement of devices with 75 ohm 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.

Replaceable parts for the Agilent 85036E

Item no.	Description	Qty per kit	Agilent replacement part number
	Calibration devices		
1	75 Ω Type-N male broadband load	1	00909-60019
2	75 Ω Type-N male combined open/short	1	85036-60016

Replaceable parts for the Agilent 85036B

Item no.	Description	Qty per kit	Agilent replacement part number
	Calibration devices		
1	75 Ω Type-N male broadband load	1	00909-60019
2	75 Ω Type-N female broadband load	1	00909-60020
3	75 Ω Type-N male short	1	85036-60012
4	75 Ω Type-N female short	1	85036-60011
5	75 Ω Type-N male open	1	85032-60007
6	75 Ω Type-N female open body	1	85032-20001
7	75 Ω Type-N female open center conductor extender	1	85036-60019
Item no.	**Description**	**Qty per kit**	**Agilent replacement part number**
	Adapters		
8	Type-N male to male	1	85036-60013
9	Type-N female to female	1	85036-60014
10	Type-N male to female	1	85036-60015

Agilent 85032E economy calibration kit, Type-N, 50 ohm

The Agilent 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.

Accessory kits

Agilent 11853A
Type-N accessory kit, 50 ohm

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

Agilent 11854A
BNC accessory kit, 50 ohm

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

Agilent 86211A
Type-F accessory kit, 75 ohm

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

Electrical specifications

The electrical specifications below apply to the devices in the Agilent 85032E 50 ohm, Type-N calibration kit.

Electrical specifications for 50 Ω Type-N devices

Device	Frequency (GHz)	Parameter	Specifications
Load	DC to ≤2	Return loss	≥49 dB (≤0.00355 ρ)
	>2 to ≤3	Return loss	≥46 dB (≤0.00501 ρ)
	>3 to ≤6	Return loss	≥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

Replacement parts for Agilent 85032E

Item no.	Description	Qty per kit	Agilent replacement part number
	Calibration devices		
1	50 Ω Type-N male broadband load	1	00909-60009
2	50 Ω Type-N combination male open/short	1	85032-60011

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

Agilent 85032F calibration kit, Type-N, 50 ohm

The Agilent 85032F calibration kit contains precision 50 ohm Type-N standards used to calibrate Agilent ENA, ENA-L, and PNA-L series for measurements of devices with 50 ohm 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 ohm Type-N adapters for accurate measurements of non-insertable devices is added with Option 500.

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)

Replacement parts for Agilent 85032F

Item no.	Description	Qty per kit	Agilent replacement part number
	Calibration devices		
1	50 Ω Type-N male broadband load	1	85032-60017
2	50 Ω Type-N female broadband load	1	85032-60018
3	50 Ω Type-N male open	1	85032-60013
4	50 Ω Type-N female open	1	85032-60014
5	50 Ω Type-N male short	1	85032-60016
6	50 Ω Type-N female short	1	85032-60015
Item no.	**Description**	**Qty per kit**	**Agilent replacement part number**
	Adapters		
7	50 Ω Type-N (f) to Type-N (f) adapter (Option 100)	1	85032-60021
8	50 Ω Type-N (m) to Type-N (m) adapter (Option 200)	1	85032-60019
9	50 Ω Type-N (m) to Type-N (f) adapter (Option 300)	1	85032-60020
10	50 Ω Type-N (f) to 7 mm adapter (Option 500)	2	85054-60001
11	50 Ω Type-N (m) to 7 mm adapter (Option 500)	2	85054-60009

Agilent 85054B calibration kit, Type-N, 50 ohm

The Agilent 85054B calibration kit contains precision standard devices to characterize the systematic errors of the Agilent PNA, and PNA-L 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.

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°

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Type-N (m) sliding load	1	85054-60035
Type-N (f) sliding load	1	85054-60036
Type-N (m) lowband load	1	00909-60011
Type-N (f) lowband load	1	00909-60012
Type-N (m) offset short	1	85054-60025
Type-N (f) offset short	1	85054-60026
Type-N (m) offset open	1	85054-60027
Type-N (f) offset open	1	85054-60028
Type-N (m) to Type-N (m)	1	85054-60038
Type-N (f) to Type-N (f)	1	85054-60037
Type-N (f) to 7 mm	2	85054-60031
Type-N (m) to 7 mm	2	85054-60032
3/4 in., 135 N-cm (12 in-lb) torque wrench	1	8710-1766
Spanner	1	08513-20014
Screw-on N gage	1	85054-80011
Type-N gage set (includes items listed below) Type-N gage (f) Type-N gage master (f) Type-N gage (m) Type-N gage master (m) Centering beads	 1 1 1 1 2	85054-60049 85054-60050 85054-60052 85054-60051 85054-60053 85054-80028

Agilent 85054D economy calibration kit, Type-N, 50 ohm

The Agilent 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.

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°

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Type-N broadband load (m)	1	85054-60046
Type-N broadband load (f)	1	85054-60047
Type-N offset short (m)	1	85054-60025
Type-N offset short (f)	1	85054-60026
Type-N offset open (m)	1	85054-60027
Type-N offset open (f)	1	85054-60028
Type-N (m) to Type-N (m)	1	85054-60038
Type-N (f) to Type-N (f)	1	85054-60037
Type-N (f) to 7 mm	2	85054-60031
Type-N (m) to 7 mm	2	85054-60032
3/4 in., 135 N-cm (12 in-lb) torque wrench	1	8710-1766
Spanner	1	08513-20014

Agilent 85038A 7-16 calibration kit

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

The Agilent 85038M and Agilent 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 ohms
Short circuits Reflection coefficient	 0.99 minimum
Open circuits Reflection coefficient Reflection phase	 0.99 minimum ±1 degree
Fixed termination VSWR	 1.02 maximum

Parts list

Agilent 85038A 7-16 calibration kit

Part number	Description	85038A	85038M	85038F
85038-80002	Open female	X		X
85038-80003	Open male	X	X	
85038-80004	Short female	X		X
85038-80005	Short male	X	X	
85038-80006	Load female	X		X
85038-80007	Load male	X	X	
11906-80015	Male to male adapter		X	
11906-80016	Female to female adapter			X

Agilent also offers the following adapter kits:

Agilent 11906A 7-16 to 7-16

Part number	Qty	Description
11906-80015	1	7-16 male to 7-16 male
11906-80016	1	7-16 female to 7-16 female
11906-80017	2	7-16 female to 7-16 male

Agilent 11906B 7-16 to Type-N 50 ohm

Part number	Qty	Description
11906-80007	1	Type-N male to 7-16 male
11906-80008	1	Type-N female to 7-16 female
11906-80009	1	Type-N female to 7-16 male
11906-80010	1	Type-N male to 7-16 female

Agilent 11906C 7-16 to 7 mm

Part number	Qty	Description
11906-80012	2	7 mm to 7-16 male
11906-80013	2	7 mm to 7-16 female

Agilent 11906D 7-16 to 3.5 mm

Part number	Qty	Description
11906-80002	1	3.5 mm male to 7-16 male
11906-80003	1	3.5 mm female to 7-16 female
11906-80004	1	3.5 mm female to 7-16 male
11906-80005	1	3.5 mm male to 7-16 female

Agilent 85031B calibration kit, 7 mm

Electrical specifications

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

Replaceable parts

Part number	Qty	Description
85031-60001	1	7 mm 50 ohm combination open/short
00909-60008	2	7 mm 50 ohm terminations

The Agilent 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-L series for measurement of devices with precision 7 mm connectors. This kit is specified from DC to 6 GHz.

Agilent 85050D, 7 mm economy calibration kit

Electrical specifications

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
7 mm broadband load	1	85050-60006
7 mm short	1	85050-80007
7 mm open	1	85050-80010

The Agilent 85050D economy calibration kit contains precision standard devices to characterize the systematic errors of the Agilent PNA, and PNA-L series network analyzers in the 7 mm interface. This kit also contains adapters to change the sex of the test port and a torque wrench for proper connection. Connector gages may be ordered separately.

Agilent 85050B calibration kit, 7 mm

The Agilent 85050B calibration kit contains precision standard devices to characterize the systematic errors of the Agilent PNA, and PNA-L series network analyzers in the 7 mm interface. This kit also contains adapters to change the sex of the test port, connector gages for verifying and maintaining the connector interface, and a torque wrench for proper connection.

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
7 mm lowband load	1	00909-60008
7 mm sliding load	1	85050-60014
7 mm broadband load	1	85050-60006
7 mm short	1	85050-80007
7 mm open	1	85050-80010
7 mm center conductor collets	4	85050-20001
7 mm connector collet extractor tool	1	5060-0370
3/4 in., 135 N-cm (12 in-lb) torque wrench	1	8710-1766

Agilent 85050C, 7 mm precision calibration kit

The Agilent 85050C precision calibration kit contains precision standard devices to characterize the systematic errors of the Agilent PNA, and PNA-L series network analyzers in the 7 mm interface. This kit also contains adapters to change the sex of the test port, connector gages for verifying and maintaining the connector interface, and a torque wrench for proper connection.

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
7 mm broadband load	1	85050-60006
7 mm lowband load	1	00909-60008
7 mm short (collet style)	1	85050-80009
7 mm short (threaded center conductor style)	1	85050-80008
TRL adapter	1	85050-60005
7 mm open	1	85050-80010
7 mm precision airline	1	85050-60003
3/4 in., 135 N-cm (12 in-lb) torque wrench	1	8710-1766
7 mm connector collet extractor tool	1	5060-0370

Agilent 85033E calibration kit, 3.5 mm

The Agilent 85033E calibration kit contains precision 3.5 mm standards used to calibrate Agilent ENA, ENA-L, and PNA-L 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	Return loss	≥46 dB (≤0.005 ρ)
	>2 to ≤3	Return loss	≥44 dB (≤0.006 ρ)
	>3 to ≤9	Return loss	≥38 dB (≤0.013 ρ)
Opens	DC to ≤2	Deviation from nominal phase	±0.55°
	>2 to ≤3	Deviation from nominal phase	±0.65°
	>3 to ≤6	Deviation from nominal phase	±0.85°
	>6 to ≤9	Deviation from nominal phase	±1.00°
Shorts	DC to ≤2	Deviation from nominal phase	±0.48°
	>2 to ≤3	Deviation from nominal phase	±0.50°
	>3 to ≤6	Deviation from nominal phase	±0.55°
	>6 to ≤9	Deviation from nominal phase	±0.65°

Replaceable parts for Agilent 85033E

Item no.	Description	Qty per kit	Agilent replacement part number
1	3.5 mm male broadband load	1	85033-60016
2	3.5 mm female broadband load	1	85033-60017
3	3.5 mm male open	1	85033-60018
4	3.5 mm female open	1	85033-60019
5	3.5 mm male short	1	85033-60020
6	3.5 mm female short	1	85033-60021

Item no.	Description	Qty per kit	Agilent replacement part number
	Adapters		
7	3.5 mm (f) to (f) adapter (Option 100)	1	85027-60005
8	3.5 mm (m) to (m) adapter (Option 200)	1	85027-60007
9	3.5 mm (m) to (f) adapter (Option 300)	1	85027-60006
10	3.5 mm (f) to Type-N (f) adapter (Option 400)	1	1250-1745
11	3.5 mm (f) to Type-N (m) adapter (Option 400)	1	1250-1744
12	3.5 mm (m) to Type-N (f) adapter (Option 400)	1	1250-1750
13	3.5 mm (m) to Type-N (m) adapter (Option 400)	1	1250-1743
14	3.5 mm (f) to 7 mm adapter (Option 500)	1	1250-1747
15	3.5 mm (m) to 7 mm adapter (Option 500)	1	1250-1746

Agilent 85052D economy calibration kit, 3.5 mm

The Agilent 85052D economy calibration kit contains precision standard devices to characterize the systematic errors of the Agilent PNA, and PNA-L series network analyzers in the 3.5 mm interface. This kit also contains adapters to change the sex of the test port and a torque wrench for proper connection. Connector gages may be ordered separately.

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
3.5 mm broadband load (m)	1	00902-60003
3.5 mm broadband load (f)	1	00902-60004
3.5 mm offset short (m)	1	85052-60006
3.5 mm offset short (f)	1	85052-60007
3.5 mm offset open (m)	1	85052-60008
3.5 mm offset open (f)	1	85052-60009
3.5 mm (m) to 3.5 mm (m) adapter	1	85052-60014
3.5 mm (m) to 3.5 mm (f) adapter	1	85052-60013
3.5 mm (f) to 3.5 mm (f) adapter	1	85052-60012
5/16 in., 90 N-cm (8 in-lb) torque wrench	1	8710-1765
7 mm open-end wrench	1	8710-1761

Agilent 85052B calibration kit, 3.5 mm

The Agilent 85052B calibration kit contains precision standard devices to characterize the systematic errors of the Agilent PNA, and PNA-L series network analyzers in the 3.5 mm interface. This kit also contains adapters to change the sex of the test port, connector gages for verifying and maintaining the connector interface, and a torque wrench for proper connection.

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
3.5 mm sliding load (m)	1	00911-60019
3.5 mm sliding load (f)	1	00911-60020
3.5 mm broadband load (m)	1	00902-60003
3.5 mm broadband load (f)	1	00902-60004
3.5 mm offset short (m)	1	85052-60006
3.5 mm offset short (f)	1	85052-60007
3.5 mm offset open (m)	1	85052-60008
3.5 mm offset open (f)	1	85052-60009
3.5 mm (m) to 3.5 mm (m) adapter	1	85052-60014
3.5 mm (m) to 3.5 mm (f) adapter	1	85052-60013
3.5 mm (f) to 3.5 mm (f) adapter	1	85052-60012
5/16 in., 90 N-cm (8 in-lb) torque wrench	1	8710-1765
7 mm open-end wrench	1	8710-1761

Agilent 85052C calibration kit, 3.5 mm

The Agilent 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 Agilent PNA, and PNA-L 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.

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
3.5 mm broadband load (m)	1	00902-60003
3.5 mm broadband load (f)	1	00902-60004
3.5 mm offset short (m)	1	85052-60006
3.5 mm offset short (f)	1	85052-60007
3.5 mm offset open (m)	1	85052-60008
3.5 mm offset open (f)	1	85052-60009
3.5 mm (m) to 3.5 mm (m) adapter	1	85052-60033
3.5 mm (f) to 3.5 mm (f) adapter	1	85052-60032
3.5 mm (m) to 3.5 mm (f) adapter	1	85052-60034
Long precision airline, 2-7 GHz (includes insertion tool)	1	85052-60036
Short precision airline, 7-32 GHz (includes insertion tool)	1	85052-60035
Spanner	1	08513-20014
5/16 in., 90 N-cm (8 in-lb) torque wrench	1	8710-1765
Hex balldriver, 4mm	1	8710-1933
Adapter anti-rotation clamp	2	85052-20060

Agilent 85056K calibration kit, 2.4 mm & 2.92 mm

The Agilent 85056K calibration kit was designed to give network analyzer systems with 2.4 mm test ports, such as the Agilent PNA, and PNA-L series, the ability to perform measurements on devices with 2.92 mm connectors. The kit can be used to achieve calibrated measurements of 2.92 mm devices up to 40 GHz, and 2.4 mm devices up to 50 GHz.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Broadband loads	DC to ≤4	Return loss	≥42 dB (≤0.00794 ρ)
	>4 to ≤20	Return loss	≥34 dB (≤0.01995 ρ)
	>20 to ≤26.5	Return loss	≥30 dB (≤0.03163 ρ)
	>26.5 to ≤50	Return loss	≥30 dB (≤0.05019 ρ)
Sliding loads	4 to ≤20	Return loss	≥42 dB (≤0.00794 ρ)
	>20 to ≤36	Return loss	≥40 dB (≤0.01000 ρ)
	>36 to ≤40	Return loss	≥38 dB (≤0.01259 ρ)
	>40 to ≤50	Return loss	≥36 dB (≤0.01585 ρ)
Adapters (2.4 mm to 2.4 mm)	DC to ≤4	Return loss	≥32 dB (≤0.02512 ρ)
	>4 to ≤26.5	Return loss	≥30 dB (≤0.03162 ρ)
	>26.5 to ≤40	Return loss	≥25 dB (≤0.05623 ρ)
	>40 to ≤50	Return loss	≥20 dB (≤0.01000 ρ)
Adapters (2.4 mm to 2.92 mm)	DC to ≤40	Return loss	≥24 dB (≤0.06310 ρ)
Offset opens	DC to ≤2	Deviation from nominal phase	±0.5°
	>2 to ≤20	Deviation from nominal phase	±1.25°
	>20 to ≤40	Deviation from nominal phase	±1.75°
	>40 to ≤50	Deviation from nominal phase	±2.25°
Offset shorts	DC to ≤2	Deviation from nominal phase	±0.5°
	>2 to ≤20	Deviation from nominal phase	±1.25°
	>20 to ≤40	Deviation from nominal phase	±1.5°
	>40 to ≤50	Deviation from nominal phase	±2.0°

2.4 mm to 2.92 mm adapter characteristics

Frequency (GHz)	Parameter	Typical Value
DC to ≤2	Return loss	≥38 dB (≤0.01259 ρ)
>2 to ≤20	Return loss	≥35 dB (≤0.01778 ρ)
>20 to ≤40	Return loss	≥30 dB (≤0.03162 ρ)
DC to ≤40	Electrical length	39.631 ps ±0.14 ps
DC to ≤40	Insertion loss	< 0.075 dB

Replaceable parts

Description	Qty per kit	Agilent replacement part number
2.4 mm broadband load (m)	1	00901-60003
2.4 mm broadband load (f)	1	00901-60004
2.4 mm offset short (m)	1	85056-60020
2.4 mm offset short (f)	1	85056-60021
2.4 mm offset open (m)	1	85056-60022
2.4 mm offset open (f)	1	85056-60023
2.4 mm (m) to 2.4 mm (m) adapter	1	85056-60005
2.4 mm (f) to 2.4 mm (f) adapter	1	85056-60006
2.4 mm (f) to 2.4 mm (m) adapter	1	85056-60007
2.4 mm (m) to 2.92 mm (m) adapter	1	11904-60001
2.4 mm (m) to 2.92 mm (f) adapter	1	11904-60003
2.4 mm (f) to 2.92 mm (m) adapter	1	11904-60004
2.4 mm (f) to 2.92 mm (f) adapter	1	11904-60002
5/16 in., 90 N-cm (8 in-lb) torque wrench	1	8710-1765
5/16 in., 56 N-cm (5 in-lb) torque wrench	1	8710-1582
7 mm open-end	1	8710-1761
2.4 mm sliding load (m)	1	00915-60003
2.4 mm sliding load (f)	1	00915-60004
2.4 mm (m/f) gage set	1	11752E
Centering bead (for gaging 2.4 mm sliding load)	2	85056-20001
Tube package	1	15040-0803

Agilent 85056D economy calibration kit, 2.4 mm

The Agilent 85056D economy calibration kit contains precision standard devices to characterize the systematic errors of the Agilent PNA, and PNA-L series network analyzers in the 2.4 mm interface. This kit also contains adapters to change the sex of the test port and a torque wrench for proper connection. Connector gages may be ordered separately.

Electrical specifications

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
2.4 mm broadband load (m)	1	00901-60003
2.4 mm broadband load (f)	1	00901-60004
2.4 mm offset short (m)	1	85056-60020
2.4 mm offset short (f)	1	85056-60021
2.4 mm offset open (m)	1	85056-60022
2.4 mm offset open (f)	1	85056-60023
2.4 mm (m) to 2.4 mm (m) adapter	1	85056-60005
2.4 mm (f) to 2.4 mm (f) adapter	1	85056-60006
2.4 mm (m) to 2.4 mm (f) adapter	1	85056-60007
5/16 in., 90 N-cm (8 in-lb) torque wrench	1	8710-1765
7 mm open-end wrench	1	8710-1761

Agilent 85056A calibration kit, 2.4 mm

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

Electrical specifications

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
2.4 mm sliding load (m)	1	00915-60003
2.4 mm sliding load (f)	1	00915-60004
2.4 mm broadband load (m)	1	00901-60003
2.4 mm broadband load (f)	1	00901-60004
2.4 mm offset short (m)	1	85056-60020
2.4 mm offset short (f)	1	85056-60021
2.4 mm offset open (m)	1	85056-60022
2.4 mm offset open (f)	1	85056-60023
2.4 mm (m) to 2.4 mm (m) adapter	1	85056-60005
2.4 mm (f) to 2.4 mm (f) adapter	1	85056-60006
2.4 mm (m) to 2.4 mm (f) adapter	1	85056-60007
5/16 in., 90 N-cm (8 in-lb) torque wrench	1	8710-1765
7 mm open-end wrench	1	8710-1761

Agilent 85058E economy calibration kit, 1.85 mm

The Agilent 85058E economy calibration kit contains six standard devices to characterize the systematic errors of Agilent 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.

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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
5.4 mm offset short (m)	1	85058-60101
5.4 mm offset short (f)	1	85058-60105
Offset open (m)	1	85058-60109
Offset open (f)	1	85058-60110
Broadband termination (m)	1	85058-60123
Broadband termination (f)	1	85058-60124
Adapter, male to male	1	85058-60113
Adapter, female to female	1	85058-60114
Adapter, male to female	1	85058-60115
5/16 in., 90 N-cm (8 in-lb) torque wrench	1	8710-1765
8 mm open-end wrench	1	8710-2466

Agilent 85058B calibration kit, 1.85 mm

The Agilent 85058B calibration kit contains twelve standard devices to characterize the systematic errors of Agilent 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.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications			
			Male		Female	
			Polynomial model	Data-based model	Polynomial model	Data-based model
Lowband 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 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
5.4 mm offset short 1 (m)	1	85058-60101
5.4 mm offset short 1 (f)	1	85058-60105
6.3 mm offset short 2 (m)	1	85058-60102
6.3 mm offset short 2 (f)	1	85058-60106
7.12 mm offset short 3 (m)	1	85058-60103
7.12 mm offset short 3 (f)	1	85058-60107
7.6 mm offset short 4 (m)	1	85058-60104
7.6 mm offset short 4 (f)	1	85058-60108
Offset open (m)	1	85058-60109
Offset open (f)	1	85058-60110
Lowband load (m)	1	85058-60111
Lowband load (f)	1	85058-60112
Adapter, male to male	1	85058-60113
Adapter, female to female	1	85058-60114
Adapter, male to female	1	85058-60115
$^{5}/_{16}$ in., 90 N-cm (8 in-lb) torque wrench	1	8710-1765
8 mm open-end wrench	1	8710-2466

Agilent 85059A precision calibration/ verification kit, 1.0 mm

The Agilent 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.

Electrical specifications for 1.0 mm 50 ohm 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 @ ~22.6 GHz intervals

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Shorts		
Male short 3	1	85059-60003
Female short 3	1	85059-60007
Male short 4	1	85059-60004
Female short 4	1	85059-60008
Male short 2	1	85059-60002
Female short 2	1	85059-60006
Male short 1	1	85059-60001
Female short 1	1	85059-60005
Opens		
Male open	1	85059-60009
Female open	1	85059-60010
Loads		
Male load	1	85059-60019
Female load	1	85059-60020
Lossy delay line	2	85059-60021
Adapters		
Male to male adapter	1	11920-60001
Female to female adapter	1	11920-60002
Male to female adapter	1	11920-60003
Cables		
Female to female cable (8.8 cm)	1	11500-60001
Verification devices		
Mismatched thru adapter	1	85059-60016
Matched thru adapter	1	85059-60017
Wrenches		
6 mm 4 in-lb torque	1	8710-2079
6 mm open-end	1	8710-2156

Agilent X11644A WR-90 mechanical calibration kit, 8.2 GHz to 12.4 GHz

The Agilent X11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the Agilent PNA, and PNA-L series network analyzers. This calibration kit has a precision 50 ohm airline 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Termination	2	00910-60003
Short	1	11644-20018
1/4 Wavelength shim	1	11644-20021
7 mm coax-to-waveguide adapter (f)	2	X281C Option 006
Standard section	1	00896-60008
Alignment pin	6	11644-20024
Slip pin	6	11644-20025
8-32 pozi dr screw (0.625 inches long)	6	2510-0109
8-32 pozi dr screw (1.0 inches long)	6	2510-0115
#8 lock washer	12	2190-0009
8-32 Hex nut	12	2580-0002
1/4 in. wrench	1	8720-0014

Agilent P11644A WR-62 mechanical calibration kit, 12.4 GHz to 18.0 GHz

The Agilent P11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the Agilent PNA, and PNA-L series network analyzers.
This calibration kit has a precision 50 ohm airline 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Termination	2	00910-60002
Short	1	11644-20017
1/4 Wavelength shim	1	11644-20020
7 mm coax-to-waveguide adapter (f)	2	P281C Option 006
Standard section	1	00896-60007
Alignment pin	6	11644-20023
Slip pin	6	11644-20025
6-32 pozi dr screw (0.562 inches long)	6	2360-0229
6-32 pozi dr screw (0.875 inches long)	6	2360-0207
#8 lock washer	12	2190-0007
6-32 Hex nut	12	2420-0003
1/4 in. wrench	1	8720-0014

Agilent K11644A WR-42 mechanical calibration kit, 18 GHz to 26.5 GHz

The Agilent K11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the Agilent PNA, and PNA-L series network analyzers. This calibration kit has a precision 50 ohm airline 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Termination	2	00910-60001
Short	1	11644-20016
1/4 Wavelength shim	1	11644-20019
3.5 mm coax-to-waveguide adapter (m)	1	00281-60001
3.5 mm coax-to-waveguide adapter (f)	1	K281C Option 006
Standard section	1	00896-60006
Alignment pin	6	11644-20022
Slip pin	6	11644-20027
4-40 pozi dr screw (0.750 inches long)	12	2200-0151
Lock washer M2.5	12	2190-0643
4-40 Hex nut	12	2260-0002
3/16 in. wrench	1	8720-0013

Agilent R11644A WR-28 mechanical calibration kit, 26.5 GHz to 40 GHz

The Agilent R11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the Agilent PNA, and PNA-L series network analyzers. This calibration kit has a precision 50 ohm airline 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Standard section (5 cm)	2	11644-60016
Standard section (10 cm)	1	11644-60001
Waveguide load	1	11644-60004
Short	1	11644-20005
R-band shim	1	11644-20003
Alignment pin	6	11644-20009
Slip pin	6	11644-20006
4-40 Hex nut (0.094 inches thick)	12	2260-0002
4-40 SKT HD screw (0.750 inches long)	12	3030-0721
Lock washer (0.115 inches)	12	2190-0030
3/16 in. wrench	1	8720-0013
Hex ball driver	1	8710-0523

Agilent Q11644A WR-22 mechanical calibration kit, 33 GHz to 50 GHz

The Agilent Q11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the Agilent PNA, and PNA-L series network analyzers. This calibration kit has a precision 50 ohm airline 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Q-band standard section (5 cm)	2	11644-60017
Q-band standard section (10 cm)	1	11644-60002
Q-band waveguide load	1	11644-60005
Q-band shim	1	11644-20001
Short (Q-band)	1	11644-20004
Slip pin (1.645 mm dia.)	6	11644-20008
Slip pin (2.367 mm dia.)	6	11644-20006
4-40 SKT HD screw (0.500 inches long)	12	3030-0203
4-40 captive screw (0.43 inches long)	12	1390-0764
4-40 captive screw (0.31 inches long)	24	1390-0671
Hex ball driver	1	8710-0523

Agilent U11644A WR-19 mechanical calibration kit, 40 GHz to 60 GHz

The Agilent U11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the Agilent PNA series network analyzers. This calibration kit has a precision 50 ohm airline 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
U-band standard section (5 cm)	2	11644-60018
U-band standard section (10 cm)	1	11644-60003
U-band waveguide load	1	11644-60006
U-band shim	1	11644-20002
Short (U-band)	1	11644-20004
Slip pin (1.645 mm dia.)	6	11644-20008
Slip pin (2.367 mm dia.)	6	11644-20006
4-40 SKT HD screw (0.500 inches long)	12	3030-0203
4-40 captive screw (0.43 inches long)	12	1390-0764
4-40 captive screw (0.31 inches long)	24	1390-0671
Hex ball driver	1	8710-0523

Agilent V11644A WR-15 mechanical calibration kit, 50 GHz to 75 GHz

The Agilent V11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the Agilent PNA series network analyzers. This calibration kit has a precision 50 ohm airline 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
V-band fixed load	1	11644-60025
V-band standard section (5 cm)	3	11644-60012
V-band shim	1	11644-20013
Short (V-band)	1	11644-20015
Slip pin (1.567 mm dia.)	6	11644-20007
4-40 captive screw (0.41 inches long)	12	1390-0765
4-40 captive screw (0.31 inches long)	24	1390-0671
Hex ball driver	1	8710-0523

Agilent W11644A WR-10 mechanical calibration kit, 75 GHz to 110 GHz

The Agilent W11644A calibration kit contains the precision mechanical standards required to calibrate the systematic errors of the Agilent PNA series network analyzers. This calibration kit has a precision 50 ohm airline 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

Replaceable parts

Description	Qty per kit	Agilent replacement part number
W-band fixed load	1	11643-60026
W-band standard section	3	11644-60013
W-band shim	1	11644-20014
Short (W-band)	1	11644-20015
Slip pin (1.567 mm dia.)	6	11644-20007
4-40 captive screw (0.41 inches long)	12	1390-0765
4-40 captive screw (0.31 inches long)	24	1390-0671
Hex ball driver	1	8710-0523

Overview

Electronic calibration (ECal) is a precision, single-connection, one, two or four-port calibration technique for your Agilent vector network analyzer. Agilent 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	Agilent model	Available options
Type-F (75 ohm)	300 kHz to 3 GHz [1]	2-port	85099C	UK6, 00F, 00M, M0F, 00A
Type-N (75 ohm)	300 kHz to 3 GHz [1]	2-port	85096C	UK6, 00F, 00M, M0F, 00A
Type-N (50 ohm)	300 kHz to 9 GHz [1]	2-port	85092C	1A7, A6J, UK6, 00F, 00M, M0F, 00A
Type-N (50 ohm)	300 kHz to 13.5 GHz [1]	4-port	N4431B Option 020	1A7, A6J, UK6
Type-N (50 ohm)	300 kHz to 18 GHz	2-port	N4690B	1A7, A6J, UK6, 00F, 00M, M0F, 00A
Type-N (50 ohm)	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 descriptions

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

19

Ordering information

Select an ECal module based on the connector type required and the frequency range of your Agilent vector network analyzer.

Order an Agilent 85097B VNA interface kit if the ECal module will be used with Agilent 8753 or 8720 families of network analyzers.

The Agilent ENA, ENA-L, PNA, and PNA-L series network analyzers can control ECal modules directly via its USB port.

Agilent 85097B VNA interface kit

Power limits

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

Electrical characteristic corrected performance [1] (Residual e-terms)

Ecal module specifications and characteristics

Specifications describe product performance covered by the product warranty over a temperature range of 0°C to +55°C. Characteristics describe performance that is useful in the application of the product, but not warranted. Typical values describe non-warranted performance that most units will exhibit. Characteristics and typical values are shown in italics.

2-port Ecal modules

7-16

85099C (RF) [2]			
Frequency range	300 kHz to 300 MHz	300 MHz to 1 GHz	1 to 3 GHz
Directivity (dB)	50	48	43
Source match (dB)	48	45	38
Reflection tracking (±dB)	0.03	0.07	0.15
Transmission tracking (±dB)	0.08	0.10	0.17
Load match (dB)	43	41	39

85099C (RF) [3]			
Frequency range	300 kHz to 300 MHz	300 MHz to 1 GHz	1 to 3 GHz
Directivity (dB)	48	43	32
Source match (dB)	46	41	26
Reflection tracking (±dB)	0.06	0.09	0.35
Transmission tracking (±dB)	0.08	0.12	0.35
Load match (dB)	43	40	29

1 Except 10 MHz to 45 MHz on N469x modules, which are typical.
2 When mated with male connectors with a 0.77 mm (0.030 in) to 0.86 mm (0.034 in) pin diameter.
3 Typical values when mated with male connectors with a 0.56 mm (0.022 in) to 1.07 mm (0.042 in) pin diameter.

2-port Ecal modules (continued)

Type-N (50 ohms)

85092C (RF)				
Frequency range	300 kHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	52	54	52	47
Source match (dB)	45	44	41	36
Reflection tracking (±dB)	0.04	0.04	0.06	0.07
Transmission tracking (±dB)	0.04	0.04	0.07	0.14
Load match (dB)	47	47	44	39

N4690B (microwave)					
Frequency range	300 kHz to 10 MHz	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 18 GHz
Directivity (dB)	40	45	48	46	42
Source match (dB)	35	40	43	40	35
Reflection tracking (±dB)	0.07	0.05	0.03	0.03	0.05
Transmission tracking (±dB)	0.12	0.08	0.07	0.07	0.12
Load match (dB)	29	35	42	41	38

Type-N (75 ohms)

85096C (RF)			
Frequency range	300 kHz to 300 MHz	300 MHz to 1 GHz	1 to 3 GHz
Directivity (dB)	50	48	43
Source match (dB)	48	45	38
Reflection tracking (±dB)	0.03	0.06	0.10
Transmission tracking (±dB)	0.08	0.09	0.16
Load match (dB)	43	41	39

3.5 mm [1]

85093C (RF)				
Frequency range	300 kHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	52	52	50.5	47
Source match (dB)	44	44	39	34
Reflection tracking (±dB)	0.03	0.03	0.05	0.07
Transmission tracking (±dB)	0.04	0.05	0.07	0.12
Load match (dB)	47	47	44	40

N4691B (microwave)						
Frequency range	300 kHz to 10 MHz	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 20 GHz	20 to 26.5 GHz
Directivity (dB)	41	46	56	54	48	44
Source match (dB)	36	41	47	45	44	40
Reflection tracking (±dB)	0.06	0.05	0.02	0.03	0.04	0.05
Transmission tracking (±dB)	0.11	0.07	0.05	0.07	0.1	0.12
Load match (dB)	31	37	45	49	45	40

[1] 3.5 mm modules have precision slotless connectors that guarantee the best calibration accuracy is transferred to your system.

2-port Ecal modules (continued)

7 mm

85091C (RF)				
Frequency range	300 kHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	52	56	55	45
Source match (dB)	45	44	41	34
Reflection tracking (±dB)	0.04	0.04	0.07	0.10
Transmission tracking (±dB)	0.06	0.06	0.13	0.23
Load match (dB)	47	47	46	39

N4696B (microwave)					
Frequency range (GHz)	300 kHz to 10 MHz	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 18 GHz
Directivity (dB)	40	46	45	50	42
Source match (dB)	35	40	40	42	36
Reflection tracking (±dB)	0.07	0.05	0.03	0.03	0.05
Transmission tracking (±dB)	0.11	0.07	0.04	0.07	0.1
Load match (dB)	30	36	40	45	39

7-16

85098C (RF)				
Frequency range	300 kHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 7.5 GHz
Directivity (dB)	47	50	46	45
Source match (dB)	43	43	38	37
Reflection tracking (±dB)	0.03	0.03	0.05	0.06
Transmission tracking (±dB)	0.05	0.06	0.08	0.10
Load match (dB)	42	43	41	38

2.92 mm

N4692A (microwave)					
Frequency range (GHz)	10 to 45 MHz, typical	45 MHz to 2 GHz	2 to 20 MHz	20 to 30 GHz	30 to 40 GHz
Directivity (dB)	35	45	43	39	38
Source match (dB)	30	36	35	30	29
Reflection tracking (±dB)	0.10	0.08	0.08	0.10	0.10
Transmission tracking (±dB)	0.10	0.14	0.14	0.20	0.25
Load match (dB)	27	36	37	33	33

2.4 mm

N4693A (microwave)						
Frequency range (GHz)	10 to 45 MHz, typical	45 MHz to 2 GHz	2 to 10 MHz	10 to 20 GHz	20 to 40 GHz	40 to 50 GHz
Directivity (dB)	32	55	49	45	43	41
Source match (dB)	25	46	42	37	35	30
Reflection tracking (±dB)	0.05	0.03	0.04	0.05	0.06	0.08
Transmission tracking (±dB)	0.10	0.06	0.08	0.11	0.13	0.17
Load match (dB)	24	45	42	40	38	36

2-port Ecal modules (continued)

1.85 mm

N4694A (microwave)								
Frequency range (GHz)	10 to 45 MHz, typical	45 MHz to 2 GHz	2 to 20 GHz	20 to 30 GHz	30 to 40 GHz	40 to 50 GHz	50 to 60 GHz	60 to 67 GHz
Directivity (dB)	33	50	50	46	44	42	41	38
Source match (dB)	25	38	39	35	34	33	30	27
Reflection tracking (±dB)	0.05	0.04	0.04	0.05	0.06	0.07	0.08	0.09
Transmission tracking (±dB)	0.15	0.07	0.1	0.11	0.13	0.15	0.19	0.25
Load match (dB)	25	41	44	42	40	38	36	32

4-port modules

Type-N (50 ohms) [1]

N4431B (RF) option 020						
Frequency range	300 kHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 8 GHz	8 to 9 GHz	9 to 13.5 GHz
Thru paths AB, CD, AD, BC						
Directivity (dB)	55	52	47	44	42	40
Source match (dB)	47	43	42	40	39	31
Reflection tracking (±dB)	0.03	0.04	0.04	0.05	0.06	0.11
Transmission tracking (±dB)	0.07	0.10	0.14	0.20	0.22	0.35
Load match (dB)	47	45	40	38	35	26
Thru paths AC, BD						
Directivity (dB)	55	52	47	44	42	40
Source match (dB)	47	43	42	40	39	31
Reflection tracking (±dB)	0.03	0.04	0.04	0.05	0.06	0.11
Transmission tracking (±dB)	0.07	0.09	0.13	0.15	0.16	0.32
Load match (dB)	47	45	40	38	36	28

3.5 mm [1]

N4431B (RF) option 010						
Frequency range	300 kHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 8 GHz	8 to 9 GHz	9 to 13.5 GHz
Thru paths AB, CD, AD, BC						
Directivity (dB)	57	55	52	50	47	40
Source match (dB)	50	47	45	44	43	32
Reflection tracking (±dB)	0.03	0.03	0.04	0.04	0.05	0.1
Transmission tracking (±dB)	0.06	0.09	0.12	0.14	0.20	0.33
Load match (dB)	47	46	45	44	42	28
Thru paths AC, BD						
Directivity (dB)	57	55	52	50	47	40
Source match (dB)	50	47	45	44	43	32
Reflection tracking (±dB)	0.03	0.03	0.04	0.04	0.05	0.1
Transmission tracking (±dB)	0.06	0.08	0.10	0.12	0.14	0.3
Load match (dB)	47	46	45	45	43	29

[1] *Specifications for the N4432A and N4433A 4-port ECal modules were unavailable at the time this catalog was prepared. For information on these models, please go to www.agilent.com/find/ecal.*

Mixed-connector options

2-port (85092C/3C/8C ECal modules only)

	Port A option			Port B option					
Model number	**Type**	**(f)**	**(m)**	**Type**	**(f)**	**(m)**	**Type**	**(f)**	**(m)**
85092C	Type-N 50 ohm	103	104	3.5 mm	201	202	7-16 [1]	205	206
85093C	3.5 mm	101	102	Type-N 50 ohm	203	204	7-16 [1]	205	206
85098C	7-16 [1]	105	106	3.5 mm	201	202	Type-N 50 ohm	203	204

4-port (N4431B ECal module only)

Connector type	Port A option	Port B option	Port C option	Port D option
3.5 mm (f)	101	201	301	401
3.5 mm (m)	102	202	302	402
Type-N 50 ohm (f)	103	203	303	403
Type-N 50 ohm (m)	104	204	304	404
7-16 (f) [1]	105	205	305	405
7-16 (m) [1]	106	206	306	406

4-port (N4432A ECal module only)

Connector type	Port A option	Port B option	Port C option	Port D option
3.5 mm (f)	101	201	301	401
3.5 mm (m)	102	202	302	402
Type-N 50 ohm (f)	103	203	303	403
Type-N 50 ohm (m)	104	204	304	404
7 mm	105	205	305	405

[1] *Limits ECal module high frequency to 7.5 GHz.*

Agilent 85055A verification kit, Type-N

The Agilent 85055A Type-N verification kit is used with an Agilent 85054B Type-N calibration kit and network analyzers, such as the Agilent PNA, or PNA-L series. Use the Agilent 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).

Replaceable parts

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	85055-60003
50 dB attenuator with data	1	85055-60004
50 ohm airline with data	1	85055-60006
25 ohm mismatch airline with data	1	85055-60007
Open-end 5.5 wrench	1	8710-1770

Agilent 85029B verification kit, 7 mm

Measuring known devices, other than the calibration standards, is a convenient way of verifying that the Agilent ENA, or PNA series is operating properly. The Agilent 85029B verification kit contains a set of precision 7 mm devices, with data traceable to NIST, used to verify the calibrated performance of an Agilent ENA series. The devices have precision 7 mm connectors and include a 20 dB pad, a 50 dB pad, and a mismatch attenuator. The verification process requires only an Agilent 85031B calibration kit and an Agilent 85029B verification kit. (Option 001 is intended solely for use with the Agilent 8702B lightwave component analyzer. Option 001 adds verification data that is compatible with the Agilent 8702B.)

Replaceable parts

The three attenuators are separately available and should be ordered by the numbers given below. Each of these devices has a serial number and the kit has a serial number. All four serial numbers appear on the verification disc label.

Description	Agilent part number
7 mm mismatch attenuator	85029-60004
7 mm 20 dB attenuator	85029-60005
7 mm 50 dB attenuator	85029-60006

Agilent 85051B verification kit, 7 mm

The Agilent 85051B 7 mm verification kit is used with an Agilent 85050B/C/D 7 mm calibration kit and network analyzers, such as the Agilent PNA, or PNA-L series. Use the Agilent 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).

Replaceable parts

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	85051-60001
50 dB attenuator with data	1	85051-60002
50 ohm airline with data	1	85051-60010
25 ohm mismatch airline with data	1	85051-60011
Open-end 5.5 wrench	1	8710-1770

Agilent 85053B verification kit, 3.5 mm

The Agilent 85053B 3.5 mm verification kit is used with an Agilent 85052B/C/D 3.5 mm calibration kit and network analyzers, such as the Agilent PNA, or PNA-L series. Use the Agilent 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).

Replaceable parts

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	85053-60001
40 dB attenuator with data	1	85053-60002
50 ohm airline with data	1	85053-60008
25 ohm mismatch airline with data	1	85053-60009

Agilent 85057B verification kit, 2.4 mm

The Agilent 85057B 2.4 mm verification kit is used with an Agilent 85056A 2.4 mm calibration kit and network analyzers, such as the Agilent PNA, or PNA-L series. Use the Agilent 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).

Replaceable parts

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	85057-60010
40 dB attenuator with data	1	85057-60011
50 ohm airline with data	1	85057-60008
20 ohm mismatch airline with data	1	85057-60009

Agilent 85058V verification kit, 1.85 mm

The Agilent 85058V 1.85 mm verification kit is used with an Agilent 85058B/E 1.85 mm calibration kit and Agilent PNA series network analyzers. Use the Agilent 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).

Replaceable parts

Description	Qty per kit	Agilent replacement part number
40 dB attenuator with data	1	85058-60125
10 dB attenuator with data	1	85058-60126
50 ohm beaded line with data	1	85058-60116
25 ohm mismatch beaded line with data	1	85058-60117

Agilent R11645A W-28 verification kit

The Agilent R band millimeter-waveguide verification kit is used with the R11644A calibration kit and network analyzer systems, such as the Agilent PNA, or PNA-L 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).

Replaceable parts

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	11645-60021
50 dB attenuator with data	1	11645-60022
50 ohm airline with data	1	11645-60016
25 ohm mismatch airline with data	1	11645-60011
Lock washer	6	2190-0030
Hex nut	6	2260-0002
Waveguide alignment pin (short)	6	11644-20009
Waveguide alignment pin (long)	6	11644-20006
4-40 Hex ball screw (0.75 inches long)	6	3030-0721
3/32-inch Hex ball driver	1	8710-1539

Agilent Q11645A W-22 verification kit

The Agilent Q band millimeter-waveguide verification kit is used with the Q11644A calibration kit and network analyzer systems, such as the Agilent PNA, or PNA-L 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).

Replaceable parts

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	11645-60023
50 dB attenuator with data	1	11645-60024
50 ohm airline with data	1	11645-60017
25 ohm mismatch airline with data	1	11645-60012
4-40 Hex ball screw (0.31 inch)	6	1390-0671
4-40 Hex ball screw (0.43 inch)	6	1390-0764
Waveguide alignment pin (short)	6	11644-20008
Waveguide alignment pin (long)	6	11644-20006
3/32-inch Hex ball driver	1	8710-1539

Agilent U11645A W-19 verification kit

The Agilent U band millimeter-waveguide verification kit is used with the U11644A calibration kit and network analyzer systems, such as the Agilent 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).

Replaceable parts

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	11645-60025
50 dB attenuator with data	1	11645-60006
50 ohm airline with data	1	11645-60018
25 ohm mismatch airline with data	1	11645-60013
4-40 Hex ball screw (0.31 inch)	6	1390-0671
4-40 Hex ball screw (0.43 inch)	6	1390-0764
Waveguide alignment pin (short)	6	11644-20008
Waveguide alignment pin (long)	6	11644-20006
3/32-inch Hex ball driver	1	8710-1539

Agilent V11645A W-15 verification kit

The Agilent V band millimeter-waveguide verification kit is used with the V11644A calibration kit and network analyzer systems, such as the Agilent 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).

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	11645-60007
50 dB attenuator with data	1	11645-60008
50 ohm airline with data	1	11645-60019
25 ohm mismatch airline with data	1	11645-60014
4-40 Hex ball screw (0.31 inch)	6	1390-0671
4-40 Hex ball screw (0.41 inch)	6	1390-0765
Waveguide alignment pin V/W	6	11644-20007
3/32-inch Hex ball driver	1	8710-1539

Agilent W11645A W-10 verification kit

The Agilent W band millimeter-waveguide verification kit is used with the W11644A calibration kit and network analyzer systems, such as the Agilent 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).

Description	Qty per kit	Agilent replacement part number
20 dB attenuator with data	1	11645-60009
50 dB attenuator with data	1	11645-60010
50 ohm airline with data	1	11645-60020
25 ohm mismatch airline with data	1	11645-60015
4-40 Hex ball screw (0.31 inch)	6	1390-0671
4-40 Hex ball screw (0.41 inch)	6	1390-0765
Waveguide alignment pin V/W	6	11644-20007
$^3/_{32}$-inch Hex ball driver	1	8710-1539

Agilent 85025 and 85037 series detectors (ac/dc)

The Agilent 85025 and 85037 series detectors are designed specifically for operation with the Agilent 8757 scalar network analyzer. The Agilent 85025/37 detectors detect either a modulated (ac) or an unmodulated (dc) microwave signal.

Agilent 85025C detector adapters

The Agilent 85025C adapters matches the scalar analyzer display to most standard crystal, silicon and gallium arsenide detectors. This enables the user to operate up to 110 GHz with the Agilent 8757. The Agilent 8502C detector adapter is designed for use with the Agilent 8757 only, and can operate in either AC or DC detection modes.

Scalar network analyzer accessories

Coaxial detector summary

Agilent model	Frequency range	Connector type	Dynamic range	Frequency	Return loss
85025A [3]	10 MHz to 18 GHz	Type-N (m) 7 mm [2]	AC mode +16 to –55 dBm DC mode + 16 to 50 dBm	0.01 to 0.04 GHz 0.04 to 4 GHz 4 to 18 GHz	10 dB 20 dB 17 dB
85025B [3]	10 MHz to 26.5 GHz	3.5 mm (m)	AC mode +16 to –55 dBm DC mode + 16 to 50 dBm	0.01 to 0.04 GHz 0.04 to 4 GHz 4 to 18 GHz 18 to 26.5	10 dB 20 dB 17 dB 12 dB
85025D [3]	10 MHz to 50 GHz	2.4 mm (m)	AC mode +16 to –55 dBm DC mode + 16 to 50 dBm	0.01 to 0.1 GHz 0.1to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	10 dB 20 dB 20 dB 15 dB 9 dB
85025E [3]	10 MHz to 26.5 GHz	3.5 mm (m)	AC mode +16 to –55 dBm DC mode + 16 to 50 dBm	0.01 to 0.1 GHz 0.1 to 18 GHz 18 to 25 GHz 25 to 26.5 GHz	10 dB 25 dB 25 dB 23 dB
85037A [1]	10 MHz to 18 GHz	Type-N (m) 7 mm [2]	AC mode +20 to –55 dBm DC mode + 20 to 50 dBm	0.01 to 0.04 GHz 0.04 to 18 GHz	10 dB 20 dB
85037B [1]	10 MHz to 26.5 GHz	3.5 mm (m)	AC mode +20 to –55 dBm DC mode + 20 to 50 dBm	0.01 to 0.04 GHz 0.04 to 18 GHz 18 to 26.5 GHz	10 dB 20 dB 18 dB

[1] The Agilent 85037A/B specifications are applicable when used with the Agilent 8757D scalar network analyzer. The absolute power accuracy and dynamic power accuracy specifications apply after a calibration via the Agilent 8757D Option 002's internal power calibrator.

[2] Option 001 changes to a 7 mm connector.

[3] The Agilent 85025 and 85037 series detectors and the Agilent 85025C detector adapter require Agilent 8757D revision 2.0 or higher.

Agilent 85027 series directional bridges (AC/DC)

The Agilent 85027 series directional bridges are designed to operate with either the HP 8757 in AC or DC detection modes. These bridges offer high directivity, excellent test port matching and a measurement range of up to 50 GHz in coax.

Directional bridge summary

Agilent model	Frequency range	Nominal impedance	Connector – input	Connector – test port	Frequency	Directivity (dB)	Frequency	Test port match (SWR)
85027A	10 MHz to 18 GHz	50 Ω	Type-N (f)	7 mm	0.01 to 18 GHz	40 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
85027B	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (f)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78
85027C	10 MHz to 18 GHz	50 Ω	Type-N (f)	Type-N (f)	0.01 to 12.4 GHz 12.4 to 18 GHz	36 dB 34 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
85027D	10 MHz to 50 GHz	50 Ω	2.4 mm (f)	2.4 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	36 dB 32 dB 30 dB 25 dB	0.01 to 16 GHz 16 to 30 GHz 30 to 40 GHz 40 to 50 GHz	<1.18 <1.27 <1.57 typically <1.85
85027E	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78

20

Agilent N1921A/22A P-series wideband power sensors

The Agilent P-series wideband power sensors are designed for use with the P-series power meters for measuring CW, average and peak signals with video bandwidth up to 30 MHz. The N192xA sensors are the first to provide internal zero and calibration. This feature eliminates the multiple connections associated with using an external calibration source, thus minimizing connector wear, test time and measurement uncertainty. The operating frequency range covers from 50 MHz to 40 GHz with wide dynamic range of –35 dBm to +20 dBm.

Agilent E9320 peak and average power sensors

E9320 peak and average power sensors cover the 50 MHz to 6/18 GHz frequency ranges and –65 to +20 dBm power range. They are optimized for comprehensive measurements on pulsed envelopes and signals with complex modulation. When teamed with the Agilent EPM-P series power meters (E4416A/17A), they can handle test signal envelopes with up to 5 MHz video bandwidth. E9320 peak and average sensors/meters feature a two-mode operation, 'normal' for most average and peak measurements (with or without time gating), and 'average only' for average power measurements on low level or CW signals.

Agilent E9300 average power sensors

E-series 9300 wide dynamic range, average power sensors are designed for use with the EPM family of power meters. It has high dynamic range of 80 dB (–60 to +44 dBm) and wide frequency range (9 kHz to 18 GHz), depending on sensor model. It is capable of accurately measuring the average power of modulated signals over wide dynamic range, regardless of signal bandwidth.

Agilent E441xA CW power sensors

E4412/13A power sensor permits measuring continuous wave (CW) power over an extended dynamic range from –70 to +20 dBm, up to a frequency range of 26.5 GHz. Their 90 dB range makes them ideal for wide-dynamic range applications such as high-attenuation component measurements. The calibration factor is measured and stored in an EEPROM within each individual sensor and downloaded into the meter automatically. Since the correction factors are derived from a CW source, they do not provide an accurate average power reading for modulated signal. They are designed to work with EPM series power meters.

Agilent 8480 series power sensors

The 8480 series power sensors are designed for use with the EPM series, EPM-P series power meters. These thermocouple and diode power sensors measure average power for all signal types regardless of signal bandwidth and provide extraordinary accuracy, stability, and SWR over a wide range of frequencies (100 kHz to 110 GHz) and power levels (–70 dBm to +44 dBm).

Agilent N192xA series power sensors

Agilent E441xA, E9300, E9320 series power sensors

Agilent 8480 series power sensors

P-series wideband power sensors

100 mW sensors (–35 to +20 dBm)

Agilent model	Minimum frequency range	Maximum frequency range	Minimum power range	Maximum power range	Measurement type	Maximum SWR	Connector type	Video bandwidth (MHz)	Works with	Option
N1921A	50 MHz	18 GHz	–35 dBm (0.316 µW)	+20 dBm (100 mW)	CW, peak, average, peak-to-average ratio, time-gated measurements; rise time and fall time, pulse width measurement	50 MHz to 10 GHz: 1.2 10 GHz to 18 GHz: 1.26	Type-N (m)	30 MHz	P-series power meters	C35
N1922A	50 MHz	40 GHz	–35 dBm (0.316 µW)	+20 dBm (100 mW)	CW, peak, average, peak-to-average ratio, time-gated measurements; rise time and fall time, pulse width measurement	50 MHz to 10 GHz: 1.2 10 GHz to 18 GHz: 1.26 18 GHz to 26.5 GHz: 1.3 26.5 GHz to 40 GHz: 1.5	2.4 mm (m)	30 MHz	P-series power meters	

Available options:
A6J ANSI Z540 compliant calibration with test data
0B1 Additional english language manual set
105 Fixed cable option length 1.5 m (5 ft)
106 Fixed cable option length 3 m (10 ft)
107 Fixed cable option length 10 m (31 ft)
1A7 ISO 17025 compliant calibration with data
C35 50 MHz to 18.5 GHz, 3.5 mm male input (for N1921A only)

E9320 peak and average power sensors

100 mW sensors (–65 to +20 dBm)

Agilent model	Minimum frequency range	Maximum frequency range	Minimum power range (Average)	Maximum power range (Average)	Peak and average/ average/ CW	Maximum SWR	Connector type	Video bandwidth	Works with
E9321A	50 MHz	6 GHz	–65 dBm (320 pW)	+20 dBm (100 mW)	CW, peak and average	50 MHz to 2 GHz 1.12 2 GHz to 10 GHz 1.16 10 GHz to 16 GHz 1.23 16 GHz to 18 GHz 1.27	Type-N (m)	300 kHz	EPM-P and P-series* power meters
E9325A	50 MHz	18 GHz	–65 dBm (320 pW)	+20 dBm (100 mW)	CW, peak and average	50 MHz to 2 GHz 1.12 2 GHz to 10 GHz 1.16 10 GHz to 16 GHz 1.23 16 GHz to 18 GHz 1.27	Type-N (m)	300 kHz	EPM-P and P-series* power meters

100 mW sensors (–60 to +20 dBm)

E9322A	50 MHz	6 GHz	–60 dBm (1 nW)	+20 dBm (100 mW)	CW, peak and average	50 MHz to 2 GHz 1.12 2 GHz to 10 GHz 1.18 10 GHz to 16 GHz 1.21 16 GHz to 18 GHz 1.27	Type-N (m)	1.5 MHz	EPM-P and P-series* power meters
E9323A	50 MHz	6 GHz	–60 dBm (1 nW)	+20 dBm (100 mW)	CW, peak and average	50 MHz to 2 GHz 1.12 2 GHz to 16 GHz 1.22 16 GHz to 18 GHz 1.26	Type-N (m)	5 MHz	EPM-P and P-series* power meters
E9326A	50 MHz	18 GHz	–60 dBm (1 nW)	+20 dBm (100 mW)	CW, peak and average	50 MHz to 2 GHz 1.12 2 GHz to 10 GHz 1.18 10 GHz to 16 GHz 1.21 16 GHz to 18 GHz 1.27	Type-N (m)	1.5 MHz	EPM-P and P-series* power meters
E9327A	50 MHz	18 GHz	–60 dBm (1 nW)	+20 dBm (100 mW)	CW, peak and average	50 MHz to 2 GHz 1.12 2 GHz to 16 GHz 1.22 16 GHz to 18 GHz 1.26	Type-N (m)	5 MHz	EPM-P and P-series* power meters

Available options:
A6J ANSI Z540 compliant calibration with test data
0B1 English language operating and service guide
ABD German language operating and service guide
ABE Spanish language operating and service guide
ABF French language operating and service guide
ABJ Japanese language operating and service guide
ABZ Italian language operating and service guide

Note:
E9320 Peak and average power sensor only workable with cables:
E9288A Power sensor cable, length 5 ft (1.5 m)
E9288B Power sensor cable, length 10 ft (3 m)
E9288C Power sensor cable, length 31 ft (10 m)
** N1917A/B/C cable adapter & backward compatibility firmware are required*

E9300 Wide dynamic range average power sensors

25 W sensors (–30 to +44 dBm)

Agilent model	Minimum frequency range	Maximum frequency range	Minimum power range	Maximum power range	Peak and average/ average/ CW	Maximum SWR	Connector type	Works with	Options
E9300B	10 MHz	18 GHz	–30 dBm (1 uW)	+44 dBm (25 W)	CW and average	10 MHz to 30 MHz 1.21 30 MHz to 2 GHz 1.15 2 GHz to 14 GHz 1.20 14 GHz to 16 GHz 1.23 16 GHz to 18 GHz 1.27	Type-N (m)	EPM-P, EPM and P-series* power meters	
E9301B	10 MHz	6 GHz	–30 dBm (1 uW)	+44 dBm (25 W)	CW and average	10 MHz to 30 MHz 1.21 30 MHz to 2 GHz 1.15 2 GHz to 6 GHz 1.20	Type-N (m)	EPM-P, EPM and P-series* power meters	

1 W sensors (–50 to +30 dBm)

E9300H	10 MHz	18 GHz	–50 dBm (10 nW)	+30 dBm (1 W)	CW and average	10 MHz to 30 MHz 1.21 30 MHz to 2 GHz 1.15 2 GHz to 14 GHz 1.20 14 GHz to 16 GHz 1.23 16 GHz to 18 GHz 1.27	Type-N (m)	EPM-P, EPM and P-series* power meters	
E9301H	10 MHz	6 GHz	–50 dBm (10 nW)	+30 dBm (1 W)	CW and average	10 MHz to 30 MHz 1.21 30 MHz to 2 GHz 1.15 2 GHz to 6 GHz 1.20	Type-N (m)	EPM-P, EPM and P-series* power meters	

100 mW sensors (–60 to +20 dBm)

E9300A	10 MHz	18 GHz	–60 dBm (1 nW)	+20 dBm (100 mW)	CW and average	10 MHz to 30 MHz 1.21 30 MHz to 2 GHz 1.15 2 GHz to 14 GHz 1.20 14 GHz to 16 GHz 1.23 16 GHz to 18 GHz 1.27	Type-N (m)	EPM-P, EPM and P-series* power meters	H24, H25
E9301A	10 MHz	6 GHz	–60 dBm (1 nW)	+20 dBm (100 mW)	CW and average	10 MHz to 30 MHz 1.21 30 MHz to 2 GHz 1.15 2 GHz to 6 GHz 1.20	Type-N (m)	EPM-P, EPM and P-series* power meters	
E9304A	9 kHz	6 GHz	–60 dBm (1 nW)	+20 dBm (100 mW)	CW and average	9 kHz to 2 GHz 1.15 2 GHz to 6 GHz 1.20	Type-N (m)	EPM-P, EPM and P-series* power meters	H18, H19

Available options:
H18 Extended frequency range 9 kHz to 18 GHz, power range –60 to +20 dBm (For E9304A only)
H19 Extended frequency range 9 kHz to 18 GHz, power range –50 to +30 dBm (For E9304A only)
H24 Extended frequency range 10 MHz to 24 GHz, –60 to +20 dBm (APC 3.5 (m) connector) (For E9300A only)
H25 Extended frequency range 10 MHz to 24 GHz, –50 to +30 dBm (APC 3.5 (m) connector) (For E9300A only)
A6J ANSI Z540 compliant calibration with test data
0B1 English language operating and service guide
ABD German language operating and service guide
ABE Spanish language operating and service guide
ABF French language operating and service guide
ABJ Japanese language operating and service guide
ABZ Italian language operating and service guide
AB1 Korean language operating and service guide

** N1917A/B/C cable adapter & backward compatibility firmware are required*

E4412/13A wide dynamic range CW power sensors

100 mW sensors (–70 to +20 dBm)

Agilent model	Minimum frequency range	Maximum frequency range	Minimum power range	Maximum power range	Peak and average/ average/ CW	Maximum SWR	Connector type	Works with	Options
E4412A	10 MHz	18 GHz	–70 dBm (100 pW)	+20 dBm (100 mW)	CW only	10 MHz to 30 MHz 1.22 30 MHz to 2 GHz 1.15 2 GHz to 6 GHz 1.17 6 GHz to 11 GHz 1.20 11 GHz to 18 GHz 1.27	Type-N (m)	EPM-P, EPM and P-series* power meters	C01 (APC-7 connector)
E4413A	50 MHz	26.5 GHz	–70 dBm (100 pW)	+20 dBm (100 mW)	CW only	50 MHz to 100 MHz 1.21 100 MHz to 8 GHz 1.19 8 GHz to 18 GHz 1.21 18 GHz to 26.5 GHz 1.26	3.5 mm (m)	EPM-P, EPM and P-series* power meters	H33

Available options:

C01 APC 7 connector (For E4412A only)
H33 Extended frequency range 50 MHz to 33 GHz, power range –70 to +20 dBm (for E4413A only)
A6J ANSI Z540 compliant calibration with test data
0B1 English language operating and service guide
ABD German language operating and service guide
ABE Spanish language operating and service guide
ABF French language operating and service guide
ABJ Japanese language operating and service guide
ABZ Italian language operating and service guide

Note:
** N1917A/B/C cable adapter & backward compatibility firmware are required*

848x Average Power Sensors

Agilent model	Minimum frequency range	Maximum frequency range	Power level	Maximum SWR	Connector type	Works with	Options
25 W sensors (0 to +44 dBm)							
8481B	10 MHz	18 GHz	0 to +44 dBm	10 MHz to 2 GHz: 1.10 2 GHz to 12.4 GHz: 1.18 12.4 GHz to 18 GHz: 1.28	Type-N (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
8482B	100 kHz	4.2 GHz	0 to +44 dBm	100 kHz to 2 GHz: 1.10 2 GHz to 4.2 GHz: 1.18	Type-N (m)	EPM series, EPM-P series, E1416A, P-series* power meters	H01, H50
3 W sensors (–10 to +35 dBm)							
8481H	10 MHz	18 GHz	–10 to +35 dBm	10 MHz to 18 GHz: 1.2 8 GHz to 12.4 GHz: 1.25 12.4 GHz to 18 GHz: 1.30	Type-N (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
8482H	100 kHz	4.2 GHz	–10 to +35 dBm	100 kHz to 4.2 GHz: 1.2	Type-N (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
100 mW Sensors (–30 to +20 dm)							
8481A	10 MHz	18 GHz	–30 to +20 dBm	10 MHz to 30 MHz: 1.4 30 MHz to 50 MHz: 1.18 50 MHz to 2 GHz: 1.10 2 GHz to 12.4 GHz: 1.78 12.4 GHz to 18 GHz: 1.28	Type-N (m)	EPM series, EPM-P series, E1416A, P-series* power meters	H42
8481A Option 001	10 MHz	18 GHz	–30 to +20 dBm	10 MHz to 30 MHz: 1.4 30 MHz to 50 MHz: 1.18 50 MHz to 2 GHz: 1.10 2 GHz to 12.4 GHz: 1.78 12.4 GHz to 18 GHz: 1.28	APC-7	EPM series, EPM-P series, E1416A, P-series* power meters	
8482A	100 kHz	4.2 GHz	–30 to +20 dBm	100 kHz to 300 kHz: 1.6 0.3 MHz to 1 MHz: 1.20 1 MHz to 2 GHz: 1.10 2 GHz to 4.2 GHz: 1.3	Type-N (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
8483A	100 kHz	2 GHz	–30 to +20 dBm	100 kHz to 600 kHz: 1.8 600 kHz to 2 GHz: 1.18	Type-N (m) (75 ohm)	EPM series, EPM-P series, E1416A, P-series* power meters	
8485A	50 MHz	26.5 GHz	–30 to +20 dBm	50 MHz to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 GHz to 12.4 GHz: 1.15 12.4 GHz to 18 GHz: 1.20 18 GHz to 26.5 GHz: 1.25	3.5 mm (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
8485A Option 033	50 MHz	33 GHz	–30 to +20 dBm	50 MHz to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 GHz to 12.4 GHz: 1.15 12.4 GHz to 18 GHz: 1.20 18 GHz to 26.5 GHz: 1.25 26.5 GHz to 33 GHz: 1.40	3.5 mm (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
8487A	50 MHz	50 GHz	–30 to +20 dBm	50 MHz to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 GHz to 12.4 GHz: 1.15 12.4 GHz to 18 GHz: 1.20 18 GHz to 26.5 GHz: 1.25 26.5 GHz to 40 GHz: 1.30 40 GHz to 50 GHz: 1.50	2.4 mm (m)	EPM series, EPM-P series, E1416A, P-series* power meters	

848x Average Power Sensors (continued)

Agilent model	Minimum frequency range	Maximum frequency range	Power level	Maximum SWR	Connector type	Works with	Options
100 mW sensors (–30 to +20 dm)							
R8486A	26.5 GHz	40 GHz	–30 to +20 dBm	1.4	waveguide flange UG-599/U	EPM series, EPM-P series, E1416A, P-series* power meters	
Q8486A	33 GHz	50 GHz	–30 to +20 dBm	1.5	waveguide flange UG-383/U	EPM series, EPM-P series, E1416A, P-series* power meters	
V8486A	50 GHz	75 GHz	–30 to +20 dBm	1.06	waveguide flange UG-385/U	EPM series, EPM-P series, E1416A, P-series* power meters	
W8486A	75 GHz	110 GHz	–30 to +20 dBm	1.08	waveguide flange UG-387/U	EPM series, EPM-P series, E1416A, P-series* power meters	
High sensitivity sensors (100 pW to 10 mW or –70 to –20 dBm)							
8481D	10 MHz	18 GHz	–70 to –20 dBm	10 MHz to 30 MHz: 1.4 30 MHz to 4 GHz: 1.15 4 GHz to 10 GHz: 1.20 10 GHz to 15 GHz: 1.30 15 GHz to 18 GHz: 1.35	Type-N (m)	EPM series, EPM-P series, E1416A, P-series* power meters	H51
8485D	50 MHz	26.5 GHz	–70 to –20 dBm	0.05 GHz to 0.1 GHz: 1.19 0.1 GHz to 4 GHz: 1.15 4 GHz to 12 GHz: 1.19 12 GHz to 18 GHz: 1.25 18 GHz to 26.5 GHz: 1.29	3.5 mm (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
8485D Option 033	50 MHz	26.5 GHz	–70 to –20 dBm	0.05 GHz to 0.1 GHz: 1.19 0.1 GHz to 4 GHz: 1.15 4 GHz to 12 GHz: 1.19 12 GHz to 18 GHz: 1.25 18 GHz to 26.5 GHz: 1.29 26.5 GHz to 33 GHz: 1.35	3.5 mm (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
8487D	50 MHz	50 GHz	–70 to –20 dBm	0.05 GHz to 0.1 GHz: 1.19 0.1 GHz to 2 GHz: 1.15 4 GHz to 12.4 GHz: 1.20 12.4 GHz to 18 GHz: 1.29 18 GHz to 34 GHz: 1.37 34 GHz to 40 GHz: 1.61 40 GHz to 50 GHz: 1.89	2.4 mm (m)	EPM series, EPM-P series, E1416A, P-series* power meters	
R8486D	26.5 GHz	40 GHz	–70 to –20 dBm	1.4	waveguide flange UG-599/U	EPM series, EPM-P series, E1416A, P-series* power meters	
Q8486D	33 GHz	50 GHz	–70 to –20 dBm	1.4	waveguide flange UG-383/U	EPM series, EPM-P series, E1416A, P-series* power meters	

Available options:
001 Installed with APC-7 connector
H42 Factory selected for the best SWR from batch
H51 Guaranteed maximum SWR of 1.2 from 18 to 18.5 GHz (All other specifications are similar to 8481D)
H01 Extended power range from 0 to +50 dBm
H50 Allows an average input power of up to 50 Watts (+47 dBm), (25 Watts is standard power range)
033 Provides extended frequency range to 33 GHz
033 Provides extended frequency range to 33 GHz

Note:
** N1917A/B/C cable adapter & backward compatibility firmware are required*

Power meter compatibility

Power sensor families	EPM series power meter E4418B/19B	EPM-P series power meter E4416A/17A	P-series power meter N1911A/12A
E441x series	Yes	Yes	Yes*
E9300 series	Yes	Yes	Yes*
E9320 series	No	Yes	Yes*
8480 series	Yes	Yes	Yes*
N192xA series	No	No	Yes

Sensor cable compatibility

Power sensor families	Power sensor cable 11730 (grey) 11730A/B/C/D/E/F	Power sensor cable E9288 (blue) E9288A/B/C	Power sensor cable adapter N1917 N1917A/B/C
E441x series	Yes	Yes	Yes
E9300 series	Yes	Yes	Yes
E9320 series	No	Yes	Yes
8480 series	Yes	Yes	Yes

Sensor cables:
N1917A P-series meter cable adapter, 1.5 M (5 ft.)
N1917B P-series meter cable adapter, 3 M (10 ft.)
N1917C P-series meter cable adapter, 10 M (31 ft.)

11730A Power sensor and SNS noise source cable, length 1.5 M (5 ft.)
11730B Power sensor and SNS noise source cable, length 3 M (10 ft.)
11730C Power sensor and SNS noise source cable, length 6.1 M (20 ft.)
11730D Power sensor cable, length 15.2 M (50 ft.)
11730E Power sensor cable, length 30.5 M (100 ft.)
11730F Power sensor cable, length 61 M (200 ft.)

Note:
** N1917A/B/C cable adapter & backward compatibility firmware are required*

21

Agilent 8447D

Agilent 11975A

Agilent 8449B

Agilent 11909A

Agilent 8447 series amplifier (100 kHz to 1300 MHz)

These amplifiers feature low noise and wide bandwidths. They are ideal for improving spectrum analyzer sensitivity and noise figure while providing input isolation. Broad frequency coverage, flat frequency response, and low distortion ensure accurate measurements.

Agilent 11975A amplifier (2 to 8 GHz)

Used in stimulus-response systems, this amplifier allows a wide variety of sources to be leveled to ±1 dB and amplitude calibrated from +6 dBm to +16 dBm. As a preamplifier, its small signal gain varies between 9 and 15 dB depending upon frequency.

Agilent 8449B preamplifier (1 to 26.5 GHz)

This high-gain, low-noise preamplifier increases the sensitivity of any RF/microwave spectrum analyzer for detection and analysis of very low level signals. The improved sensitivity can dramatically reduce measurement time.

Agilent 11909A low noise amplifier (9 kHz to 1 GHz)

The Agilent 11909A amplifier improves receiver and spectrum analyzer sensitivity by offering excellent noise figure (1.8 dB typ.) and gain (32 dB). Radiated emissions from measurements using a spectrum analyzer and antenna are improved by the increased sensitivity that this unit offers. It is ideally suited for use with Agilent 11940A and 11941A close field probes to detect low level emissions.

11940A/11941A close field probe (9 kHz to 30 MHz/30 MHz to 1 GHz)

These are hand-held probe specially designed to measure magnetic field radiation from surface currents, slots, cable, and ICs for EMC diagnostic and troubleshooting measurements. The 11940A covers 9 kHz to 30 MHz, and the 11941A covers 30 MHz to 1 GHz. Their unique design results in a high level of electric field rejection. This significantly reduces errors allowing calibrated and repeatable measurements. Each probe is calibrated and comes with a two-meter, RG-223 coaxial cable, an SMA (f) to Type-N (m) adapter, and an SMA (f) to BNC (m) adapter.

Agilent 11694A 75 Ω matching transformer (3 to 500 MHz)

Allows measurements in 75 Ω systems while retaining amplitude calibration with a 50 Ω spectrum analyzer input. VSWR is less than 1.2; insertion loss is less than 0.75 dB. See Option 001 and 002 for 75 Ω versions of the Agilent 8590 series spectrum analyzer. Connectors are type BNC (m) 50Ω to BNC (f) 75Ω.

Agilent 86205A RF Bridge (300 kHz to 6 GHz, 50 Ω)

The Agilent 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.

Agilent 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.

Agilent 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 Agilent spectrum analyzers including the PSA, ESA, and 856xEC series and network analyzers like the PNA series, 4395, 871x, 875x and 872x.

Agilent 41800A active probe

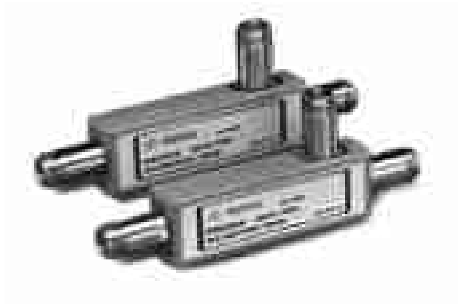
This probe offers high input impedance from 5 Hz to 500 MHz. It works with many Agilent spectrum analyzers to evaluate the quality of circuits by measuring spurious level, harmonics, and noise. Low input capacitance offers probing with negligible circuit loading for precise, in-circuit measurements of audio, video, HF, and VHF bands.

Agilent 11742A blocking capacitor

The Agilent 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 Agilent 11742A suppresses low frequency signals that can damage expensive measuring equipment or affect the accuracy of your RF and microwave measurements.

Agilent 11694A

Agilent 86205A/86207A



Ordering information

Agilent 8447A: 0.1 to 400 MHz amplifier
Agilent 8447D: 0.1 to 1300 MHz amplifier
Agilent 11909A: 9 kHz to 1 GHz amplifier
Agilent 11975A: 2 to 8 GHz amplifier
Agilent 8449B: 1 to 26.5 GHz preamplifier
Agilent 87405B: 10 MHz to 4 GHz preamplifier
Agilent 11867A: DC to 1.8 GHz RF limiter
Agilent 11694A: 75 Ω matching transformer
Agilent 11852B: 75 Ω minimum-loss pad
  Option 004: 50 Ω Type-N (m), 75 Ω Type-N (f)
Agilent 86205A: 50 Ohm RF bridge (300 KHz to 6 GHz)
Agilent 86207A: 75 Ohm RF bridge (300 KHz to 3 GHz)
Agilent 85024A: High-frequency probe
Agilent 41800A: 5 Hz to 500 MHz active probe
Agilent 11940A: Close field probe (9 kHz to 30 MHz)
Agilent 11941A: Close field probe (30 MHz to 1 GHz)

Agilent 87405B preamplifier (10 MHz to 4 GHz)

The Agilent 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.

Agilent 11867A limiters

These limiters 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. The Agilent 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.

Agilent 87405B

Agilent 11867A

Waveguide Accessories

22

Waveguide accessory selection guide

Type	Application	Agilent model number series [1]	X 8.20 – 12.4	P 12.4 – 18.0	K 18.0 – 26.5	R 26.5 – 40.0	Q 33.0 – 50.0	U 40.0 – 60.0	V 50.0 – 75.0	W 75.0 – 110.0
			Frequency coverage by band (GHz)							
Adapters	Coaxial to waveguide interconnect	281A	X			X	X	X	X	
		281B		X		X	X	X	X	
		281C	X	X	X				X	X
		281D							X	X
Detectors	Detect RF power, CW or pulsed; measure reflection coefficient, insertion loss	422C				X				
Calibration and verification kits [2]	Network analyzer accessories	11644A	X	X	X	X	X	X	X	X
		11645A				X	X	X	X	X

[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.*

Agilent 281 series adapters

Agilent 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

Agilent 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 **Option 012:** N (m) **Option 013:** N (f)	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 64	1.17	WR-15 —	385 —	1.85 mm (f)	32 (1.25)	0.2 (0.5)
V281B	50 to 64	1.17	WR-15 —	385 —	1.85 mm (m)	32 (1.25)	0.2 (0.5)
V281C	50 to 75	1.16	WR-15 3-018	385 67B-002	1.0 mm (f)	32 (1.25)	0.1 (0.2)
V281D	50 to 75	1.16	WR-15 3-018	385 67B-002	1.0 mm (m)	32 (1.25)	0.1 (0.2)
W281C	75 to 110	1.16	WR-10 3-024	387 67B-010	1.0 mm (f)	32 (1.25)	0.1 (0.2)
W281D	75 to 110	1.16	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 Agilent products.*
[2] *Option 006 adds two alignment holes.*

Agilent R422C detector

The Agilent R422C is a 26.5 to 40 GHz GaAs Planar Doped Barrier diode detector. It comes standard with negative output polarity.

Specifications

Agilent 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 Agilent products.*

Agilent R422C

Agilent waveguide product data

Agilent band designation	Frequency range TE_{10} mode (GHz)	Waveguide band designator [1] EIA WR-( )	IEC R-( )	British WG-( )	JAN RG-( )/U	MIL-W-85/( )	Other common usage	Materials [1]	Flange designator [1] Cover MIL-F-3922/()	Cover JAN UG-()/U	Cover EIA CMR-( )	Choke MIL-F 3922/( )	Choke JAN UG-( )/U	Choke EIA CPR-( )
S	2.6 to 3.95	284	32	10	75	1-041		Alum alloy	56B-002	584	284	61-001	585A	284
G	3.95 to 5.85	187	48	12	95	1-053	C, H	Alum alloy	57B-001	407	187	62-001	406B	187
J	5.85 to 8.2	137	70	14	106	1-065	Xn, C, G	Alum alloy	55B-002	441	137	60-002	440B	137
H	7.05 to 10	112	84	15	51 68	1-073 1-072	Xb, W	Copper alloy Alum alloy	54C-005 54C-006	51 138	112 —	59D-015 59D-016	522B 137B	 112
X	8.2 to 12.4	90	100	16	52 67	1-079 1-078		Copper alloy Alum alloy	54C-007 54C-008	39 135	90 —	59D-013 59D-014	40B 136B	— 90
M	10 to 15	75	120	17	346 347	1-085 1-084		Copper alloy Alum alloy	70A-004 70A-005	— —	75 —	59D-010 —	— —	— —
P	12.4 to 18	62	140	18	91 349	1-089 1-091	Ku, Y, U	Copper alloy Alum alloy	70A-007 70A-008	419 —	— —	59D-001 59D-002	541A —	— —
N	15 to 22	51	180	19	353 351	1-096 1-098		Copper alloy Alum alloy	70A-010 70A-011	— —	— —	69D-004 69D-005	— —	— —
K	18 to 26.5	42	220	20	53 121	1-102 1-104		Copper alloy Alum alloy	54C-001 54C-002	595 597	— —	59D-003 59D-004	596A 598A	— —
R	26.5 to 40	28	320	22	96 —	3-007 3-009	V, Ka, U, A	Copper alloy Alum alloy	54C-003 —	599 —	— —	59D-005 —	600A —	— —
Q	33 to 50	22	400	23	272 —	3-011 3-013		Copper alloy Alum alloy	67B-006 67B-013	383 —	— —	— —	— —	— —
U	40 to 60	19	500	24	358 —	3-015 —		Copper alloy Alum alloy	67B-007 —	383 (mod) —	— —	— —	— —	— —
V	50 to 75	15	620	25	273 —	3-018 —	M	Copper alloy Alum alloy	67B-002 —	385 —	— —	— —	— —	— —
W	75 to 110	10	900	27	359 —	3-024 —		Copper alloy Alum alloy	67B-010 —	387 (mod) —	— —	— —	— —	— —

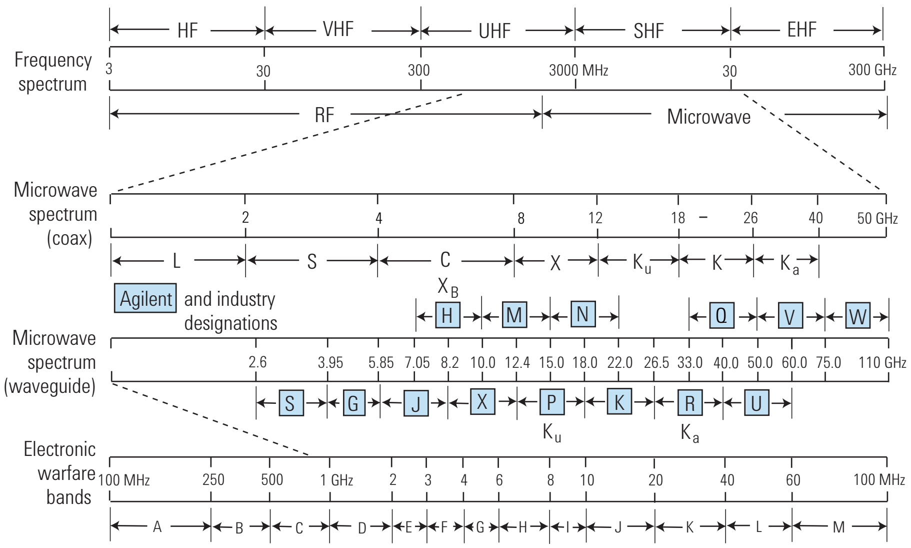
[1] *The waveguide/flange designator is provided to determine interface dimensions and generic material of Agilent products.*

Abbreviations
EIA – Electronic Industries Association
IEC – International Electrotechnical Commission
JAN – Joint Army Navy

Agilent waveguide product data (continued)

Agilent band designation	Waveguide dimensions: Inside dimensions Width mm (in)	Height mm (in)	Tol ± mm (in)	Outside dimensions Width mm (in)	Height mm (in)	Tol ± mm (in)	Nom. wall thickness mm (in)	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)
S	72.14 (2.84)	34.04 (1.34)	0.15 (0.006)	76.20 (3.0)	38.10 (1.5)	0.15 (0.006)	2.03 (0.08)	2.08	0.950 to 0.651	7.645 to 10.85	13.42 to 19.59
G	47.55 (1.872)	22.15 (0.872)	0.13 (0.005)	50.80	25.40 (2.0)	0.13 (1.0)	1.63 (0.005)	3.155 (0.064)	1.785 to 1.238	3.296 to 4.69	5.165 to 7.446
J	34.85 (1.372)	15.80 (0.622)	0.10 (0.004)	38.10 (1.5)	19.05 (0.75)	0.10 (0.004)	1.63 (0.064)	4.285	3.532 to 1.999	1.975 to 2.53	2.076 to 3.667
H	28.50 (1.122)	12.62 (0.497)	0.10 (0.004)	31.75 (1.250)	15.88 (0.625)	0.10 (0.004)	1.63 (0.064)	5.260 5.260	4.114 to 3.197 4.166 to 3.238	1.284 to 1.702 1.284 to 1.702	1.607 to 2.067 1.523 to 1.958
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
M	19.05 (0.75)	9.53 (0.375)	0.08 (0.003)	21.59 (0.850)	12.07 (0.475)	0.08 (0.003)	1.27 (0.05)	7.847 7.847	7.601 to 5.309 7.698 to 5.377	0.622 to 0.903 0.622 to 0.903	0.6621 to 0.9479 0.6273 to 0.8982
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
N	12.95 (0.51)	6.48 (0.255)	0.06 (0.0025)	14.99 (0.59)	8.51 (0.335)	0.08 (0.003)	1.02 (0.04)	11.54 11.54	13.08 to 9.477 13.25 to 9.598	0.312 to 0.433 0.312 to 0.433	0.2899 to 0.4000 0.2746 to 0.3791
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



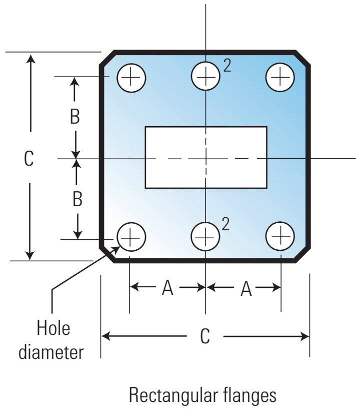


Figure 1. Rectangular flanges H, X, M, P, N, K, R Bands

Agilent flange data (7.05 to 40.0 GHz) [1]

	Waveguide designator			Flange designator			Dimensions mm (in)			
Agilent band	Frequency range (GHz)	EIA	MIL-W-85/( )	Material B: Copper alloy A: Alum. alloy	JAN UG-( )/U	MIL-F-3922/( )	A	B	C	Hole diameter
H	7.05 to 10	WR-112	1-073 1-072	B A	51 138	54C-005 54C-006	17.2 (0.676)	18.7 (0.737)	47.6 (1.875)	4.3 (0.169)
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)
M	10 to 15	WR-75	1-085 1-084	B A	— —	70A-004 70A-005	13.2 (0.52)	14.2 (0.561)	38.1 (1.50)	3.6 (0.14)
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)
N	15 to 22	WR-51	1-096 1-098	B A	— —	70A-010 70A-011	10.3 (0.405)	11.3 (0.443)	30.1 (1.187)	3.6 (0.14)
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*

Waveguide Accessories

Waveguide Accessories (continued)

Agilent circular flange data (2.6 to 8.2 GHz) [1]

Agilent band	Frequency range (GHz)	Waveguide designator: EIA	Waveguide designator: MIL-W-85/( )	Material	Flange designator: MIL-F-3922/( )	Flange designator: JAN UG-( )/U
S	2.60 to 3.95	WR-284	1-041	Alum. Alloy	56B-002	584
G	3.95 to 5.85	WR-187	1-053	Alum. Alloy	57B-001	407
J	5.85 to 8.20	WR-137	1-065	Alum. Alloy	55B-002	441

[1] *See Figures 2a, 2b, and 2c.*

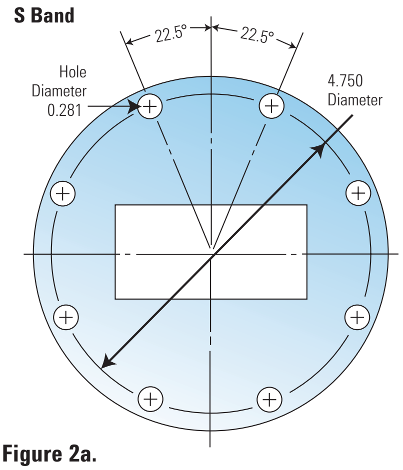


Figure 2a.

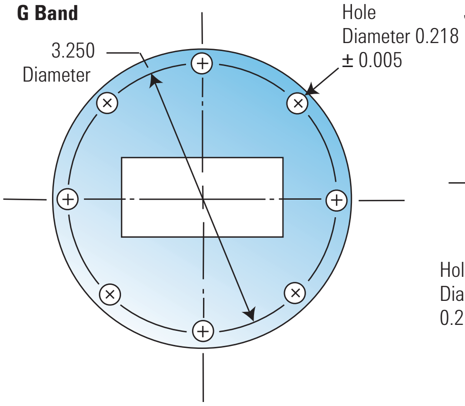


Figure 2b.

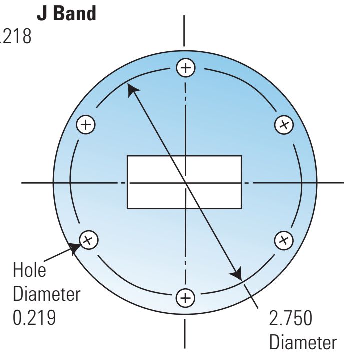


Figure 2c.

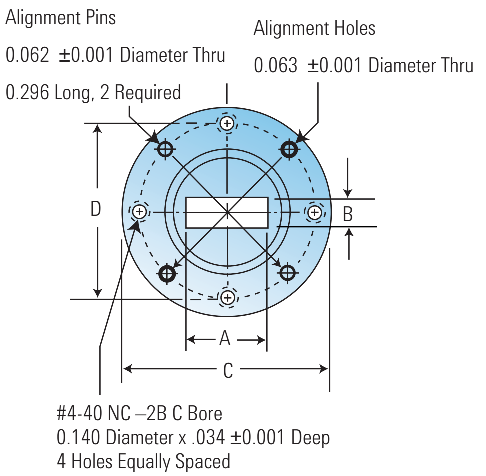


Figure 3. K, R, Q, U, V, W Bands

Agilent precision circular flange data (18.0 to 110.0 GHz) [2]

Agilent band	Frequency range (GHz)	Waveguide designator: EIA	Waveguide designator: MIL-W-85/( )	Flange designator: Material B: Copper alloy A: Alum. alloy	Flange designator: MIL-F-3922/( )	Flange designator: JAN UG-( )/U	Dimensions mm (in): A	Dimensions mm (in): B	Dimensions mm (in): C diameter	Dimensions mm (in): 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)

[2] *See Figure 3.*

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23

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