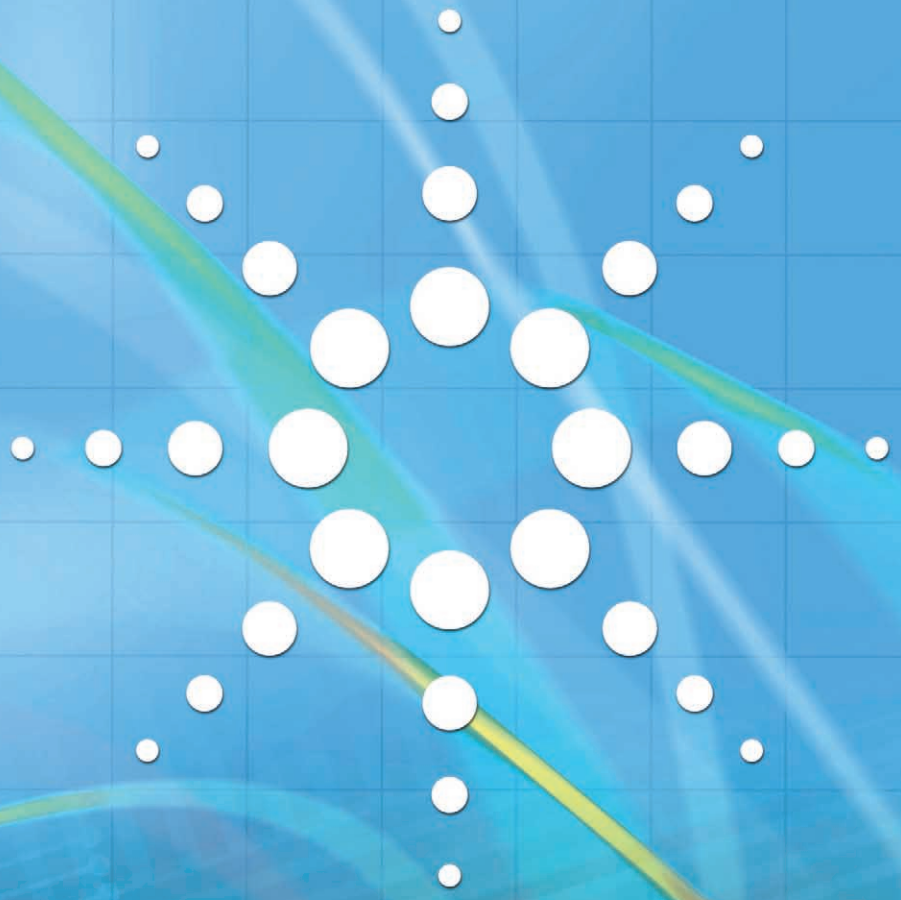


Agilent

RF and Microwave Test Accessories Catalog

Agilent Technologies

Innovating the HP Way

Table of Contents 1

Agilent offers the broadest line of RF and microwave test accessories.

Dear Agilent customer:

As you may have heard, Hewlett-Packard recently decided to realign into two independent companies, enabling each one to better serve its core group of customers. The computing and imaging businesses will continue under the HP name, while the test and measurement business, along with the semiconductor components and chemical analysis, is now known as Agilent Technologies.

We're excited by the opportunity to return to our roots in test and measurement, focusing all our energies on the needs of the engineers. Building on the HP heritage of quality and innovation with a new organization concentrated on serving engineers' needs, we strive to offer the best possible combination of value, performance, and customer assistance. From comprehensive information on the Web to technical assistance from experienced engineers, we're ready to make sure you get the most from your Agilent accessories.

Complete accessory solutions for all of your RF and microwave engineering challenges

The accessories catalog allows you to quickly and conveniently research the RF and microwave test accessories you need to get back to focusing on your test challenges.

Quality and innovation is the foundation of Agilent's heritage and our product solutions. Our accessories are the result of decades of innovation in creating the key 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.

Quality: There is no limit to Agilent's commitment

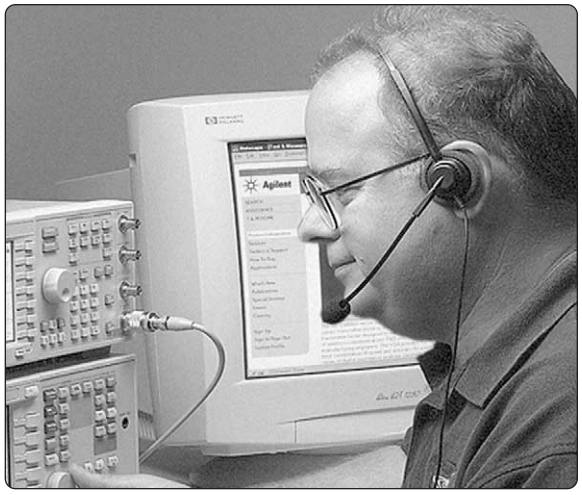
Quality is a passion for the Agilent engineers who design and manufacture our RF and microwave test accessories. We give you exceptional precision through our integrated approach to manufacturing, such as the advanced fabrication facilities with state-of-the-art milling equipment and sophisticated metallurgical and plating processes. This commitment to quality ensures you will always have:

- Exceptional reliability – our products meet their specs for their entire specified life.
- Long life – many of our switches are specified for 5 million cycles.
- High accuracy – our worst case performance gives you more margin for your measurements.
- Excellent repeatability – the precision of our accessories means less variability in your measurements.

1

Satisfaction guaranteed

Your purchases are protected by standard Agilent warranties, and if you're not satisfied with your new Agilent accessory, for any reason, simply return it for a full refund. It's the sort of approach you'd expect engineers to come up with: minimize the headaches, maximize the results, and get out of the way so people can get their work done.



By engineers, for engineers

Easy access to knowledgeable test and measurement experts

Beyond the accessories themselves, we aim to be the ideal test equipment partner, with efficient information access, knowledgeable advice from fellow engineers, and fast response to questions and problems.

When you call Agilent, you can talk to experienced test and measurement engineers. Describe your application and we'll work with you to find the best solution inside your budget. And after you buy, you can take advantage of continuing technical support, making sure your accessory works as expected.

Straightforward and complete accessories information online

For the times when you need quick access to product information, we've placed extensive product and application information online.

The accessories' web site lets you take immediate action, at any time. Whether you need a quick answer to a simple question or detailed product specifications, we've assembled a variety of information sources to meet your needs.

Go online at www.agilent.com/find/accessories and you'll find links that let you research products and explore application notes.

Agilent Technologies is about engineers serving the needs of fellow engineers, with innovation, integrity, and respect for everything the term "engineer" represents. We look forward to helping you meet your engineering challenges, no matter where they may take you.

Visit Agilent's accessories home page at **www.agilent.com/find/accessories** for product and support information.

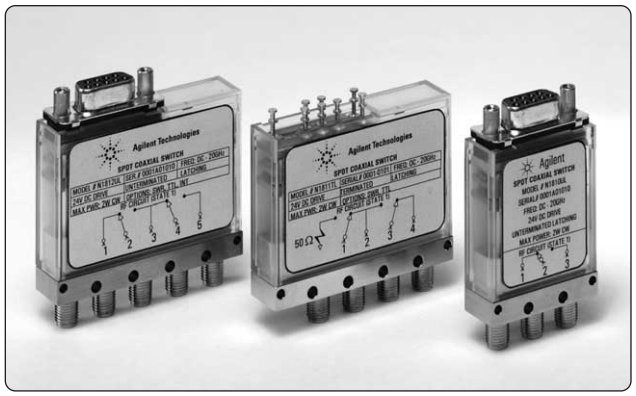
For answers to any test and measurement questions, call Agilent Technologies at **1-800-452-4844**.

See page 203 for ordering information and further information on how to contact Agilent Technologies.

Questions? Call Agilent at **1-800-452-4844**

For the latest updates and additions to this listing visit Agilent's website:

http://www.agilent.com/find/accessories



Agilent N1810/1/2 latching coaxial switch

RF & Microwave test accessories

For designers of high-volume wireless manufacturing test systems, Agilent offers a new, versatile family of electromechanical switches. Combining industry-leading isolation performance with long life and excellent repeatability, these switches safeguard your test platform from failures, recalibration, downtime, and lost production. By fully customizing the manufacturing and ordering process, Agilent allows you to pay for only the performance you need. Options include:

- Reduced SWR
- Increased isolation
- Position indicators
- Current interrupts
- Standard or TTL/5V CMOS compatible drive
- D-subminiature 9-pin connectors or solder lug terminals
- 5V, 15V, or 24V coil voltage levels

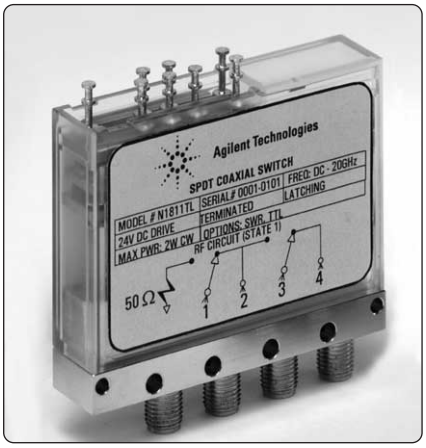
Key specifications

- 5 million lifecycles
- .03 dB repeatability
- 90 dB isolation @ dc standard

Agilent N1810UL – Unterminated latching

The Agilent N1810UL is a single-pole double-throw switch available in the frequency range from dc to 26.5 GHz. In precision measurements and monitoring applications where insertion loss repeatability is crucial, these switches operate in excess of 5 million cycles with better than .03 dB of insertion loss repeatability at 25°C.

New Products Highlights (continued)



Agilent N1810TL - Terminated latching

The Agilent N1810TL is a single-pole double-throw switch available in the frequency range from dc to 26.5 GHz. The unused port is terminated into 50 ohms, making it ideal for applications where port matching is required.

Agilent N1811TL - Terminated latching

The N1811TL is a terminated bypass switch available in the frequency range from dc to 26.5 GHz. The switch's internal load can terminate the device under test when in the bypass mode (up to 1 watt). Because of its compact design, it is ideal for drop-in, dropout applications.

Agilent N1812UL - Unterminated latching

The N1812UL is a versatile, unterminated 5-port switch available in the frequency range from dc to 26.5 GHz. In transfer switch applications, the fifth port can be terminated externally with a high-power termination. It can also be utilized for signal path reversal or as a calibration port.

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-ohm connector was designed in the 1940s for military systems operating below 4 GHz. In the 1960s, improvements pushed performance to 12 GHz and later, 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-ohm products use a type-N design with smaller center conductor diameters, and thus are not compatible with 50-ohm connectors.

SMA connector

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

3.5-mm connector

The 3.5-mm connector was primarily developed at Hewlett Packard—now 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. Many experts have considered this connector to be the smallest possible coaxial connector for common usage up to 65 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-ohm and 75-ohm 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.

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)
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 selection guide[1]

Connector type	1.85 mm	2.4 mm	2.92 mm	3.5 mm	7 mm	50 Ω Type-N	75 Ω Type-N
1.85 mm[2]	85058-60007 85058-60008 85058-60009						
2.4 mm		11900A,B,C	11904A,B,C,D	11901A,B,C,D	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	
7 mm						11524A, 11525A	
50 Ω Type-N							11852B

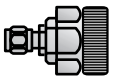
[1] See page 18 for general purpose grade adapters. See Network Analyzer/Waveguide Accessories chapters for additional adapter products.
[2] 1.85 mm is compatible with 2.4 mm. To adapt 1.85 mm to other connector types, use Agilent 1190X series adapters.

Typical configuration

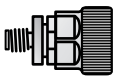
Agilent 11900A
Agilent 11901A
Agilent 11904A
Agilent 83059A
Agilent 1250-1159
Agilent 1250-1748
85058-60007

Agilent 11900B
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



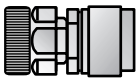
Agilent 11534A
Agilent 1250-1747

Agilent 11903A
Agilent 1250-1636
Agilent 1250-1743

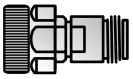
Agilent 11903D
Agilent 1250-1250
Agilent 1250-1744

Agilent 11903C
Agilent 1250-1562
Agilent 1250-1750

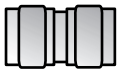
Agilent 11903B
Agilent 1250-1745
Agilent 1250-1772



Agilent 11525A



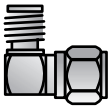
Agilent 11524A



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

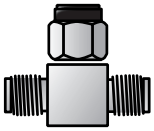
Agilent 1250-0777
Agilent 1250-1472
Agilent 1250-1529

Agilent 11852B
Agilent 11852B Opt. 004
Agilent 1250-0597

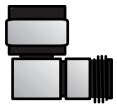


Agilent 1250-1249

Agilent 1250-1397



Agilent 1250-1698



Agilent 1250-0176

Agilent 1250-0559

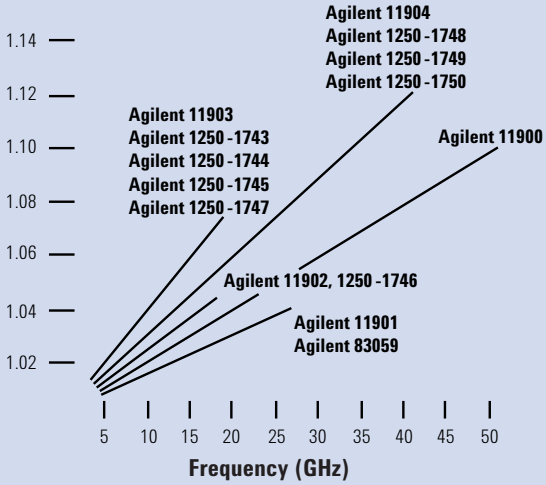
Agilent 1250-0846

Metrology grade [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 $|\Delta\Gamma|$,where $|\Delta\Gamma| = |\Gamma m_1 - \Gamma m_2|$.
[4] 2.92 mm is compatible with 3.5 mm.

Typical precision adapter performance



Instrument grade

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 ohm Type-N (f), 75 ohm Type-N (m)	dc to 3 GHz	30 dB	60.1 (2.37)	50.2 (1.98)	22 (0.87)
11852B Opt. 004[4]	50 ohm Type-N (m), 75 ohm 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-18
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 Adapters

General purpose grade selection guide

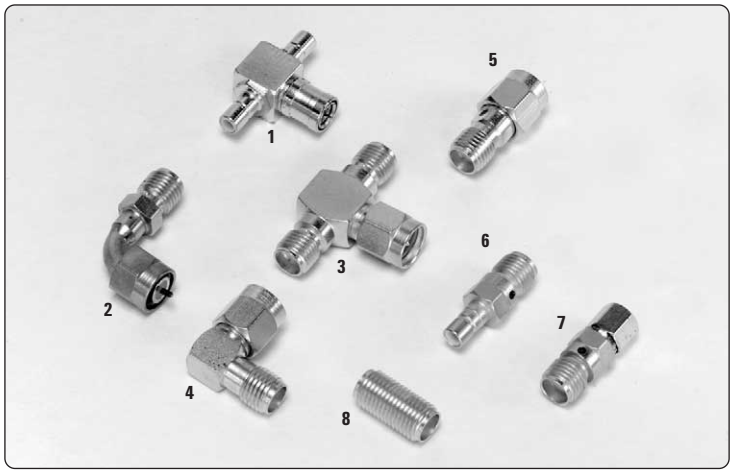
Adapters APC-7[1]	
11524A	APC-7 to Type-N (f)
11525A	APC-7 to Type-N (m)
11533A	APC-7 to SMA (m)
11534A	APC-7 to SMA (f)
Adapters Type-N, standard 50 Ω	
	SWR <1.03 to 1.3 GHz
1250-1472	Type-N (f) to Type-N (f)
1250-1473	Type-N (m) to BNC (m)
1250-1474	Type-N (f) to BNC (f)
1250-1475	Type-N (m) to Type-N (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)

General purpose grade (continued)

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 (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 Ohm
5 Agilent 1250-1473 Standard, N (m) to BNC (m), Precision 50 Ohm Adapter
6 Agilent 1250-0595 Adapter, BNC (f) to BNC Triaxial (m)
7 Agilent 1250-1930 Adapter, BNC (m) to BNC (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

1 Agilent 1250-0597 Adapter, Type-N (m) 50 Ohm to Type-N (f) 75 Ohm
2 Agilent 1250-1778 Standard N (m) to Standard N (m) Adapter, 50 Ohm
3 Agilent 1250-1529 Standard N (f) to Standard N (f) Adapter, 75 Ohm
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 Ohm
8 Agilent 1250-1533 Standard N (m) to BNC (m) Adapter, 75 Ohm
9 Agilent 1250-1250 Adapter, Type-N (m) to SMA (f), 50 Ohm
10 Agilent 1250-0846 Tee Adapter, Standard N (f) (f) (f)
11 Agilent 1250-1636 Adapter, Type-N (m) to SMA (m) 50 Ohm
12 Agilent 1250-0559 Tee Adapter, Standard N (m) (f) (f)
13 Agilent 1250-0176 Right Angle Standard N (m) to Standard N (f)

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

Increased measurement versatility

For Microwave and RF engineers making coax measurements at 50, 65 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 ohm 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 8510XF.

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

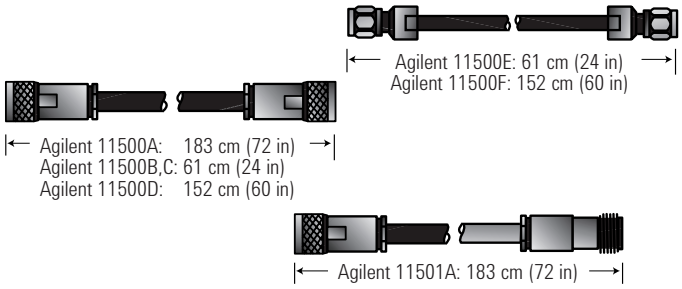
Each connector has an air dielectric interface and a center conductor that is supported by a low-loss plastic bead. Available with male and female connectors, these Agilent 1.0 mm adapters provide ease-of-use for microwave engineers who need to connect their test systems. The Agilent 1.0 mm adapters 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	11921A 11921B 11921C 11921D	11922A 11922B 11922C 11922D	11923A
Features	← Excellent accuracy and Measurement versatility →			
Frequency range	dc-20 GHz 20-50 GHz 50-75 GHz 75-110 GHz	dc - 65 GHz	dc - 50 GHz	dc - 110 GHz
Frequency response				
Insertion loss:	-0.5 dB	-0.5 dB	-0.7 dB	-1.0 dB
Return loss:	-24 dB dc-20 GHz -20 dB 20-50 GHz -18 dB 50-75 GHz -14 dB 75-110 GHz	-20 dB	-20 dB	-16 dB
Input power				
Max CW power	← 10 W →			6W
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:	1mm(m) to 1mm(m)	1mm(m) to 1.85mm(m)	1mm(m) to 2.4mm(m)	1mm(f) to circuit card launch
B:	1mm(f) to 1mm(f)	1mm(f) to 1.85mm(f)	1mm(f) to 2.4mm(f)	
C:	1mm(m) to 1mm(f)	1mm(m) to 1.85mm(f)	1mm(m) to 2.4mm(f)	
D:		1mm(f) to 1.85mm(m)	1mm(f) to 2.4mm(m)	

[1] Measured at 25° C

Cables, Connector Bead



Agilent model	Frequency range (GHz)	Length (nom) cm (in)	Connectors	SWR (max)	Insertion loss (nom)(dB)
11500A	dc to 12.4	183 (72)	Type-N (m) (2)	—	—
11500B	dc to 12.4	61 (24)	Type-N (m) (2)	—	—
11501A	dc to 12.4	183 (72)	Type-N (m) to Type-N (f)	—	—
11500C	dc to 18	61 (24)	Precision N (m) (2)	1.4	1.5
11500D	dc to 18	152 (60)	Precision N (m) (2)	1.4	3.0
11500E	dc to 26.5	61 (24)	3.5 mm (m) (2)	1.4	2.0
11500F	dc to 26.5	152 (60)	3.5 mm (m) (2)	1.4	4.0

Precision 7-mm connector bead

Agilent 33391C microwave insulator (bead) assembly

The Agilent 33391C insulator bead assemblies are designed for use in 7-mm connectors such as type-N and APC-7. These are temperature stable devices, giving low-signal loss due to their excellent reflection characteristics. They operate up to 18 GHz. The Agilent 33391C assemblies are packaged in convenient quantities of 50 per container.

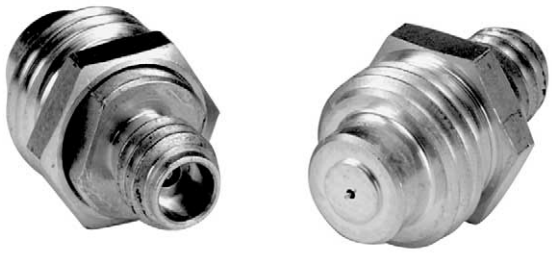
Agilent 33391C specifications

SWR (typ): 1.004, dc to 2 GHz; 1.004 + 0.0009/GHz, 2 to 18 GHz
Inner/Outer Ring Coplanarity: ±0.0005 inch typ., ± 0.0007 inch maximum

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 8510XF 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 (see figure 1). 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".

1.0mm (f) connector launch

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

Supplemental characteristics

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

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	Page
Type-F(75 ohm)	DC to 3	Economy	5%-1%	**85039B**	1BP, 1BN, UK6, 00M, 00F	88
Type-N(75 ohm)	DC to 3	Economy	5%-1%	**85036E**	1BN, 1BP, UK6, 910	89
Type-N(75 ohm)	DC to 3	Standard	5%-1%	**85036B**	1BN, 1BP, UK6, 910	89
Type-N(50 ohm)	DC to 6	Economy	5%-1%	**85032E**	1BN, 1BP, UK6, 910	90
Type-N(50 ohm)	DC to 6	Standard	5%-1%	**85032B**	1BN, 1BP, UK6, 910, 001	90
Type-N(50 ohm)	DC to 9	Standard	5%-1%	**85032F**	1BN, 1BP, UK6, 100, 200,300,400*	92
Type-N(50 ohm)	0.045 to 18	Economy	5%-1%	**85054D**	1BN, 1BP, 002	94
Type-N(50 ohm)	0.045 to 18	Standard	2%-0.3%	**85054B**	1BN, 1BP, 002	93
7-16	DC to 7.5	Standard	2%	**85038A**	none	95
7-16	DC to 7.5	Standard	2%	**85038F**	none	95
7-16	DC to 7.5	Standard	2%	**85038M**	none	95
7 mm	DC to 6	Economy	2%-0.3%	**85031B**	1BN, 1BP, UK6, 910	96
7 mm	0.045 to 18	Economy	5%-1%	**85050D**	1BN, 1BP, 910, 002	96
7 mm	0.045 to 18	Standard	2%-0.05%	**85050B**	1BN, 1BP, 910, 002	97
7 mm	0.045 to 18	Precision	0.3%-0.05%	**85050C**	1BN, 1BP, 910, 002	98
3.5 mm	DC to 6	Economy	5%-1%	**85033D**	1BN, 1BP, UK6, 910, 001, 002	99
3.5 mm	DC to 9	Standard	5%-1%	**85033E**	1BN, 1BP, UK6, 100, 200, 300, 400**,500	100
3.5 mm	0.045 to 26.5	Economy	5%-1%	**85052D**	1BN, 1BP, 910, 002	101
3.5 mm	0.045 to 26.5	Standard	3%-0.5%	**85052B**	1BN, 1BP, 910, 002	102
3.5 mm	0.045 to 26.5	Precision	2%-0.5%	**85052C**	1BN, 1BP, 910, 002	103
2.92 mm	0.045 to 50	Economy	11%-4% (Option 001 65%-3%)	**85056K**	1BN, 1BP, 001*, 002	104, 105
2.4 mm	0.045 to 50	Economy	5%-1%	**85056D**	1BN, 1BP, 910, 002	106
2.4 mm	0.045 to 50	Standard	4%-0.5%	**85056A**	1BN, 1BP, 910, 002	107
1 mm	0.045 to 110	Precision	5%-1%	**85059A**	none	108, 109

Option description

002: Add calibration/verification data on magnetic tape in addition to 3.5" floppy
002*: Replaces 7 mm to 3.5 mm adapters with Type-N to 3.5 mm adapters
1BN: MIL standard 45662A calibration certification
1BP: MIL standard 45662A calibration certification with test data
UK6: Commercial calibration certificate with test data
00M: Includes male standards & male-male adapter
00F: Includes female standards and female-female adapter
001: Deletes 7 mm to 3.5 mm adapters
001*: Adds 2.4 mm sliding load and 2.4 mm gauges
001:** Adds data for Agilent 8702 lightwave component analyzer
100: Includes female-female adapter
200: Includes male-male adapter
300: Includes male-female adapter
400*: Adds four 7 mm to Type-N adapters
400:** Adds four 3.5 mm to Type-N adapters
500: Adds four 7 mm to 3.5 mm adapters
910: Adds extra manual

Note: For more information on connector care, visit the website *http://www.agilent.com/go/mta/support/faq*

Waveguide mechanical calibrations kits

Connector	Frequency range	Type	VNA calibration accuracy	Agilent model	Available options	Page
WR-90	8.2 to 12.4	Precision	0.3%-0.05%	**X11644A**	002	110
WR-62	12.4 to 18	Precision	0.3%-0.05%	**P11644A**	002	111
WR-42	18 to 16.5	Precision	0.3%-0.05%	**K11644A**	002	112
WR-28	26.5 to 40	Precision	0.3%-0.05%	**R11644A**	002	113
WR-22	33 to 50	Precision	0.3%-0.05%	**Q11644A**	002	114
WR-19	40 to 60	Precision	0.3%-0.05%	**U11644A**	002	115
WR-15	50 to 75	Precision	0.3%-0.05%	**V11644A**	002	116
WR-10	75 to 110	Precision	0.3%-0.05%	**W11644A**	002	117

Coaxial electronic calibration kits (ECal)

Connector	Frequency range(GHz)	Type	VNA calibration accuracy	Agilent model	Available options	Page
7 mm	30 kHz to 9 GHz	Standard	1% - 0.1%	**85091B**	See detailed descriptions	118
Type-N (50 ohm)	30 kHz to 9 GHz	Standard	1% - 0.1%	**85092B**		118, 119, 120
3.5 mm	30 kHz to 9 GHz	Standard	2% - 0.2%	**85093B**		118, 119, 121
Type-N (75 ohm)	30 kHz to 3 GHz	Standard	N/A	**85096B**		119
7-16	30 kHz to 7.5 GHz	Standard	N/A	**85098B**		119
Type-F	30 kHz to 3 GHz	Standard	N//A	**85099B**		119
7 mm	1 GHz to 18 GHz	Standard	2% - 0.05%	**85060B**		118, 119, 120
3.5 mm	1 GHz to 26.5 GHz	Standard	3% - 0.5%	**85062B**		118, 119, 121
Type-N (50 ohm)	1 GHz to 18 GHz	Standard	2% - 0.1%	**85064B**		118, 119, 120
PC Interface kit	N/A	N/A	N/A	**85097A**		118

Mechanical verification kits

Connector	Frequency Range(GHz)	Type	VNA calibration accuracy	Agilent model	Available options	Page
Type-N	0.045 to 18 GHz	Precision	N/A	**85055A**	1BP,002,910	123
7 mm	DC to 6 GHz	Precision	N/A	**85092B**	1BP,001**,910	123
7 mm	0.045 to 18 GHz	Precision	N/A	**85051B**	1BP,002,910	124
3.5 mm	0.045 to 26.5 GHz	Precision	N/A	**85053B**	1BP,002,910	124
2.4 mm	0.045 to 50 GHz	Precision	N/A	**85057B**	1BP,002,910	125
WR-28	26.5 to 40	Precision	N/A	**R11645A**	1BP,002	125
WR-22	33 to 50	Precision	N/A	**Q11645A**	1BP,002	126
WR-19	40 to 60	Precision	N/A	**U11645A**	1BP,002	126
WR-15	50 to 75	Precision	N/A	**V11645A**	1BP,002	127
WR-10	75 to 110	Precision	N/A	**W11645A**	1BP,002	127

Option description

002: Add calibration/verification data on magnetic tape in addition to 3.5" floppy
1BN: MIL standard 45662A calibration certification
1BP: MIL standard 45662A calibration certification with test data
UK6: Commercial calibration certificate with test data
00M: Includes male standards & male-male adapter
00F: Includes female standards and female-female adapter
001: Deletes 7 mm to 3.5 mm adapters
001*: Adds 2.4 mm sliding load an 2.4 mm gauges
001:** Adds data for Agilent 8702 lightwave component analyzer
910: Adds extra manual

Agilent 83020A

Agilent 83017A

Agilent 83018A

Agilent 83006A

Agilent 83050/51A

Agilent 87415A

Agilent 87405A

The Agilent 83006/018/020/050/051A 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 87405A 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 87405A). 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 34.

Specifications (+20 to +30 °C)

Agilent model	Frequency (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 - 0.75Δf) dBm [2] (64 - 7.8Δf) mw [2] (20 ≤ f ≤ 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 - 0.7Δf) dBm min [2] (1000 - 65Δf) mw min [2] (20 ≤ f ≤ 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 - 0.2Δf) dBm [3] (80 - 3.1Δf) mw [3] (40 < f ≤ 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)
87405A	0.01 to 3	+7/5 typ.	+4/2.5	22 min 27 max	6.5 to 2 GHz 7.5 to 3 GHz	No	+15 V @ 80 mA	N (f) N (m)
87415A	2 to 8	+26/400 typ.	+23/200	25	13	No	+12 V @ 900 mA	SMA (f)

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 87405A:** 0.27 kg (0.6 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 34.

Power supply specifications

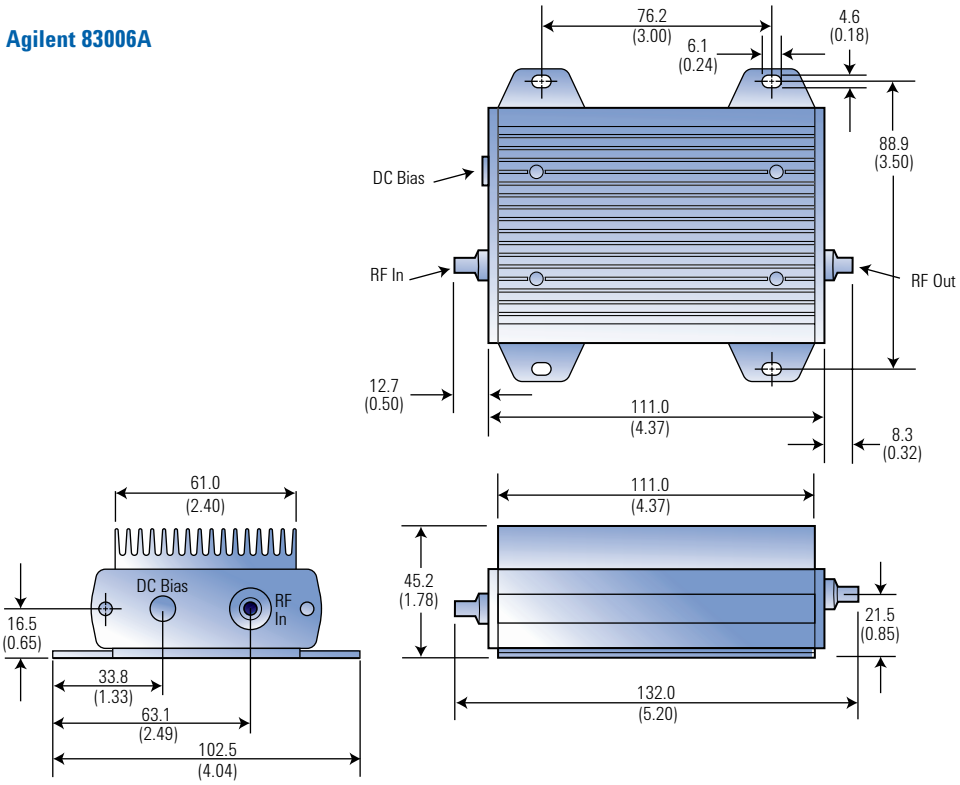
Agilent model	ac Input voltage	dc Output (nom)	Output power	Size (H,W,D)
87421A	100 to 240 VAC 50/60 Hz	+12 V @ 2.0 A, -12 V @ 200 mA	25 W max	57, 114, 176 mm 2.3, 4.5, 6.9 in
87422A [4]	100 to 240 VAC 50/60 Hz	+15 V @ 3.3 A, -15 V @ 50 mA +12 V @ 2.0 A, -12 V @ 200 mA	70 W max	86, 202, 276 mm 3.4, 8.0, 10.9 in

Power cable (shipped with power supplies): 2-meter cables to connect between amplifier and power supplies. See amplifier power cable cross reference on page 34.

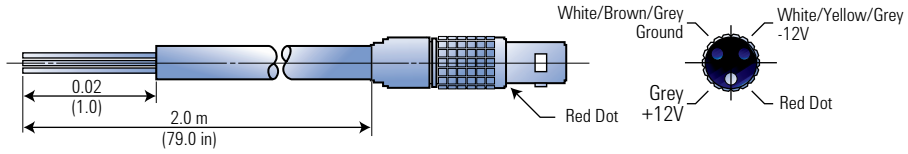
[1] Detector output can be utilized for leveling output power at the test port.
[2] Δf = f(GHz) – 20.
[3] Δf = f(GHz) – 40.
[4] The ±15 V output is designed to power the Agilent 83020A; the ±12 V output can be used to power an additional amplifier.

Amplifier Outline Drawings

Agilent 83006A



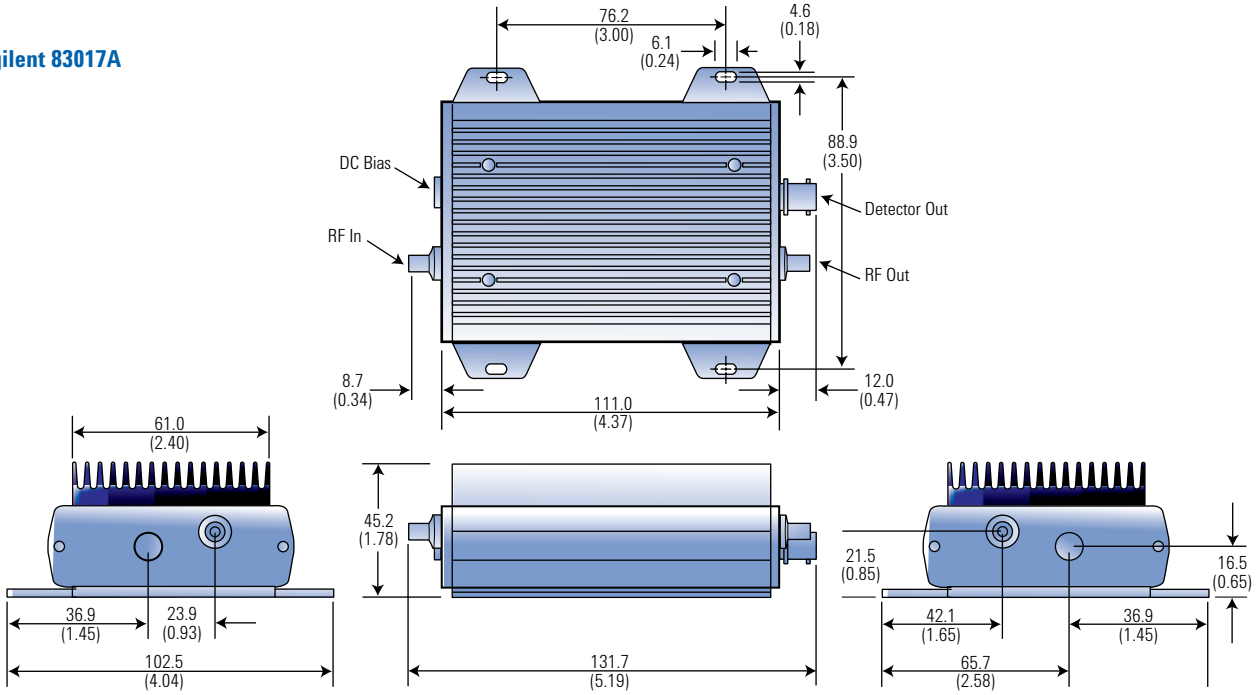
Agilent 83006-60004 cable (Shipped with Agilent 83006A, 83017A, 83018A, 83050A, 83051A, 87415A)



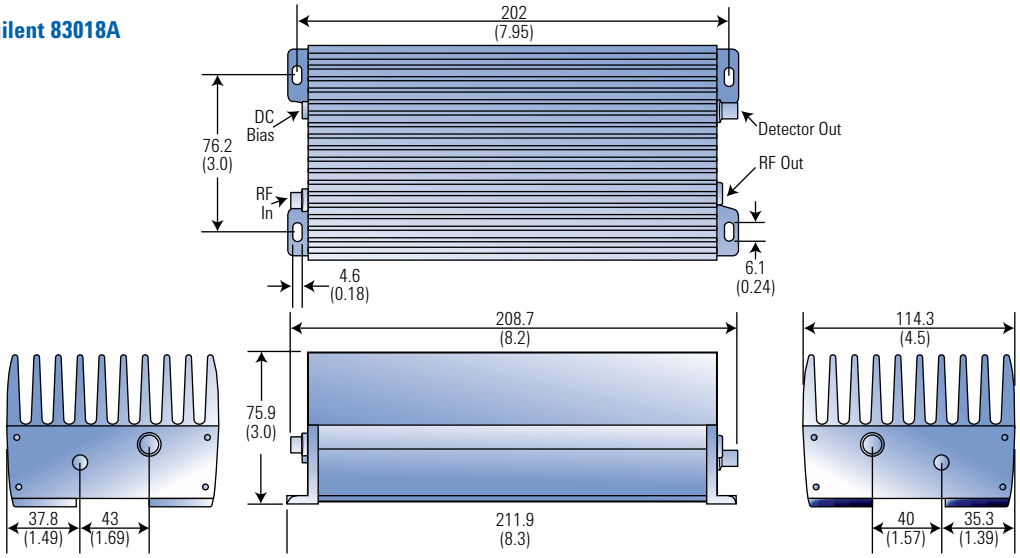
Dimensions are in mm (inches) nominal, unless otherwise specified.

Amplifier Outline Drawings

Agilent 83017A



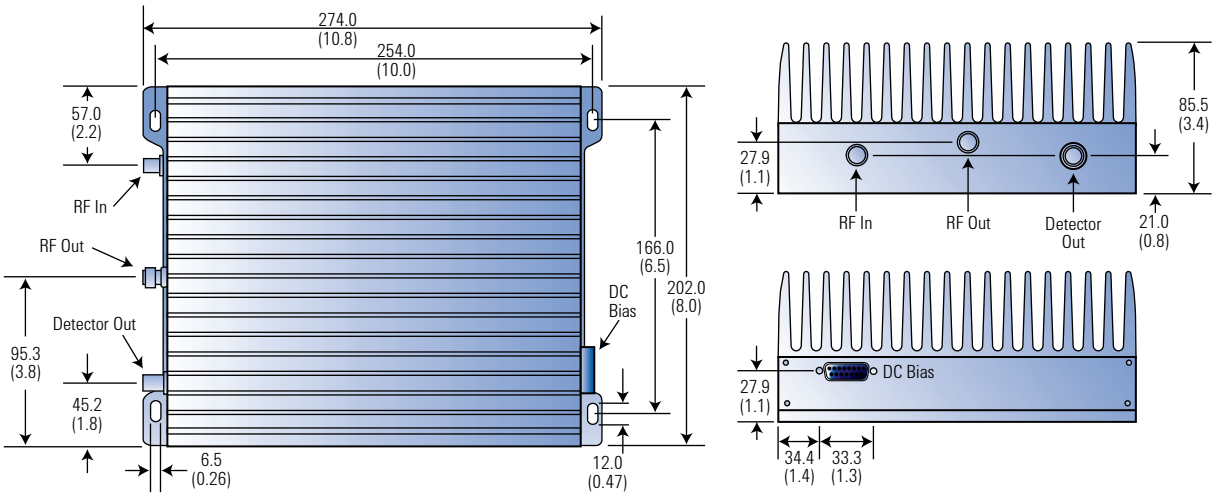
Agilent 83018A



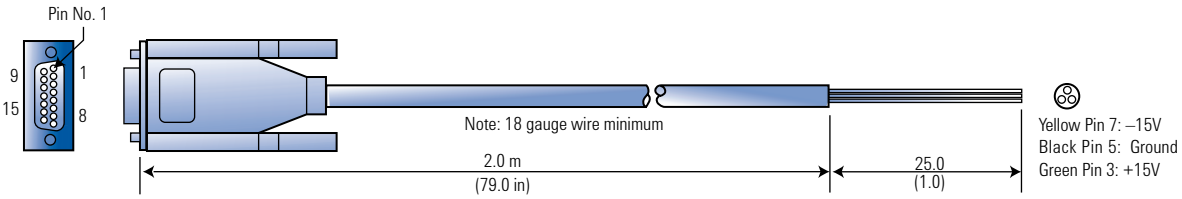
Dimensions are in mm (inches) nominal, unless otherwise specified.

Amplifier Outline Drawings

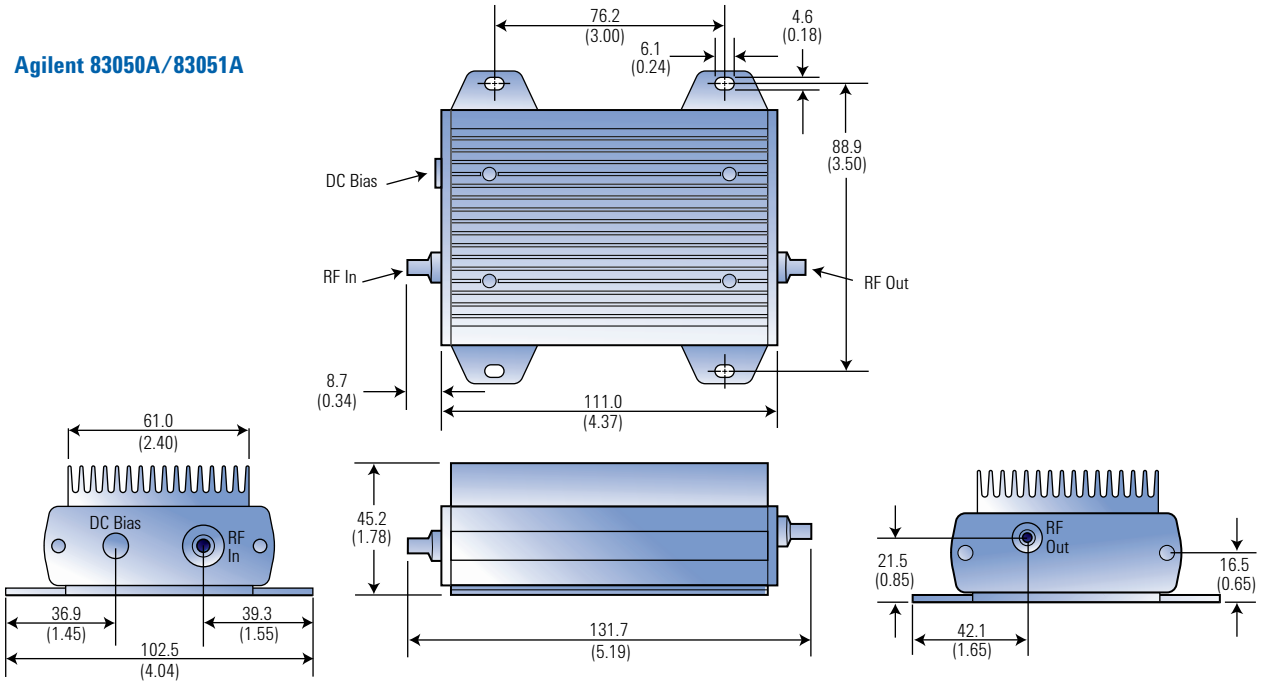
Agilent 83020A



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



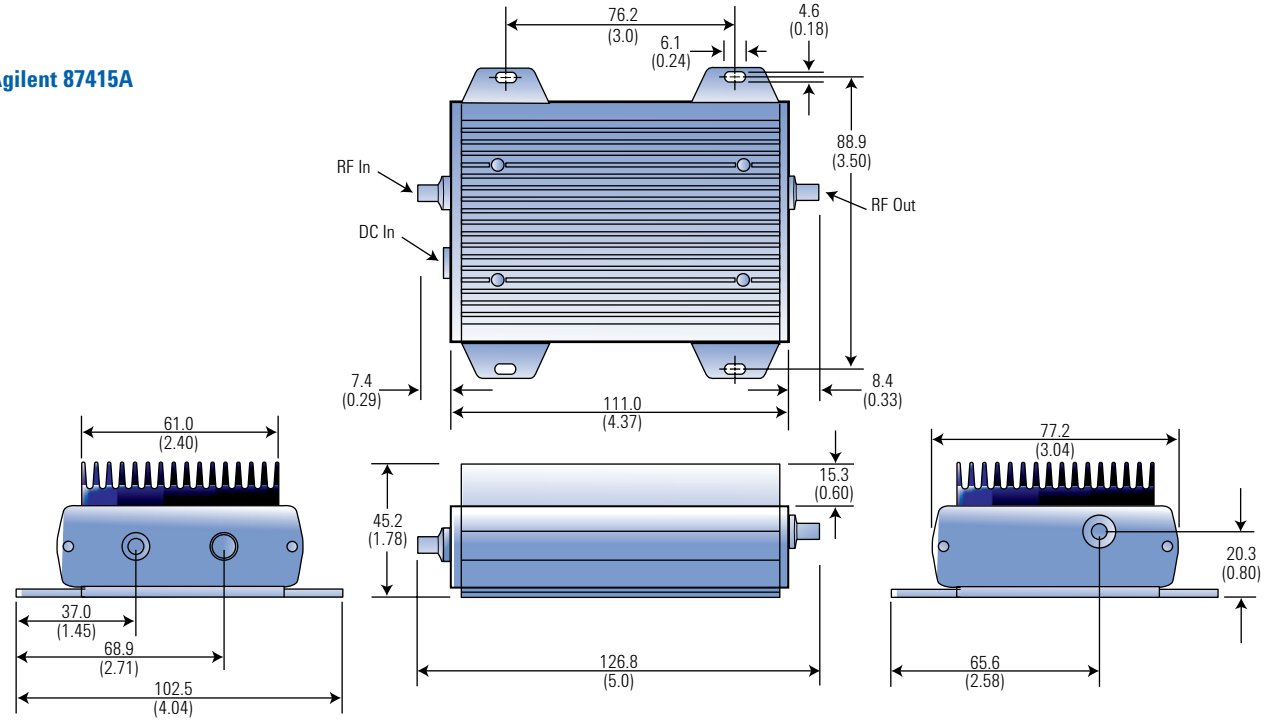
Agilent 83050A/83051A



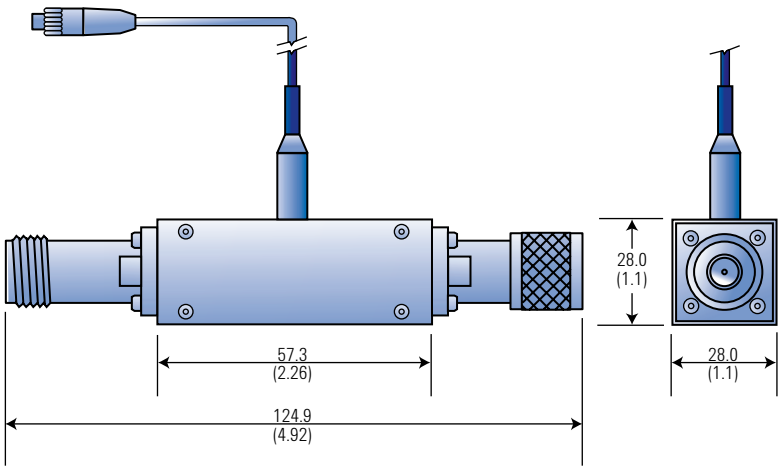
Dimensions are in mm (inches) nominal, unless otherwise specified.

Amplifier Outline Drawings

Agilent 87415A



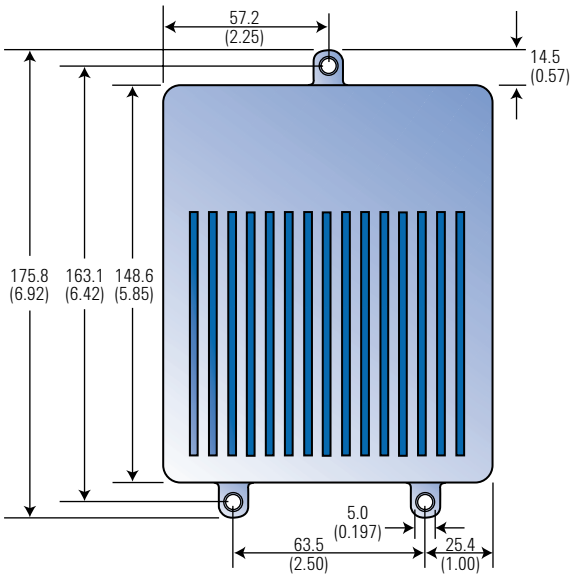
Agilent 87405A

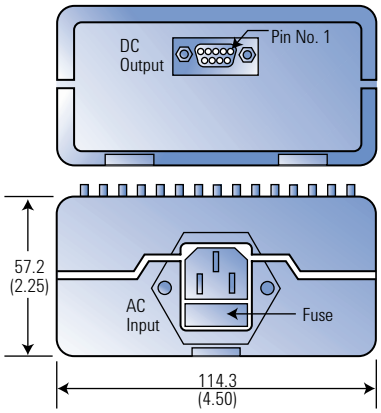


Dimensions are in mm (inches) nominal, unless otherwise specified.

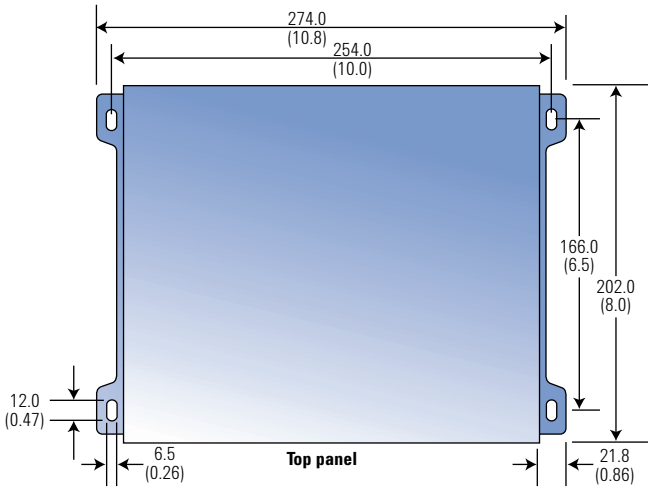
Amplifier Power Supply Drawings

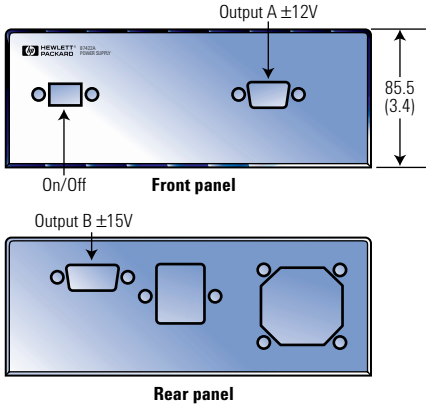
Agilent 87421A





Agilent 87422A

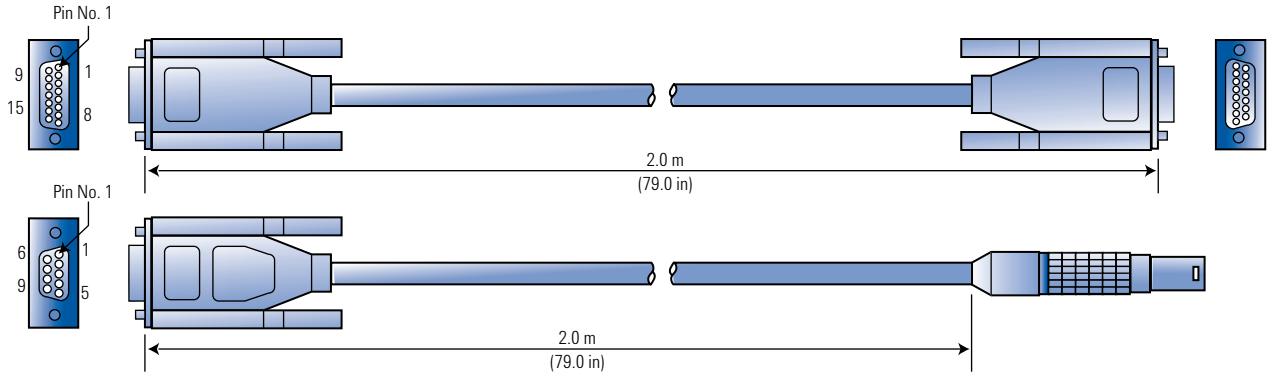




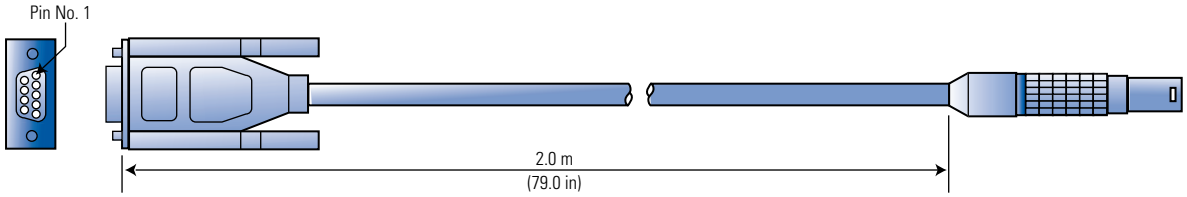
Dimensions are in mm (inches) nominal, unless otherwise specified.

Amplifier Outline Drawings

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.

Agilent 8347A

Agilent 8348A

Agilent 8349B

The Agilent 8347/48/49 microwave amplifier family offers system-compatible, loss-compensation gain blocks in self-contained rack mountable or benchtop packages. Whether overcoming cable losses, driving high-power amps, or driving Agilent millimeter-wave modules, this amplifier family features internal power supplies and bias networks to ensure simple system integration and trouble free operation.

The Agilent 8349B microwave amplifier's internal coupler and detector make it ideal for external leveling and system loss compensation applications with Agilent microwave sources. Benchtop and ATE applications will benefit from the simple drop-in system compatibility of these broadband amplifiers.

Millimeter-wave signal sources are easily configured using new or existing microwave sources with the Agilent 8349B as a driver for the Agilent 83550 series millimeter-wave source modules. The built-in source module interface on the Agilent 8349B ensures that proper dc bias and control signals are maintained.

The Agilent 8347A, 8348A, and 8349B are general purpose broadband instrumentation amplifiers capable of producing power and gain to overcome systematic RF path losses, drive high-power devices, and improve measurement system performance.

Specifications

Agilent model	Frequency range	Output power	Gain	Harmonics	Input SWR (typ)	Output SWR (typ)
8347A	Unleveled:					
	100 kHz to 2 GHz	—	≥ 25 dB	≤ 25 dBc	2.0	2.0
	2 GHz to 3 GHz		≥ 25 dB	≤ 25 dBc	2.0	3.0
	Leveled:					
	100 kHz to 3 GHz	≥ 20 dBm	≥ 25 dB	≤ 20 dBc	2.0	1.5
8348A	Unleveled:					
	2 to 20 GHz	≥ 25 dBm	≥ 25 dB	< -15 dBc (typ)	3.0	4.5
	20 to 26.5 GHz	≥ 23 dBm	≥ 23 dB	< -15 dBc (typ)	3.0	2.0
8349B	Unleveled:					
	2 to 18.6 GHz	≥ 20 dBm	≥ 15 dB	≤ 20 dBc	2.8	≤ 4.8
	18.6 to 20 GHz	≥ 18 dBm	≥ 13 dB	≤ 20 dBc	2.8	≤ 3.2
	Leveled:					
	2 to 18.6 GHz	≥ 19 dBm	≥ 15 dB	≤ 20 dBc	2.8	2.5
	18.6 to 20 GHz	≥ 17 dBm	≥ 13 dB	≤ 20 dBc	2.8	2.5

Agilent 8447A

Agilent 8447D

Agilent 8447 series amplifiers

These low-noise, high-gain amplifiers improve the sensitivity of counters, spectrum analyzers, RF voltmeters, EMI meters, power meters, and other devices. They will also increase the maximum power available from a signal generator or sweeper.

Options

Standard connectors are BNC (f) on all amplifiers
Option 010 – single-channel amplifier, N (f) connectors
Option 001 – dual-channel amplifier, BNC (f) connectors
Option 011 – dual-channel amplifier, N (f) connectors
Dual-channel 50 Ω (nominal) amplifiers are ideal for dual-channel systems such as oscilloscopes or network analyzers. Channels may also be cascaded for increased small-signal gain.

General specifications

Weight: net, 1.56 kg (3.4 lb); shipping, 2.30 kg (5.1 lb)
Size: 85.8 H x 130 W x 216 D mm (3.4 in x 5.1 in x 8.5 in)
Power requirements: 110 or 230 Vac ± 10%, 48-440 Hz, 15 watts

Specifications

Agilent model	Agilent 8447A	Agilent 8447D
Frequency range	0.1 to 400 MHz	100 kHz to 1.3 GHz
Typical 3 dB bandwidth	50 kHz to 700 MHz	75 kHz to 1.7 GHz
Gain (mean, per channel)	20 dB ± 1.0 dB at 10 MHz (20 °C to 30 °C) 20 dB ± 1.7 dB at 10 MHz (0 °C to 55 °C)	>25 dB (20 °C to 30 °C)
Gain flatness	± 1.8 dB (0 °C to 55 °C)	± 1.5 dB
Across full Frequency range	± 0.7 dB (20 °C to 30 °C) (Characteristic)	
Noise figure	<7 dB	<8.5 dB
Output power for 1 dB Gain compression	>+6 dBm	>+7 dBm typical
Harmonic distortion	–32 dB for 0 dBm output	–30 dB for 0 dBm output (typical)
Output for <–60 dB Harmonic distortion	–25 dBm (Characteristic)	–30 dBm
SWR	<1.7	<2.0 input <2.2 output 1 to 1300 MHz
Reverse isolation	>30 dB	>40 dB
Maximum DC voltage input	±10 V	±10 V
Options available	001	001, 010, 011

Agilent 8449B preamplifier

- 1 to 26.5 GHz frequency range
- 30 dB gain
- 10 dB noise figure
- Measure extremely low-level signals
- <-150 dBm sensitivity
- Improve measurement speed

This wideband 1 to 26.5 GHz preamplifier combines high gain with low noise making it suitable for a wide variety of applications. It is useful in the laboratory as a general purpose accessory to increase the sensitivity of spectrum analyzers, counters, power meters, and other instruments.

Specifications:

Frequency range: 1.0 to 26.5 GHz

Maximum safe input power: +20 dBm

Maximum dc input: +20 Vdc

Gain compression: <1 dB for signals ≤ +7 dBm at the output (characteristic)

Gain: 20 to 30 °C: >26 dB (30 dB typ.)
0 to 55 °C: >23 dB

Noise figure

Frequency band	Guaranteed	Typical
1.0 to 12.7 GHz	<8.5 dB	7 dB
12.7 to 22.0 GHz	<12.5 dB	9 dB
22.0 to 26.5 GHz	<14.5 dB	12 dB

Third-order intercept:
+15 dBm at the output (characteristic)

Second-harmonic distortion:
-30 dB for 0 dBm output (characteristic)

Gain flatness

Band	Variation
1.0 to 26.5 GHz	+4.5 dB (0 to 55 °C)
2.0 to 22.0 GHz	+2.4 dB (20 to 30 °C, typical)

Amplitude temperature drift:
≤0.12 dB/°C (characteristic)

Agilent 8449B

Displayed average noise level:
0 dB attenuation (characteristic)

With Agilent 8563E (1 Hz RBW)		With Agilent 8566B (10 Hz RBW)	
1.0 to 2.9 GHz	–165 dBm	1.0 to 2.5 GHz	–155 dBm
2.75 to 6.46 GHz	–168 dBm	2.0 to 5.8 GHz	–154 dBm
5.86 to 13.0 GHz	–163 dBm	5.8 to 12.5 GHz	–150 dBm
12.4 to 22.0 GHz	–160 dBm	12.5 to 18.6 GHz	–144 dBm
22.0 to 26.5 GHz	–158 dBm	18.6 to 22.0 GHz	–140 dBm

RF input/output 3.5 mm (m), 50 Ω (nominal)

Input SWR	1.0 to 2.0 GHz	2.0:1
	2.0 to 12.5 GHz	1.5:1
	12.5 to 26.5 GHz	2.0:1
Output SWR	1.0 to 26.5 GHz	2.0:1

Reverse isolation: >75 dB

Temperature:
Operation, 0 ° to +55 °C; storage, – 40 ° to +75 °C

EMI: FTZ 1046; CISPR Pub 11; MIL-STD 461C, part 7, CE03 and RE02

Power requirements: 100, 120, 220, or 240 volts (+10%), 47-63 Hz

Calibration cycle: 3 years (recommended)

Weight: 4 kg (8.8 lb)

Size:
102 H x 213 W x 297 mm D (4 in x 8.4 in x 11.74 in)

Ordering information

Agilent 8449B (1 to 26.5 GHz preamplifier)
Option 907 front handle kit
Option 908 rack mount kit (half rack width)

Applications

Agilent fixed and step attenuators[1] 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.

[1] See Waveguide chapter for additional products.

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 (except the Agilent 355E,F). This long life results in lower cost of ownership by reducing periodic maintenance, downtime, and repairs.

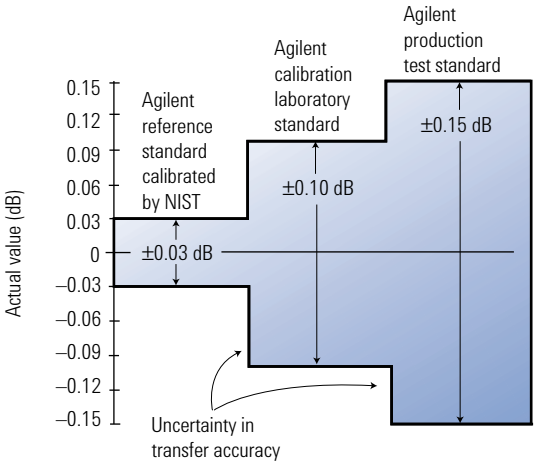


Figure 1. Accuracy traceability example.

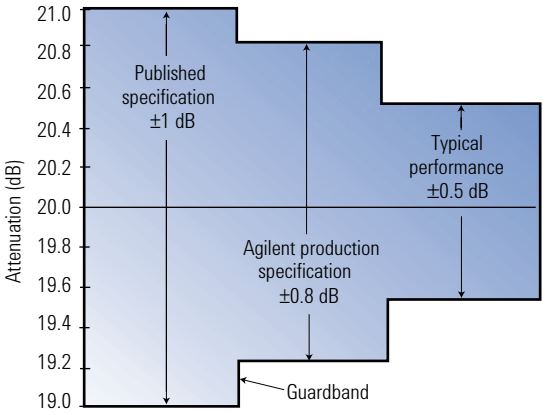


Figure 2. Guardband example.

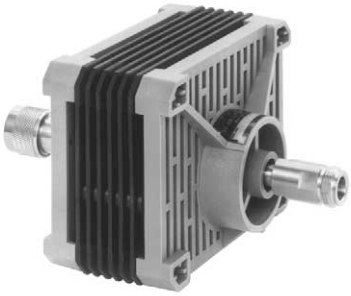
Agilent 8490D

Agilent 8491A/B/C

Agilent 8492A

Agilent 8493A

Agilent 8498A



Agilent 8491A/B/C, 8492A, 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 (except for the Agilent 8491C).

Agilent 8498A high-power attenuator

The Agilent 8498A Option 030 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

A set of four attenuators (3, 6, 10, and 20 dB) is furnished in a walnut accessory case. The Agilent 11581A set consists of Agilent 8491A attenuators; the Agilent 11582A set, Agilent 8491B attenuators; the Agilent 11583A set, Agilent 8492A 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, 3, 6, 10, and 20 dB, 75 ohm type-N attenuators 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.

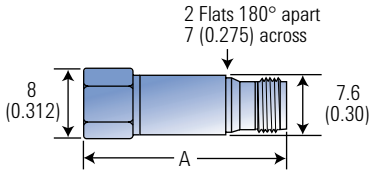
Specifications

Agilent model	Frequency range (GHz)	Maximum input power			Option:	003	006	010	020	030	040	Connectors
					Atten.	3 dB	6 dB	10 dB	20 dB	30 dB	40 dB	
8490D	dc to 50	1 W avg.	**Attenuation:**	**Min:** 0 to 50 GHz		2.5	5.4	9.4	19.2	29.2	38.2	2.4 mm (m, f)
				Max: 0 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:** 0 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

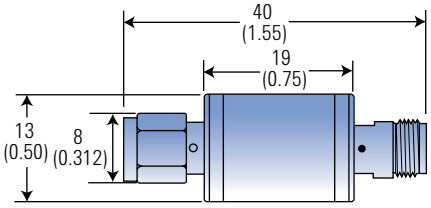
Agilent model	Frequency range (GHz)	Maximum SWR	Maximum input power	Attenuation accuracy (± dB) 3 dB	6 dB	10 dB	20 dB	30 dB	40 dB	50 dB	60 dB	Connectors
8491A 3 to 30 dB 40 to 60 dB	dc to 12.4	1.2 to 8 GHz 1.3 to 12.4 GHz	2 W avg. 100 W peak	0.3	0.3	0.5	0.5	1.0	1.5	1.5	2	N (m, f)
8491B 3 to 30 dB 40 to 60 dB	dc to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz		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)
8491C 3 to 30 dB	dc to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz		0.3 to 12.4 GHz 0.4 to 18 GHz	0.4 to 12.4 GHz 0.5 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	—	—	—	N (m, f)
8492A 3 to 30 dB 40 to 60 dB	dc to 18	1.15 to 8 GHz 1.25 to 12.4 GHz 1.35 to 18 GHz		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	APC-7
8493A 3 to 20 dB 30 dB	dc to 12.4	1.2 to 8 GHz 1.3 to 12.4 GHz		0.3	0.3	0.5	0.5	1.0	—	—	—	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		±0.3 dB	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	—	—	—	SMA (m, f)
8493C 3 to 30 dB	dc to 26.5	1.1 to 8 GHz 1.15 to 12.4 GHz		0.5 to 18 GHz 1.0 to 26.5 GHz	0.6	0.3	0.5	0.7	1.0	—	—	3.5 mm (m, f)
40 dB		1.25 to 26.5 GHz[1]			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)	—	—	—	—	1.0	—	—	—	N (m, f)

[1] 1.27 for Option 006.

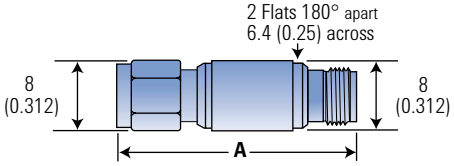


Dimension A
3, 6, 10, 20 dB: 27 (1.06)
30, 40 dB: 29 (1.14)

Agilent 8490D



Agilent 8493A,B



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

Agilent 8493C

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 **3C** Option **010** Option **UK6**

Frequency range
0D: dc to 50 GHz
1A: dc to 12.4 GHz
1B: dc to 18 GHz
1C: dc to 18 GHz
2A: 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
UKS: Commercial calibration certificate

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

Step attenuator selection guide

	Step size	Attenuation range	Frequency range				
			dc to 1000 MHz	dc to 4 GHz	dc to 18 GHz	dc to 26.5 GHz	dc to 40 GHz
Manual	1 dB	0 to 11 dB		8494A	8494B		
		0 to 12 dB	355C				
	10 dB	0 to 70 dB		8495A	8495B	8495D	
		0 to 110 dB		8496A	8496B		
		0 to 120 dB	355D				
Programmable	1 dB	0 to 11 dB		8494G	8494H	84904K	84904L
		0 to 12 dB	355E				
	10 dB	0 to 70 dB		8495G	8495H	8495K	
						84907K	84907L
		0 to 90 dB				8497K	
						84906K	84906L
		0 to 110 dB		8496G	8496H		
		0 to 120 dB	355F				

Agilent 355 series specifications

Manual	**Agilent 355C**	(0 to 12 dB, 1 dB steps)
	Agilent 355D	(0 to 120 dB, 10 dB steps)
Programmable	**Agilent 355E**	(0 to 12 dB, 1 dB steps)
	Agilent 355F	(0 to 120 dB, 10 dB steps)

The manual and programmable Agilent 355 series attenuators offer exceptional attenuation accuracy to 1 GHz; 0.1 dB to 1 kHz, 0.25 dB to 500 MHz, 0.35 dB to 1 GHz. They feature BNC (f) RF connectors, with optional type-N (Option 001) and TNC (Option 005) also available. To achieve 1 dB steps up to a range of 132 dB, serially connect two attenuators using a standard UG-491A/U BNC (m)-to-BNC (m) adapter. Programmable Agilent 355EF models feature a 7-pin connector. To protect your transistor driver against transients during the switching cycle, order Option 007 to install a protective diode between each solenoid and driver.

Agilent 355C/D

Agilent 84904L

Agilent 8494/95/96A/B/D

Agilent 8494/95/96G/H/K

Agilent 84904/906/907 series

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

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 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. Also, see page 179 for product descriptions of the Agilent 87130A and 70611A (MMS) attenuator/switch drivers.

Interconnect cable selections include various connector and ribbon cable configurations to match user applications. Standard interconnect cables are described in the Attenuator Cables table on page 53.

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 mode)	Frequency range (GHz)	Attenuation range	Insertion loss @ 0 dB	Maximum SWR	Repeatability [1] life	Maximum RF input power	Shipping weight
355C (Manual)	dc to 1	0 to 12 dB 1 dB steps	0.2 dB + 2.3 dB/GHz	1.2 to 250 MHz 1.3 to 500 MHz 1.5 to 1 GHz	0.03 dB max 0.5 million cycles per section	0.5 W avg. 350 W peak [2] (10 µs max.)	1.4 kg (3 lb)
355E (Programmable)	dc to 1	0 to 12 dB 1 dB steps					
355D (Manual)	dc to 1	0 to 120 dB 10 dB steps					
355F (Programmable)	dc to 1	0 to 120 dB 10 dB steps					
8494A (Manual)	dc to 4	0 to 11 dB 1 dB steps	0.6 dB + 0.09 dB/GHz	1.5	0.03 dB max 5 million cycles per section	1 W avg. 100 W peak [2] (10 µs max.)	0.9 kg (2 lb)
8494G (Programmable)	dc to 4	0 to 11 dB 1 dB steps					
8494B (Manual)	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			
8494H (Programmable)	dc to 18	0 to 11 dB 1 dB steps					
8495A (Manual)	dc to 4	0 to 70 dB 10 dB steps	0.4 dB + 0.07 dB/GHz	1.35			
8495G (Programmable)	dc to 4	0 to 70 dB 10 dB steps					
8495B (Manual)	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			
8495H (Programmable)	dc to 18	0 to 70 dB 10 dB steps					
8495D (Manual)	dc to 26.5	0 to 70 dB 10 dB steps	0.5 dB + 0.13 dB/GHz	1.6 to 6 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz 2.2 to 26.5 GHz	0.03 dB max to 18 GHz 0.05 dB max to 26.5 GHz 5 million cycles per section		
8495K (Programmable)	dc to 26.5	0 to 70 dB 10 dB steps					
8496A (Manual)	dc to 4	0 to 110 dB 10 dB steps	0.6 dB + 0.09 dB/GHz	1.5	0.03 dB max 5 million cycles per section		
8496G (Programmable)	dc to 4	0 to 110 dB 10 dB steps					
8496B (Manual)	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			
8496H (Programmable)	dc to 18	0 to 110 dB 10 dB steps					
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	0.03 dB max to 18 GHz 0.05 dB max to 26.5 GHz 5 million cycles per section		

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

Agilent 355 series options

	Std.	Opt. 001	Opt. 005
RF connectors	BNC (f)	N (f)	TNC (f)
Drive circuit protection	**Opt. 007:** Protection diodes for Agilent 355E,F		

Agilent 8494/95/96/97 series options

	Std.	Opt. 011	Opt. 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	**Opt. 001:** N (f)	**Opt. 002:** SMA (f)	**Opt. 003:** APC-7
K models	**Opt. 004:** 3.5 mm (f)		
DC connectors			
G,H,K models	**Std:** 12-pin Viking connector **Opt. 008:** 8-inch ribbon cable with 14-pin DIP plug **Opt. 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 (dB)	Maximum SWR Std. (Opt. 006)	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 max. 5 million cycles per section	1 W avg. 100 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

	Std.	Opt. 011	Opt. 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
	125 mA	322 mA	187 mA
RF connectors			
K models	**Std.:** 3.5 mm (f)	**Opt. 104:** 3.5 mm (f) [3]	
		3.5 mm (m) [4]	
L models	**Std.:** 2.4 mm (f)	**Opt. 006:** 2.92 mm (f)	**Opt. 100:** 2.4 mm (f) [3] 2.4 mm (m) [4] **Opt. 106:** 2.92 mm (f) [3] 2.92 mm (m) [4]
Calibration documentation	See ordering information		

[3] Drive cable end.

[4] End opposite to drive cable.

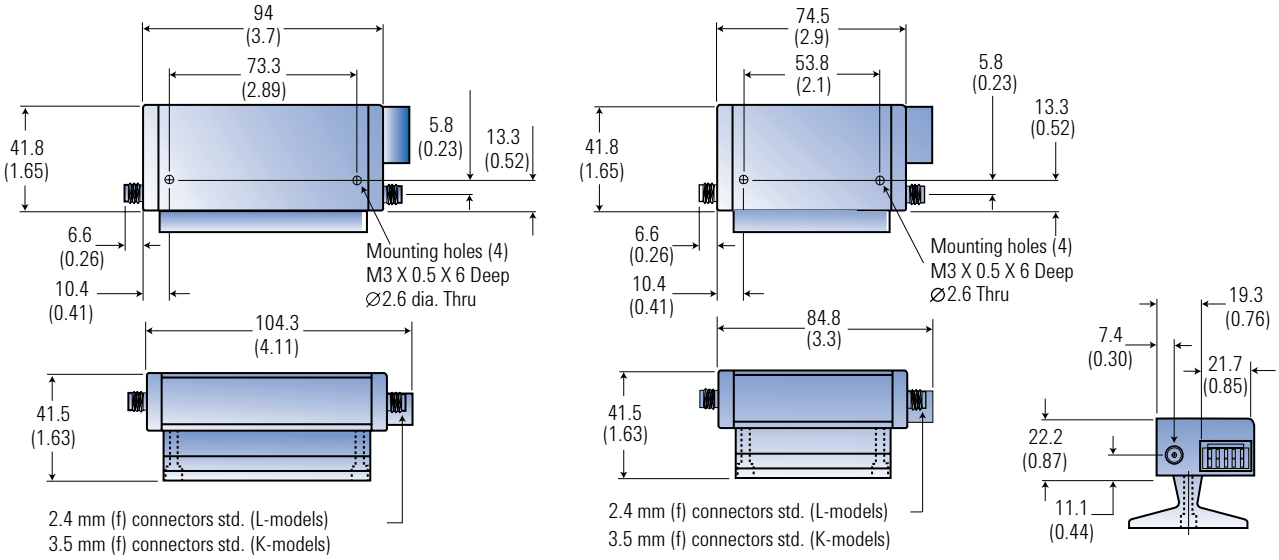
Some Agilent attenuators were available as OEM equivalents to standard models. This table shows the corresponding model numbers.

Agilent Model Number	OEM Model Number	Agilent Model Number	OEM Model Number
8494A	33320A	**8496H**	33322H
8494B	33320B	**8497K**	33323K
8494G	33320G	**84904K**	33324K
8494H	33320H	**84904L**	33324L
8495G	33321G	**84906K**	33326K
8495H	33321H	**84906L**	33326L
8495K	33321K	**84907K**	33327K
8496G	33322G	**84907L**	33327L

OEM models of step attenuators are furnished without a base.

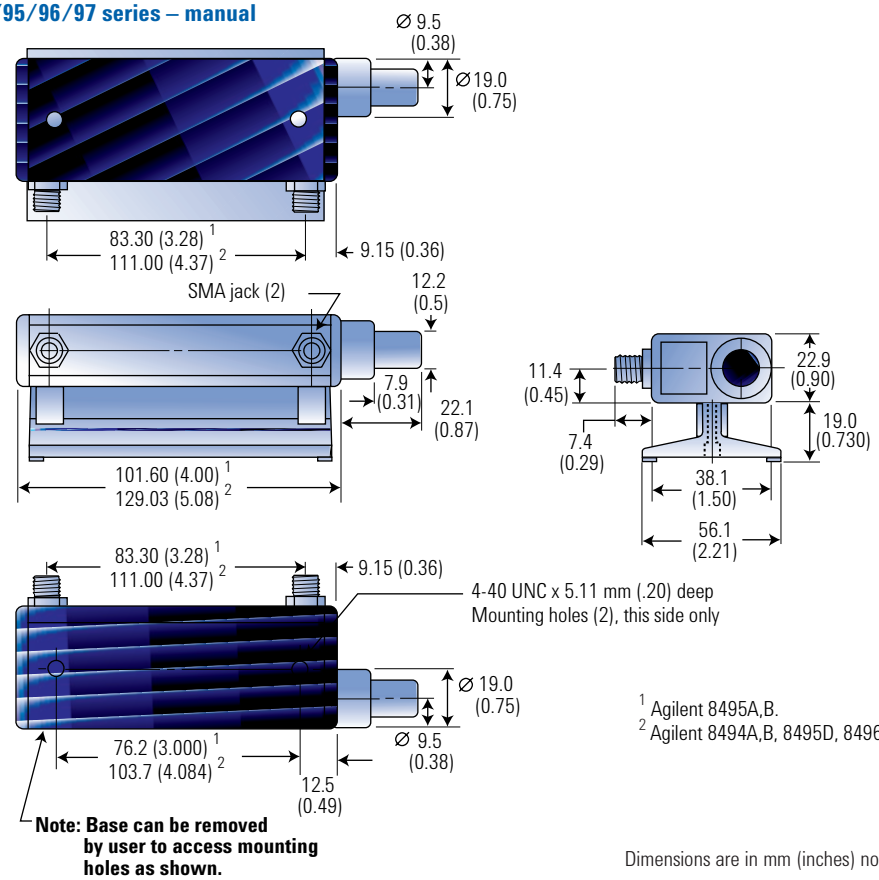
Outline Drawings

Agilent 84904/906/907 series – programmable



See ordering example for connector options

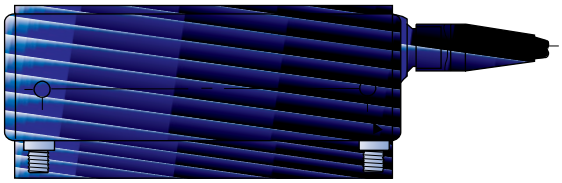
Agilent 8494/95/96/97 series – manual

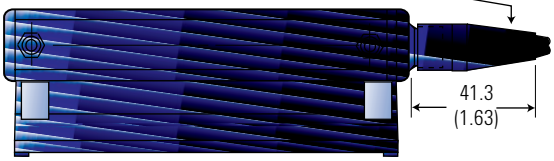


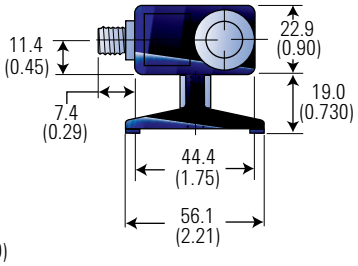
[1] Agilent 8495A,B.
[2] Agilent 8494A,B, 8495D, 8496A,B.

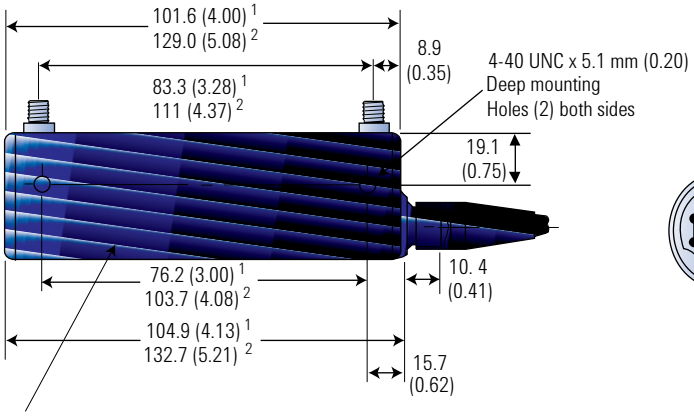
Dimensions are in mm (inches) nominal, unless otherwise specified.

Agilent 8494/95/96/97 series – programmable



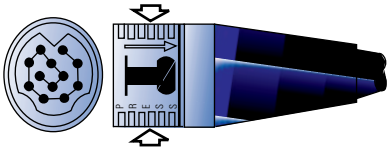






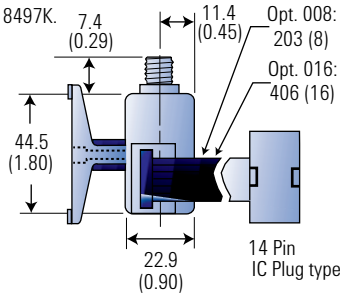
Note: Base can be removed by user to access mounting holes as shown above.

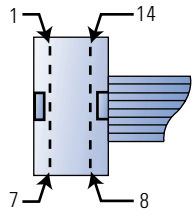
Solenoid drive plug detail



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 355 series ordering example

Agilent 355 D Option 001 Option 007

Type/attenuation range
C: Manual, 0 to 12 dB, 1 dB steps
D: Manual, 0 to 120 dB, 10 dB steps
E: Programmable, 0 to 12 dB, 1 dB steps
F: Programmable, 0 to 120 dB, 10 dB steps

RF connector
Std: BNC (f)
001: N (f)
005: TNC (f)

Drive circuit protection
007: Protection diodes for Agilent 355E,F (see page 38)

Agilent 8494/95/96/97 series ordering example

Agilent 8494 A Option 001 Option 011 Option 008 Option UK6

Attenuation range
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

Type/frequency range
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]

RF connector[1]
A,B,G,H models:
001: N (f)
002: SMA (f)
003: APC-7
D,K models:
004: 3.5 mm (f)[3]

Supply voltage
Std.: 24 Vdc
011: 5 Vdc

DC connector
G, H, K models
Std.: 12-pin Viking connector
008: 8-inch ribbon cable with 14-pin DIP plug
016: 16-inch ribbon cable with 14-pin DIP plug

Calibration documentation[5]
UK6: Commercial calibration test data with certificate
UKS: Commercial calibration certificate

[1] Each order must include RF connector option.
[2] Available with Agilent 8495 only.
[3] Available with Agilent 8495/97 only.

Agilent 84904/906/907 series ordering example[4]

Agilent 8490 4 K Option 011 Option 006 Option UK6

Attenuation range
4: 11 dB max, 1 dB steps
6: 90 dB max, 10 dB steps
7: 70 dB max, 10 dB steps

Frequency range
K: dc to 26.5 GHz
L: dc to 40 GHz

Supply voltage
Std.: 24 Vdc
011: 5 Vdc
015: 15 Vdc

RF connector
K models
104: 3.5 mm (f) drive cable end
3.5 mm (m) opposite end

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

Calibration documentation[5]
UK6: Commercial calibration test data with certificate
UKS: Commercial calibration certificate

[4] Drive cable not included. See Attenuator Cables table on next page.
[5] Option UK6/UKS not available with Option 106.

Attenuator drive cables

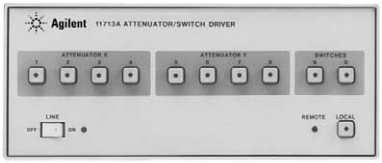
Agilent model number	Agilent part number	Where used	Description
11764A		11713A to 84904/906/907	10-pin DIP to Viking conn., 60 inches
11764B		84904/906/907 to ribbon	10-pin DIP to 60 inch ribbon cable, bare leads
11764C		84904/906/907 to DIP	10-pin DIP to 14-pin DIP, 8-inch ribbon cable
11764D		84904/906/907 to DIP	10-pin DIP to 14-pin DIP, 16-inch ribbon cable
	11764-60005	84941A dist bd to 8494/95/96/97	Viking to (4) 4-pin Berg conn., 30 inches
	11764-60006	84941A dist bd to 84904/906/907	10-pin DIP to (4) 4-pin Berg conn., 30 inches
	70612-60017	84941A dist bd to 8494/95/96/97	Viking to (4) 4-pin Berg conn., 20 inches
	70612-60018	84941A dist bd to 84904/906/907	10-pin DIP to (4) 4-pin Berg conn., 20 inches

For complete cable configuration information, request publication number 5963-2038E, *Agilent 70611A, Agilent 87130A and Agilent 11713A Switch Attenuator Driver Configuration Guide*.

6

Attenuator/switch driver attenuator accessories

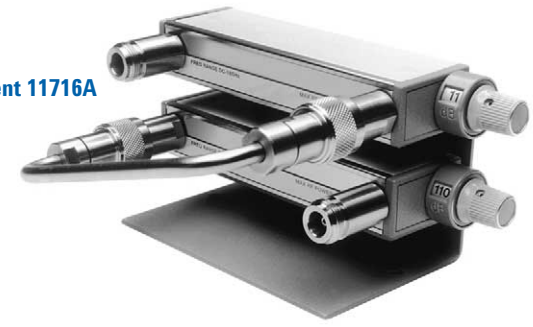
Agilent 11713A



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 electro-mechanical switches (Agilent 8761, 8762, or 8765 series). The Agilent 11713A can also be used to supply +24V common and ten pairs of current sinking contacts (total current draw <1.25A peak for 1 sec., 0.65A 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.

Agilent 11716A



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, APC-7, and SMA connectors as described below.

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

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 PDB 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.

[1] See Waveguide chapter for additional products.

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 PDB detectors, is exceptionally flat beyond 26.5 GHz.

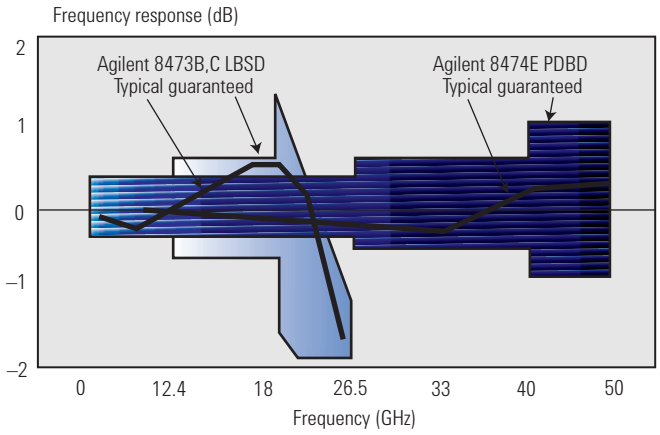


Figure 1. Detector frequency response characteristics.

Open circuit voltage sensitivity

The open circuit voltage sensitivity (K) describes the slope of the transfer function of the detectors. This represents the conversion of RF/microwave power to a voltage at the output connector, typically specified in mV/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.

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

Where:
B = Video amplifier bandwidth (Hz)
F = Video amplifier noise factor
= 10 (Noise figure/10)
R_v = Video resistance (Ω)
K = Open circuit voltage Sensitivity (mV/mW)

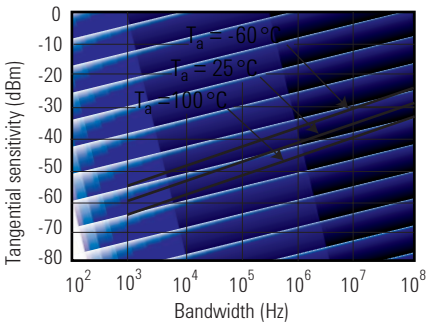


Figure 2. Typical tangential sensitivity performance.

Output voltage versus temperature

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

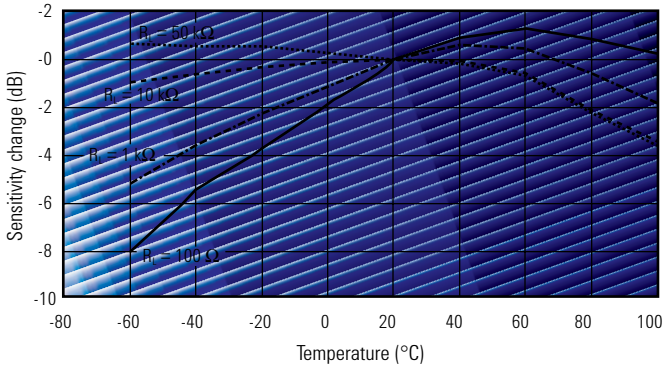


Figure 3. Typical output response with temperature (Pin < -20 dBm) (Schottky diode).

Rise time

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

Figure 4 shows the typical equivalent circuit of a test detector, and can help in devising the external terminations and cables to connect to an oscilloscope or other instrument. The following equation gives the approximate rise time for different conditions of load resistance and capacitance. Note that rise time can be improved (lowered) with a termination 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.

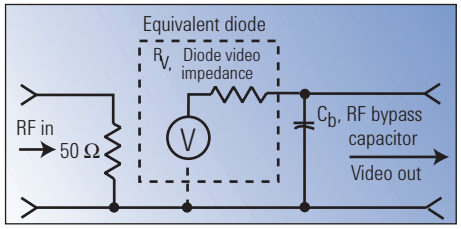
Broadband match (SWR)

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

Figure 5 represents the mismatch error introduced by multiple reflections caused by mismatch between the detector and the source. For a detector SWR of 2.0 and source SWR of 2.0, this uncertainty is ±1.0 dB. For the LBSD and PDBD models, the integration of the diode with the 50 Ω matching resistor results in excellent broadband match. Both LBSD and PDBDs 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.

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

Where	Determined by
R_L = Load impedance	Measuring equipment
R_v = Video impedance	Detector
C_L = Load capacitance	Measuring equipment
C_b = Bypass capacitance	Detector



Typical values:

R_v (diode video impedance) = 1.5 kΩ [1]

C_b (RF bypass capacitor) = 27 pF nom.

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

Figure 4. Detector model.

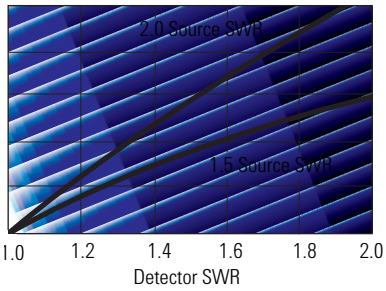


Figure 5. Mismatch error from detector and source mismatch.

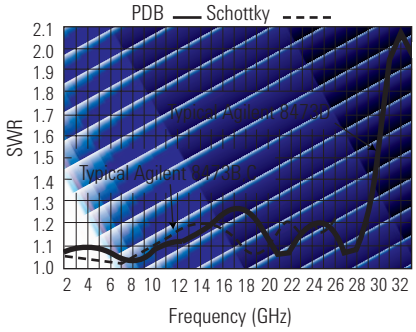


Figure 6. Typical SWR of detectors.

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 Option 002, 102 (optional square law load), the deviation from ideal square law response will be ±0.5 dB (although the sensitivity specification is decreased by a factor of 4).

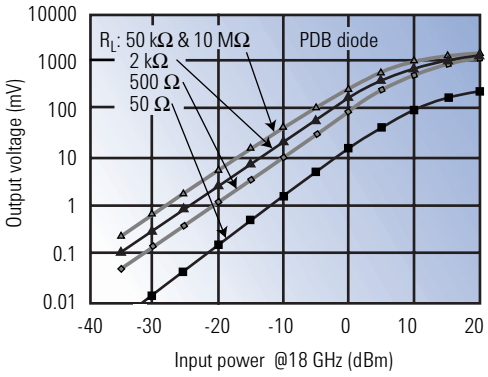


Figure 7. Typical detector square law response (mV).

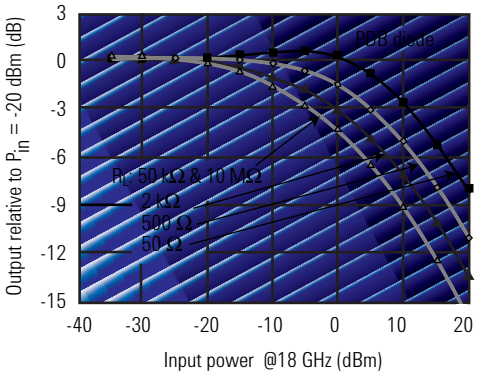


Figure 8. Typical detector square law response (dB).

Agilent 423B

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 video load option (Option 002) extends the square law region to at least 0.1 mW (-10 dBm).

Agilent 8471D,E

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,E and 33330D 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 8474 family

Planar-Doped Barrier Diode

Specifications

Agilent model	8471D	8471E	8473D	8474B	8474C	8474E	33330D
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	0.01 to 33
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	±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	±0.25 to 14 GHz ±0.4 to 26.5 GHz ±1.25 to 33 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	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	1.2 to 14 GHz 1.4 to 26.5 GHz 3.0 to 33 GHz
Low-level sensitivity (mV/µW)	>0.5	>0.5	>0.5	>0.4	>0.4	>0.4 to 40 GHz >0.34 to 50 GHz	>0.4
Maximum operating input power	100 mW	← 200 mW →					
Typical short term maximum input power (<1 minute)	0.7 W	0.7 W	← 1 W →				
Video impedance (nom)	← 1.5 kΩ →						
RF bypass capacitance (nom)	6800 pF	← 30 pF →					
Output polarity	← Negative →						
Input connector	BNC (m)	SMA (m)	3.5 mm (m)	Type-N (m)	3.5 mm (m)	2.4 mm (m)	3.5 mm (m)
Output connector	BNC (f)	SMC (m)	BNC (f)	BNC (f)	SMC (m)	SMC (m)	SMC (m)

Options

Agilent model	8471D	8471E	8473D	8474B	8474C	8474E	33330D
Optimal square law load[1]	Opt. 102	N/A	N/A	Opt. 102	N/A	N/A	N/A
Positive polarity output	Opt. 103	Opt. 103	N/A	Opt. 103	Opt. 103	Opt. 103	Opt. 003
Frequency band	N/A	N/A	N/A	See PDBD Frequency Band Options table on page 56			N/A

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

Low-Barrier Schottky Diode Detector

Specifications

Agilent model	423B	8470B	8472B	8473B	8473C
Freq. range (GHz)	0.01 to 12.4	0.01 to 18	0.01 to 18	0.01 to 18	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 20 GHz ±1.5 to 26.5 GHz [1]
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	1.15 to 4 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 2.2 to 26.5 GHz
Low-level sensitivity (mV/µW)	>0.5	>0.5	>0.5	>0.5	>0.5 to 18 GHz >0.18 to 26.5 GHz
Maximum operating input power	← 200 mW →				
Typical short term maximum input power (< 1 minute)	← 1 W →				
Noise	← <50 µV →				
Video impedance (nom)	← 1.3 kΩ →				
RF bypass capacitance (nom)	← 30 pf →				
Output polarity	← Negative →				
Input connector	Type-N (m)	APC-7 (m)	SMA (m)	3.5 mm (m)	3.5 mm (m)
Output connector	BNC (f)	BNC (f)	BNC (f)	BNC (f)	BNC (f)

Options

Agilent model	423B	8470B	8472B	8473B	8473C
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 ±0.5 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**
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	08473-80004
Option 001	00423-60007	08470-60016	08470-60016	08473-80002	08473-80005
Option 002	00423-60005	08470-60014	08470-60014	08473-80003	08473-80006
Option 003	00423-60004				

[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.

Detectors

Agilent 8474B options	002	004	008	012	018
Frequency range (GHz)	0.01 to 2	2 to 4	4 to 8	8 to 12.4	12.4 to 18
Frequency response (dB)	±0.25	±0.25	±0.25	±0.25	±0.30
Maximum SWR	1.09	1.1	1.2	1.3	1.3

Agilent 8474C options	004	008	012	018	026	033
Frequency range (GHz)	2 to 4	4 to 8	8 to 12.4	12.4 to 18	18 to 26.5	26.5 to 33
Frequency response (dB)	±0.2	±0.2	±0.25	±0.3	±0.3	±0.3
Maximum SWR	1.1	1.16	1.2	1.3	1.4	2.2

Agilent 8474E options	026	040	050
Frequency range (GHz)	18 to 26.5	26.5 to 40	33 to 50
Frequency response (dB)	±0.3	±0.5	±0.8
Maximum SWR	1.2	1.6	2.8

Outline drawings

Diagram 1

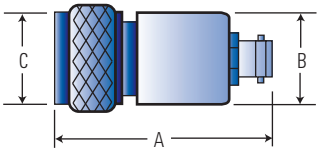


Diagram 2

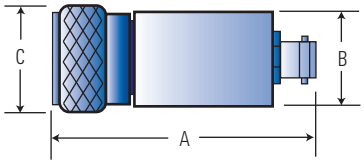
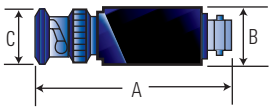


Diagram 3

Diagram 4

Diagram 5



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 (2 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)	227 g (8 oz)
8473B	48 mm (1.89 in)	10 mm (0.39 in)	7.9 mm (0.31 in)	57 g (2 oz)	227 g (8 oz)
8473C	48 mm (1.89 in)	10 mm (0.39 in)	7.9 mm (0.31 in)	57 g (2 oz)	227 g (8 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)	43 g (1.5 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, 33330D (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. It is comprised of a resistive bridge and PDB diode that yields a very broadband device with excellent frequency response, temperature response and square law response characteristics.

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.

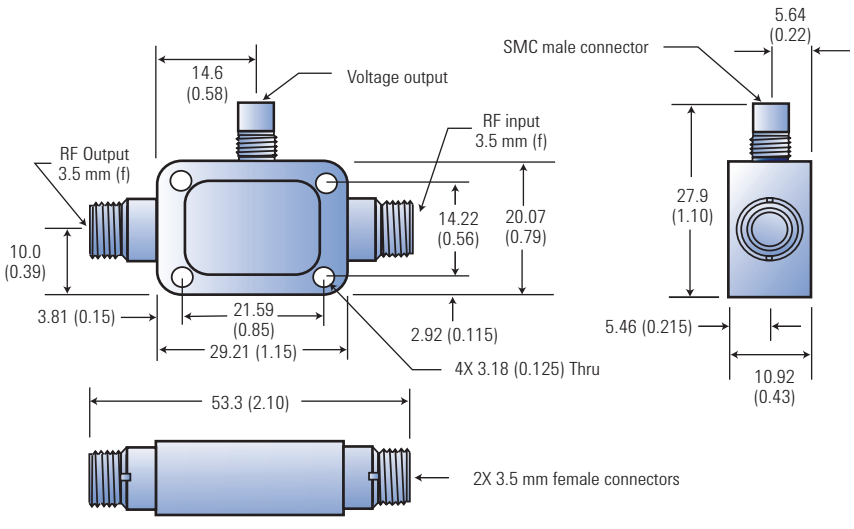
The Agilent 83036C has been used with great success as the sampling element for external leveling of broadband swept frequency sources. The extended frequency range increases the usable band to 100 MHz to 26 GHz, giving the user full use of a broadband source with external leveling. Other uses include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

Agilent 83036C

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

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.

Applications

Directional couplers[1] 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

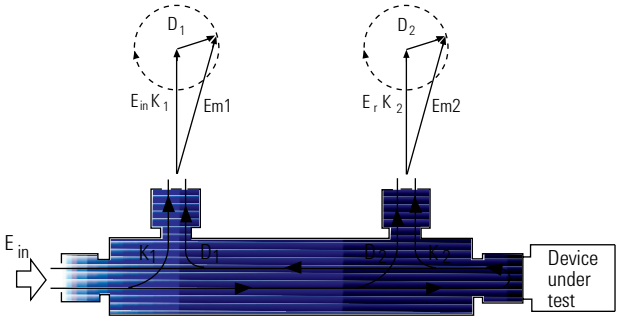
Directivity

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 E_{m2} can only be compensated or corrected on a broadband basis using vector analyzers.

[1] See Waveguide chapter for additional products.

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, E_{m1}, 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.

Directional Couplers and Bridges

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.

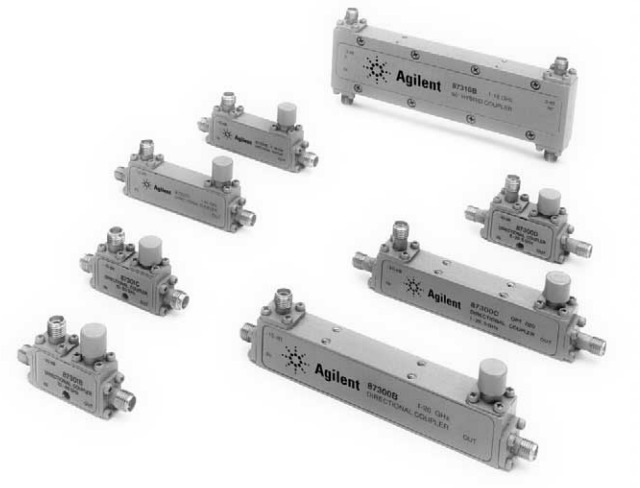
Transmission loss

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.

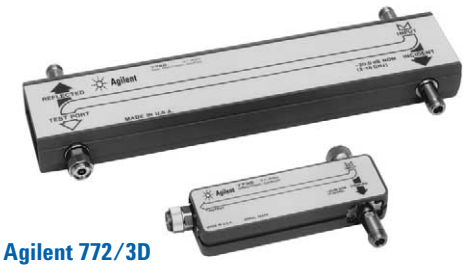
Transmission loss is usually not important at low frequencies where most swept sources have sufficient available power. However, in the millimeter ranges, power sources are limited and lower loss devices become significant. In general, broadband couplers have transmission losses on the order of 1 dB. 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.

Single- and Dual-Directional Couplers, 90° Hybrid Coupler

Agilent 775D

Agilent 776D

Agilent 777D

Agilent 778D

Agilent 779D

Agilent 775D-778D 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 779D directional coupler

This high directivity coupler has a multi-octave range of 1.7 to 12.4 GHz. With directivity over 30 dB to 4 GHz and 26 dB to 12.4 GHz, it is useful for broadband reflectometer measurements. With ±0.75 dB coupling variation, the coupler is also useful for power leveling applications. Optional connectors provide flexibility in mating with various devices under test.

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. The dual couplers make it possible to measure both reflection and transmission parameters of a device under test at one time.

Agilent 11691D

Agilent 11692D

Single- and Dual-Directional Couplers, 90° Hybrid Coupler

Specifications [1]

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 to18 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
779D	1.7 to 12.4	20±0.75	>30 to 4 GHz >26 to 12.4 GHz	1.2[5]	<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 66 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.

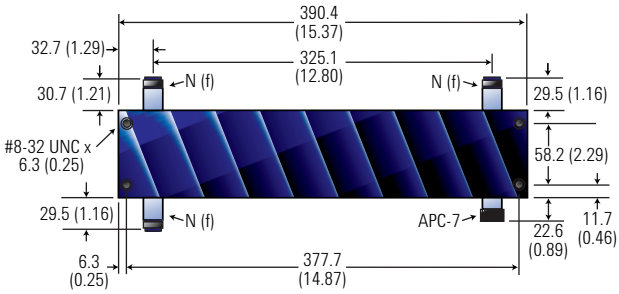
Agilent 87310B specifications

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)

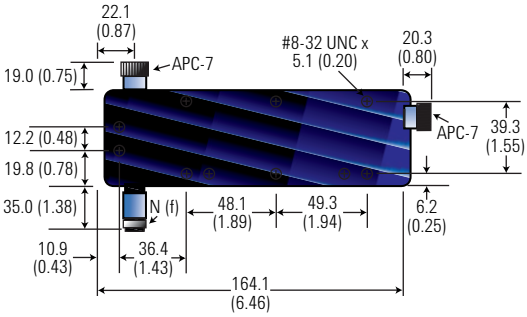
Single- and Dual-Directional Couplers, 90° Hybrid Coupler

Outline drawings

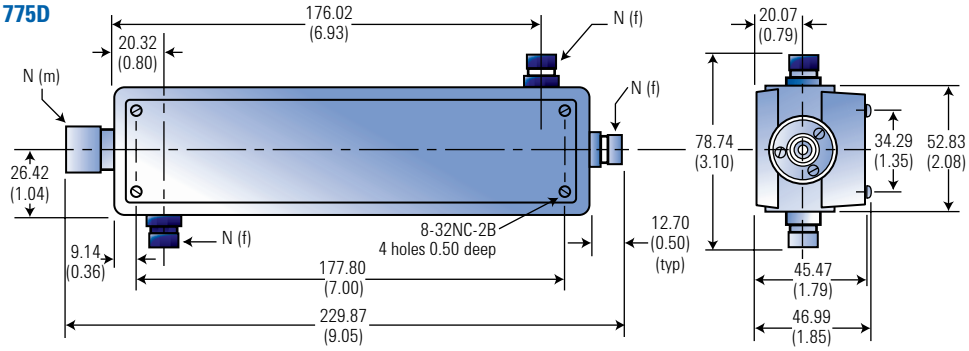
Agilent 772D



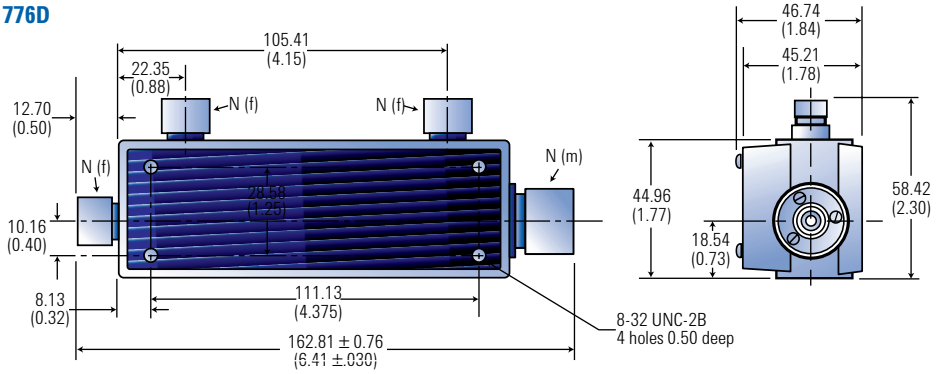
Agilent 773D



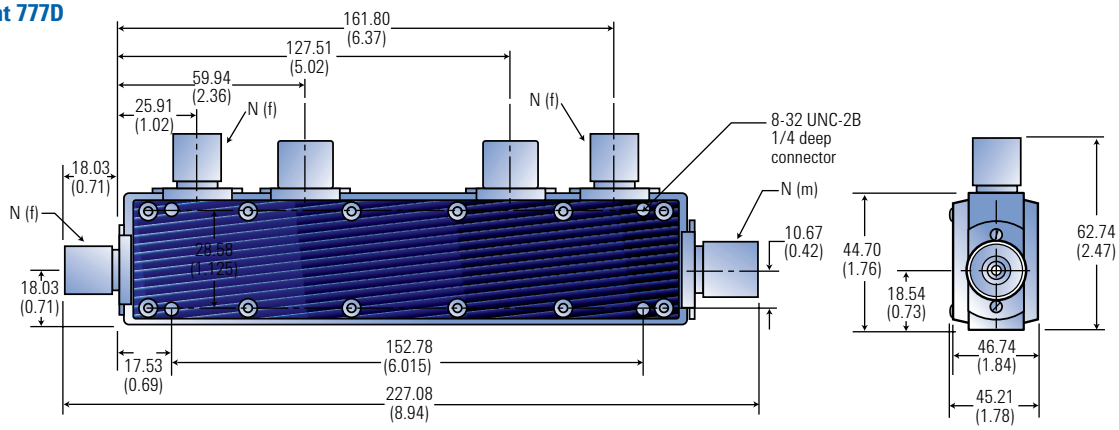
Agilent 775D



Agilent 776D



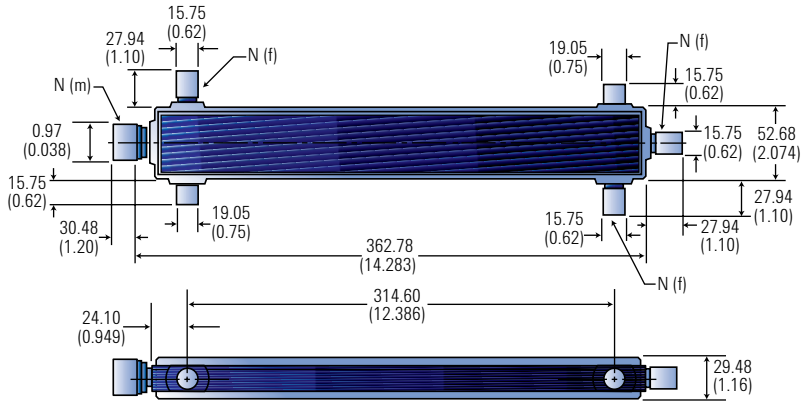
Agilent 777D



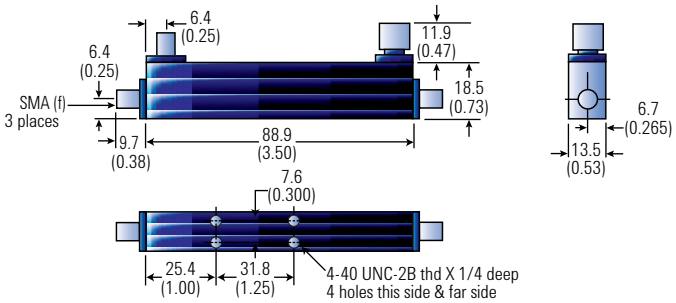
Dimensions are in mm (inches) nominal, unless otherwise specified.

Single- and Dual-Directional Couplers, 90° Hybrid Coupler

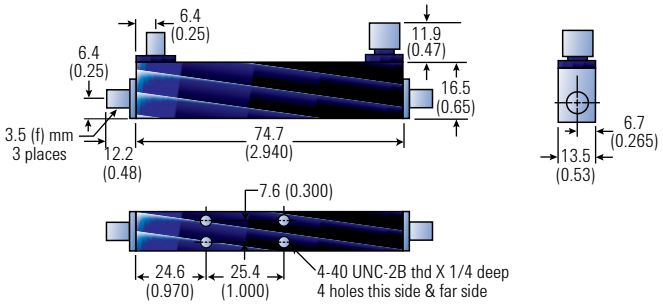
Agilent 778D



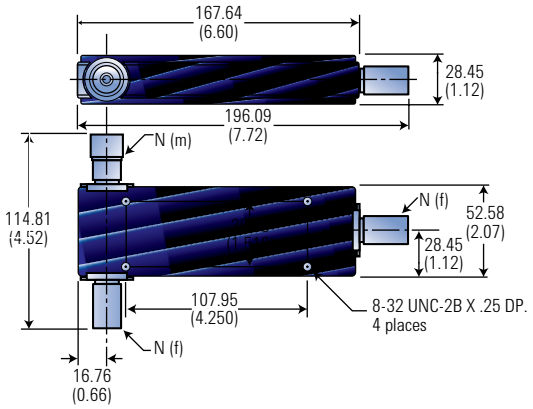
Agilent 87300B



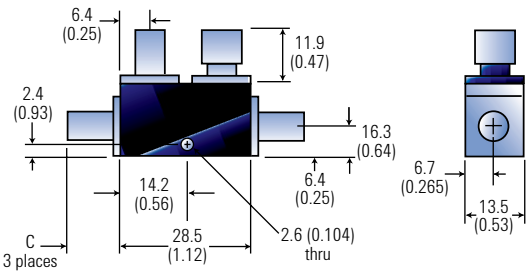
Agilent 87300C



Agilent 779D



Agilent 87300D, 87301B, 87301C

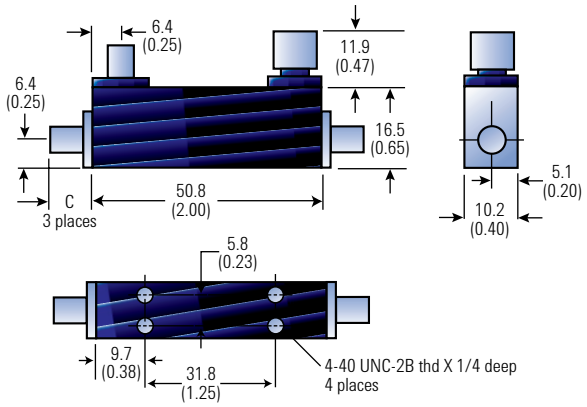


Agilent model	Connector type	C dimension
87300D	3.5 mm (f)	12.2 (0.48)
87301B	2.9 mm (f)	9.7 (0.38)
87301C	2.4 mm (f)	28.4 (1.0)

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

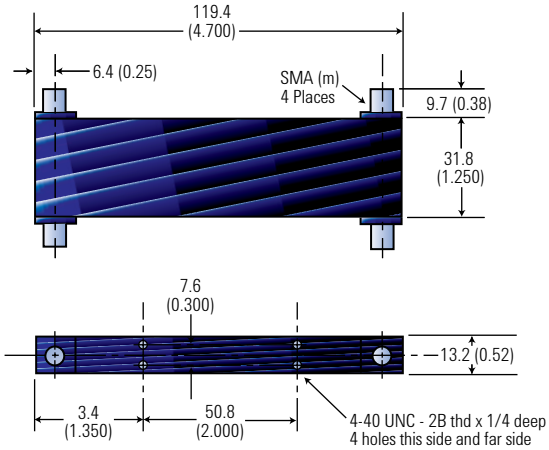
Single- and Dual-Directional Couplers, 90° Hybrid Coupler

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

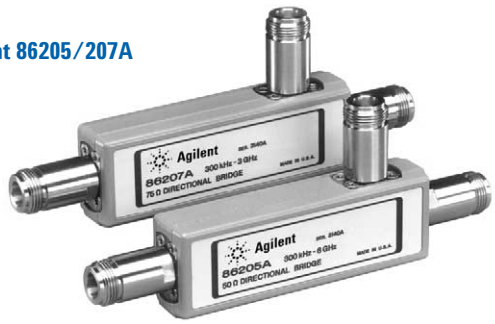


Agilent model	Standard connectors and options
772D	Primary line: APC-7, APC-7
	Auxiliary arms: N (f)
Option 001	All N (f)
773D	Primary line: APC-7, APC-7
	Auxiliary arms: N (f)
Option 001	All N (f)
775D -777D	Primary line: N (m), N (f)
	Auxiliary arms: N (f), N (f)
778D	Primary line: N (f), N (m)
	Auxiliary arms: N (f), N (f)
Option 011	Primary line: APC-7, N (f)
Option 012	Primary line: N (m), N (f)
779D	Primary line: N (m) input, N (f) output
	Auxiliary arm: N (f)
Option 010	Primary line: N (f) input, N (m) output
	Auxiliary: N (f)
11691D	Primary: APC-7, APC-7, Auxiliary: N (f)
Option 001	All N (f)
Option 002	Primary: N (f), N (m), Auxiliary: N (f)
Option 003	Primary: N (f), APC-7, Auxiliary: N (f)
Option 004	Primary: N (f), APC-7, Auxiliary: APC-7
Option 005	All APC-7
11692D	Primary: N (f), APC-7, Auxiliary: N (f), N (f)
Option 001	Primary: N (f), N (f) Auxiliary: N (f), N (f)
Option 002	Primary: N (f), N (m) Auxiliary: N (f), N (f)
Option 003	Primary: N (f), APC-7, Auxiliary: APC-7, APC-7
Option 004	All APC-7
87300B	SMA (f), SMA (f), SMA (f)
87300C	3.5 mm (f), 3.5 mm (f), 3.5 mm (f)
Option 020	3.5 mm (f), 3.5 mm (f), 3.5 mm (f)
87300D	3.5 mm (f), 3.5 mm (f), 3.5 mm (f)
87301B	2.92 mm (f), 2.92 mm (f), 2.92 mm (f)
87301C	2.4 mm (f), 2.4 mm (f), 2.4 mm (f)
87301D	2.4 mm (f), 2.4 mm (f), 2.4 mm (f),
Option 292	2.92 mm (f), 2.92 mm (f), 2.92 mm (f)
87301E	2.4 mm (f), 2.4 mm (f), 2.4 mm (f)
87302C	3.5 mm (f), 3.5 mm (f), 3.5 mm (f)
87303C	3.5 mm (f), 3.5 mm (f), 3.5 mm (f)
87304C	3.5 mm (f), 3.5 mm (f), 3.5 mm (f)
87310B	SMA (m), SMA (m), 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 86205/207A



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 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) 6 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 (>3 GHz) 16.5 dB, -0.20 dB/GHz

Agilent 0955-0759
50 Ω band pass filter

This 50 Ω band pass filter has a center frequency of 175 MHz, a 3 dB bandwidth of 150 to 200 MHz, and 50 dB stop band rejection. Insertion loss is 2.5 dB, SWR is 2:1 and connectors are type-N (f) to N (m).

Agilent 0955-0760
75 Ω band pass filter

This 75 Ω band pass filter has a center frequency of 175 MHz, a 3 dB bandwidth of 150 to 200 MHz, and 50 dB stop band rejection. Insertion loss is 2.5 dB, SWR is 2:1 and connectors are type-N (f) to N (m).

Specifications

Frequency range	Return loss	Insertion loss
50 to 100 MHz	≥12 dB	≤ 2.5 dB
100 MHz to 8 GHz	≥16 dB	≤1.0 dB
8 to 12 GHz	≥14 dB	≤1.0 dB
12 to 18 GHz	≥14 dB	≤1.5 dB

Maximum input: +27 dBm
Connectors: N (f), N (m)
Shipping weight: 0.28 kg (10 oz)

Increased power protection

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.

Excellent accuracy

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. A typical application is shown in Figure 1. Here port 2 of an Agilent 8753E network analyzer is protected from inadvertent overload due to high level signals from the amplifier under test. In Figure 2 typical data for output power versus input power is shown for Agilent 11930A/B. Figures 3 and 4 illustrate typical insertion loss and return loss.

Agilent 11930A/B power limiters

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

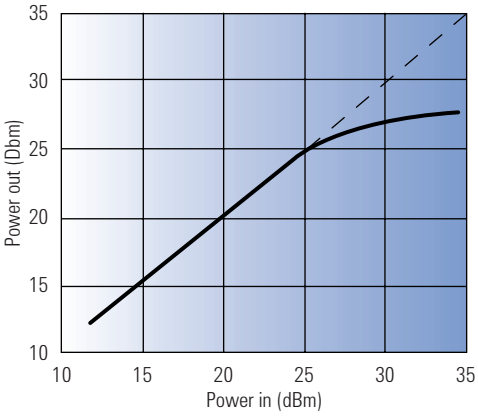


Figure 2. Agilent 11930A typical insertion and return loss versus frequency.

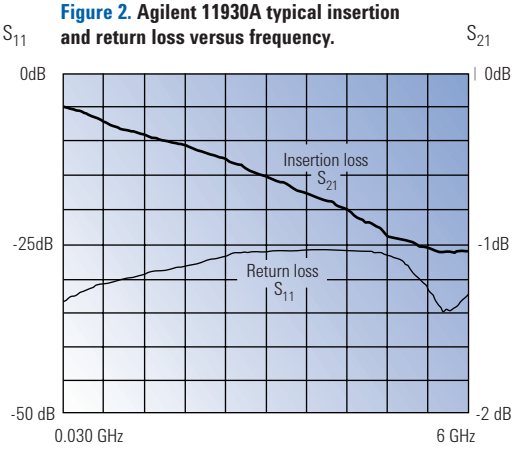
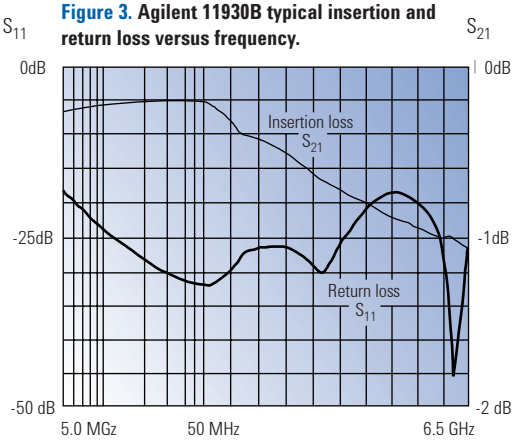


Figure 3. Agilent 11930B typical insertion and return loss versus frequency.



Power Limiters (continued)

Specifications

Agilent model	Agilent 11930A	Agilent 11930B
Features	High power protection Exceptional return loss Excellent accuracy	
Impedance	50 ohm, nominal	
Frequency range	dc to 6 GHz	5 MHz to 6.5 GHz[1]
Frequency response		
Insertion loss:	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
Return loss:	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
Maximum DC current	350 mA	N/A
Maximum input power levels		
Continuous:	3 Watts	
Pulse:	6 Watts	
Pulse width:	30 ms	
Duty cycle:	10%	
Limiting threshold	30 dBm, typical	
Maximum DC volt	30 V	
Input/output connectors	APC-7 (7 mm)	Type-N

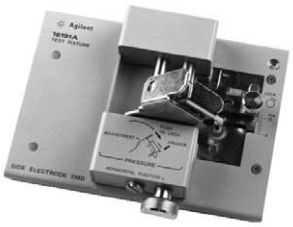
[1] 6 to 6.5 GHz, typical
[2] 5 to 16 MHz insertion and return loss limited by internal 1500 pfarads blocking cap

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 3GHz.

Agilent 16191A bottom electrode SMD test fixture

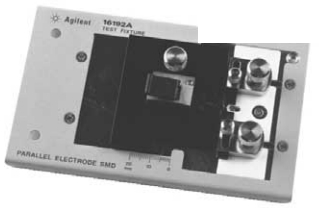
This test fixture is designed for impedance evaluations of bottom electrode SMD components. The minimum SMD size that this fixture is adapted to evaluate is 2 (L) [mm].



Agilent16191A

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 16192A

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 16194A

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 3GHz.

Agilent 16196A/B/C

Agilent 16197A bottom electrode SMD test fixture

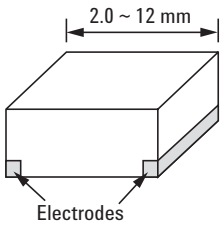
This test fixture is designed for impedance evaluations of bottom electrode SMD components up to 3GHz. This test fixture accommodates various sizes of SMDs; as small as 1005(mm)/0402(inch) and as large as 3225(mm)/1210(inch). Accommodation of the 0603(mm)/0201(inch) SMD is available with Option 001.

Agilent 16197A

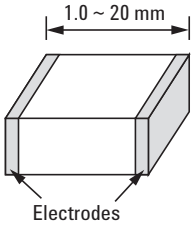
Impedance Test Accessories

Specifications

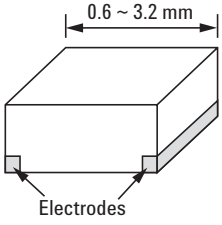
Agilent model	Frequency range	Terminal connector	Maximum voltage peak max (AC + DC)	Operating temperature	Electrode configuration	Device under test size
16191A	DC to 2 GHz	7 mm	±40 V	–55 to +85°C	Bottom	2.0 to 12 mm (length)
16192A	DC to 2 GHz	7 mm	±40 V	–55 to +85°C	Parallel	1.0 to 20 mm (length)
16194A	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)



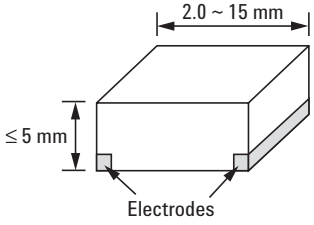
Agilent 16191A



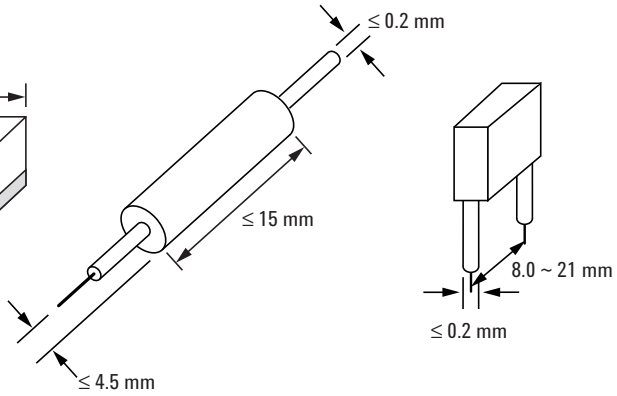
Agilent 16192A



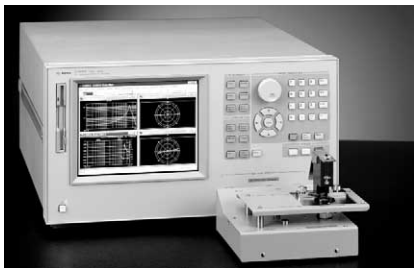
Agilent 16197A



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

Agilent 11970, 11974 series

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.

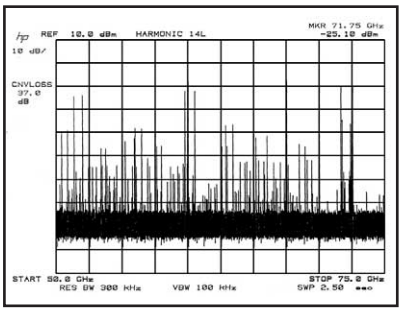
These mixers feature advanced barium-ferrite technology and come with a stand alone power supply. They are particularly useful for broadband millimeter signal analysis, millimeter electromagnetic-interference (EMI) measurements, and unattended monitoring of millimeter signals.

Compatibility

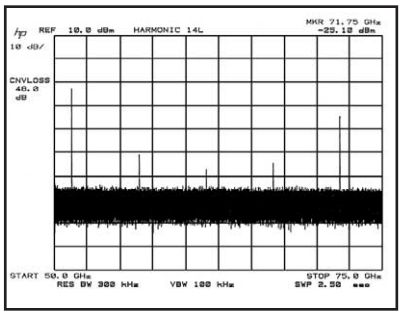
All Agilent 8560E series analyzers and Agilent 70907B external mixer interface modules are fully compatible with the Agilent 11974 series.

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	<±2.3	–54	+6
11974Q	33 to 50	–106	<±2.3	–50	0
11974U	40 to 60	–109	<±2.6	–50	0
11974V	50 to 75	–100	<±4.5	–50 (to 67 GHz) –40 (67 to 75 GHz)	+3

[1] Specifications apply when connected to the Agilent 8566B or 70000 series spectrum analyzers.

[2] Typical characteristic.

Mixers (continued)

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.

- 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 8560E, 8561E, 8562E, and 8563A,E portable spectrum analyzers; except the Agilent 8560A,E with built-in tracking generator (Option 002). 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)

Overview

Accessories for the Agilent 8712E, 8753ET/ES, 8720E, 8510C, and the PNA Series network analyzers include a variety of calibration kits, verification kits, cables, and adapters from dc to 110 GHz.

Calibration kits

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

Electronic calibration kits

ECal modules consist of a connector-specific calibration standard. Modules are available with 3.5mm, 7mm, Type-N (50 and 75 ohm), Type-F, and 7-16 connectors. The Type-N, Type-F, 7-16, and 3.5mm modules have one male and one female connector. Options exist for modules with two male or two female connectors. ECal modules are controlled via the 85097A PC interface kit and ECal software that runs on a Windows-based PC (not included) when used with the Agilent 8753, 8719, 8720, 8722, and 8510 series of network analyzers. The PNA Series network analyzers can control RF ECal modules directly via its USB port and does not require the 85097A kit.

Mechanical calibration kits

All network analyzer coaxial mechanical calibration kits contain precision standard devices to characterize the systematic errors of the Agilent 8712, 8753 series, PNA Series, 8720 series or 8510C network analyzer system. Each mechanical calibration kit also contains 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.

Network Analyzer Accessories and Cal Kits

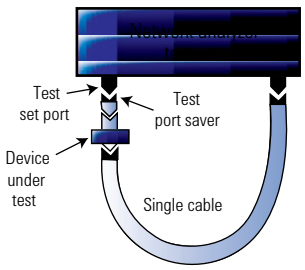
Test port cables and adapters

Test port cables and adapters sets are available for various connector types. The cable/adapter configurations are described below. Cables used with the 8720 series and 8510 series network analyzers are designed with one end that connects directly to the special rugged ports of the network analyzer test set, and one end that connects to the device under test. Special test port adapter sets are also available to convert the rugged ports of the network analyzer test set to the desired connector interface. Each kit contains two adapters, one male and one female.

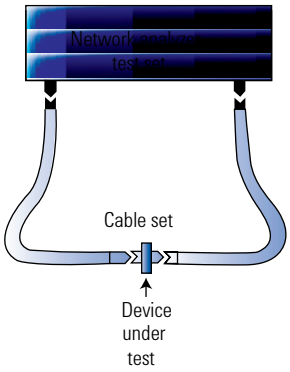
These cables and special adapters have a 3.5 mm or 2.4 mm ruggedized female connector on one end, which is designed to connect to the 8720 series or 8510 series network analyzer two-port test set. This connector cannot be mated to standard 3.5 mm or 2.4 mm connectors. However, the other end of the cable or adapter has a connector that can be mated to standard 3.5 mm or 2.4 mm connectors.

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

Configuration A



Configuration B



Configuration A

3.5 mm test set ports

DUT connector	Cables/adapters
3.5 mm	Agilent 85131C semi-rigid cable with a 3.5 mm (f) connector
	Agilent 85131E flexible cable with a 3.5 mm (f) connector
	Agilent 85130D adapter set with 3.5 mm (m,f) connectors
7 mm	Agilent 85132C semi-rigid cable with 7 mm connector
	Agilent 85132E flexible cable with a 7 mm connector
	Agilent 85130B adapter set with 7 mm connectors
Type-N	Use 7 mm cables and the 7 mm to Type-N adapters included in the Agilent 85054B,D calibration kit.

Configuration A

2.4 mm test set ports

DUT Connector	Cables/adapters
2.4 mm	Agilent 85133C semi-rigid cable with a 2.4 mm (f) connector
	Agilent 85133E flexible cable with a 2.4 mm (f) connector
	Agilent 85130G adapter set with 2.4 mm (m,f) connectors
3.5 mm	Agilent 85134C semi-rigid cable with a 3.5 mm (f) connector
	Agilent 85134E flexible cable with a 3.5 mm (f) connector
	Agilent 85130F adapter set with 3.5 mm (m,f) connectors
7 mm	Agilent 85135C semi-rigid cable with a 7 mm connector
	Agilent 85135E flexible cable with a 7 mm connector
	Agilent 85130E adapter set with 7 mm connectors

Cables (for network analyzer)

11857B 75-ohm Type-N test port cables (two)
11857D 50-ohm, APC-7, test-port extension cables
11857F 75-ohm Type-F cables (two)
11851B 50-ohm Type-N cables (four)
N6314A 50-ohm Type-N cable (one)

Configuration B

3.5 mm test set ports

DUT Connector	Cable set
3.5 mm	Agilent 85131D semi-rigid cable set with 3.5 mm (m,f) connectors
	Agilent 85131F flexible cable set with 3.5 mm (m,f) connectors
7 mm	Agilent 85132D semi-rigid cable set with 7 mm connector
	Agilent 85132F flexible cable set with 7 mm connector
Type-N	Use 7 mm cables and the 7 mm to Type-N adapters included in the Agilent 85054B,D calibration kit.

Configuration B

2.4 mm test set ports

DUT Connector	Cable set
2.4 mm	Agilent 85133D semi-rigid cable set with 2.4 mm (m,f) connectors
	Agilent 85133F flexible cable set with 2.4 mm (m,f) connectors
3.5 mm	Agilent 85134D semi-rigid cable set with 3.5 mm (m,f) connectors
	Agilent 85134F flexible cable set with 3.5 mm (m,f) connectors
7 mm	Agilent 85135D semi-rigid cable set with 7 mm connectors
	Agilent 85135F flexible cable set with 7 mm connectors

Accessories

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 will suppress low-frequency signals that can damage expensive measuring equipment or will affect the accuracy of your RF and microwave measurements.

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 RF spectrum network analyzers.

Coaxial mechanical calibration kits

Connector	Frequency range	Type	VNA calibration accuracy	Agilent model	Available options	Page
Type-F(75 ohm)	DC to 3	Economy	5%-1%	**85039B**	1BP, 1BN, UK6, 00M, 00F	88
Type-N(75 ohm)	DC to 3	Economy	5%-1%	**85036E**	1BN, 1BP, UK6, 910	89
Type-N(75 ohm)	DC to 3	Standard	5%-1%	**85036B**	1BN, 1BP, UK6, 910	89
Type-N(50 ohm)	DC to 6	Economy	5%-1%	**85032E**	1BN, 1BP, UK6, 910	90
Type-N(50 ohm)	DC to 6	Standard	5%-1%	**85032B**	1BN, 1BP, UK6, 910, 001	90
Type-N(50 ohm)	DC to 9	Standard	5%-1%	**85032F**	1BN, 1BP, UK6, 100, 200,300,400*	92
Type-N(50 ohm)	0.045 to 18	Economy	5%-1%	**85054D**	1BN, 1BP, 002	94
Type-N(50 ohm)	0.045 to 18	Standard	2%-0.3%	**85054B**	1BN, 1BP, 002	93
7-16	DC to 7.5	Standard	2%	**85038A**	none	95
7-16	DC to 7.5	Standard	2%	**85038F**	none	95
7-16	DC to 7.5	Standard	2%	**85038M**	none	95
7 mm	DC to 6	Economy	2%-0.3%	**85031B**	1BN, 1BP, UK6, 910	96
7 mm	0.045 to 18	Economy	5%-1%	**85050D**	1BN, 1BP, 910, 002	96
7 mm	0.045 to 18	Standard	2%-0.05%	**85050B**	1BN, 1BP, 910, 002	97
7 mm	0.045 to 18	Precision	0.3%-0.05%	**85050C**	1BN, 1BP, 910, 002	98
3.5 mm	DC to 6	Economy	5%-1%	**85033D**	1BN, 1BP, UK6, 910, 001, 002	99
3.5 mm	DC to 9	Standard	5%-1%	**85033E**	1BN, 1BP, UK6, 100, 200, 300, 400**,500	100
3.5 mm	0.045 to 26.5	Economy	5%-1%	**85052D**	1BN, 1BP, 910, 002	101
3.5 mm	0.045 to 26.5	Standard	3%-0.5%	**85052B**	1BN, 1BP, 910, 002	102
3.5 mm	0.045 to 26.5	Precision	2%-0.5%	**85052C**	1BN, 1BP, 910, 002	103
2.92 mm	0.045 to 50	Economy	11%-4% (Option 001 65%-3%)	**85056K**	1BN, 1BP, 001*, 002	104, 105
2.4 mm	0.045 to 50	Economy	5%-1%	**85056D**	1BN, 1BP, 910, 002	106
2.4 mm	0.045 to 50	Standard	4%-0.5%	**85056A**	1BN, 1BP, 910, 002	107
1 mm	0.045 to 110	Precision	5%-1%	**85059A**	none	108, 109

Waveguide mechanical calibrations kits

Connector	Frequency range	Type	VNA calibration accuracy	Agilent model	Available options	Page
WR-90	8.2 to 12.4	Precision	0.3%-0.05%	**X11644A**	002	110
WR-62	12.4 to 18	Precision	0.3%-0.05%	**P11644A**	002	111
WR-42	18 to 16.5	Precision	0.3%-0.05%	**K11644A**	002	112
WR-28	26.5 to 40	Precision	0.3%-0.05%	**R11644A**	002	113
WR-22	33 to 50	Precision	0.3%-0.05%	**Q11644A**	002	114
WR-19	40 to 60	Precision	0.3%-0.05%	**U11644A**	002	115
WR-15	50 to 75	Precision	0.3%-0.05%	**V11644A**	002	116
WR-10	75 to 110	Precision	0.3%-0.05%	**W11644A**	002	117

Option description

002: Add calibration/verification data on magnetic tape in addition to 3.5" floppy
002*: Replaces 7 mm to 3.5 mm adapters with Type-N to 3.5 mm adapters
1BN: MIL standard 45662A calibration certification
1BP: MIL standard 45662A calibration certification with test data
UK6: Commercial calibration certificate with test data
00M: Includes male standards & male-male adapter
00F: Includes female standards and female-female adapter
001: Deletes 7 mm to 3.5 mm adapters
001*: Adds 2.4 mm sliding load and 2.4 mm gauges
001:** Adds data for Agilent 8702 lightwave component analyzer
100: Includes female-female adapter
200: Includes male-male adapter
300: Includes male-female adapter
400*: Adds four 7 mm to Type-N adapters
400:** Adds four 3.5 mm to Type-N adapters
500: Adds four 7 mm to 3.5 mm adapters
910: Adds extra manual

Coaxial electronic calibration kits (ECal)

Connector	Frequency range(GHz)	Type	VNA calibration accuracy	Agilent model	Available options	Page
7 mm	30 kHz to 9 GHz	Standard	1% - 0.1%	**85091B**	See detailed descriptions	118
Type-N (50 ohm)	30 kHz to 9 GHz	Standard	1% - 0.1%	**85092B**		118, 119, 120
3.5 mm	30 kHz to 9 GHz	Standard	2% - 0.2%	**85093B**		118, 119, 121
Type-N (75 ohm)	30 kHz to 3 GHz	Standard	N/A	**85096B**		119
7-16	30 kHz to 7.5 GHz	Standard	N/A	**85098B**		119
Type-F	30 kHz to 3 GHz	Standard	N//A	**85099B**		119
7 mm	1 GHz to 18 GHz	Standard	2% - 0.05%	**85060B**		118, 119, 120
3.5 mm	1 GHz to 26.5 GHz	Standard	3% - 0.5%	**85062B**		118, 119, 121
Type-N (50 ohm)	1 GHz to 18 GHz	Standard	2% - 0.1%	**85064B**		118, 119, 120
PC Interface kit	N/A	N/A	N/A	**85097A**		118

Mechanical verification kits

Connector	Frequency Range(GHz)	Type	VNA calibration accuracy	Agilent model	Available options	Page
Type-N	0.045 to 18 GHz	Precision	N/A	**85055A**	1BP,002,910	123
7 mm	DC to 6 GHz	Precision	N/A	**85092B**	1BP,001**,910	123
7 mm	0.045 to 18 GHz	Precision	N/A	**85051B**	1BP,002,910	124
3.5 mm	0.045 to 26.5 GHz	Precision	N/A	**85053B**	1BP,002,910	124
2.4 mm	0.045 to 50 GHz	Precision	N/A	**85057B**	1BP,002,910	125
WR-28	26.5 to 40	Precision	N/A	**R11645A**	1BP,002	125
WR-22	33 to 50	Precision	N/A	**Q11645A**	1BP,002	126
WR-19	40 to 60	Precision	N/A	**U11645A**	1BP,002	126
WR-15	50 to 75	Precision	N/A	**V11645A**	1BP,002	127
WR-10	75 to 110	Precision	N/A	**W11645A**	1BP,002	127

Option description

002: Add calibration/verification data on magnetic tape in addition to 3.5" floppy
1BN: MIL standard 45662A calibration certification
1BP: MIL standard 45662A calibration certification with test data
UK6: Commercial calibration certificate with test data
00M: Includes male standards & male-male adapter
00F: Includes female standards and female-female adapter
001: Deletes 7 mm to 3.5 mm adapters
001*: Adds 2.4 mm sliding load and 2.4 mm gauges
001:** Adds data for Agilent 8702 lightwave component analyzer
910: Adds extra manual

Agilent 85039B calibration kit, Type-F

The Agilent 85039B 75 Ω type-F calibration kit is used to calibrate Agilent 8752C, Agilent 8753, and Agilent 8712E network analyzer systems for measurements of components with 75 Ω type-F connectors up to 3 GHz.

Electrical specifications

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

Adapters

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

[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

Part Number	Description	85039B	Opt 00M	Opt 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 load	X		X
85039-60005	75 ohm Type-F female load	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			

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 kits

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.

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.

Electrical specifications

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

Replaceable parts for the Agilent 85036E

Item no.	Description	Qty per kit	Agilent replacement part number
	Calibration devices		
1	75Ω Type-N male broadband load	1	00909-60019
2	75Ω 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	75Ω Type-N male broadband load	1	00909-60019
2	75Ω Type-N female broadband load	1	00909-60020
3	75Ω Type-N male short	1	85036-60012
4	75Ω Type-N female short	1	85036-60011
5	75Ω Type-N male open	1	85032-60007
6	75Ω Type-N female open body	1	85032-20001
7	75Ω Type-N female open center conductor extender	1	85036-60010

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.

Parts list

Agilent 11853A

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

Part number	Qty	Description
1250-0929	2	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

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

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

The Agilent 85032B calibration kit contains precision 50 ohm type-N standards used to calibrate Agilent 8712ES, Agilent 8753, PNA Series and 50 ohm test sets for measurement of devices with 50 ohm type-N connectors. Precision phase-matched 7 mm to 50 ohm type-N adapters are included for accurate measurements of non-insertable devices. Standards include fixed terminations, open circuits, and short circuits in both sexes. This kit is specified from DC to 6 GHz. Option 001 removes the precision phase-matched 7 mm to Type-N adapters.

Adapter kits

11853A	**50 ohm Type-N accessory kit**
	(m) to (m)
	(f) to (f)
	(m) short
	(m) short
11854A	**50 ohm BNC accessory kit**
	(m) short
	BNC (m) to N (m)
	BNC (f) to N (f)
	BNC (m) to N (f)
	BNC (f) to N (m)

Electrical specifications

The electrical specifications in table 2-2 apply to the devices in both the Agilent 85032B and Agilent 85032E 50 ohm, type-N calibration kits.

Table 2-2 electrical specifications for 50 Ω Type-N devices

Device	Frequency (GHz)	Parameter	Specifications
Loads	DC to ≤2	Return loss	≥49dB (≤0.00355ρ)
	> 2 to ≤3	Return loss	≥46 dB (≤0.00501ρ)
	> 3 to ≤6	Return loss	≥40 dB (≤0.01000ρ)
Female open [1]	DC to ≤6	Deviation from nominal: phase	±0.50° ±0.484° / GHz
Female short [1]	DC to ≤6	Deviation from nominal: phase	±0.490° ±0.385° / GHz
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
Adapters (7 mm to type-N)	DC to ≤6	Return loss	≥30 dB (≤0.03162ρ)

Replacement parts for Agilent 85032E

Description	Qty per kit	Agilent replacement part number
Calibration devices		
50Ω Type-N male broadband load	1	00909-60009
50Ω Type-N combination male open/short	1	85032-60011

Replacement parts for Agilent 85032B

Description	Qty per kit	Agilent replacement part number
Calibration devices		
50Ω Type-N male broadband load	1	00909-60009
50Ω Type-N female broadband load	1	00909-60010
50Ω Type-N male short	1	85032-60008
50Ω Type-N female short	1	85032-60009
50Ω Type-N male open	1	85032-60007
50Ω Type-N female open [2]	1	85032-60012
Adapters (not included with Option 001)		
50Ω Type-N male to 7 mm	2	85054-60009
50Ω Type-N female to 7 mm	2	85054-60001

[1] The specifications for the opens and shorts are given as allowed deviation from the nominal model as defined in the standard definitions.
[2] Includes center conductor extender

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

The Agilent 85032F calibration kit contains precision 50 ohm Type-N standards used to calibrate Agilent 8712ES, 8753, PNA Series, and 50 ohm test sets 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 001 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 400.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Loads	DC to ≤2	Return loss	≥48dB (≤0.0398ρ)
	> 2 to ≤3	Return loss	≥45 dB (≤0.00562ρ)
	> 3 to ≤6	Return loss	
	> 6 to ≤9	Return loss	≥40 dB (≤0.010ρ)
Opens	DC to ≤3	Deviation from nominal: phase	±0.65°
	> 3 to ≤9	Deviation from nominal: phase	±1.00°
Shorts	DC to ≤3	Deviation from nominal: phase	±0.65°
	> 3 to ≤9	Deviation from nominal: phase	±1.00°
Adapters			

Replacement parts for Agilent 85032F

Description	Qty per kit	Agilent replacement part number
Calibration devices		
50Ω Type-N male broadband load	1	85032-60017
50Ω Type-N female broadband load	1	85032-60018
50Ω Type-N male open	1	85032-60013
50Ω Type-N female open	1	85032-60014
50Ω Type-N male short	1	85032-60016
50Ω Type-N female short	1	85032-60015
Adapters		
50Ω Type-N (f) to Type-N (f) adapter (Option 100)	1	85032-60021
50Ω Type-N (m) to Type-N (m) adapter (Option 200)	1	85032-60019
50Ω Type-N (m) to Type-N (f) adapter (Option 300)	1	85032-60020
50Ω Type-N (f) to 7 mm adapter (Option 400)	2	85054-60001
50Ω Type-N (m) to 7 mm adapter (Option 400)	2	85054-60009

Agilent 85054B mechanical calibration kit, Type-N

The Agilent 85054B mechanical calibration kit contains precision standard devices to characterize the systematic errors of the Agilent 8720 series or 8510C network analyzer system in the 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. Included are standards definitions on disk for the 8510C.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Lowband loads	DC to ≤ 2	Return loss	≥ 48dB (≤0.00398 ρ)
Sliding loads	> 2 to ≤ 18	Return loss	≥ 42dB (≤0.00794 ρ)
Adapters (both types)	DC to ≤ 8	Return loss	≥ 34dB (≤0.00200 ρ)
	> 8 to ≤ 18	Return loss	≥ 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	1	8710-1766
Spanner	1	08513-20014
Screw-on N gage	1	85054-80011
Type-N gage set (includes items listed below)		85054-60049
Type-N gage (f)	1	85054-60050
Type-N gage master (f)	1	85054-60052
Type-N gage (m)	1	85054-60051
Type-N gage master (m)	1	85054-60053
Centering beads	2	85054-80028

Agilent 85054D economy mechanical calibration kit, Type-N

The Agilent 85054D type-N economy calibration kit is used to calibrate network analyzer systems (such as the Agilent 8510 or Agilent 8720 series) for measurements of components with type-N connectors up to 18 GHz.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Broadband loads	DC to ≤2	Return loss	≥40dB (≤0.01000 ρ)
	>2 to ≤8	Return loss	≥36dB (≤0.01585 ρ)
	>8 to ≤18	Return loss	≥42dB (≤0.01995 ρ)
Adapters (both types)	DC to ≤8	Return loss	≥34dB (≤0.00200 ρ)
	>8 to ≤18	Return loss	≥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	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 8753, PNA Series, and Agilent 8712E 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	0.99 minimum
Reflection phase	+/- 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	
85038-80015	Male to male adapter		X	
85038-80016	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	1	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	1	7 mm to 7-16 male
11906-80013	1	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

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 PNA Series, Agilent 8753, and its 50 ohm test sets for measurement of devices with precision 7 mm connectors. This kit is specified 300 kHz to 6 GHz.

Device	Specification	
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

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

Agilent 85050D, 7 mm economy mechanical calibration kit

The Agilent 85050D economy mechanical calibration kit contains precision standard devices to characterize the systematic errors of the Agilent 8720 series or 8510C network analyzer system 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. Included are standards definitions on disk for the 8510C. Connector gages may be ordered separately.

Electrical specifications

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

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

Agilent 85050B mechanical calibration kit, 7 mm

The Agilent 85050B mechanical calibration kit contains precision standard devices to characterize the systematic errors of the Agilent 8720 series or 8510C network analyzer system 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. Included are standards definitions on disk for the 8510C.

Electrical specifications

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

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	1	8710-1766

Agilent 85050C, 7 mm precision mechanical calibration kit

The Agilent 85050C precision mechanical calibration kit contains precision standard devices to characterize the systematic errors of the Agilent 8720 series or 8510C network analyzer system 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. Included are standards definitions on disk for the 8510C.

Electrical specifications

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

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	85050-80010
3/4 in., 135 N-cm (12 in-lb) torque	1	8710-1766
7 mm connector collet extractor	1	5060-0370

Agilent 85033D calibration kit, 3.5 mm

The Agilent 85033D calibration kit contains fixed loads and open and short circuits in both sexes to calibrate the 50 ohm test sets for measurement of devices with precision 3.5 mm and SMA connectors. Phase-matched 7 mm to 3.5 mm adapters for male and female connectors are included for use with 7 mm test port cables. This kit is specified from dc to 6 GHz. Option 001 removes the precision phase-matched 7 mm to 3.5 mm adapter.

Electrical specifications

Device	Specifications	Frequency (GHz)
Broadband loads (male and female)	Return loss ≥46 dB (ρ≤0.005)	dc to ≤1.3
	Return loss ≥44 dB (ρ≤0.006)	> 1.3 to ≤3
	Return loss ≥38 dB (ρ≤0.013)	> 3 to ≤6
Offset opens[1] (male and female)	±0.65° from nominal	dc to ≤1.3
	±0.65° from nominal	> 1.3 to ≤3
	±0.85° from nominal	> 3 to ≤6
Offset shorts1 (male and female)	±0.48° from nominal	dc to ≤1.3
	±0.50° from nominal	> 1.3 to ≤3
	±0.55° from nominal	> 3 to ≤6

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

Replaceable parts

Item No.	Description	Qty per kit	Agilent replacement part number
	Calibration devices		
1	3.5 mm male broadband load	1	85033-60009
2	3.5 mm female broadband load	1	85033-60010
3	3.5 mm male offset open	1	85033-60011
4	3.5 mm female offset open	1	85033-60012
5	3.5 mm male offset short	1	85033-60013
6	3.5 mm female offset short	1	85033-60014
	Adapters (not included with option 001)		
7	7 mm to 3.5 mm male	2	85052-60004
8	7 mm to 3.5 mm female	2	85052-60003
	Adapters (Option 002)		
9	Type-N male to 3.5 mm male	1	1250-1743
10	Type-N male to 3.5 mm female	1	1250-1744
11	Type-N female to 3.5 mm female	1	1250-1745
12	Type-N female to 3.5 mm male	1	1250-1750

Agilent 85033E
mechanical calibration kit, 3.5 mm

The Agilent 85033E calibration kit contains precision 3.5 mm standards used to calibrate Agilent 8712ES, 8753, PNA Series, and 50 ohm test sets 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 001 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 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	≥46dB (≤0.005ρ)
	> 2 to ≤3	Return loss	≥44 dB (≤0.006ρ)
	> 3 to ≤9	Return loss	≥38 dB (≤0.013ρ)
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

Description	Qty per kit	Agilent replacement part number
3.5 mm male broadband load	1	85033-60016
3.5 mm female broadband load	1	85033-60017
3.5 mm male open	1	85033-60018
3.5 mm female open	1	85033-60019
3.5 mm male short	1	85033-60020
3.5 mm female short	1	85033-60021
Adapters		
3.5 mm (f) to (f) adapter (Option 100)	1	85027-60005
3.5 mm (m) to (m) adapter (Option 200)	1	85027-60007
3.5 mm (m) to (f) adapter (Option 300)	1	85027-60006
3.5 mm (f) to Type-N (f) adapter (Option 400)	1	1250-1745
3.5 mm (f) to Type-N (m) adapter (Option 400)	1	1250-1744
3.5 mm (m) to Type-N (f) adapter (Option 400)	1	1250-1750
3.5 mm (m) to Type-N (m) adapter (Option 400)	1	1250-1743
3.5 mm (f) to 7 mm adapter (Option 500)	1	1250-1746
3.5 mm (m) to 7 mm adapter (Option 500)	1	1250-1747

Agilent 85052D
economy mechanical calibration kit, 3.5 mm

The Agilent 85052D economy mechanical calibration kit contains precision standard devices to characterize the systematic errors of the Agilent 8720 series or 8510C network analyzer system 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. Included are standards definitions on disk for the 8510C. Connector gages may be ordered separately.

Electrical specifications

Device	Specifications	Frequency (GHz)
Broadband loads	≥46 dB return loss (≤0.00501ρ)	dc to ≤2
	≥44 dB return loss (≤0.00631ρ)	> 2 to ≤3
	≥38 dB return loss (≤0.01259ρ)	> 3 to ≤8
	≥36 dB return loss (≤0.01585ρ)	> 8 to ≤20
	≥34 dB return loss (≤0.01995ρ)	> 20 to ≤26.5
Adapters	30 ≥dB return loss (≤0.03162ρ)	dc to ≤8
	28 ≥dB return loss (≤0.03981ρ)	>8 to ≤18
	26 ≥dB return loss (≤0.05012ρ)	>18 to ≤26.5
Offset opens	±0.65° from nominal	dc to ≤3
	±1.20° from nominal	> 3 to ≤8
	±2.00° from nominal	> 8 to ≤20
	±2.00° from nominal	> 20 to ≤26.5
Offset shorts	±0.50° from nominal	dc to ≤3
	±1.00° from nominal	> 3 to ≤8
	±1.75° from nominal	> 8 to ≤20
	±1.75° from nominal	> 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)	1	85052-60014
3.5 mm (m) to 3.5 mm (f)	1	85052-60013
3.5 mm (f) to 3.5 mm (f)	1	85052-60012
5/16 in., 90 N-cm (8 in-lb) Torque	1	8710-1765
7 mm open-end	1	8710-1761

Agilent 85052B mechanical calibration kit, 3.5 mm

The Agilent 85052B mechanical calibration kit contains precision standard devices to characterize the systematic errors of the Agilent 8720 series or 8510C network analyzer system 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. Included are standards definitions on disk for the 8510C.

Electrical specifications

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

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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)	1	85052-60014
3.5 mm (m) to 3.5 mm (f)	1	85052-60013
3.5 mm (f) to 3.5 mm (f)	1	85052-60012
5/16 in., 90 N-cm (8 in-lb) torque	1	8710-1765
7 mm open-end	1	8710-1761

Agilent 85052C mechanical 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 8510 and Agilent 8720 and PNA Series using the TRL (thru-reflect-line) calibration method. The calibration devices in this kit have very precise mechanical dimensions and must be handled with care.

Electrical specifications

Device	Specifications	Frequency (GHz)
Broadband loads	≥46 dB return loss (≤0.00501ρ)	dc to ≤2
	≥44 dB return loss (≤0.00631ρ)	> 2 to ≤3
	≥38 dB return loss (≤0.01259ρ)	> 3 to ≤8
	≥36 dB return loss (≤0.01585ρ)	> 8 to ≤20
	≥34 dB return loss (≤0.01995ρ)	> 20 to ≤26.5
Long precision airline	≥56 dB return loss (≤0.00158ρ)	> 2 to ≤7
Short precision airline	≥50 dB return loss (≤0.00316ρ)	> 7 to ≤26.5
Precision adapters	≥30 dB return loss (≤0.03162ρ)	dc to ≤20
	≥27 dB return loss (≤0.00447ρ)	>20 to ≤26.5
Offset opens	±0.65° from nominal	dc to ≤3
	±1.20° from nominal	> 3 to ≤8
	±2.00° from nominal	> 8 to v20
	±2.00° from nominal	> 20 to ≤26.5
Offset shorts	±0.50° from nominal	dc to ≤3
	±1.00° from nominal	> 3 to ≤8
	±1.75° from nominal	> 8 to ≤20
	±1.75° from nominal	> 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)	1	85052-60033
3.5 mm (m) to 3.5 mm (f)	1	85052-60032
3.5 mm (f) to 3.5 mm (f)	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	1	8710-1765
Hex balldriver, 4mm	1	8710-1933
Adapter anti-rotation clamp	2	85052-20060

Agilent 85056K mechanical 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 8510 or Agilent 8722, 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	≥42dB (≤0.00794ρ)
	> 4 to ≤20	Return loss	≥34 dB (≤0.01995ρ)
	> 20 to ≤26.5	Return loss	≥30 dB (≤0.03163ρ)
	> 26.5 to ≤50	Return loss	≥30 dB (≤0.05019ρ)
Sliding loads	4 to ≤20	Return loss	≥42dB (≤0.00794ρ)
	> 20 to ≤36	Return loss	≥40 dB (≤0.01000ρ)
	> 36 to ≤40	Return loss	≥38 dB (≤0.01259ρ)
	> 40 to ≤50	Return loss	≥36 dB (≤0.01585ρ)
Adapters (2.4 mm to 2.4 mm)	DC to ≤4	Return loss	≥32dB (≤0.02512ρ)
	> 4 to ≤26.5	Return loss	≥30 dB (≤0.03162ρ)
	> 26.5 to ≤40	Return loss	≥25 dB (≤0.05623ρ)
	> 40 to ≤50	Return loss	≥20 dB (≤0.01000ρ)
Adapters (2.4 mm to 2.92 mm)	DC to ≤40	Return loss	≥24dB (≤0.06310ρ)
Offset opens	DC to ≤2	Deviation from nominal:	±0.5°
	> 2 to ≤20	Deviation from nominal:	±1.25°
	> 20 to ≤40	Deviation from nominal:	±1.75°
	> 40 to ≤50	Deviation from nominal:	±2.25°
Offset shorts	DC to ≤2	Deviation from nominal:	±0.5°
	> 2 to ≤20	Deviation from nominal:	±1.25°
	> 20 to ≤40	Deviation from nominal:	±1.5°
	> 40 to ≤50	Deviation from nominal:	±2.0°

2.4 mm to 2.92 mm adapter characteristics

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

Agilent 85056K mechanical calibration kit, 2.4 mm & 2.92 mm (continued)

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)	1	85056-60005
2.4 mm (f) to 2.4 mm (f)	1	85056-60006
2.4 mm (f) to 2.4 mm (m)	1	85056-60007
2.4 mm (m) to 2.92 mm (m)	1	11904-60001
2.4 mm (m) to 2.92 mm (f)	1	11904-60003
2.4 mm (f) to 2.92 mm (m)	1	11904-60004
2.4 mm (f) to 2.92 mm (f)	1	11904-60002
5/16 in., 90 N-cm (8 in-lb) torque	1	8710-1765
5/16 in., 56 N-cm (5 in-lb) torque	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 mechanical calibration kit, 2.4 mm

The Agilent 85056D economy mechanical calibration kit contains precision standard devices to characterize the systematic errors of the Agilent 8720 series or 8510C network analyzer system 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. Included are standards definitions on disk for the 8510C. Connector gages may be ordered separately.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Broadband loads	DC to ≤4	Return loss	≥42dB (≤0.00794ρ)
	> 4 to ≤20	Return loss	≥34 dB (≤0.01995ρ)
	> 20 to ≤26.5	Return loss	≥30 dB (≤0.03163ρ)
	> 26.5 to ≤50	Return loss	≥30 dB (≤0.05019ρ)
Adapters (2.4 mm to 2.4 mm)	DC to ≤4	Return loss	≥32dB (≤0.02512ρ)
	> 4 to ≤26.5	Return loss	≥30 dB (≤0.03162ρ)
	> 26.5 to ≤40	Return loss	≥25 dB (≤0.05623ρ)
	> 40 to ≤50	Return loss	≥20 dB (≤0.01000ρ)
Offset opens	DC to ≤2	Deviation from nominal:	±0.5°
	> 2 to ≤20	Deviation from nominal:	±1.25°
	> 20 to ≤40	Deviation from nominal:	±1.75°
	> 40 to ≤50	Deviation from nominal:	±2.25°
Offset shorts	DC to ≤2	Deviation from nominal:	±0.5°
	> 2 to ≤20	Deviation from nominal:	±1.25°
	> 20 to ≤40	Deviation from nominal:	±1.5°
	> 40 to ≤50	Deviation from nominal:	±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)	1	85056-60005
2.4 mm (m) to 2.4 mm (f)	1	85056-60006
2.4 mm (f) to 2.4 mm (f)	1	85056-60007
5/16 in., 90 N-cm (8 in-lb) torque	1	8710-1765
7 mm open-end	1	8710-1761

Agilent 85056A calibration kit

The Agilent 85056A 2.4 mm calibration kit is used to calibrate network analyzer systems (such as the Agilent 8510 or Agilent 8722) for measurements of components with 2.4 mm connectors up to 50 GHz.

Electrical specifications

Device	Frequency (GHz)	Parameter	Specifications
Broadband loads	DC to ≤4	Return loss	≥42dB (≤0.00794ρ)
	> 4 to ≤20	Return loss	≥34 dB (≤0.01995ρ)
	> 20 to≤26.5	Return loss	≥30 dB (≤0.03163ρ)
	> 26.5 to ≤50	Return loss	≥30 dB (≤0.05019ρ)
Sliding loads	4 to ≤20	Return loss	≥42dB (≤0.00794ρ)
	> 20 to ≤36	Return loss	≥40 dB (≤0.01000ρ)
	> 36 to ≤40	Return loss	≥38 dB (≤0.01259ρ)
	> 40 to ≤50	Return loss	≥36 dB (≤0.01585ρ)
Adapters (2.4 mm to 2.4 mm)	DC to ≤4	Return loss	≥32dB (≤0.02512ρ)
	> 4 to ≤26.5	Return loss	≥30 dB (≤0.03162ρ)
	> 26.5 to ≤40	Return loss	≥25 dB (≤0.05623ρ)
	> 40 to ≤50	Return loss	≥20 dB (≤0.01000ρ)
Offset opens	DC to ≤2	Deviation from nominal:	±0.5°
	> 2 to ≤20	Deviation from nominal:	±1.25°
	> 20 to ≤40	Deviation from nominal:	±1.75°
	> 40 to ≤50	Deviation from nominal:	±2.25°
Offset shorts	DC to ≤2	Deviation from nominal:	±0.5°
	> 2 to ≤20	Deviation from nominal:	±1.25°
	> 20 to ≤40	Deviation from nominal:	±1.5°
	> 40 to ≤50	Deviation from nominal:	±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)	1	85056-60005
2.4 mm (m) to 2.4 mm (f)	1	85056-60006
2.4 mm (f) to 2.4 mm (f)	1	85056-60007
5/16 in., 90 N-cm (8 in-lb) torque	1	8710-1765
7 mm open-end	1	8710-1761

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 45 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 45 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 GHz	Return loss	30 dB	30 dB
	2 GHz to 18 GHz		30 dB	30 dB
	18 GHz to 40 GHz		26 dB	26 dB
	40 GHz to 50 GHz		24 dB	24 dB
Opens	DC to 2 GHz	Deviation from	±1.0°	±1.0°
	2 GHz to 18 GHz	nominal phase	±1.5°	±3.0°
	18 GHz to 50 GHz		±2.5°	±4.0°
Short 3	DC to 2 GHz	Deviation from	±0.8°	±1.0°
	2 GHz to 18 GHz	nominal phase	±1.2°	±2.0°
	18 GHz to 50 GHz		±1.5°	±2.5°
	50 GHz to 110 GHz		±3.0°	±5.0°
Short 1	50 GHz to 110 GHz	Deviation from nominal phase	±2.5°	±4.0°
Short 2	75 GHz to 110 GHz	Deviation from nominal phase	±2.5°	±4.0°
Short 4	50 GHz to 75 GHz	Deviation from nominal phase	±2°	±4.5°

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

Agilent 85059A precision calibration/verification kit, 1.0 mm (continued)

Replaceable parts

Description	Qty per kit	Agilent replacement part number
Shorts:		
M short 3	1	85059-60003
F short 3	1	85059-60007
M short 4	1	85059-60004
F short 4	1	85059-60008
M short 2	1	85059-60002
F short 2	1	85059-60006
M short 1	1	85059-60001
F 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 8510C or 8720 series network analyzer systems. This calibration kit has a precision 50 ohm airline for performing the Thru-Reflect-Line (TRL) calibration, the most accurate error-correction technique for coaxial measurements. This kit also contains 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 0.015 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	K281C
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 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 8510C or 8720 series network analyzer systems. This calibration kit has a precision 50 ohm airline for performing the Thru-Reflect-Line (TRL) calibration, the most accurate error-correction technique for coaxial measurements. This kit also contains 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	<1.06
Insertion loss	0.10 dB
Center conductor	0.0076 to 0.038 mm
Pin recession tolerance	(0.0003 to 0.015 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
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 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 8510C or 8720 series network analyzer systems. This calibration kit has a precision 50 ohm airline for performing the Thru-Reflect-Line (TRL) calibration, the most accurate error-correction technique for coaxial measurements. This kit also contains 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 0.015 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	K281C opt 12
3.5 mm coax-to-waveguide adapter (f)	1	K281C
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 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 8510C or Agilent 8720 series network analyzer systems. This calibration kit has a precision 50 ohm airline for performing the Thru-Reflect-Line (TRL) calibration, the most accurate error-correction technique for coaxial measurements. This kit also contains 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)	2	11644-60001
Waveguide load	1	00914-60028
Short	1	11644-20005
R-band shim	1	11644-20003
Alignment pin	6	11644-20009
Slip pin	6	11644-20006
4-40 hex nut .094 inches thick	12	2260-0002
4-40 SKT HD screw .750 inches long	12	3030-0721
Lock washer .115 inches	12	2190-0030
Open-end wrench	1	8720-0013
Hex ball	1	8710-1539

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 8510C network analyzer system. This calibration kit has a precision 50 ohm airline for performing the Thru-Reflect-Line (TRL) calibration, the most accurate error-correction technique for coaxial measurements. This kit also contains flush short circuit, a precision shim, and a fixed termination.

Electrical specifications

Device	Specifications
Frequency range	30 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)	2	11644-60002
Q-band waveguide load	1	11644-60005
Q-band shim	1	11644-20001
Short (Q-band)	1	11644-20004
Alignment pin	6	11644-20008
Slip pin	6	11644-20006
4-40 SKT HD screw .500 inches long	12	3030-0209
4-40 captive screw .43 inches long	12	1390-0764
4-40 captive screw .31 inches long	24	1390-0671
Hex ball	1	8710-1539

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 8510C network analyzer system. This calibration kit has a precision 50 ohm airline for performing the Thru-Reflect-Line (TRL) calibration, the most accurate error-correction technique for coaxial measurements. This kit also contains 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)	2	11644-60003
U-band waveguide load	1	11644-60006
U-band shim	1	11644-20002
Short (U-band)	1	11644-20004
Alignment pin	6	11644-20008
Slip pin	6	11644-20006
4-40 SKT HD screw .500 inches long	12	3030-0209
4-40 captive screw .43 inches long	12	1390-0764
4-40 captive screw .31 inches long	24	1390-0671
Hex ball	1	8710-1539

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 8510C network analyzer system. This calibration kit has a precision 50 ohm airline for performing the Thru-Reflect-Line (TRL) calibration, the most accurate error-correction technique for coaxial measurements. This kit also contains 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
Element SWR	±1.025

Replaceable parts

Description	Qty per kit	Agilent replacement part number
V-band fixed load	1	11643-60025
V-band standard section	3	11644-60012
V-band shim	1	11644-20013
Short (V-band)	1	11644-20015
Slip pin	6	11644-20007
4-40 captive dcrew .41 inches long	12	1390-0765
4-40 captive dcrew .31 inches long	24	1390-0671
Hex ball	1	8710-1539

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 8510C network analyzer system. This calibration kit has a precision 50 ohm airline for performing the Thru-Reflect-Line (TRL) calibration, the most accurate error-correction technique for coaxial measurements. This kit also contains 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
Element 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	6	11644-20007
4-40 captive screw .41 inches long	12	1390-0765
4-40 captive screw .31 inches long	24	1390-0671
Hex ball	1	8710-1539

Overview

Electronic calibration (ECal) is a precision, single-connection, one or two-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, and less wear on the connectors—and on you. Calibrations for non-insertable devices are equally convenient and straightforward.

ECal modules and available options [A, B]

Connector type [1]	Frequency range	ECal module model number	Available options
7 mm	30 kHz to 9 GHz [2]	**Agilent 85091B**	1BN, 1BP, 910, UK6
7 mm	1 GHz to 18 GHz	**Agilent 85060B**	001, 1BN, 1BP, 910, UK6
Type-N (50 ohm)	30 kHz to 9 GHz [2]	**Agilent 85092B**	00F, 00M, 00A, 1BN, 1BP, 910, UK6
Type-N (50 ohm)	1 GHz to 18 GHz	**Agilent 85064B**	001, 00F, 00M, 00A, 1BN, 1BP, 910, UK6
3.5 mm	30 kHz to 9 GHz [2]	**Agilent 85093B**	00F, 00M, 00A, 1BN, 1BP, 910, UK6
3.5 mm	1 GHz to 26.5 GHz	**Agilent 85062B**	001,00F, 00M, 00A, 1BN, 1BP, 910, UK6

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Option	Description
001	Adds a 30 kHz to 9 GHz RF module [2]
00F	Replace f/m connectors on ECal module(s) with f/f connectors
00M	Replace f/m connectors on ECal module(s) with m/m connectors
00A	Adds male-to-male and female-to-female adapters (also adds a 5/16" 90 N-cm [8 in-lb] torque wrench to 3.5 mm modules)
1BN	Mil-STD 45662 calibration certificate
1BP	Mil-STD 45662 calibration certificate with measured data
910	Add an extra operating and service manual
UK6	Commercial calibration certificate with measured data

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 85097A PC interface module with control software to drive all Agilent ECal modules. If you will be using the Agilent 85097A to control an older Agilent 85060 series module with serial number below 800, the module will require a small modification by an Agilent service center.

The PNA Series network analyzer can control RF ECal modules directly via its USB port and does not require the 85097A.

[1] For ECal modules with sexed (m-f) connectors, the standard modules have one female and one male connector.

[2] RF ECal modules are specified to operate from 300 kHz to 9 GHz, with typical performance down to 30 kHz.

[A] Agilent 85060 series modules cover a frequency range of 1 GHz to either 18 or 26.5 GHz. The upper frequency is limited by the connector cutoff frequency. Each module is supplied with a torque wrench and foam-padded wood storage box.

[B] Agilent 85090 series modules cover a frequency range of 30 kHz to 9 GHz. Each module is supplied with a torque wrench and foam-padded wood storage box.

PC requirements

The Agilent 85097A requires a customer-supplied PC, meeting the following minimum requirements:

- Windows® 95, Windows NT® 4.0 or later operating system
- 486 or later CPU
- 32 MB of RAM
- 10 MB available hard-disk space
- One of the following GPIB interface cards: Agilent 82340A/B, 82341C/D, National Instruments AT-GPIB/TNT, National Instruments AT-GPIB/TNT (plug-and-play) or National Instruments PCI-GPIB

Agilent 85097A PC interface kit

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.**

	Agilent 85091B [1]	Agilent 85092B [1]	Agilent 85093B [1]	Agilent 85060B	Agilent 85062B	Agilent 85064B
Frequency range						
Standard	30 kHz - 9 GHz	30 kHz - 9 GHz	30 kHz - 9 GHz.	1 - 18 GHz.	1 - 26.5 GHz.	1 - 18 GHz.
Option 001 [1,2]	N/A.	N/A.	N/A.	30 kHz - 18 GHz	30 kHz - 26.5 Hz	30 kHz - 18 GHz
Maximum power	+20 dBm	+20 dBm	+20 dBm	+20 dBm	+20 dBm	+20 dBm
Minimum power	–45 dBm	–45 dBm	–45 dBm	–45 dBm	–45 dBm	–45 dBm
Connectors						
Standard	7 mm	Type-N (m-f)	3.5 mm (m-f) [3]	7 mm	3.5 mm (m-f) [3]	Type-N (m-f)
Option 00F	N/A	Type-N (f-f)	3.5 mm (f-f)	N/A	3.5 mm (f-f)	Type-N (f-f)
Option 00M	N/A	Type-N (m-m)	3.5 mm (m-m)	N/A	3.5 mm (m-m)	Type-N (m-m)

Additional coaxial electronic calibrations kits

Connector	Frequency range	Agilent model	Available options
Type-N (75 ohm)	30 kHz to 3 GHz	**85096B**	00F, 00M, 00A, 1BN, 1BP, 910, UK6
7-16	30 kHz to 7.5 GHz	**85098B**	00F, 00M, 00A, 1BN, 1BP, 910, UK6
Type-F	30 kHz to 3 GHz	**85099B**	00F, 00M, 00A, 1BN, 1BP, 910, UK6

[1] Performance is specified from 300 kHz to 9 GHz and typical from 30 kHz to 300 kHz.

[2] Option 001 adds an RF ECal module (30 kHz - 9 GHz)

[3] 3.5 mm modules have precision slotless connectors that guarantee the best calibration accuracy is transferred to your system.

[4] Specifications include the effects of the following environmental conditions: sine vibration, random vibration, storage survival, operating temperature stability, shock, and humidity.

Measurement port specifications[1] (Residual e-terms)

7 mm ECal modules

RF ECal module

Agilent 85091B	Frequency range				
	30 kHz to 300 kHz (typical)	300 kHz to 1.3 GHz	1.3 GHz to 3 GHz	3 GHz to 6 GHz	6 GHz to 9 GHz
Directivity (dB)	–52	–52	–56	–55	–47
Source match (dB)	–45	–45	–44	–41	–34
Reflection tracking (±dB)	0.05	0.038	0.038	0.068	0.1
Transmission tracking (±dB)	0.14	.060	0.055	0.13	0.23
Load match (dB)	–41	–47	–47	–46	–39

Microwave ECal module

Agilent 85060B	Frequency range (GHz)		
	1 to 2	2 to 8	8 to 18
Directivity (dB)	–50	–49	–46
Source match (dB)	–46	–45	–40
Reflection tracking (±dB)	.032	.046	.065
Transmission tracking (±dB)	.043	.050	0.14
Load match (dB)	–46	–44	–40

Option 001	Add RF ECal module (30 kHz to 9 GHz)	See Agilent 85091B specifications

Type-N ECal modules

RF ECal module

Agilent 85092B	Frequency range				
	30 kHz to 300 kHz (typical)	300 kHz to 1.3 GHz	1.3 GHz to 3 GHz	3 GHz to 6 GHz	6 GHz to 9 GHz
Directivity (dB)	–52	–52	–54	–52	–47
Source match (dB)	–45	–45	–45	–41	–34
Reflection tracking (±dB)	0.05	0.038	0.038	0.068	0.1
Transmission tracking (±dB)	0.14	0.060	0.055	0.13	0.23
Load match (dB)	–41	–47	–47	–44	–39

Microwave ECal module

Agilent 85064B	Frequency range (GHz)		
	1 to 2	2 to 8	8 to 18
Directivity (dB)	–50	–49	–46
Source match (dB)	–46	–45	–40
Reflection tracking (±dB)	0.034	0.046	0.065
Transmission tracking (±d	0.043	0.050	0.14
Load match (dB)	–46	–44	–40

Option 001	Add RF ECal Module (30 kHz to 9 GHz)	See Agilent 85029B specifications

[1] Specifications include the effects of the following environmental conditions: sine vibration, random vibration, storage survival, operating temperature stability, and shock. Based on 28% humidity. Higher humidity levels may degrade performance.

3.5 mm ECal modules[1]

RF ECal module

Agilent 85093B	Frequency range				
	30 kHz to 300 kHz (typical)	300 kHz to 300 MHz	300 MHz to 3 GHz	3 GHz to 6 GHz	6 GHz to 9 GHz
Directivity (dB)	–50	–50	–52	–50.5	–47
Source match (dB)	–43	–43	–42	–39	–34
Reflection tracking (±dB)	0.05	0.043	0.043	0.055	0.1
Transmission tracking (±dB)	0.14	0.050	0.045	0.13	0.23
Load match (dB)	–41	–47	–47	–44	–39

Microwave ECal module

Agilent 85062B	Frequency range (GHz)			
	1 to 2	2 to 8	8 to 20	20 to 26.5
Directivity (dB)	–48	–49	–46	–44
Source match (dB)	–45	–43	–40	–37
Reflection tracking (±dB)	0.041	0.041	0.064	0.088
Transmission tracking (±dB)	0.048	0.068	0.13	0.17
Load match (dB)	–45	–43	–40	–38
Option 001	Add RF ECal Module (30 kHz to 9 GHz)	See Agilent 85093B specifications		

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

Parts for Type-N 50 ohm ECal modules

Description	Qty	Agilent part number
Agilent 85064B, 1 GHz to 18 GHz microwave ECal modules		
Insertable (standard)	1	85064-60002
Non-insertable male (Option 00M)	1	85064-60004
Non-insertable female (Option 00F)	1	85064-60006
Agilent 85092B, 30 kHz to 9 GHz RF ECal modules		
Insertable (85064B Option 001 or 85092A)	1	85092-60005
Non-insertable male (85064B Option 001 and Option 00M or 85092A Option 00M)	1	85092-60006
Non-insertable female (85064B Option 001 and Option 00F or 85092A Option 00F)	1	85092-60007
Adapters (added with option 00A)		
Type-N female-to-female	1	85054-60037
Type-N male-to-male	1	85054-60038

Parts for 3.5mm ECal modules

Description	Qty	Agilent part number
Agilent 85062B, 1 GHz to 26.5 GHz microwave ECal modules		
Module with male/female connectors (standard)	1	85062-60002
Module with male/male connectors (Option 00M)	1	85062-60004
Module with female/female connectors (Option 00F)	1	85062-60006
Agilent 85093B, 30 kHz to 9 GHz RF ECal modules		
Module with male/female connectors (85062B Option 001 or 85093A)	1	85093-60005
Module with male/male connectors (85062B Option 001 and 00M, or 85093A Option 00M)	1	85093-60006
Module with female/female connectors (85062B Option 001 and 00F, or 85093A Option 00F)	1	85093-60007
Adapters (added with Option 00A)		
3.5 mm female/female	1	85052-60012
3.5 mm male/male	1	85052-60014

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 8510, Agilent 8719, Agilent 8720, or PNA 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
20 ohm mismatch airline with data	1	85055-60007
Open-end 5.5 wrench	1	8710-1770

Agilent 85092B verification kit, 7 mm

Measuring known devices, other than the calibration standards, is a convenient way of verifying that the Agilent 8753 measurement system 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 8753 measurement system. 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 85050 7 mm calibration kit and network analyzers, such as the Agilent 8510, Agilent 8719, or Agilent 8720 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
20 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 85052 3.5 mm calibration kit and network analyzers, such as the Agilent 8510, Agilent 8719, Agilent 8720, or PNA 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	85053-60010
20 ohm mismatch airline with data	1	85053-60011

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 8510 or Agilent 8722. 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 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 8510 and Agilent 85106. 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 8510 and Agilent 85106. 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 captive screw 0.31 inch	6	1390-0671
4-40 captive 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 8510 and Agilent 85106. 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 captive screw 0.31 inch	6	1390-0671
4-40 captive 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 8510 and Agilent 85106. 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 captive screw 0.31 inch	6	1390-0671
4-40 captive 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 8510 and Agilent 85106. 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 captive screw 0.31 inch	6	1390-0671
4-40 captive 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 85026 series detectors (ac/dc)

The Agilent 85025 and 85026 series detectors are designed specifically for operation with the Agilent 8757 scalar network analyzer. The Agilent 85025/26 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	Frequency response	Power (at 50 MHz)	Dynamic accuracy[4]	Absolute accuracy[5]
85025A[3]	10 MHz to 18 GHz	Type-N (m) 7 mm2	ac mode +16 to –55 dBm	0.01 to 0.04 GHz	10 dB	±0.8 dB	16 dBm	±0.8 dB	±0.8 dB
				0.04 to 4 GHz	20 dB	±0.5 dB	6 dBm	±0.4 dB	±0.4 dB
			dc mode	4 to 18 GHz	17 dB	±0.5 dB	–35 dBm	±0.4 dB	±0.4 dB
			+ 16 to 50 dBm				–50 dBm	±1.3 dB	±1.3 dB
85025B[3]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +16 to –55 dBm	0.01 to 0.04 GHz	10 dB	±0.8 dB	16 dBm	±0.8 dB	±0.8 dB
				0.04 to 4 GHz	20 dB	±0.5 dB	6 dBm	±0.4 dB	±0.4 dB
			dc mode	4 to 18 GHz	17 dB	±0.5 dB	–35 dBm	±0.4 dB	±0.4 dB
			+ 16 to 50 dBm	18 to 26.5	12 dB	±2.0 dB	–50 dBm	±1.3 dB	±1.3 dB
85025D[3]	10 MHz to 50 GHz	2.4 mm (m)	ac mode +16 to –55 dBm	0.01 to 0.1 GHz	10 dB	±0.8 dB	16 dBm	±1.0 dB	±0.8 dB
				0.1to 20 GHz	20 dB	±0.5 dB	6 dBm	±0.4 dB	±0.4 dB
			dc mode	20 to 26.5 GHz	20 dB	±1.0 dB	–35 dBm	±0.4 dB	±0.4 dB
			+ 16 to 50 dBm	26.5 to 40 GHz	15 dB	±2.5 dB	–50 dBm	±1.3 dB	±1.3 dB
				40 to 50 GHz	9 dB	±3.0dB			
85025E[3]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +16 to –55 dBm	0.01 to 0.1 GHz	10 dB	±0.8 dB	16 dBm	±1.0 dB	±1.0 dB
				0.1 to 18 GHz	25 dB	±0.5 dB	6 dBm	±0.4 dB	±0.4 dB
			dc mode	18 to 25 GHz	25 dB	±0.5 dB	–35 dBm	±0.4 dB	±0.4 dB
			+ 16 to 50 dBm	25 to 26.5 GHz	23 dB	±1.4 dB	–50 dBm	±1.3 dB	±1.3 dB
85037A[1]	10 MHz to 18 GHz	Type-N (m) 7 mm2	ac mode +20 to –55 dBm	0.01 to 0.04 GHz	10 dB	±0.35 dB	20 dBm	±0.25 dB	±0.25 dB
				0.04 to 18 GHz	20 dB	±0.18 dB	10 dBm	±0.11 dB	±0.11 dB
			dc mode				–30 dBm	±0.11 dB	±0.11 dB
			+ 20 to 50 dBm				–50 dBm	±0.85dB	±0.85dB
85037B[1]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +20 to –55 dBm	0.01 to 0.04 GHz	10 dB	±0.35 dB	20 dBm	±0.25 dB	±0.25 dB
				0.04 to 18 GHz	20 dB	±0.18 dB	10 dBm	±0.11 dB	±0.11 dB
			dc mode	18 to 26.5 GHz	18 dB	±0.22 dB	–30 dBm	±0.11 dB	±0.11 dB
			+ 20 to 50 dBm				–50 dBm	±0.85dB	±0.85dB

[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 85026 series detectors and the Agilent 85025C detector adapter require Agilent 8757Q ri4m2q43 43vision 2.0 or higher. To upgrade previous revisions, order the Agilent 11614A firmware enhancement.

[4] Dynamic accuracy refers to measurement accuracy as power varies (in dB) from a 0 dBm reference. 25° ±5°C, 50 MHz.

[1] DC mode, 25° ±5°C.

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.

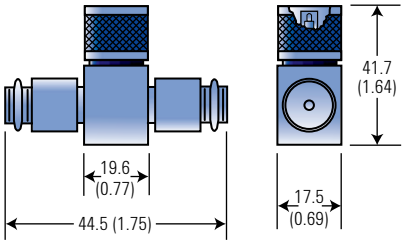
Directional bridge summary

Agilent model	Frequency range	Nominal impedance	Connector–input	Connector–input	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	<1.15
							8.4 to 12.4 GHz	<1.25
							12.4 to 18 GHz	<1.43
85027A	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (f)	0.01 to 20 GHz	40 dB	0.01 to 8.4 GHz	<1.15
					20 to 26.5 GHz	36 dB	8.4 to 20 GHz	<1.43
							20 to 26.5 GHz	<1.78
85027A	10 MHz to 18 GHz	50 Ω	Type-N (f)	Type-N (f)	0.01 to 12.4 GHz	36 dB	0.01 to 8.4 GHz	<1.15
					12.4 to 18 GHz	34 dB	8.4 to 12.4 GHz	<1.25
							12.4 to 18 GHz	<1.43
85027A	10 MHz to 50 GHz	50 Ω	2.4 mm (f)	2.4 mm (m)	0.01 to 20 GHz	36 dB	0.01 to 16 GHz	<1.18
					20 to 26.5 GHz	32 dB	16 to 30 GHz	<1.27
					26.5 to 40 GHz	30 dB	30 to 40 GHz	<1.57
					40 to 50 GHz	25 dB	40 to 50 GHz	typically <2.00
85027A	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (m)	0.01 to 20 GHz	40 dB	0.01 to 8.4 GHz	<1.15
					20 to 26.5 GHz	36 dB	8.4 to 20 GHz	<1.43
							20 to 26.5 GHz	<1.78

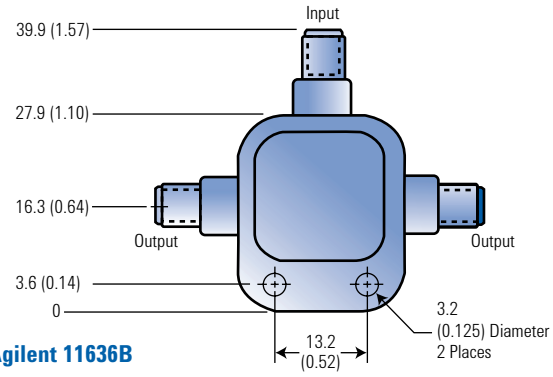
Agilent 11636A,B power dividers

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, as well as power combining. They are not recommended for ratio and leveling applications.

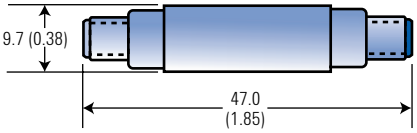
Agilent 11636A



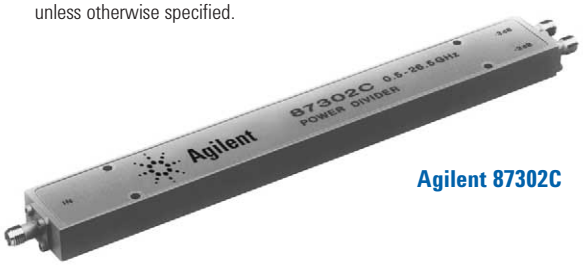
Dimensions are in mm (inches) nominal, unless otherwise specified.



Agilent 11636B



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



Agilent 87302C

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.

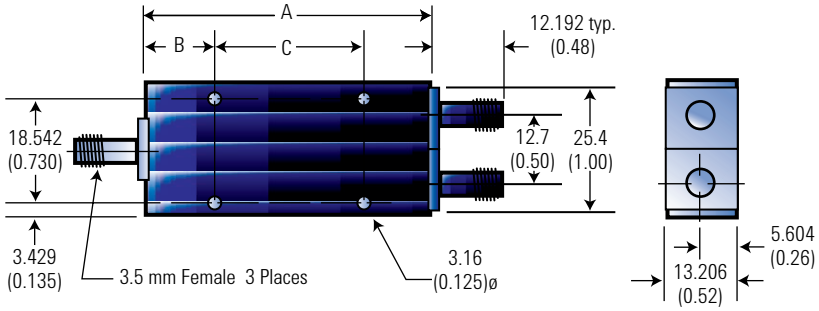
Agilent model	Frequency range (GHz)	Max. SWR	Maximum insertion loss (dB)	Minimum isolation (dB)	Maximum amplitude tracking (dB) [1]	Maximum phase tracking deg) [1]
11636A	dc to 18	1.35	6.0 typ. [2]		0.5 [3]	±2° typ.
11636B	dc to 26.5	1.29	7.5		0.25 [3]	±2° typ.
87302C	0.5 ST	1.45	1.5	19	0.3	6
	26.5 ST	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.

Power Dividers and Splitters

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)

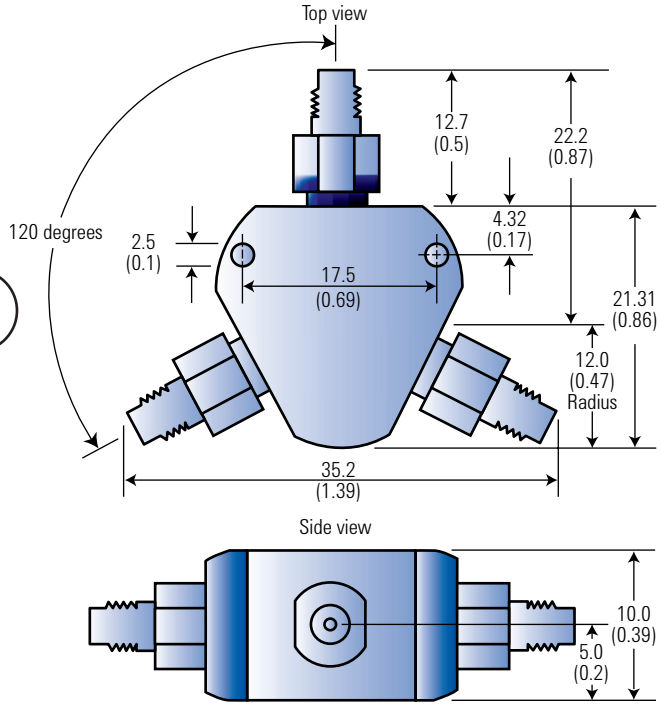
Dimensions are in mm (inches)
nominal, unless otherwise specified.

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.

Agilent 11850C,D

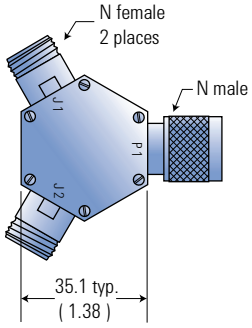
Agilent 11850C,D power splitter

These three-way power splitters are designed for source leveling or ratio measurements. One output port provides the reference for a leveling or ratio detector, while the other two ports can be used for two independent transmission measurements or a comparison measurement.

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 lb (kg)
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 **Opt. 001:** N (m) in, N (f) out **Opt. 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)
11850C	dc to 3.0 GHz	1.22	0.1 W	9.5 dB + 1 dB/GHz	+0.25 dB, ±3 °	N (f) 50 Ω all ports	0.2 (0.5)
11850D	dc to 2 GHz	1.09		7.8 dB	±0.2 dB, ±2.5 °	N (f) 50 Ω in N (f) 75 Ω out	0.2 (0.5)

Agilent 0955-0751



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

Agilent 0955-0751

Agilent 0955-0751 power splitter

This power splitter is recommended for most 50 Ω economy network analyzer applications. A two resistor splitter provides excellent output SWR at the auxiliary arm over frequency allowing wideband measurements to be made with minimum uncertainty. The frequency range is 300 KHz to 3 GHz. Tracking flatness between output areas is within ± 0.25 dB and ± 3 degrees of phase. Equivalent source match is 25 dB to 2 GHz and 20 dB to 3 GHz. Insertion loss is 6 dB nominal. Input port match is 20 dB to 3 GHz. Connectors are type-N (f) output and type-N (m) input. Power rating is 1 watt.

Agilent 0955-0752 power splitter

This 75 Ω power splitter has a frequency range from 300 KHz to 3 GHz. Tracking flatness is within ± 0.25 dB and ± 3 degrees of phase. Equivalent source match is 25 dB to 2 GHz and 20 dB to 3 GHz. Insertion loss is 6 dB nominal. Input port match is 20 dB to 3 GHz. Connectors are type-N (m) input, type-N (f) output. Power rating is 1 watt.

Agilent 8480 series specifications

25 Watt Sensors 1mW to 25W (0 to +44dBm)

Agilent model	Frequency range	Maximum SWR	Power linearity [1]	Maximum power	Connector type
8481B	10MHz to 18GHz	10MHz to 2GHz:1.10 2 to 12.4 GHz:1.18 12.4 to 18GHz:1.28	+35 to +44 dBm; +/-4%	0°to 35°C:30W avg [2] 35°to55°C:25W avg 0.01 to 5.8GHz:500W pk	Type-N(m)
8482B	100kHz to 4.2GHz	100kHz to 2 GHz: 1.10 2 to 4.2GHz:1.18		5.8 to 18GHz:125W pk 500 W-ms per pulse	Type-N(m)

3 Watt sensors 100mW to 3W (-10 to +35 dBm)

8481H	10MHz to 18GHz	10MHz to 8GHz:1.20 8 to 12.4GHz:1.25 12.4 to 18GHz:1.30	+25 to +35dBm; +/-5%	3.5W avg,100W pk 100W-ms per pulse	Type-N(m)
8482H	100kHz to 4.2GHz	100kHz to 4.2GHz:1.20			Type-N(m)

100mW sensors 1 mW to 100mW (-30 to +20 dBm)

8485A	50MHz to 26.5GHz	50 to 100MHz:1.15 100MHz to 2GHz:1.10	+10 to +20dBm; +2,-4% 2 to 2.4GHz:1.15 12.4 to 18GHz:1.20 18 to 26.5GHz:1.25	300mW avg,15W pk	APC-3.5mm(m) 30W-ms per pulse
Option 033	50MHz to 33GHz	26.5 to 33GHz:1.40			
8481A	10MHz to 18GHz	10 to 30MHz:1.40 30 to 50MHz:1.18 50MHz to 2GHz:1.10 2 to 12.4GHz:1.18 12.4 to 18GHz:1.28			Type-N(m)
8482A	100kHz to 4.2GHz	100 to 300kHz:1.60 0.3 to 1MHz:1.20 1MHz to 2GHz:1.10 2 to 4.2GHz:1.30			Type-N(m)
8483A (75Ω)	100kHz to 2GHz	100 to 600kHz:1.80 600kHz to 2GHz:1.18		300mW avg, 10W pk	Type-N(m) (75Ω)
R8486A	26.5 to 40GHz	1.4	+10 to +20dBm; +2, -4%	300mW avg, 15W pk 30W-ms per pulse	Waveguide Flange UG-599/U
Q8486A	33 to 50GHz	1.5			Waveguide Flange UG-383/U
V8486A	50 to 75GHz	1.06	+1,-3%	200mW avg 50W peak	Waveguide Flange UG-385/U
W8486A	75 to 110GHz	1.08	+1, -3%	200mW avg 40W peak	Waveguide Flange UG-387/U
8487A	50MHz to 50GHz	50 to 100MHz:1.15 100MHz to 2GHz:1.10 2 to 12.4GHz:1.15 12.4 to 18GHz:1.20 18 to 26.5GHz:1.25 26.5 to 40GHz:1.30 40 to 50GHz:1.50	+10 to +20dBm; +2,-4%	300mW avg, 15W pk 30W-ms per pulse	2.4mm(m)

[1] Negligible deviation except for those power ranges noted.

[2] For pulses greater than 30W the maximum average power (P_a) is limited by the energy per pulse (E) in W -ms according to P_a=30-0.02E.

High sensitivity sensors 100pW to 10mW (-70 to -20 dBm)

Agilent model	Frequency range	Maximum SWR	Power linearity[1]	Maximum power	Connector type
8481D[2,3]	10MHz to 18GHz	10 to 30MHz:1.40	-30 to –20dBm; 30MHz to 4GHz:1.15 4 to 10GHz:1.20 10 to 15GHz:1.30 15 to 18GHz:1.35	100mW avg +/-1%	Type-N(m) 100mW pk
8485D	50MHz to 26.5GHz	0.05 to 0.1GHz:1.19 0.1 to 4GHz:1.15	-30 to –20dBm; 4 to 12GHz:1.19 12 to 18GHz:1.25 18 to 26.5GHz:1.29	100mW avg +/-2%	APC-3.5mm(m) 100mW pk
Option 033	50MHz to 33GHz	26.5 to 33GHz:1.35			
8487D[2]	50MHz to 50GHz	0.05 to 0.1GHz:1.19 0.1 to 2GHz:1.15 2 to 12.4GHz:1.20 12.4 to 18GHz:1.29 18 to 34GHz:1.37 34 to 40GHz:1.61 40 to 50GHz:1.89	-30 to –20dBm; +/-2%	100mW pk 100mW avg	2.4mm(m)
R8486D[2]	26.5 to 40GHz	1.4	-30 to –25dBm; +/-3%	100mW avg or pk 40Vdc max	Waveguide Flange UG-599/U
Q8486D[2]	33 to 50GHz	1.4	-25 to –20dBm; +/-5%		Waveguide Flange UG-383/U

Wide dynamic range CW sensors

E4412A	10MHz to 18GHz	10MHz to 30MHz:1.34 30MHz to 10GHz:1.22 10GHz to 18GHz:1.27	-70 to +10dBm +/-4%(25+/-5°C) -70 to +10dBm +/-8%(0 to 55°C) +10 to +20dBm +/-5.5%(25+/-5°C) +10 to +20dBm +/-11%(0+/-55°C)	200mW avg	Type-N(m)
E4413A	50MHz to 26.5GHz	50MHz to 2GHz:1.25 2GHz to18GHz:1.21 18GHz to 26.5GHz:1.26		200mW avg	Type-N(m)

[1] Negligible deviation except for those power ranges noted.
[2] Includes Agilent 11708A 30dB attenuator for calibrating against a 0dBm, 50MHz power reference. Agilent 11708A is factory set to 30dB +/-0.05 dB at 50MHz, traceable no NIST.SWR,1.05 at 50MHz.
[3] This sensor directly replaces the popular Agilent 8484A power sensor.

Agilent 8447D

Agilent 11975A

Agilent 8449B

Agilent 8447 series amplifier (9 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.

Spectrum Analyzer Accessories

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

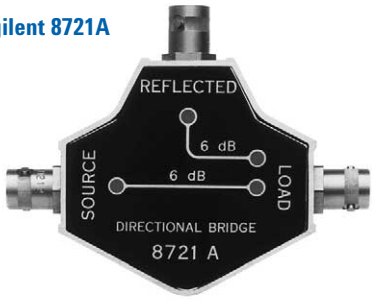
Allows measurements in 75 Ω systems while retaining amplitude calibration with a 50 Ω spectrum analyzer input. VSWR is less than 1.2; insertion loss is less than 0.75 dB. See Option 001 and 002 for 75 Ω versions of the Agilent 8590 series spectrum analyzer. Connectors are type BNC (m) 50Ω to BNC (f)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

Agilent 11694A

Agilent 8721A directional bridge (100 kHz to 100 MHz)

Used in return-loss measurements made with a swept source such as a tracking generator and spectrum analyzer. This 50 Ω bridge (75 Ω option) has a 6 dB insertion loss and 6 dB coupled to the auxiliary arm. The frequency response is ±0.5 dB (0.1 to 110 MHz); directivity is >40 dB (1 to 110 MHz) and load-port return loss is >30 dB; maximum input power is + 20 dBm. See Agilent 86205/207A RF bridges for reflection measurements above 110 MHz.

Agilent 8721A



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 RF spectrum and network analyzers.

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 will suppress low frequency signals that can damage expensive measuring equipment or affect the accuracy of your RF and microwave measurements.

Ordering information

Agilent 8447A: 0.1 to 400 MHz amplifier

Agilent 8447D: 0.1 to 1300 MHz amplifier

Agilent 8447F: 9 kHz to 1300 MHz amplifier

Agilent 11975A: 2 to 8 GHz amplifier

Agilent 8449B: 1 to 26.5 GHz preamplifier

Agilent 87405A: Preamplifier

Agilent 11867A: dc to 1.8 GHz RF limiter

Agilent 11693A: 0.1 to 12.4 GHz microwave limiter

Agilent 11694A: 75 Ω matching transformer

Agilent 11852B: 75Ω minimum-loss pad

Option 004: 50Ω Type-N (m), 75Ω Type-N (f)

Agilent 8721A: Directional bridge

Option 008: 75 Ω impedance

Agilent 85024A: High-frequency probe

Agilent 41800A: 5 Hz to 500 MHz active probe

Agilent 87405A preamplifier

The Agilent 87405A preamplifier has a frequency range of 0.01 to 3GHz. Compact size, 22 to 27 dB gain, 6.5 dB noise figure, and convenient probe-power bias connection make it ideal for use with a number of instruments.

Agilent 11867A and 11693A 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. The Agilent 11693A microwave limiter (0.1 to 12.4 GHz, useable to 18 GHz) guards against input signals over 1 milliwatt up to 1 watt average power and 10 watts peak power.

Agilent 11867A

Agilent 11693A

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 family 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 40 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 are 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.

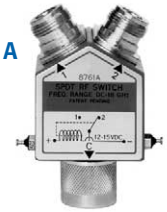
Life

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 families 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 40 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. The Selection Guide on page 145 describes the product families and their features.

Agilent 8761A



Agilent 8762/63/64 family

Agilent 8765 family

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 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

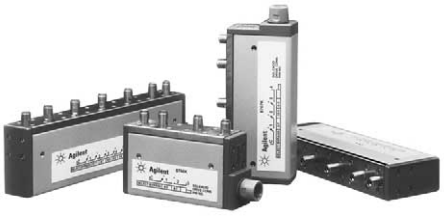
Agilent 8763A,B,C switches operate up to 26.5 GHz. They are preferred for drop-in, drop-out applications because of their compact design. These switches are used to automatically insert or remove a test component from a signal path. Because of their excellent isolation, they can also be used as the intersection (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 family

Agilent 87104/106 family

Agilent 87204/206 family

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.

Agilent 87204A,B,C and 87206A,B,C switches are fully equivalent to models Agilent 87104/106 in their RF switching performance. However, their drive circuits are primarily designed to work with the Agilent 87130A and 70611A switch drivers. In particular, the switches are best suited for interfacing with the switch driver's monitor circuits. In automated systems, the importance of switch position monitoring and reporting is often critical to system operation. See pages 184 and 185 for more information on switch driver instruments. 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 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, 3235A, 3488A, or E1700A. These drivers are all GPIB (IEEE 488) compatible as is the Agilent 87130A switch driver, a stand alone system for automated control of up to 248 switches. For systems configured in the Agilent Modular Measurement System, use the Agilent 70611A to operate up to 248 switches. Drivers are also available for Agilent VXI and Agilent VEE systems.

Switch driver cables

See page 183 for a brief listing of driver cables. For complete cable configuration information, request publication number 5963-2038E, *Agilent 70611A, Agilent 87130A and Agilent 11713A Switch and Attenuator Driver Configuration Guide*.

Agilent model	Frequency range	Features	Product category: SPDT configurable connectors	SPDT high performance	SPDT high reliability	Transfer high performance: 4-port	Transfer high performance: 5-port	Multiport low-profile: SP3T	SP4T	SP5T	SP6T
N1810UL	dc to 26.5 GHz	• 5 million cycles			X						
N1810TL	dc to 26.5 GHz	• < 0.03 dB repeatability		X							
N1811TL	dc to 26.5 GHz	• TTL/5V CMOS option				X					
N1812UL	dc to 26.5 GHz	• Current interrupts and position indicators options • High performance options					X				
8761A	dc to 18 GHz	• 1 million cycles	X								
8761B	dc to 18 GHz	• Selectable connector configuration	X								
8762A	dc to 4 GHz	• 1 million cycles		X							
8762B	dc to 18 GHz	• High repeatability		X							
8762C	dc to 26.5 GHz	• All-ports terminated		X							
8762F (75 Ω)	dc to 4 GHz	• Current interrupts and position indication capability • TTL/5V CMOS option		X							
8763A	dc to 4 GHz	• 1 million cycles				X					
8763B	dc to 18 GHz	• High repeatability				X					
8763C	dc to 26.5 GHz	• 1-port terminated • Current interrupts and position indication capability • TTL/5V CMOS option				X					
8764A	dc to 4 GHz	• 1 million cycles					X				
8764B	dc to 18 GHz	• High repeatability					X				
8764C	dc to 26.5 Ghz	• Unterminated • Current interrupts and position indication capability • TTL/5V CMOS option					X				
8765A	dc to 4 GHz	• Highest frequency range			X						
8765B	dc to 20 GHz	• 5 million cycles			X						
8765C	dc to 26.5 GHz	• High repeatability			X						
8765D	dc to 40 GHz	• Unterminated			X						
8765F (75 Ω)	dc to 4 GHz				X						
8766K	dc to 26.5 GHz	• 5 million cycles					X				
8767K	dc to 26.5 GHz	• High repeatability						X			
8768K	dc to 26.5 GHz	• Unterminated								X	
8769K	dc to 26.5 GHz	• Current interrupts and position indication capability									X

Selection Guide (continued)

Agilent model	Frequency range	Features	Product category: High performance transfer 4-port	Product category: High performance matrix SP6T
87104A	dc to 4 GHz	• 5 million cycles • High repeatability • All-ports terminated • Optoelectronic interrupts and position indicators • TTL/5V CMOS option	X	
87104B	dc to 20 GHz		X	
87104C	dc to 26.5 GHz		X	
87106A	dc to 4 GHz			X
87106B	dc to 20 GHz			X
87106C	dc to 26.5 GHz			X
87204A	dc to 4 GHz	• 5 million cycles • High repeatability • All-ports terminated • Optoelectronic interrupts and position indication capability	X	
87204B	dc to 20 GHz		X	
87204C	dc to 26.5 GHz		X	
87206A	dc to 4 GHz			X
87206B	dc to 20 GHz			X
87206C	dc to 26.5 GHz			X
87222C	dc to 26.5 GHz	• 5 million cycles • High repeatability • Opto-electronic indicators and interrupts • TTL/5V CMOS compatible • Unterminated	X	
87222D	dc to 40 GHz		X	
87222E	dc to 50 GHz		X	
87406B	dc to 20 GHz	• 5 million cycles • High repeatability • Opto-electronic indicators and interrupts • TTL/5V CMOS option • Terminated ports		X
87606B	dc to 20 GHz	• 5 million cycles • High repeatability • Opto-electronic indicators and interrupts • Sensing capability • Terminated ports		X

N1810UL, N1810TL[1]

Standard performance specifications

Isolation (dB) = 90 - 1.13 XF, where F is specific in GHz					
	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
	90	85	76	67	60
Insertion loss (dB) = 0.3 + 0.019 X F, where F is specified in GHz					
	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
	0.30	0.38	0.53	0.68	0.80
SWR	dc - 2 GHz	2 - 4 GHz	4 - 12.4 GHz	12.4 - 20 GHz	20 - 26.5 GHz
	1.10	1.15	1.20	1.30	1.60

Optional high performance specifications

Isolation (dB) = 125 - 1.32 X F, where F is specified in GHz					
	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
Opt. 301	125	120	109	99	90
Insertion loss (dB) =0.3 + 0.019 X F, where F is specified in GHz					
	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
Opt. 302	0.15	0.23	0.38	0.53	0.65
SWR	dc - 2 GHz	2 - 4 GHz	4 - 12.4 GHz	12.4 - 20 GHz	20 - 26.5 GHz
	1.06	1.10	1.15	1.20	1.45

[1] Specifications include margins for measurement uncertainties

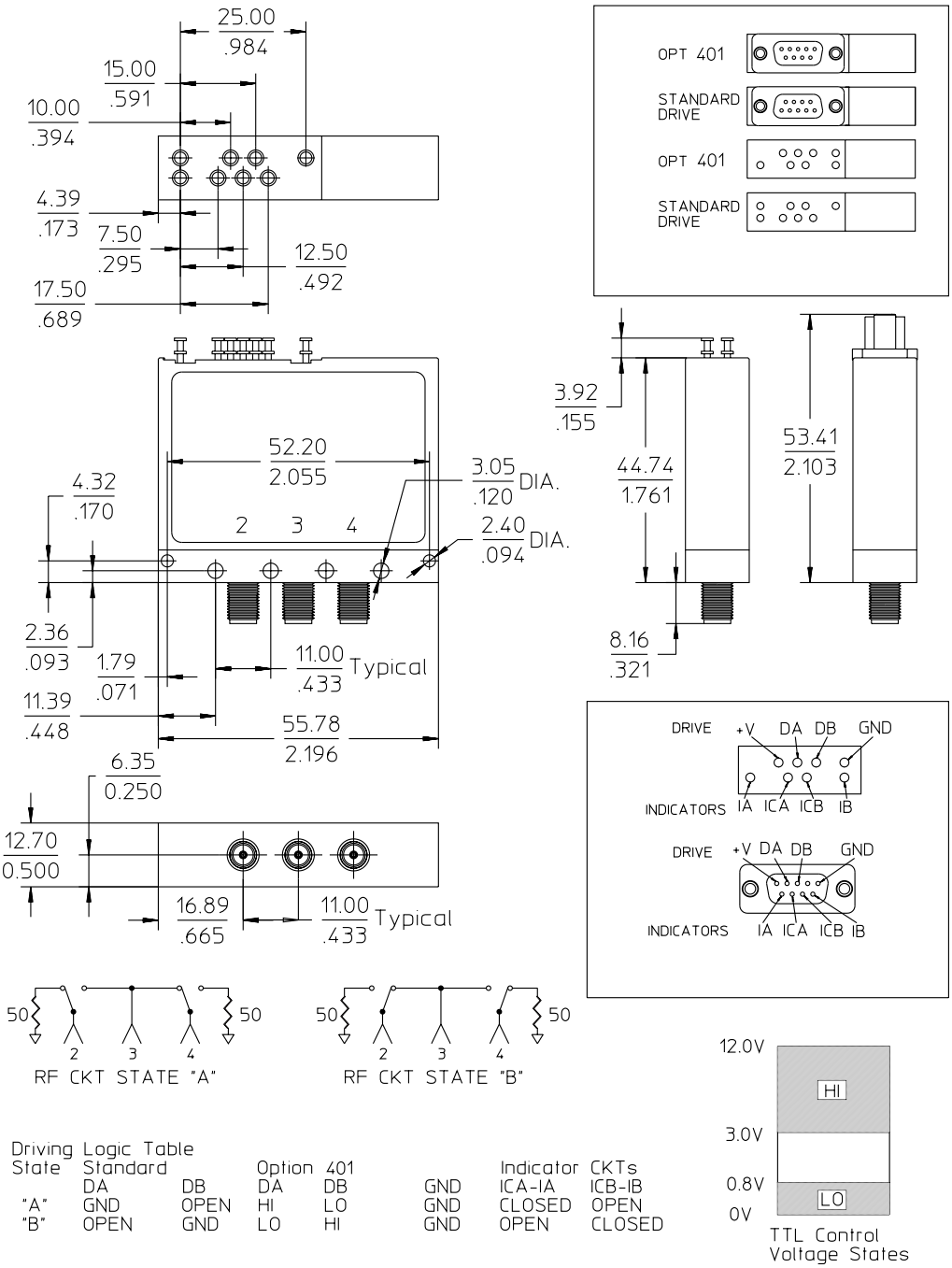
Options – N1810TL, N1810UL

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

[2] Option 105 includes Option 402 and Option 403.

Product outlines

Agilent N1810UL

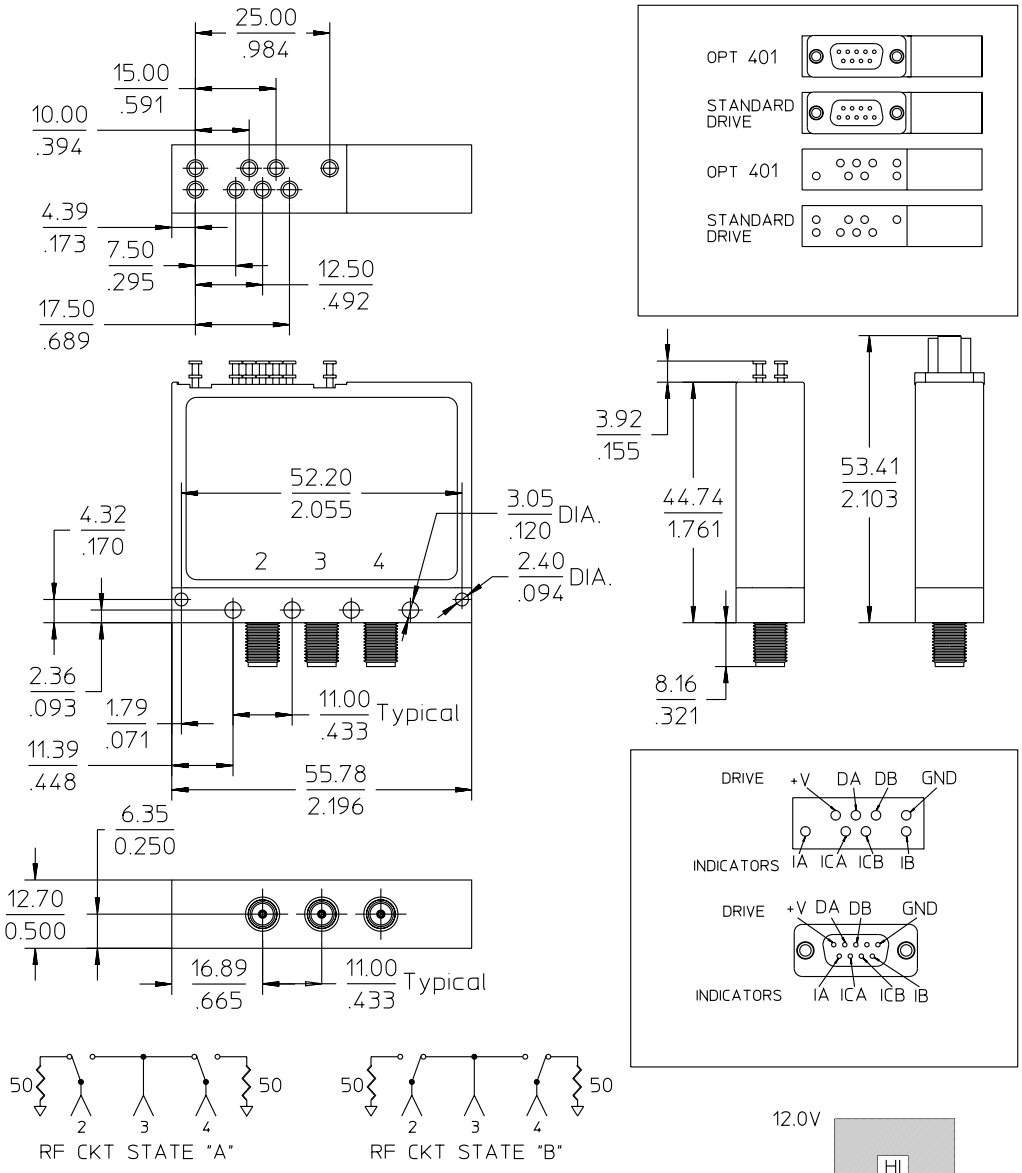


Driving Logic Table

State	Standard		Option 401		Indicator CKTs		
	DA	DB	DA	DB			
"A"	GND	OPEN	HI	LO	GND	ICA-IA	ICB-IB
"B"	OPEN	GND	LO	HI	GND	CLOSED	OPEN
					GND	OPEN	CLOSED

Product outlines

Agilent N1810TL



Driving Logic Table

State	Standard		Option 401			Indicator CKTs	
	DA	DB	DA	DB	GND	ICA-IA	ICB-IB
"A"	GND	OPEN	HI	LO	GND	CLOSED	OPEN
"B"	OPEN	GND	LO	HI	GND	OPEN	CLOSED

Specifications

Agilent model	8761A, 8761B	8762A, 8762B	8762C	8762F	8765A, 8765B, 8765C	8765D	8765F
Features	Unterminated Break-before-make Selectable connector configuration	Terminated Break-before-make Current interrupts Position indication capability[1]			Unterminated Break-before-make		
Impedance	50 Ω	50 Ω	50 Ω	75 Ω	50 Ω	50 Ω	75 Ω
Frequency range	dc to 18 GHz	**A:** dc to 4 GHz **B:** dc to 18 GHz	dc to 26.5 GHz	dc to 4 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
Insertion loss (dB)	<0.5 to 12.4 GHz <0.8 to 18 GHz	**A:** <0.20 to 2 GHz <0.25 to 4 GHz **B:** <0.25 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	**A & B:** **$0.2 + 0.025f^2$** max **C:** **$0.25 + 0.027f^2$** max 0.2 @ 4 GHz typ. 0.5 @ 20 GHz typ. 0.7 @ 26.5 GHz typ.	**$0.2 + 0.023f^2$** max 0.2 typ. @ 4 GHz 0.5 typ. @ 20 GHz 0.7 typ. @ 26.5 GHz **$0.75 + 0.023\Delta f^3$** max ($26.5 \le f \le 40$) 1.0 typ. @ 40 GHz	<0.18 to 1 GHz <0.24 to 2 GHz <0.4 to 4 GHz
SWR (through line)	See connector code Option data on page 93	**A:** <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 <1.40 to 18 GHz <1.8 to 26.5 GHz	<1.30	**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	<1.25 to 4 GHz <1.45 to 18 GHz <1.7 to 40 GHz	<1.15 to 1 GHz <1.20 to 4 GHz
SWR (into termination) Option 7:	Add 0.05 to SWR (Through Line) of connector selected	**A:** <1.1 to 2 GHz <1.2 to 4 GHz **B:** <1.15 to 2 GHz <1.20 to 12.4 GHz <1.30 to 18 GHz	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.40 to 18 GHz <1.8 to 26.5 GHz	<1.30	N/A		
Isolation (dB)	>50 to 12.4 GHz >45 to 18 GHz	>100 to 4 GHz >90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz	>100	**$110 - 2.25f^2$** min 120 typ. @ 4 GHz 90 typ. @ 20 GHz 60 typ. @ 26.5 GHz	**$110 - 2.25f^2$** min 120 typ. @ 4 GHz 90 typ. @ 20 GHz 60 typ. @ 26.5 GHz 55 typ. @ 40 GHz >50 (26.5 to 40 GHz)	>100 to 1 GHz >90 to 4 GHz

[1] Provides position sensing when used with Agilent 87130A/70611A or customer supplied external circuitry.
[2] f is frequency in GHz.
[3] $\Delta f = f\ (GHz) - 26.5$.

Specifications (continued)

Agilent model	8761A,B	8762A,B	8762C	8762F	8765A,B,C	8765D	8765F	N1810x
Input power average peak [1]	10 W 5 kW [2]	1 W 100 W (10 µs max)			2 W 100 W (10 µs max)			1 W 50 W (15 µs max)
Switching time (max)	50 ms	30 ms			15 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
Life (min)	1,000,000 cycles	1,000,000 cycles			5,000,000 cycles			
RF connectors	See connector options in ordering example	SMA (f)	3.5 mm (f)	Mini SMB (m) [4] (75 Ω)	A & B: SMA (f) C: 3.5 mm (f)	2.4 mm (f) See options	Mini SMB (m) [4] (75 Ω)	SMA (f)
DC connectors	Solder terminals	Solder terminals			Ribbon cable			D-submini 9 pin or solder terminals

[1] Not to exceed average power (non-switching).
[2] Option 7: 2 W average, 100 W peak (10 µs max).
[3] Measured at 25 °C.
[4] 75 Ω Mini SMB does not mate with 75 Ω SMB. See data sheet for more information.

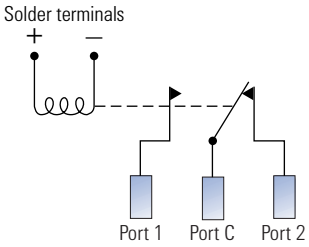
Options

Agilent model	8761A	8761B	8762A,B,C,F			8765A,B,C,D,F			
Supply voltage, current and impedance [5]			Std. / Opt. T24	Opt. 011	Opt. 015/Opt. T15	Opt. 005	Opt. 010	Opt. 015	Opt. 024
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		**Opt. T15:** TTL/5V CMOS compatible logic with 15 Vdc supply [6] **Opt. T24:** TTL/5V CMOS compatible logic with 24 Vdc supply [6]			N/A			
RF connector	See ordering information		N/A			**D (Opt. 292):** 2.92 mm (f)			
DC connectors	N/A					**Opt. 100:** Solder terminals **Opt. 108:** 8-inch ribbon cable extension **Opt. 116:** 16-inch ribbon cable extension			
Calibration documentation	See ordering information								

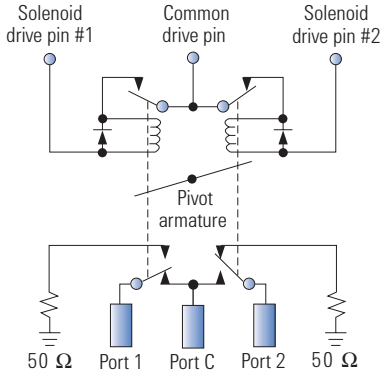
[5] Must specify option for Agilent 8765 series products.
[6] Not available with Agilent 8762F.

Schematics

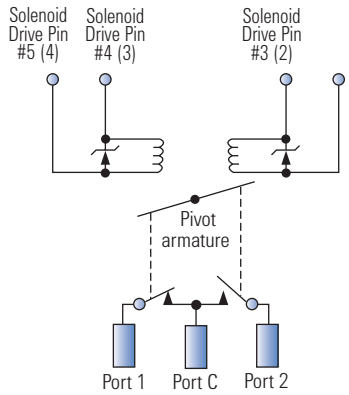
Agilent 8761 series



Agilent 8762 series



Agilent 8765 series[1]



[1] Opt. 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

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

Agilent 8762 series

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

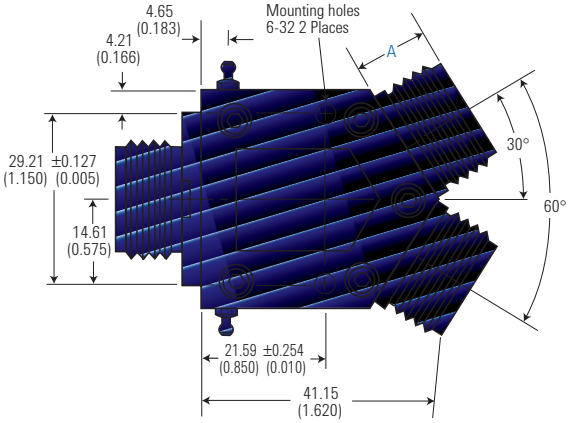
[2] Drive pin C is supply voltage.
[3] Not available on Agilent 8762F.

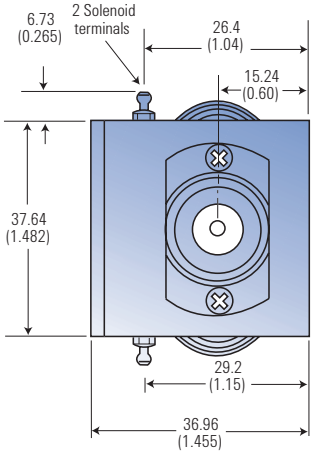
Agilent 8765 series

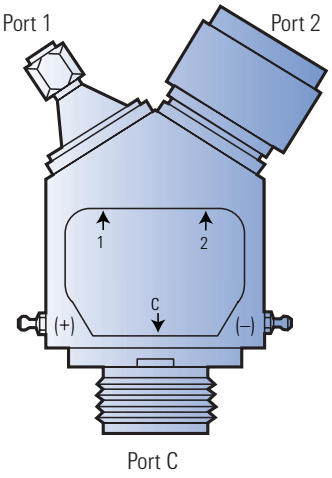
RF path	Drive control alternatives[4]								
		Common positive drive voltage			Common negative drive voltage			Polarity reversal drive voltage		
	Std. (Opt. 100)	Pin 1 (1)	Pin 3/4 (2/3)	Pin 5 (4)	Pin 3 (2)	Pin 1/5 (1/4)	Pin 4 (3)	Pin 1 (1)	Pin 3/4 (2/3)	Pin 5 (4)
1 to C		Open	Supply voltage	Ground	Open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

[4] See data sheet for additional information on these drive control alternatives.

Agilent 8761 series







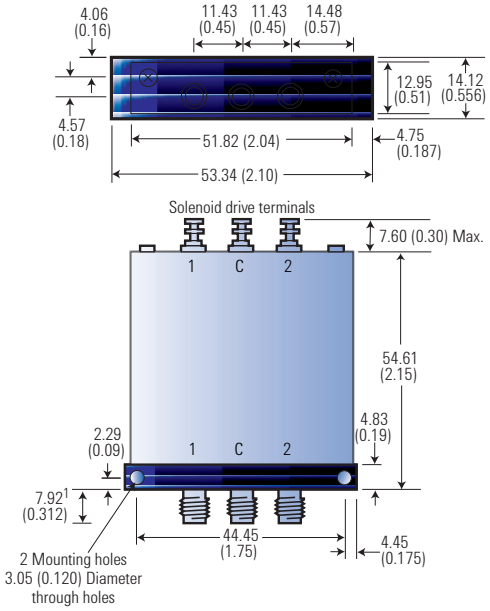
See ordering example for Agilent 8761 options on page 155.

Agilent 8761 series connector dimensions

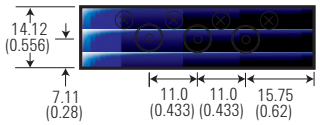
Connector code option	Connector type	Dimension "A" mm	(inch)	SWR (through line)
0	Type-N (f)	13.72	(0.540)	<1.25 to 18 GHz
1	Type-N (m)	19.79	(0.775)	<1.25 to 18 GHz
2	APC-7 threaded sleeve	9.27	(0.365)	<1.2 to 18 GHz
3	APC-7 coupling nut	11.94	(0.470)	<1.2 to 18 GHz
4	UT-250 coax	9.27	(0.365)	<1.25 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)	

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

Agilent 8762 Series



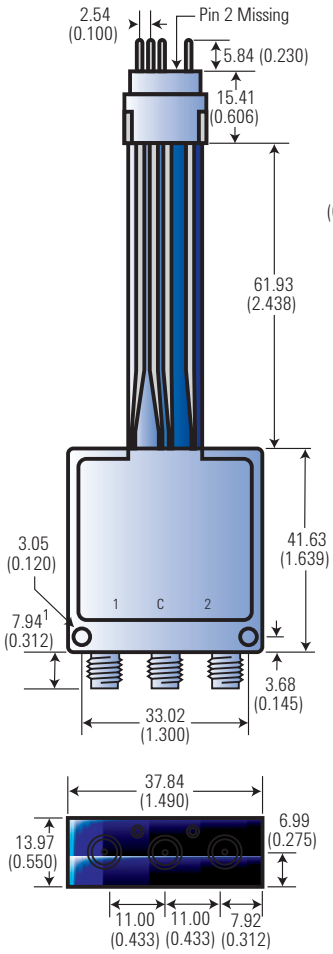
RF Connectors:
A,B: SMA (f) C: 3.5 mm (f) F: 75 Ω Mini-SMB



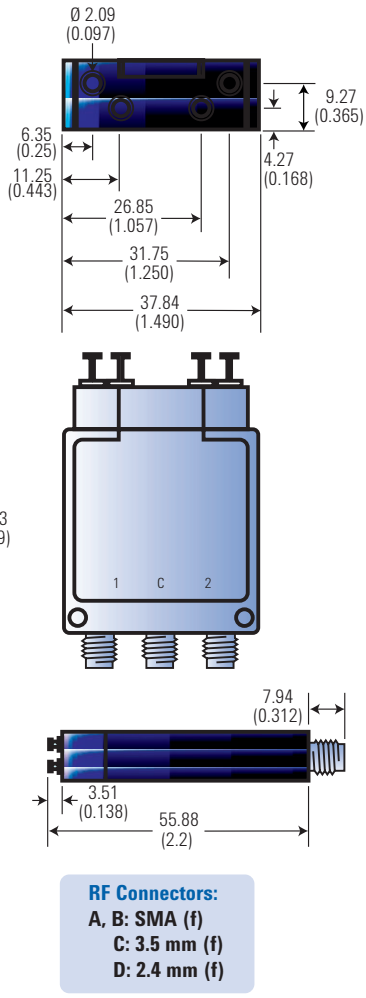
[1] 10.0 (0.393) for F version

Agilent 8765A,B,C,D

Standard



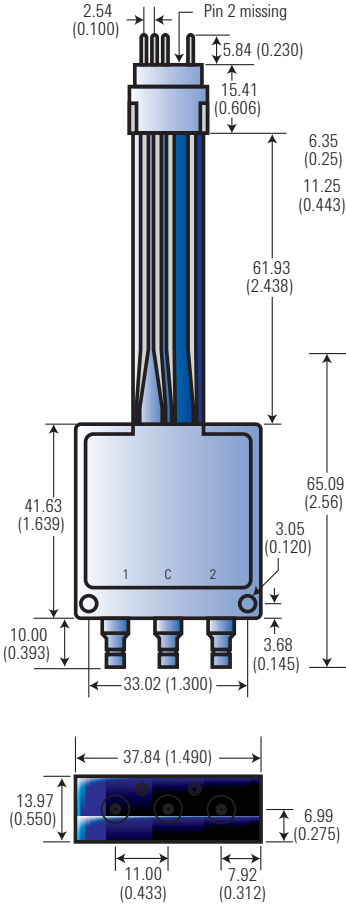
Option 100



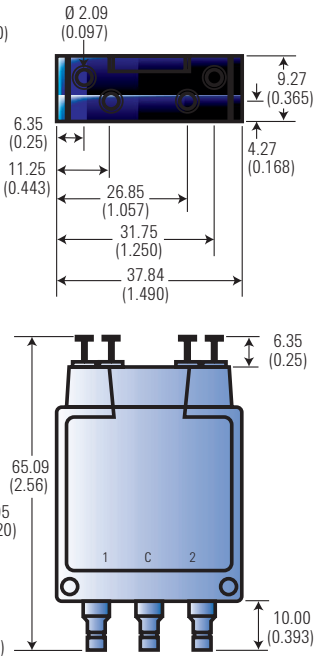
RF Connectors:
A, B: SMA (f)
C: 3.5 mm (f)
D: 2.4 mm (f)

Agilent 8765F

Standard



Option 100



RF Connectors:
75 Ω Mini-SMB (m)[2]

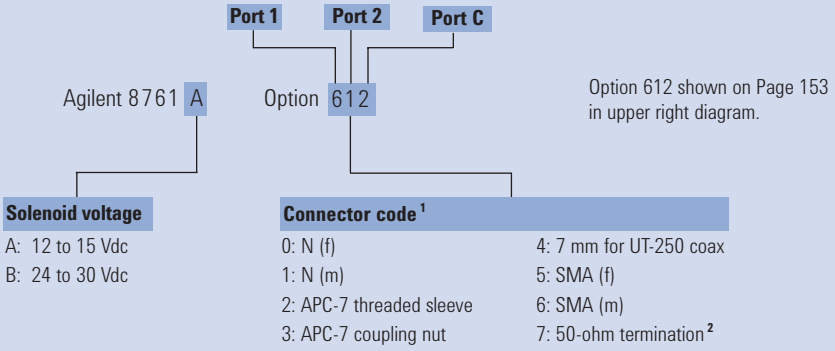
[1] 8.46 (0.333) for D versions.

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

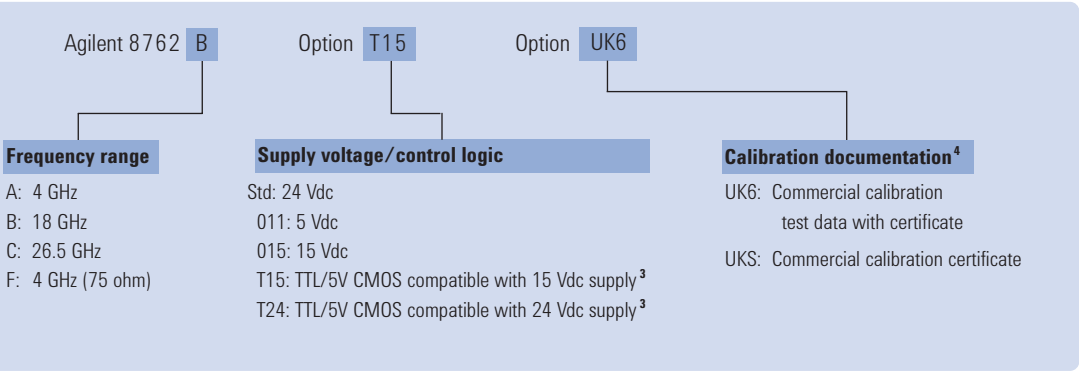
Dimensions are in millimeters (inches) nominal, unless otherwise specified.

Ordering Information

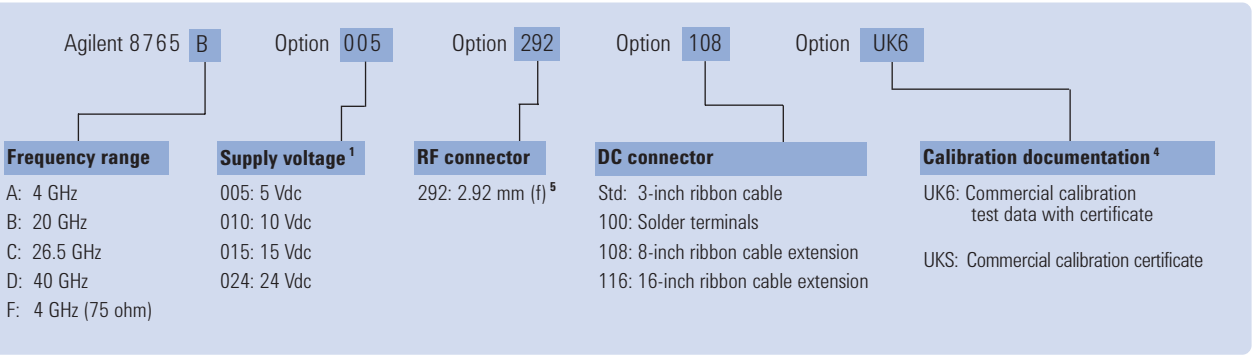
Agilent 8761 series ordering example



Agilent 8762 series ordering example



Agilent 8765 series ordering example



[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 Opt. 292, or 8765F.

[5] Available with Agilent 8765 only.

Specifications

	8763A	8763B	8763C	8764A	8764B	8764C
Configuration	← 4-Port →			← 5-Port →		
Features	Terminated			Unterminated		
	Break-before-make ← Current interrupts → Position indication capability[1]					
Impedance	← 50 Ω →					
Frequency range	dc to 4 GHz	dc to 18 GHz	dc to 26.5 GHz	dc to 4 GHz	dc to 18 GHz	dc to 26.5 GHz
Insertion loss (dB)	<0.20 to 2 GHz <0.25 to 4 GHz	<0.20 to 2 GHz <0.50 to 18 GHz	<0.25 to 2 GHz <0.50 to 18 GHz <1.25 to 26.5 GHz	<0.20 to 2 GHz <0.25 to 4 GHz	<0.20 to 2 GHz <0.50 to 18 GHz	<0.25 to 2 GHz <0.50 to 18 GHz <1.25 to 26.5 GHz
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 <1.40 to 18 GHz <1.8 to 26.5 GHz	<1.1 to 2 GHz <1.2 to 4 GHz	<1.1 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.40 to 18 GHz <1.8 to 26.5 GHz
SWR (into termination)	<1.1 to 2 GHz <1.2 to 4 GHz	<1.15 to 4 GHz <1.2 to 4 GHz <1.3 to 18 GHz	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.40 to 18 GHz <1.8 to 26.5 GHz	N/A	N/A	N/A
Isolation (dB)	>100 to 4 GHz	>90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz	>100 to 4 GHz	>90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz
Input Power						
Average	← 1 W →					
Peak[2]	← 100 W (10 µs max) →					
Switching Time (max)	← 30 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 to 18 GHz 0.5 dB to 26.5 GHz
Life (min)	← 1,000,000 cycles →					
RF connectors	SMA (f)	SMA (f)	3.5 mm (f)	SMA (f)	SMA (f)	3.5 mm (f)
DC connectors	← Solder terminals →					

[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.

Options

Control logic	**Opt. T15:** TTL/5V CMOS compatible logic with 15 Vdc supply **Opt. T24:** TTL/5V CMOS compatible logic with 24 Vdc supply		
Supply voltage, current and impedance	**Std/Opt. T24**	**Opt. 011**	**Opt. 015/Opt. 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		

N1811TL, N1812UL[1]

Standard performance specifications

Isolation (dB) = 90 - 1.13 XF, where F is specific in GHz					
	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
	90	85	76	67	60
Insertion loss (dB) = 0.3 + 0.019 X F, where F is specified in GHz					
	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
	0.30	0.38	0.53	0.68	0.80
SWR	dc - 2 GHz	2 - 4 GHz	4 - 12.4 GHz	12.4 - 20 GHz	20 - 26.5 GHz
	1.10	1.15	1.20	1.30	1.60

Optional high performance specifications

Isolation (dB) = 125 - 1.32 X F, where F is specified in GHz					
	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
Opt. 301	125	120	109	99	90
Insertion loss (dB) =0.3 + 0.019 X F, where F is specified in GHz					
	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
Opt. 302	0.15	0.23	0.38	0.53	0.65
SWR	dc - 2 GHz	2 - 4 GHz	4 - 12.4 GHz	12.4 - 20 GHz	20 - 26.5 GHz
	1.06	1.10	1.15	1.20	1.45

General operating characteristics

Switch Speed	Repeatability	Life	Impedance
< 15 ms	< .03 dB typical	> 5 mil cycles	50 ohms

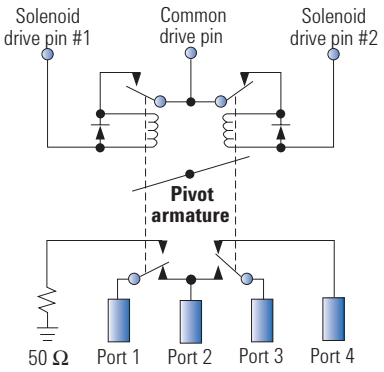
Options – N1811TL, N1812UL

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

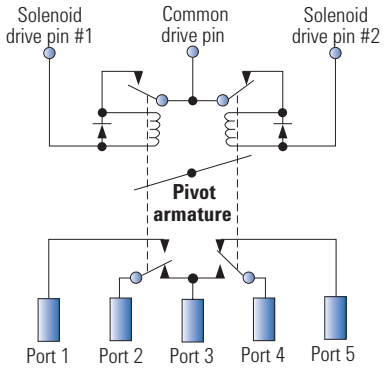
[1] Specifications include margins for measurement uncertainties
[2] Opt. 105 includes Opt. 402 and Opt. 403

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.

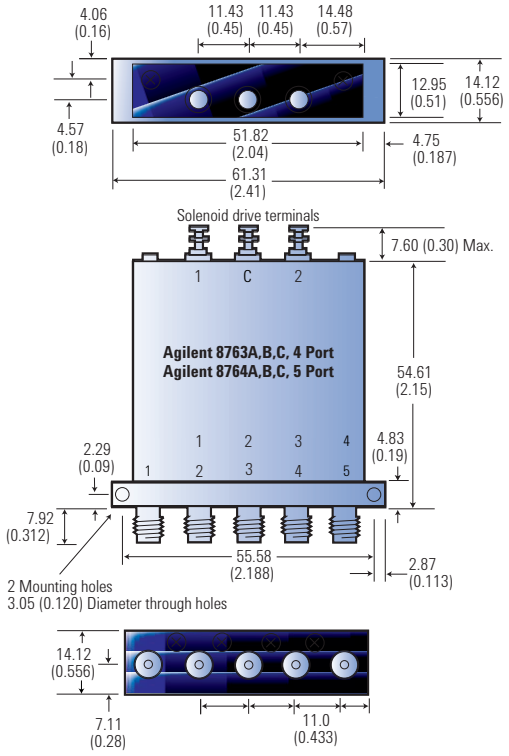
Agilent 8763/64 Series

Agilent Model	RF Path	Drive Control Alternatives			
		Standard Drive Voltage [1]		TTL/5V CMOS Drive Voltage [1]	
		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.

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 [UKS]

Type
3: 4 port
4: 5 port

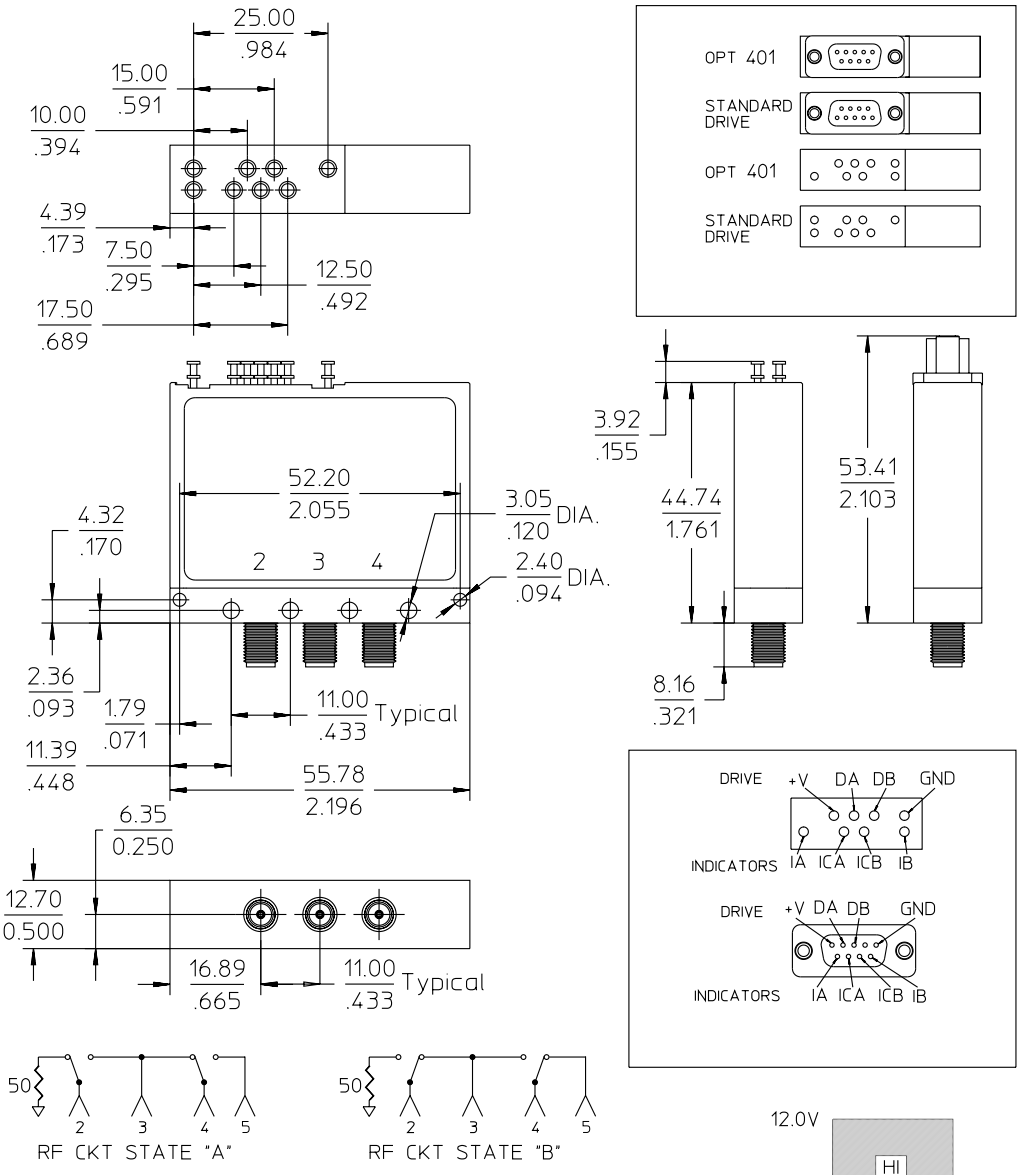
Frequency range
A: 4 GHz
B: 18 GHz
C: 26.5 GHz 015: 15 Vdc

Supply voltage/control logic
Std: 24 Vdc
011: 5 Vdc
T15: TTL/5V CMOS compatible logic with 15 Vdc supply
T24: TTL/5V CMOS compatible logic with 24 Vdc supply

Calibration Documentation
UK6: Commercial calibration test data with certificate
UKS: Commercial calibration certificate

Product outlines

Agilent N1812TL

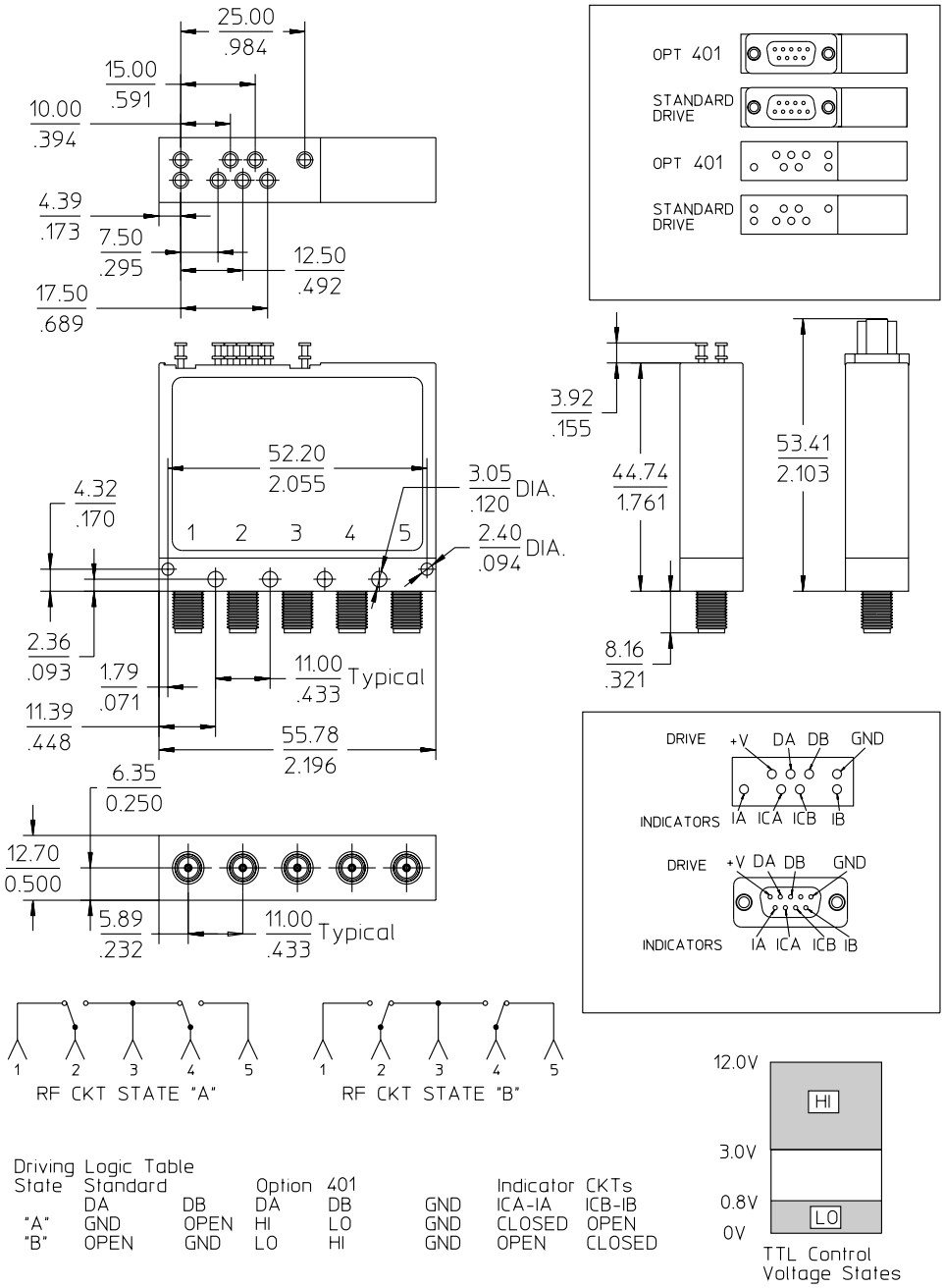


Driving Logic Table

State	Standard		Option 401			Indicator CKTs	
	DA	DB	DA	DB	GND	ICA-IA	ICB-IB
"A"	GND	OPEN	HI	LO	GND	CLOSED	OPEN
"B"	OPEN	GND	LO	HI	GND	OPEN	CLOSED

Product outlines

Agilent N1811UL



Driving Logic Table

State	Standard		Option 401			Indicator CKTs	
	DA	DB	DA	DB	GND	ICA-IA	ICB-IB
"A"	GND	OPEN	HI	LO	GND	CLOSED	OPEN
"B"	OPEN	GND	LO	HI	GND	OPEN	CLOSED

Specifications

Agilent model	8766K	8767K	8768K	8769K
Configuration	SP3T	SP4T	SP5T	SP6T
Features	Unterminated Break-before-make Current interrupts Position indication capability [1]			
Impedance	50 Ω			
Frequency range	dc to 26.5 GHz			
Insertion loss (dB)	**Signal path** Common to Port 1: 0.2 dB + 0.05 dB x f (GHz) Common to Port 2: 0.2 dB + 0.06 dB x f (GHz) Common to Port 3: 0.2 dB + 0.08 dB x f (GHz) Common to Port 4: 0.25 dB + 0.095 dB x f (GHz) Common to Port 5: 0.25 dB + 0.108 dB x f (GHz) Common to Port 6: 0.25 dB + 0.12 dB x f (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 <1.55 to 12.4 GHz <1.8 to 18 GHz <2.05 to 26.5 GHz
Isolation (dB)	See chart on page 165			
Input power Average Peak [2]	1 W 100 W (10 µs max)			
Switching time (max)	30 ms			
Repeatability (max) [3]	0.01 dB to 18 GHz 0.05 dB to 26.5 GHz			
Life (min)	5,000,000 cycles			
RF connectors	3.5 mm (f)			
DC connectors	Viking cable connector			

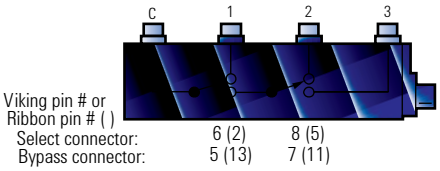
Options

Supply voltage, current, and impedance	Std.	Opt. 011	Opt. 015
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	**Opt. 002:** SMA (f) [4]		
DC connectors	**Opt. 008:** 8-inch ribbon cable		
	Opt. 016: 16-inch ribbon cable		
Calibration documentation	See ordering information		

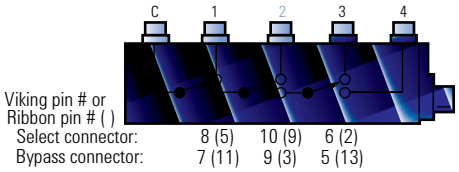
[1] Provides position sensing when used with Agilent 87130A/70611A switch driver or customer supplied external circuitry.
[2] Not to exceed 1 W average (non-switching).
[3] Measured at 25 °C.
[4] Use to 18 GHz only.

Simplified schematics

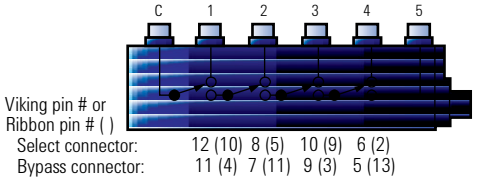
Agilent 8766K



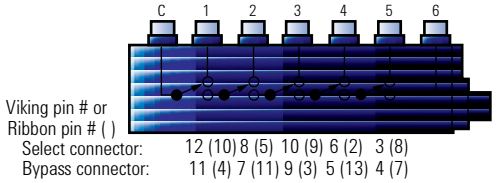
Agilent 8767K



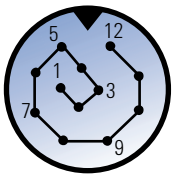
Agilent 8768K



Agilent 8769K

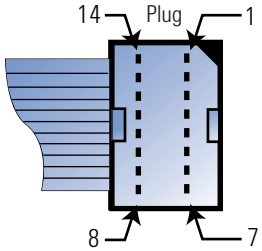


Viking plug detail [1, 2]



STD

DIP plug [3]



Option 008, 016
Pin side up

[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.

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

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
Opt. 008/016 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
Opt. 008/016 Dual inline Pin connector	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

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
Opt. 008/016 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

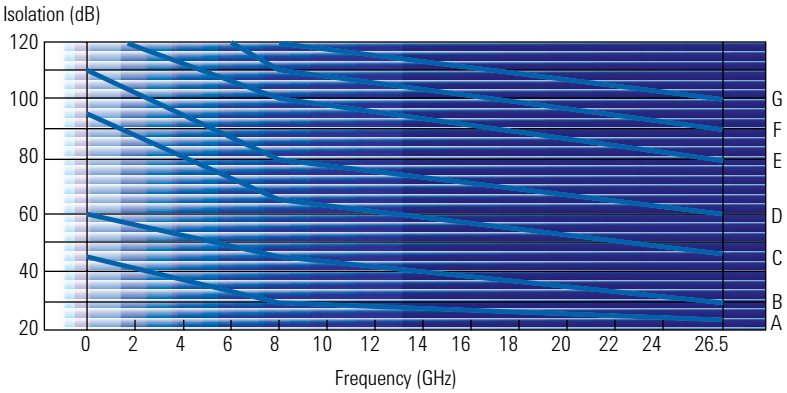
Agilent 8769K SP6T switch

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
Opt. 008/016 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 1	Section status 2	Isolation curve for Port ( ) 1	Isolation curve for Port ( ) 2	Isolation curve for Port ( ) 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	-

Agilent 8767K SP4T switch

Section	Section status 1	Section status 2	Section status 3	Isolation curve for Port ( ) 1	Isolation curve for Port ( ) 2	Isolation curve for Port ( ) 3	Isolation curve for Port ( ) 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	D
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

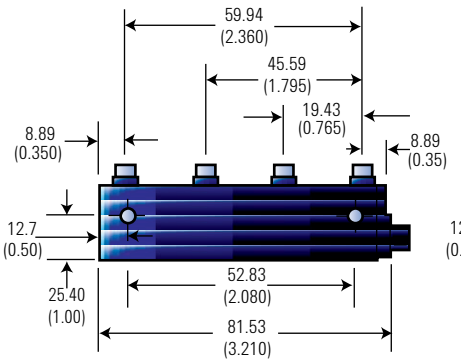
	Section status				Isolation curve for Port ( )				
Section	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**
Common to Port 1	Select	Select	Select	Select	–	B	D	E	F
Common to Port 1	Select	Select	Bypass	Select	–	B	E	D	E
Common to Port 1	Select	Bypass	Select	Select	–	C	B	D	E
Common to Port 1	Select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

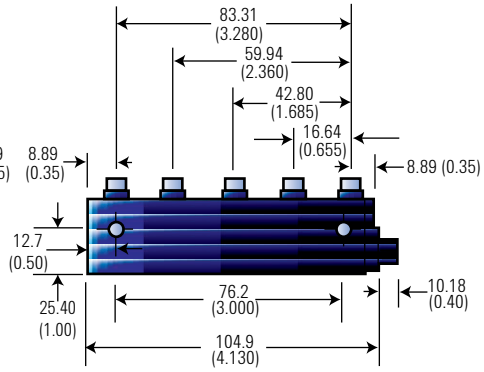
	Section status					Isolation curve for Port ( )					
Section	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**
Common to Port 1	Select	Select	Select	Select	Select	–	B	D	E	F	G
Common to Port 1	Select	Select	Select	Bypass	Select	–	B	D	F	E	F
Common to Port 1	Select	Select	Bypass	Select	Select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

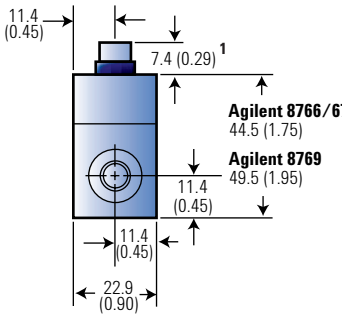
Outline drawings

Agilent 8766K



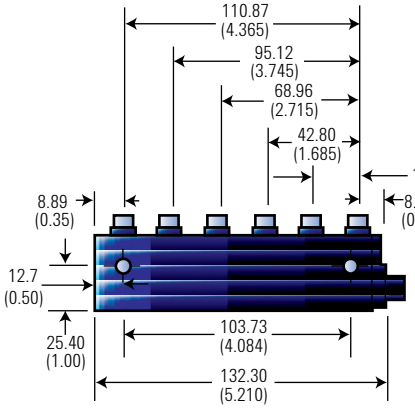
Agilent 8767K



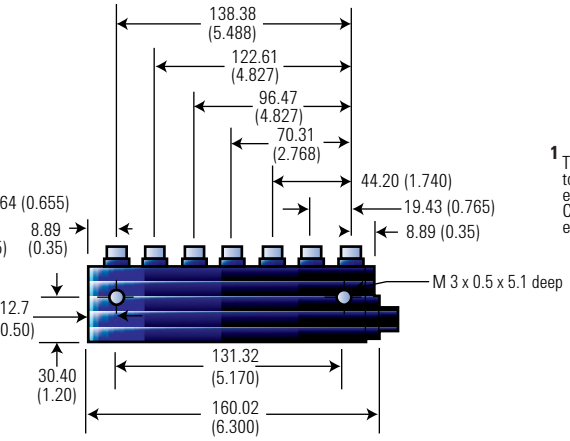


1 This dimension applies to connectors on each end of the switch. Connectors between the ends are 0.05 inches taller.

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 **008** Option **UK6**

Type	Supply Voltage	RF Connector	DC Connector	Calibration Documentation
6: SP3T	Std: 24 Vdc	Std: 3.5 mm (f)	Std: Viking cable connector	UK6: Commercial calibration test data with certificate
7: SP4T	011: 5 Vdc	002: SMA (f)	008: 8-inch ribbon cable	UKS: Commercial calibration certificate
8: SP5T	015: 15 Vdc		016: 16-inch ribbon cable	
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 Optoelectronic position indication capability[2] Direct path control	
Impedance	50 Ω			
Frequency range	**A**: dc to 4 GHz **B:** dc to 20 GHz **C:** dc to 26.5 GHz			
Insertion loss (dB)	0.3 + 0.015 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			
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			
Input power				
Average	1 W			
Peak[3]	50 W (10 µs max)			
Switching time (ms)	<15			
Repeatability (max)[4]	0.03 dB			
Life (min)	5,000,000 cycles			
Supply voltage and current				
Supply voltage range	20 to 32 Vdc			
Supply voltage (nom)	24 Vdc			
Current (nom)[5]	200 mA			
RF connectors	SMA (f)			
DC connectors	Ribbon cable receptacle			

Options

	87104A,B,C	87106A,B,C	87204A,B,C	87206A,B,C
Control logic	**Opt. T24:** TTL/5V CMOS compatible logic with 24 Vdc supply		N/A	
DC connectors	**Opt. 100:** Solder terminals			
Calibration Documentation	See ordering information			

[1] Position sensing when used with customer supplied external circuitry only.

[2] Position sensing when used with Agilent 87130A/70611A switch driver or customer supplied external circuitry.

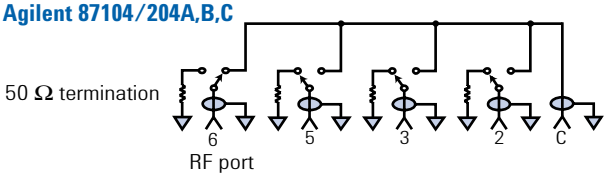
[3] Not to exceed average power (non-switching).

[4] Measured at 25 °C.

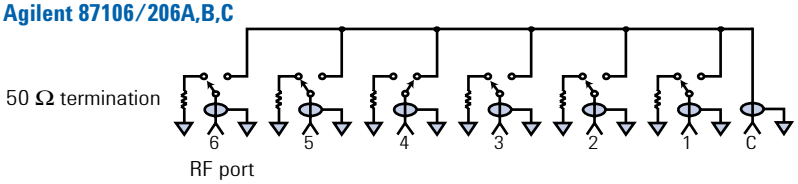
[5] Closing one RF path requires 200 mA. Add 200 mA for each additional RF path closed or opened.

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]

RF Path	Pin No. [2]	Drive Control Voltages [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.

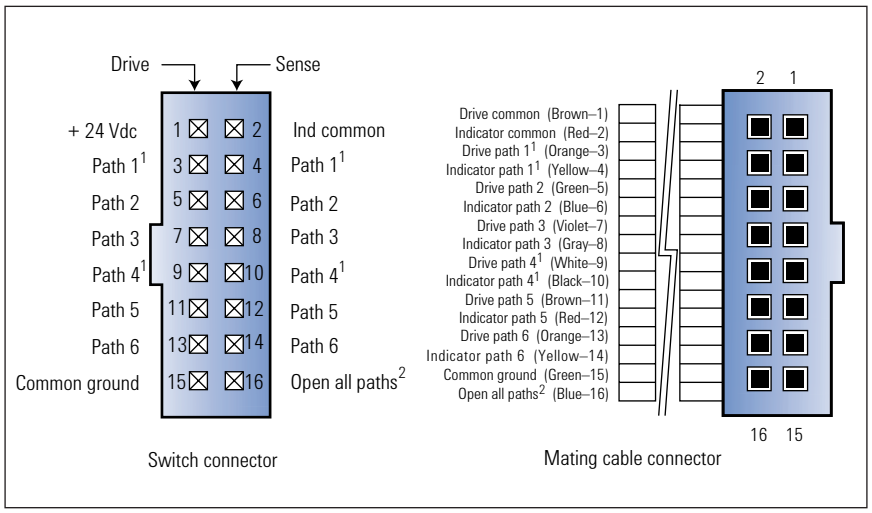
[3] Paths 1 and 4 are not available for Agilent 87104A,B,C.

[4] Not available on Option 100.

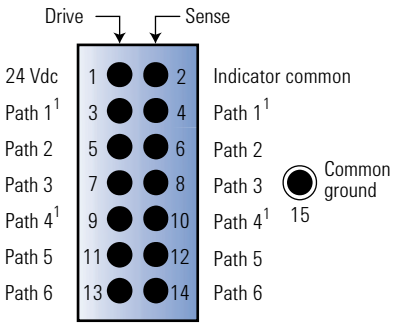
Drive connection diagrams

Agilent 87104/106 series

Standard/Option T24

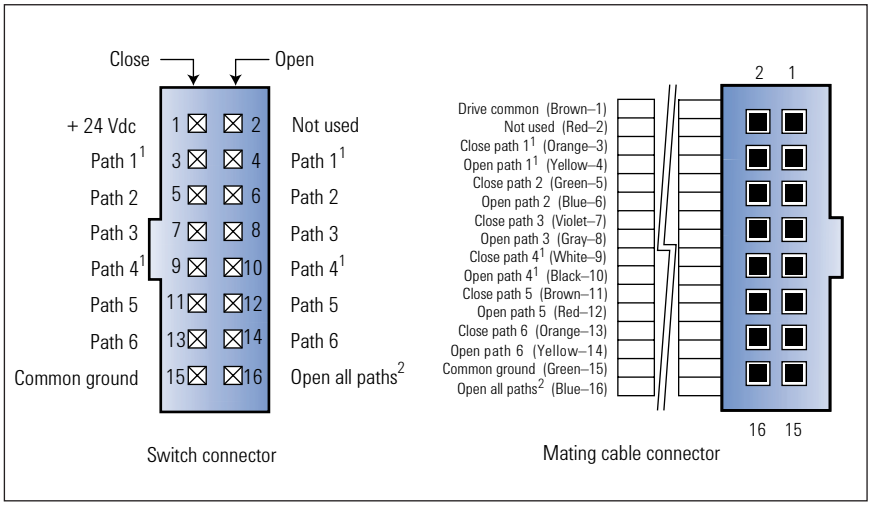


Option 100 (solder terminals)

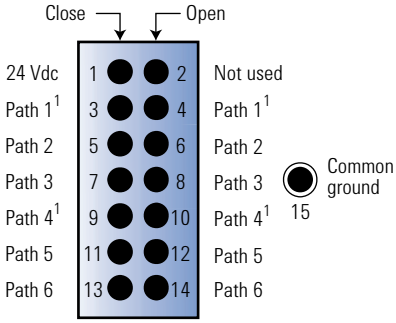


Agilent 87204/206 series

Standard



Option 100 (solder terminals)

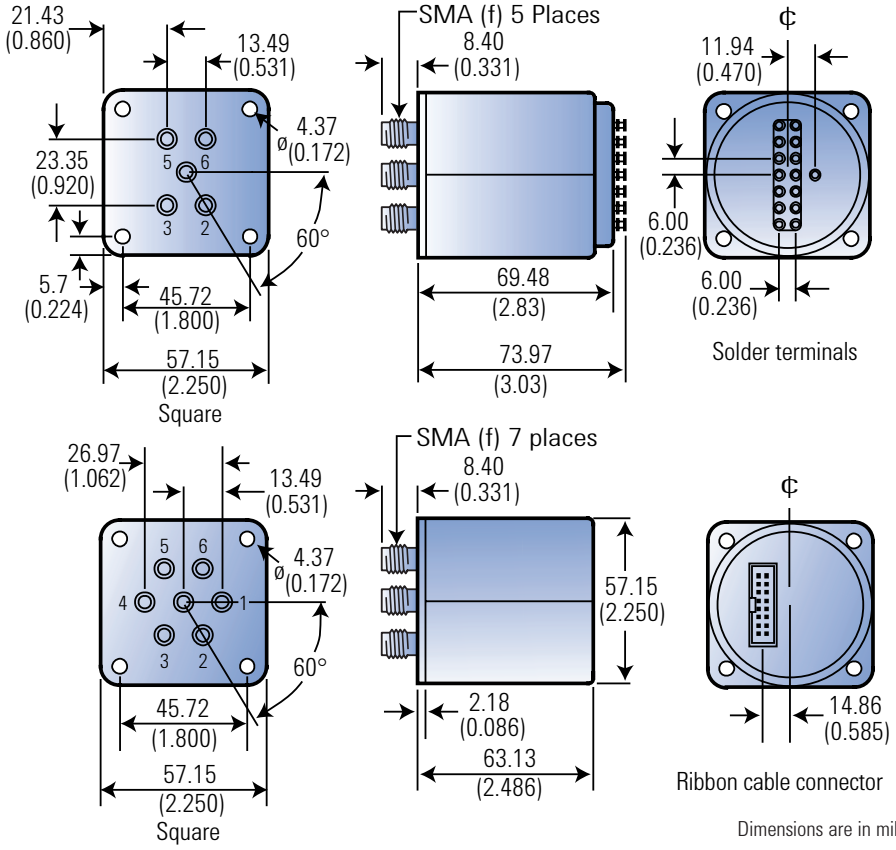


[1] Paths 1 and 4 are not connected for Agilent 87104/204 series.

[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
4: SP4T
6: SP6T

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

DC connector
Std: Ribbon receptacle
100: Solder terminals

Control logic[1]
T24: TTL/5V CMOS compatible logic with 24 Vdc supply

Calibration documentation
UK6: Commercial calibration test data with certificate
UKS: Commercial calibration certificate

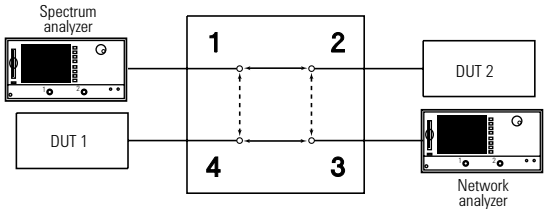
[1] Option T24 not available with Agilent 87204/206 series products.

High Performance Transfer Switch

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

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.

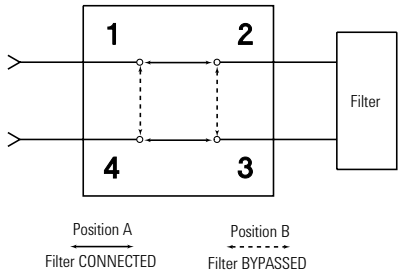


Figure 3. Drop-out switch

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.

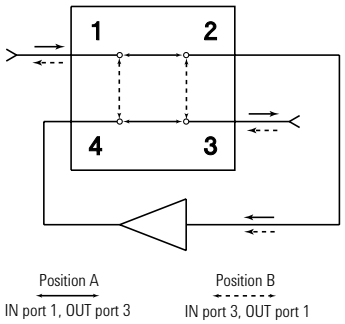


Figure 2. Signal reversal

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

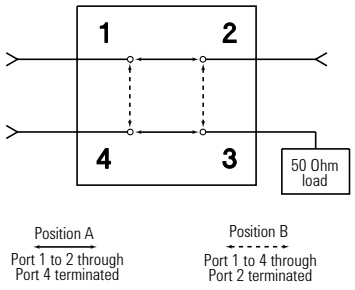
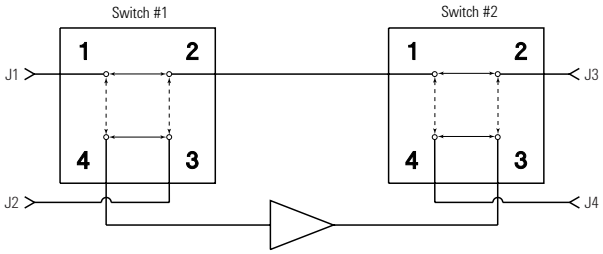


Figure 4. SPDT terminated

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. 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 for users of the 11713A Switch Driver: Do not drive the 8722C/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 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:

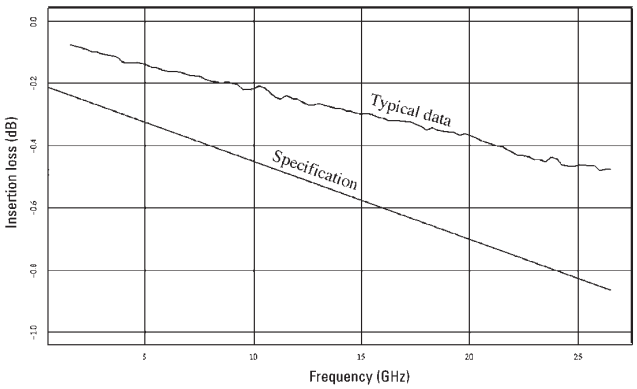
See Figure 6 for drive connection diagrams.
See Figure 7 for TTL Voltage States.
- Connect Pin 1 to supply (+20 VDC to +32 VDC)
- Connect Pin 9 to ground (see notes 2,4)
- Connect Pin 8 to TTL "High"
- Select position "A" by applying TTL "High" to pin 7 (see note 3)
- Select position "B" by applying TTL "Low" to pin 7 (see note 3)

(III) Dual line TTL drive:

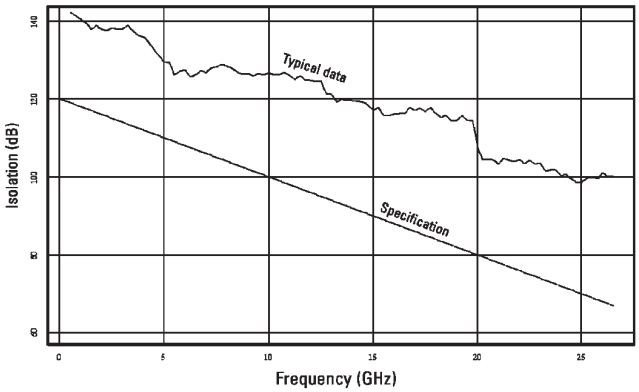
See Figure 6 for drive connection diagrams.
See Figure 7 for TTL Voltage States.
- Connect Pin 1 to supply (+20 VDC to +32 VDC)
- Connect Pin 9 to ground (see notes 2,4)
- Select position "A" by applying TTL "High" to pin 7 and TTL "Low" to pin 8 (see note 3)
- Select Position "B" by applying TTL "Low" 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



Agilent 87222C/D/E insertions loss versus frequency



Agilent 87222C/D/E isolation versus frequency

Specifications

Agilent model	87222C	87222D	87222E
Configuration	4-Port	4-Port	4-Port
Features	Opto-electronic indicators and interrupts[1] TTL/5V CMOS compatible Unterminated	Opto-electronic indicators and interrupts[1] TTL/5V CMOS compatible Unterminated	Opto-electronic indicators and interrupts[1] TTL/5V CMOS compatible Unterminated
Impedance	50 ohms	50 ohms	50 ohms
Frequency range	dc to 26.5 GHz	dc to 40 GHz	dc to 50 GHz
Insertion loss (dB)	0.2 dB + 0.025x frequency (GHz)	0.2 dB + 0.025x frequency (GHz)	0.15 dB + 0.025x frequency (GHz)
SWR	1.10 maximum dc to 2 GHz 1.15 maximum 2 to 4 GHz 1.25 maximum 4 to 12.4 GHz 1.40 maximum 12.4 to 20 GHz 1.65 maximum 20 to 26.5 GHz	1.30 maximum dc to 12.4 GHz 1.40maximum 12.4 to 25 GHz 1.70 maximum 25 to 40 GHz	1.30 maximum dc to 12.4 GHz 1.40 maximum 12.4 to 20 GHz 1.50 maximum 20 to 30 GHz 1.60 maximum 30 to 40 GHz 1.70 maximum 40 to 50 GHz
Isolation (dB)	120 dB -2.0x frequency (GHz)	dc to 26.5 GHz 120 dB -2.0x frequency (GHz)	dc to 26.5 GHz 120 dB -2.0x frequency (GHz)
		26.5 to 40 GHz 60 dB	26.5 to 50 GHz 60 dB
Input power			
Average	1W	1W	1W
Peak[2]	50W	50W	50W
Switching speed (max)	15 ms	15 ms	15 ms
Repeatability (max)[3]	0.03 dB	<0.03 dB typical	<0.03 dB typical
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] Provides position sensing when used with Agilent87130A/70611A switch driver and the Agilent 11764-60010 accessory cable.

[2] Not to exceed 1W average

[3] Measured at 25° C

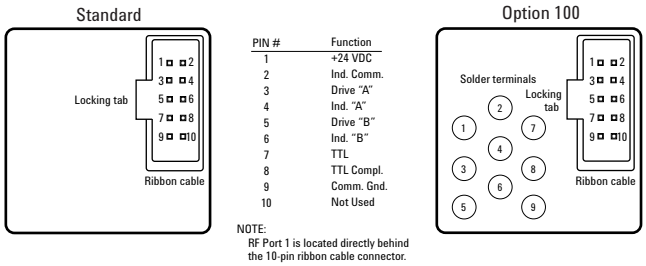


Figure 6. Drive connections

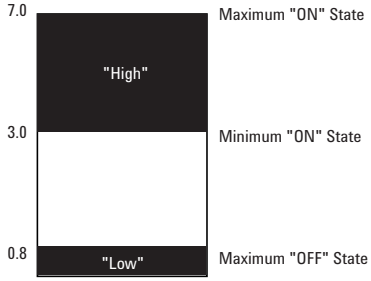


Figure 7. TTL control voltage states

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

Table A

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.

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 B

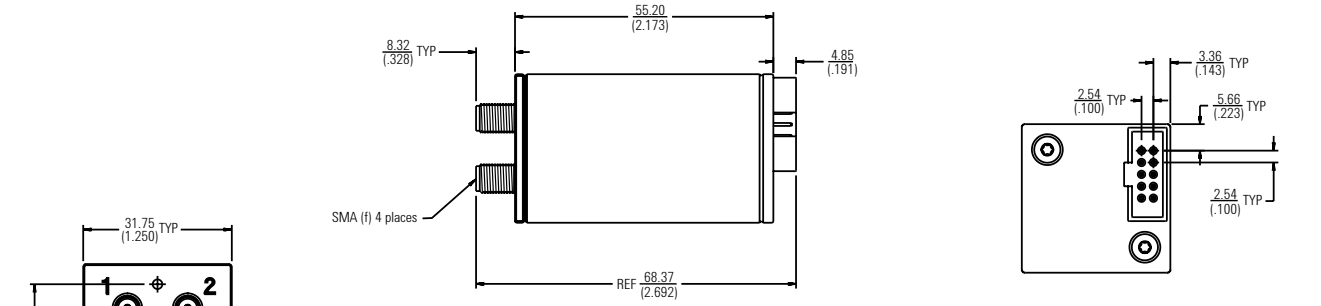
TTL Specific drive specifications

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

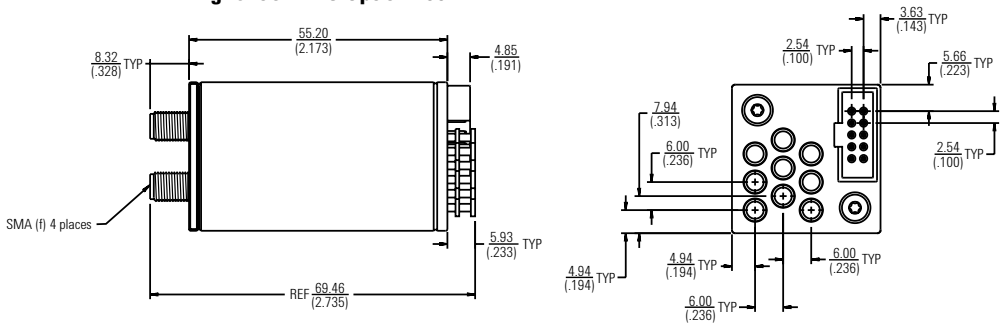
Table C

Product outlines

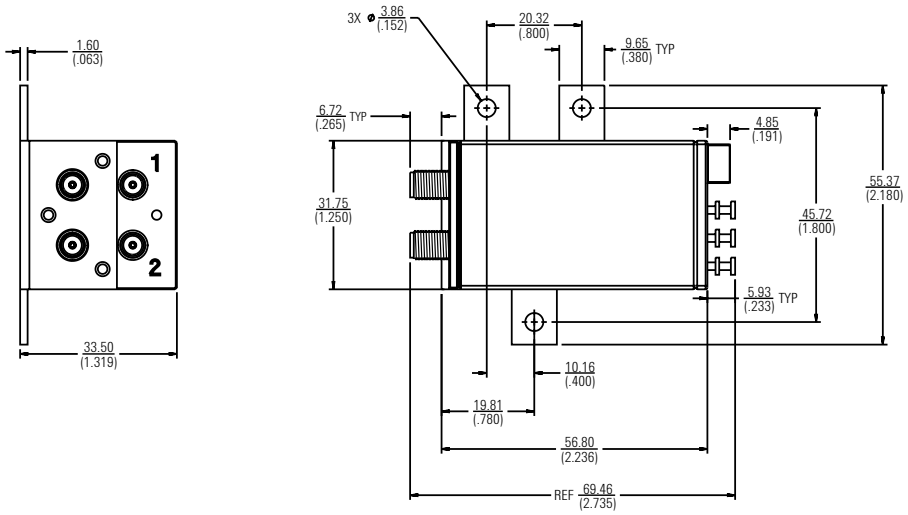
Agilent 87222C standard



Agilent 87222C Option 100



Agilent 87222C Option 100 and 201



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

Applications

Matrix signal routing

Figures 1 and 2 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).

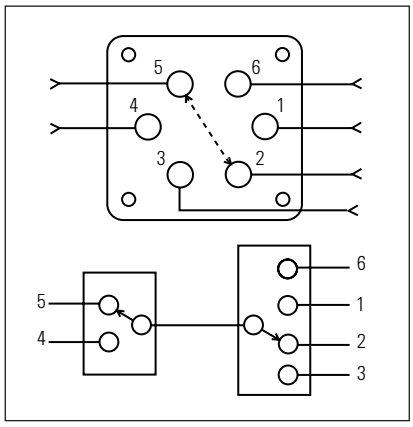


Figure 1. Matrix switch configured for a 2 x 4 blocking application (RF Path 5 to 2 shown)

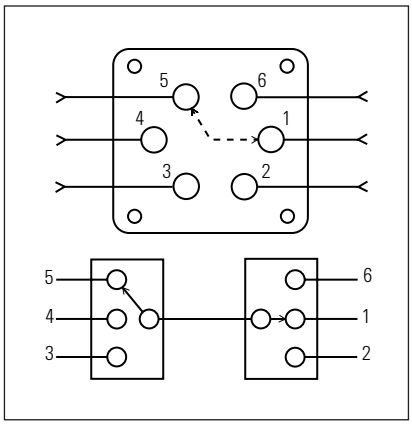


Figure 2. Matrix switch configured for a 3 x 3 blocking application (RF Path 5 to 1 shown)

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:

Agilent 87406B RF port drive pin control data

Table 1. Agilent 87406B 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 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. Use the Agilent 87606B if pulse drive, such as used on Agilent 70611A or 87130A, is desired.

Open all RF ports

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

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

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

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 (standard) 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:

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				

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

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:

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

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

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 2 and 3, close ports 2 and 5 while opening all other ports (1, 3, 4, 6); ground pins 4, 5, 8, 10, 11, 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 to open all paths, then apply ground to pins 5 and 11, to close parts 2 and 5.

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).

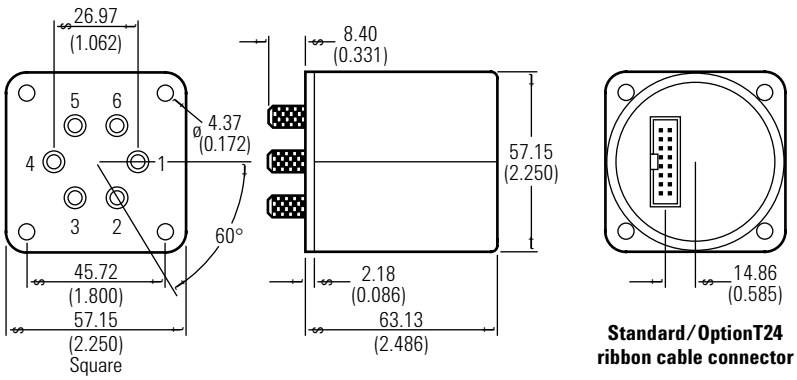
Switch drive specifications

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

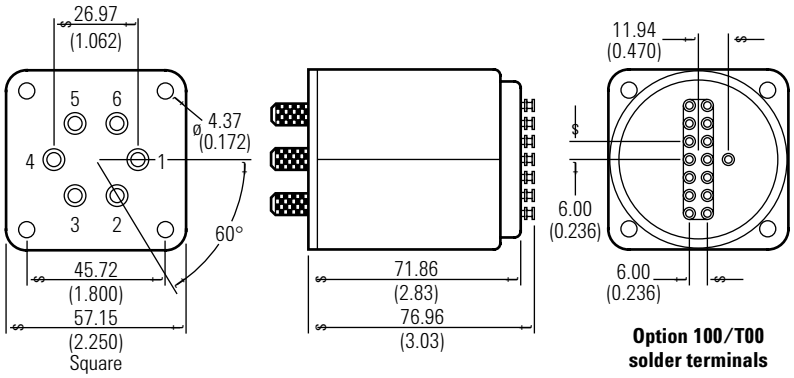
[1] 200 mA is required for each RF port closed or open. Using "open all ports" (pin 16) will require up to 1200 mA (6 ports times 200 mA each). See General Operation Section.

Product outline

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



Standard/OptionT24 ribbon cable connector



Option 100/T00 solder terminals

High Performance Matrix Switch

Matrix

Agilent model	87406B	87606B
Configuration	SP6T	
Features	3x3, 2x4 and 1x5 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 ohms	
Frequency range	dc to 20 GHz	
Insertion loss (dB)	0.34 dB + 0.033 x frequency (GHz) maximum	
SWR	1.21 maximum from dc to 4 GHz 1.35 maximum from 4 to 10 GHz 1.5 maximum from 10 to 15 GHz 1.7 maximum from 15 to 18 GHz 1.9 maximum from 18 to 20 GHz	
Isolation (dB)	100 dB minimum to 12 GHz 80 dB minimum from 12 to 15 GHz 70 dB minimum 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)	5,000,000 cycles	
RF connectors	SMA (f)	

Agilent model number	Options:
Agilent 87406B	**100:** Solder terminals to replace ribbon cable **T24:** TTL/5V CMOS compatibility (requires 24VDC power supply) **T00:** Solder terminals to replace ribbon cable and TTL/5V CMOS compatibility
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

Switch Cables[1]

Agilent model number	Agilent part number	Where used	Description
11761A		11713A to 8765	Viking to (4) ribbon cable connectors
	11764-60007	84941A dist bd to 87104/106[2]	16-pin DIP to (6) 4-pin Berg connector, 30-inches
	11764-60008	84941A dist bd to 87204/206	16-pin DIP to (6) 4-pin Berg connector, 30-inches
	70611-60008	84941A dist bd to 8762/63/64, 8765 Opt. 100	(31) 52-inch cables, 4-pin Berg connector to bare wires
		84941A dist bd to 87104/106 Opt. 100[2]	
		84941A dist bd to 87204/206 Opt. 100	
84941A-K03		84941A dist bd to 8769K	12-pin Viking to (5) 4-pin Berg connector, 60-inches
87106/206)	**5061-0969**	11713A to 87104/106 Opt. 100	Viking to bare wires, 60-inches (2 required for Agilent 11713A to 87204/206 Opt. 100

[1] For complete cable configuration information, used for connection to Agilent attenuator/switch drivers, request publication number 5963-2038E, *Agilent 70611A, Agilent 87130A and Agilent 11713A Switch Attenuator Driver Configuration Guide.*

[2] Does not provide sensing when used with Agilent attenuator/switch drivers.

Figure 1. Agilent 11713A (upper left), Agilent 70611A (upper right), Agilent 87130A (lower).

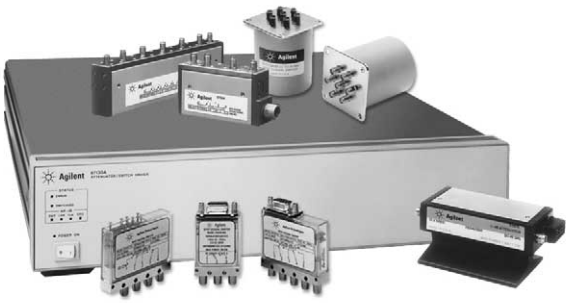


Figure 2. Agilent 87130A with various attenuators and switches.

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 of the Agilent 11713A can deliver control signals totaling 0.625 amps continuously or 1.25 amps for one second. Each Agilent 11713A comes equipped with two plug-in drive cables for driving attenuators. Other cables are also available. The convenient front panel controls allow manual control of individual attenuator sections and/or switches.

Agilent 70611A attenuator/switch driver for MMS

The Agilent 70611A is a 1/8 MMS module capable of driving up to 248 electromechanical switches or attenuator switch sections. The Agilent 70611A is MSIB, SCPI and GPIB compatible. In addition to being programmable, the Agilent 70611A features an extremely user-friendly manual interface via any MMS display unit. The highlight of the manual interface is the operator's ability to customize groups of switch control lines and their settings, then identify these switch settings with user-defined alphanumeric labels. In this manner, end users of the Agilent 70611A can define custom menus with their own identification labels for simplified manual control.

The Agilent 70611A can store up to 256 user-defined, labeled paths. Path definitions can be stored in non-volatile EPROM. Groups of paths can be stored in "directories" for easier access to similar path commands. The Agilent 70611A controls switches or attenuator sections in banks of 31 (eight banks total) through individual Agilent 84940A I/O driver cards which are, in turn, directly wired to the switches and/or attenuators.

Agilent 70612/613 series MMS interface modules

In addition to custom interface modules, Agilent offers off-the-shelf interface solutions in MMS. The Agilent 70612 (1 x 6 switch tree) series and the Agilent 70613 (2 x 5 switch tree) series are microwave matrixes available in 2/8 MMS modules with integrated controllers. They are equipped with front panel indicators to facilitate manual use and the integrated controller has all the capabilities of the Agilent 70611A attenuator/switch driver. A variety of options are available for the Agilent 70612/13 series including performance to 26.5 GHz, terminated or unterminated switches, integrated attenuators and a choice of port locations. For a more detailed description of these products, refer to publication number 5091-4897E, Modular Measurement System Technical Data Sheet.

Agilent 87130A attenuator/switch driver

The Agilent 87130A is a 3.5-inch high (2 rack units), full rack width attenuator/switch driver capable of driving up to 248 electromechanical switches or attenuator sections. The Agilent 87130A is controlled over GPIB via standard commands for programmable instruments (SCPI). The Agilent 87130A has been designed for use in both ATE switching systems and computer controlled bench-top applications. Control and programming are accomplished via application programs in IBASIC, RMB, C or Pascal. An ITG driver is also available for use separately or in conjunction with Agilent's Visual Engineering Environment (VEE).

The Agilent 87130A is electronically identical to the Agilent 70611A and shares its performance characteristics with the exception of the method of manual control. The Agilent 87130A has no front panel controls. Manual control of the Agilent 87130A is realized through its ITG driver and a computer controller. The Agilent 87130A can drive 31 switches or attenuator sections directly and up to an additional 217 switches via seven additional Agilent 84940A driver cards. A distribution board, Agilent 84941A, is available to facilitate the interconnection of the Agilent 87130A to switches or attenuators.

Agilent E1368A, E1369A and E1370A VXI attenuator and switch drivers

Agilent's VXI family of instrumentation includes modules for microwave switching and attenuation control up to 18.0 GHz. Agilent E1368A contains three factory-installed SPDT switches such as the Agilent 8762B which feature all-port termination, dc to 18.0 GHz. Agilent E1369A is identical to the Agilent E1368A except that the switches are not included. This allows user-substitution of Agilent 8763/64 series transfer switches. Agilent E1370A allows the user to customize the internal configuration for Agilent 8766 series multiport switches or Agilent 8494/95/96/97 series step attenuators.

For more information, request a copy of the Agilent VXI Catalog, Publication number 5964-3970E, 5964-6898E (CD format).

Agilent 84940A switch driver and Agilent 84941A distribution card

The Agilent 84940A is an expansion driver card for the Agilent 70611/12/13 family of MMS attenuator/switch drivers and the Agilent 87130A attenuator/switch driver. The Agilent 84940A has been designed for incorporation into large interfaces located remotely from their controller. A single Agilent 84940A can control up to 31 switches and can be located up to 150 feet (45 m) from an Agilent 70611/12/13 or Agilent 87130A. The physical interconnection to the switches or attenuators is realized via 31 four-pin output connectors which permit quick connection and disconnection of the switches or attenuators. The Agilent 84941A is a signal distribution card designed to simplify the interconnection of the drive cable from an Agilent 70611A, Option 001, or Agilent 87130A to the 31 components directly driven by these controllers. The Agilent 84941A also provides 31 four-pin connectors for convenient interconnection to switches or attenuators. Included with the Agilent 84941A is a pack of 31 cables, to connect as many as 31 switches or attenuator sections to the Agilent 84941A.

Agilent 909 series

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 find wide use 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

Specifications

Agilent model	Impedance	Frequency range (GHz)	Maximum SWR	Maximum power	Connector type	Length mm (in)	Diameter mm (in)	Shipping weight kg (lb)
909A	50 Ω	dc to 18	0 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 Opt. 012	50 Ω	dc to 18	0 to 4 GHz: 1.06 4 to 12.4 GHz: 1.11 12.4 to 18 GHz: 1.30		**Opt. 012:** N (m)	51 (2)	21 (0.8)	
909A Opt. 013	50 Ω	dc to 18			**Opt. 013:** 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 (0.5)	22 (0.9)	
909C Opt. 012	50 Ω	dc to 2	1.01		**Opt. 012:** N (m)	51 (2)	21 (0.8)	
909C Opt. 013	50 Ω	dc to 2	1.01		**Opt. 013:** N (f)		17 (0.7)	
909C Opt. 200	50 Ω	dc to 0.2	1.005		Must also order **Opt. 012:** N (m) or **Opt. 013:** N (f)		21 (0.8) 17 (0.7)	
909C Opt. 201	50 Ω	dc to 0.2	1.01		Must also order **Opt. 012:** N (m)		21 (0.8)	
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 Opt. 011	50 Ω	dc to 26.5			3.5 mm (f)	23 (0.9)	8 (0.3)	
909D Opt. 040	50 Ω	dc to 26.5	dc to 4 GHz: 1.02 4 to 6 GHz: 1.036 6 to 26.5 GHz: 1.12		3.5 mm (m)	23 (0.9)	8 (0.3)	
909E	75 Ω	dc to 3	1.02	1/2 W avg. 100 W peak	N (m)	51 (2)	21 (0.8)	
909E Opt. 011	75 Ω	dc to 3	1.02		N (f)		16 (0.6)	
909E Opt. 201	75 Ω	dc to 0.2	1.01		N (m)		21 (0.8)	
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		22 (0.9)	
909F Opt. 012	50 Ω	dc to 18	dc to 2 GHz: 1.007 2 to 3 GHz: 1.01		**Opt. 012:** N (m)		21 (0.8)	
909F Opt. 013	50 Ω	dc to 18	3 to 6 GHz: 1.02 6 to 18 GHz: 1.15		**Opt. 013:** N (f)		17 (0.7)	
85138A	50 Ω	dc to 50			2.4 (m)			
85138B	50 Ω	dc to 50			2.4 (f)			

Agilent 911 series

The Agilent 911D,E family of sliding loads represents an advance in calibration and verification of network analyzers. They utilize integral connectors to form a near perfect airline without the discontinuities associated with changeable connectors, which cause reflections. The load element is highly stable, with a reflection coefficient variation of less than 0.00032 as the element location is varied, greatly increasing the integrity of a calibration. A locking mechanism is used to locate and lock the center conductor reference plane to within 0.00005 inch of the outer reference plane.

Agilent 911D,E

Specifications

Agilent model	Frequency range (GHz)	Load stability connector & airline	Maximum input power	Connector type	Length mm (in)	Shipping weight kg (lb)
911D	3 to 26.5	1.008	1 W avg. 1 kW peak	3.5 mm (m)	256 (10.1)	0.95 (2)
911E	3 to 26.5	1.008	1 W avg. 1 kW peak	3.5 mm (f)	256 (10.1)	0.95 (2)

Type	Uses	Agilent model number series [1]	Frequency coverage by band – GHz							
			X	P	K	R	Q	U	V	W
			8.20-12.4	12.4-18.0	18.0-26.5	26.5-40.0	33.0-50.0	40.0-60.0	50.0-75.0	75.0-110.0
Adapters	Interconnect coaxial-waveguide system	**281A** [2, 4]	X			X	X	X	X	
		281B		X		X	X	X	X	
		281C	X	X	X				X	X
		281D							X	X
Variable Attenuators	Measure reflection coefficient, insertion loss, transfer characteristics by RF substitution source mismatch	**382A**	X	X	X	X				
Detectors	Detect RF power, CW or pulsed; measure reflection coefficient, insertion loss	**422C**			X	X				
Directional Couplers	Sample high power, level power, measure reflection coefficient, reduce mismatch	**752C**	X	X	X	X	X	X	X	X
		752D	X	X	X	X	X	X	X	
		752CS, DS				X				
Isolators	Reduce mismatch at mm-wave frequencies	**365A**				X	X	X	X	X
Mixers [3]	Extend spectrum analyzer frequency range to millimeter band	**11970K**			X					
		11970R				X				
		11970Q					X			
		11970U							X	
		11970V								X
		11970W								
Network Analyzer [4]	Waveguide calibration kits	**11644A**	X	X	X	X	X	X	X	X
	Waveguide verification kits	**11645A**				X	X	X	X	X
Terminations	Fixed loads for terminating waveguide systems, sliding loads for separating load reflections from other system reflections	**910A**		X		X	X	X		
		910B	X							
		910C								X
		914B	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] Also available in the following bands (in GHz): S (2.6 to 3.95), G (3.95 to 5.85), J (5.3 to 8.2), and H (7.05 to 10).

[3] See Mixer section of this catalog for product details.

[4] See Network Analyzer section of this catalog for product details.

Agilent 281 series

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)
S281A	2.6 to 3.95	1.25	WR-284 1-041	584 56B-002	N (f)	140 (5.5)	0.54 (1.19)
G281A	3.95 to 5.85	1.25	WR-187 1-053	407 57B-001	N (f)	95 (3.75)	0.27 (0.5)
J281A	5.3 to 8.2	1.3	WR-137 1-065	441 55B-002	N (f)	51 (2)	0.45 (1)
H281A	7.05 to 10	1.25	WR-112 1-071	138 54C-006	N (f)	41 (1.63)	0.45 (1)
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 **Opt. 012:** N (m) **Opt. 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 **Opt. 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 **Opt. 012:** N (m) **Opt. 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) **Opt. 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 R382A

Agilent P382A

Agilent 382A series

The attenuation value of these direct-reading, precision attenuators depends on the rotation angle of the resistive card, rather than on the resistivity value of the attenuating material. Therefore, they are insensitive to changes in temperature and humidity which can affect the resistive card of ordinary adjustable flap attenuators. The attenuation value is highly accurate and is stable from 0 to 50 dB. The instruments feature large, easy-to-read dials, and can handle considerable microwave power.

Specifications

Agilent model	Frequency range (GHz)	Maximum SWR	Attenuation accuracy	Attenuation range (dB)	Maximum residual attenuation (0 dB setting) (dB)	Maximum power (CW) (watts)	Waveguide[1] designator EIA MIL-W-85/( )	Flange[1] designator UG-( )/U MIL-F-3922/( )	Dimensions mm (in)	Shipping weight kg (lb)
X382A	8.2 to 12.4	1.15	±2% of reading or 0.1 dB whichever is greater	0 to 50	1	10	WR-90 1-077	135 54C-008	397 x 194 x 119 (15.63 x 7.63 x 4.69)	3.6 (8)
P382A	12.4 to 18			1	5	WR-62	419 1-090	318 x 197 x 121 70A-008	(12.5 x 7.75 x 4.75)	3.6 (8)
K382A	18 to 26.5				1	2	WR-42 1-103	595 54C-002	194 x 156 x 121 (7.63 x 6.13 x 4.75)	2.7 (6)
R382A	26.5 to 40				1	1	WR-28 3-008	599 54C-003	162 x 156 x 121 (6.38 x 6.13 x 4.75)	2.7 (6)

[1] The Waveguide/Flange Designator is provided to determine interface dimensions and generic material of Agilent products.

Agilent K422C

Agilent K/R422C

The Agilent K422C (18 to 26.5 GHz) and R422C (26.5 to 40 GHz) are GaAs Planar-Doped Barrier diode detectors. They both have negative output polarity as standard, and the Agilent K422C is available with an optional square law load resistor to extend the dynamic range to approximately 0 dBm.

Specifications

Agilent model	K422C	R422C
Frequency range	18 to 26.5 GHz	26.5 to 40 GHz
Frequency response (dB)	±0.6	±0.6
Maximum SWR	1.36	1.78
Low level sensitivity (mV/µW)	>0.42	>0.42
Maximum input power (avg)	100 mW	100 mW
Typical short term power (max. < 1 minute)	1 W	1 W
Video impedance	1.5 kΩ	1.5 kΩ
RF bypass capacitance (nominal)	10 pF	10 pF
Standard output polarity	Negative	Negative
Optional square law load	**Opt. 002**	—
Waveguide designator [1]		
EIA	WR-42	WR-28
MIL-W-85/( )	1-103	3-008
Flange designator [1]		
UG-( )/U	595	599
MIL-F-3922/( )	54C-002	54-003
Output connector	BNC (f)	BNC (f)
Shipping weight – kg (lb)	0.5 (1)	0.5 (1)

[1] The Waveguide/Flange Designator is provided to determine interface dimensions and generic material of Agilent products.

Agilent X752C,D

Agilent R752DS

Agilent 752 Series

The Agilent 752 series couplers are an essential part of many microwave measurement applications. Attenuation measurements, reflectometer setups, power measurements, source leveling and network analysis are just a few areas in which directional couplers find use.

Agilent's X, P, K, and R band couplers have a conventional multi-hole design featuring greater than 40 dB directivities. The Agilent R752CS,DS and Q, U, V, W 752C,D couplers are designed with "split-block" technology, and provide greater than 33 dB directivity. Split-block designs are used to assure greater precision in machining the ultra-small internal dimensions required by the 26.5 to 110.0 GHz waveguide. The split block units are equipped to interface with the precision circular cover flanges with matching alignment pins common to those applications.

Each coupler is swept-frequency tested to ensure that the main guide SWR and directivity specifications are accurate. Performance characteristics are unaffected by humidity, temperature and time. This makes these units especially useful in microwave "standards" measurements.

Specifications

Agilent model	Frequency range (GHz)	Nominal [1] coupling (dB)	Mean coupling accuracy (dB)	Maximum coupling variation (dB)	Minimum directivity (dB)	Maximum primary line SWR	Maximum auxiliary arm SWR	Maximum primary line power (CW)(Watts)	Waveguide [2] designator EIA MIL-W-85/( )	Flange [2] designator UG-( )/U MIL-F- 3922/	Length ( )mm (in)	Shipping weight kg (lb)
X752C	8.2 to 12.4	10	±0.4	±0.5	40	1.05	1.15	10	WR-90	39	399 (15.69)	1.4 (3)
X752D		20				1.05	1.15	100	1-079	54C-007	399 (15.69)	
P752C	12.4 to 18	10	±0.4	±0.5	40	1.05	1.2	10	WR-62	419	311 (12.25)	0.9 (2)
P752D		20				1.05	1.2	100	1-089	70A-007	311 (12.25)	
K752C	18 to 26.5	10	±0.7	±0.5	40	1.05	1.2	5	WR-42	595	252 (9.94)	0.45 (1)
K752D		20				1.05	1.2	50	1-102	54C-001	252 (9.94)	
R752C	26.5 to 40	10	±0.7	±0.5	40	1.05	1.2	5	WR-28	599	219 (8.63)	0.45 (1)
R752D		20		±0.6		1.05	1.2	50	3-006	54C-003	222 (8.72)	
R752CS	26.5 to 40	10	±0.7	±0.6	40	1.04	1.05	5	WR-28	381	165 (6.5)	0.24 (.5)
R752DS		20				1.04	1.05	50	3-009	67B-005		
Q752C	33 to 50	10	±0.7	±0.7	40	1.05	1.1	5	WR-22	383	140 (5.5)	0.45 (1)
Q752D		20				1.05	1.1	50	3-013	67B-013		
U752C	40 to 60	10	±0.7	±0.7	39	1.06	1.1	5	WR-19	383 (mod)	140 (5.5)	0.45 (1)
U752D		20				1.06	1.1	50	3-014	67B-007		
V752C	50 to 75	10	±1.0	±0.7	36	1.08	1.14	3	WR-15	385	97 (3.81)	0.45 (1)
V752D		20				1.08	1.14	30	3-017	67B-008		
W752C	75 to 110	10	±1.0	±0.7	33	1.08	1.14	2	WR-10	387 (mod)	97 (3.81)	0.45 (1)
W752D		20				1.08	1.14	20	3-023	67B-010		

[1] Nominal coupling, coupling factor, and coupling attenuation are terms that describe the same parameter.
[2] The waveguide/flange designator is provided to determine interface dimensions and generic material of Agilent products.

Agilent 365A series

These products are ideal isolators for test and measurement applications. Their high, broadband isolation (better than 25 dB) minimizes the reflection effects of a source. Their low SWR and low insertion loss help to improve accuracy without the attenuation of matching pads.

The Agilent 365A isolators use a Faraday-rotation design. It consists of a waveguide section that contains low-loss ferrite material and impedance matching elements. A permanent magnet supplies the external magnetic bias field to the ferrite core.

Agilent V365A

Specifications

Agilent model	Frequency range (GHz)	Max. SWR	Maximum insertion loss (dB)	Minimum isolation (dB)	Minimum input power (avg)	Waveguide[1] designator EIA MIL-W-85/( )	Flange[1] designator UG-( )/U MIL-F-3922/( )
R365A	26.5 to 40	1.4	1.5	25	1.5 W	WR-28 3-006	599 54C-003
Q365A	33 to 50	1.4	1.6	25	1.5 W	WR-22 3-010	383 67B-006
U365A	40 to 60	1.4	1.8	25	1.5 W	WR-19 3-014	383 (mod) 67B-007
V365A	50 to 75	1.5	2.0	25	1 W	WR-15 3-017	385 67B-008
W365A	75 to 110	1.5	2.5	25	1 W	WR-10 3-023	387 (mod) 67B-010

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

Agilent P910A

Agilent X914B

Agilent 910 Series fixed terminations

Agilent 910 waveguide loads are designed for terminating test systems operating at low average powers. The loads are carefully designed to absorb virtually all of the applied power and ensure a lower SWR. They may be used wherever a matched load is required, as in the measurements of reflection, discontinuities, or obstacles in waveguide systems.

Agilent X914B sliding load

This sliding load consists of a movable, tapered, low-reflection load element mounted in a section of precision waveguide. A plunger controls the position of the load, and provides a controllable range of at least one-half wavelength at the lowest waveguide frequency. This movement permits the phase of the residual load reflection to be reversed so that this reflection can be separated from other small reflections in the waveguide system. Sliding loads are often used in calibration procedures.

Specifications

Agilent model	Frequency range (GHz)	Maximum SWR	Maximum power (avg)	Waveguide[1] designator EIA MIL-W-85/( )	Flange[1] designator UG- ( )/U MIL-F-3922/( )	Length mm (in)	Shipping weight kg (lb)
X910B	8.2 to 12.4	1.015	1 W	WR-90 1-077	39 54C-008	168 (6.6)	0.9 (2)
P910A	12.4 to 18	1.02	1 W	WR-62 1-089	419 70A-007	111 (4.4)	0.45 (1)
R910A	26.5 to 40	1.025	1 W	WR-28 3-006	599 54-003	60 (2.4)	0.2 (0.5)
Q910A	33 to 50	1.03	1 W	WR-22 3-013	383 67B-013	71 (2.8)	0.2 (0.5)
U910A	40 to 60	1.04	1 W	WR-19 3-015	383 (mod) 67B-007	71 (2.8)	0.2 (0.5)
W910C	75 to 110	1.03	0.2 W	WR-10 3-024	387 (mod) 67B-010	56 (2.2)	0.013 (0.03)
X914B	8.2 to 12.4	1.01 (load element)	1 W	WR-90 1-077	39 54C-008	257 (10.1)	0.9 (2)

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

Waveguide Accessories

Agilent waveguide products data

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

[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 band designation	Waveguide dimensions							Cutoff frequency (GHz)	Theoretical attenuation low to high frequency (dB/100 ft)	Theoretical peak power rating- low to high frequency megawatts (kw)	Theoretical CW power rating- low to high frequency kilowatts (watts)
	Inside dimensions			Outside dimensions			Nom. wall thickness mm (in)				
	Width mm (in)	Height mm (in)	Tol ± mm (in)	Width mm (in)	Height mm (in)	Tol ± mm (in)					
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 - 0.651	7.645 - 10.85	13.42 - 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 - 1.238	3.296 - 4.69	5.165 - 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	3.532-1.999	1.975 - 2.53	2.076 - 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	4.114 - 3.197	1.284 - 1.702	1.607 - 2.067
								5.260	4.166 - 3.238	1.284 - 1.702	1.523 - 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	6.424 - 4.445	0.758 - 1.124	0.8621 - 1.246
								6.560	6.506 - 4.502	0.758 - 1.124	0.8169 - 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	7.601 - 5.309	0.622 - 0.903	0.6621 - 0.9479
								7.847	7.698 - 5.377	0.622 - 0.903	0.6273 - 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	9.578 - 7.041	0.457 - 0.633	0.4513 - 0.6139
								9.490	9.700 - 7.131	0.457 - 0.633	0.4276 - 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	13.08 - 9.477	0.312 - 0.433	0.2899 - 0.4000
								11.54	13.25 - 9.598	0.312 - 0.433	0.2746 - 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	20.48 - 15.04	0.171 - 0.246	0.1565 - 0.2132
								14.08	20.74 - 15.23	0.171 - 0.246	0.1483 - 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	23.02 - 15.77	(96.0 - 146)	(109.7 - 160.1)
								21.10	34.46 - 23.59	(96.0 - 146)	(73.27 - 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	32.44 - 22.05	(64.4 - 97.0)	(68.89 - 101.4)
								26.35	48.53 - 32.99	(64.4 - 97.0)	(46.05 - 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	39.81 - 28.60	(48.0 - 70.0)	(51.32 - 71.43)
								30.69	—	(48.0 - 70.0)	—
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	60.25 - 41.17	(30.0 - 40.0)	(30.27 - 44.30)
								39.90	—	(30.0 - 40.0)	—
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	105.6 - 74.26	(14.0 - 20.0)	(14.73 - 20.86)
								58.85	—	(14.0 - 20.0)	—

Frequency band data

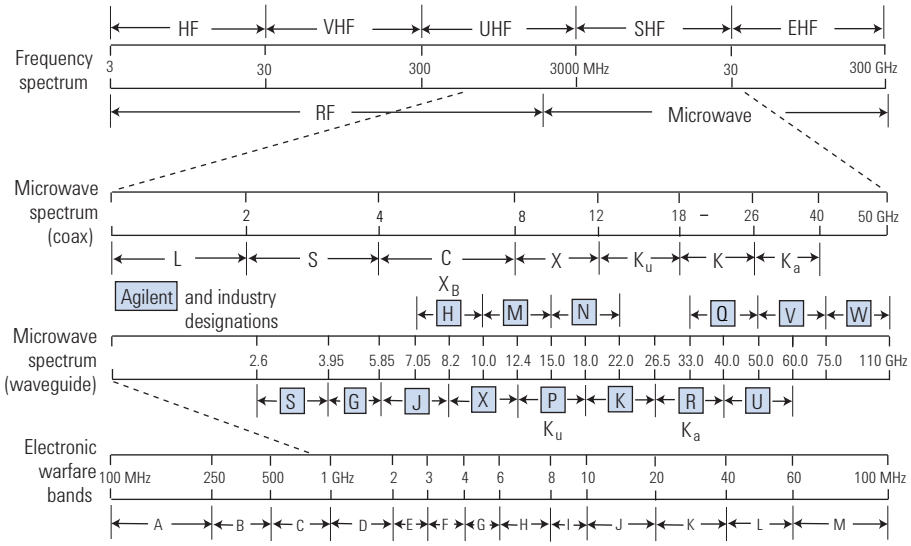
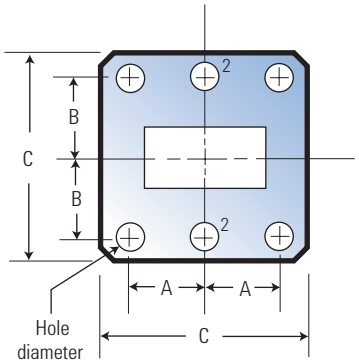


Figure 1. Rectangular flanges H, X, M, P, N, K, R Bands



Rectangular flanges

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

Agilent band	Waveguide designator: Frequency range (GHz)	Waveguide designator: EIA	Waveguide designator: MIL-W-85/( )	Flange designator: Material B: Copper alloy A: Alum. alloy	Flange designator: JAN UG-( )/U	Flange designator: MIL-F-3922/( )	Dimensions mm (in): A	Dimensions mm (in): B	Dimensions mm (in): C	Dimensions mm (in): Hole diameter
H	7.05 to 10	WR-112	1-073	B	51	54C-005	17.2	18.7	47.6	4.3
			1-072	A	138	54C-006	(0.676)	(0.737)	(1.875)	(0.169)
X	8.2 to 12.4	WR-90	1-079	B	39	54C-007	15.5	16.3	41.3	4.3
			1-078	A	135	54C-008	(0.61)	(0.64)	(1.625)	(0.169)
M	10 to 15	WR-75	1-085	B	—	70A-004	13.2	14.2	38.1	3.6
			1-084	A	—	70A-005	(0.52)	(0.561)	(1.50)	(0.14)
P	12.4 to 18	WR-62	1-089	B	419	70A-007	12.6	12.1	33.5	3.7
			1-091	A	—	70A-008	(0.497)	(0.478)	(1.32)	(0.144)
N	15 to 22	WR-51	1-096	B	—	70A-010	10.3	11.3	30.1	3.6
			1-098	A	—	70A-011	(0.405)	(0.443)	(1.187)	(0.14)
K	18 to 26.5	WR-42	1-102	B	595	54C-001	8.1	8.5	22.2	2.9
			1-104	A	597	54C-002	(0.32)	(0.335)	(0.875)	(0.116)
R	26.5 to 40	WR-28	3-007	B	599	54-003	6.35	6.7	19.1	2.9
			3-009	A	—	—	(0.25)	(0.265)	(0.75)	(0.116)

[1] See Figure 1.
[2] R band only, hole diameter 2.38 mm, -0, + 0.025

Figure 2a.

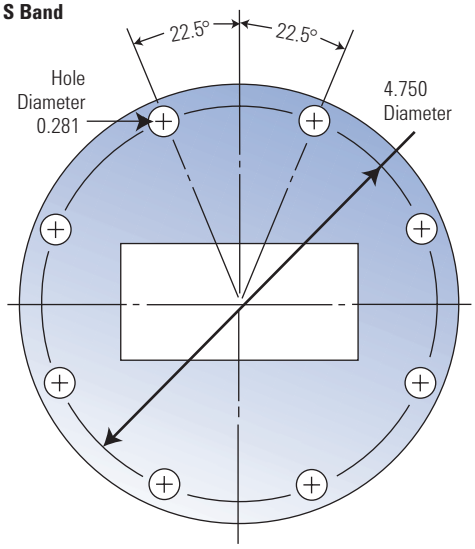


Figure 2b.

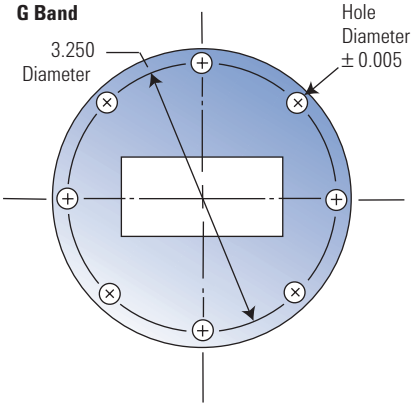
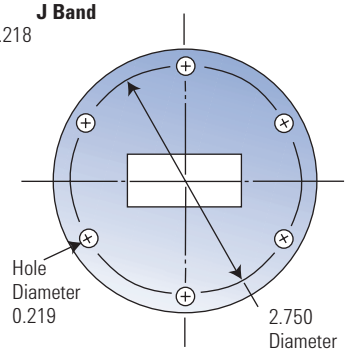


Figure 2c.



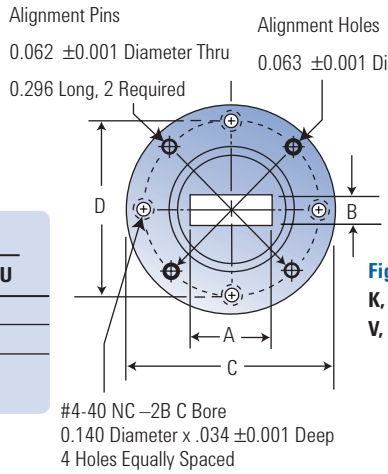


Figure 3.
K, R, Q, U,
V, W Bands

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

Agilent band	Frequency range (GHz)	Waveguide designator EIA	MIL-W-85/( )	Material	Flange designator MIL-F-3922/( )	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.

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

Agilent band	Frequency Range (GHz)	Waveguide designator EIA	85/( )	Material MIL-W- A: Alum. Alloy	Flange designator B: Copper Alloy 3922/( )	UG-( )/U	Dimensions mm (in) MIL-F A	JAN B	C diameter	D diameter
K	18 to 26.5	WR-42	1-102	B	67B-004	425	10.7	4.3	28.6	23.8
			1-104	A	67B-011	—	(0.42)	(0.17)	(1.125)	(0.9375)
R	26.5 to 40	WR-28	3-007	B	67B-005	381	7.1	3.6	28.6	23.8
			3-009	A	67B-012	—	(0.28)	(0.14)	(1.125)	(0.9375)
Q	33 to 50	WR-22	3-011	B	67B-006	383	5.7	2.8	28.6	23.8
			3-013	A	67B-013	—	(0.224)	(0.112)	(1.125)	(0.9375)
U	40 to 60	WR-19	3-015	B	67B-007	383 (mod)	4.8	2.4	28.6	23.8
			—	A	—	—	(0.188)	(0.094)	(1.125)	(0.9375)
V	50 to 75	WR-15	3-018	B	67B-002	385	3.8	1.9	19.1	14.3
			—	A	—	—	(0.148)	(0.074)	(0.75)	(0.5625)
W	75 to 110	WR-10	3-024	B	67B-010	387 (mod)	2.5	1.3	19.1	14.3
			—	A	—	—	(0.10)	(0.050)	(0.75)	(0.5625)

[2] See Figure 3.

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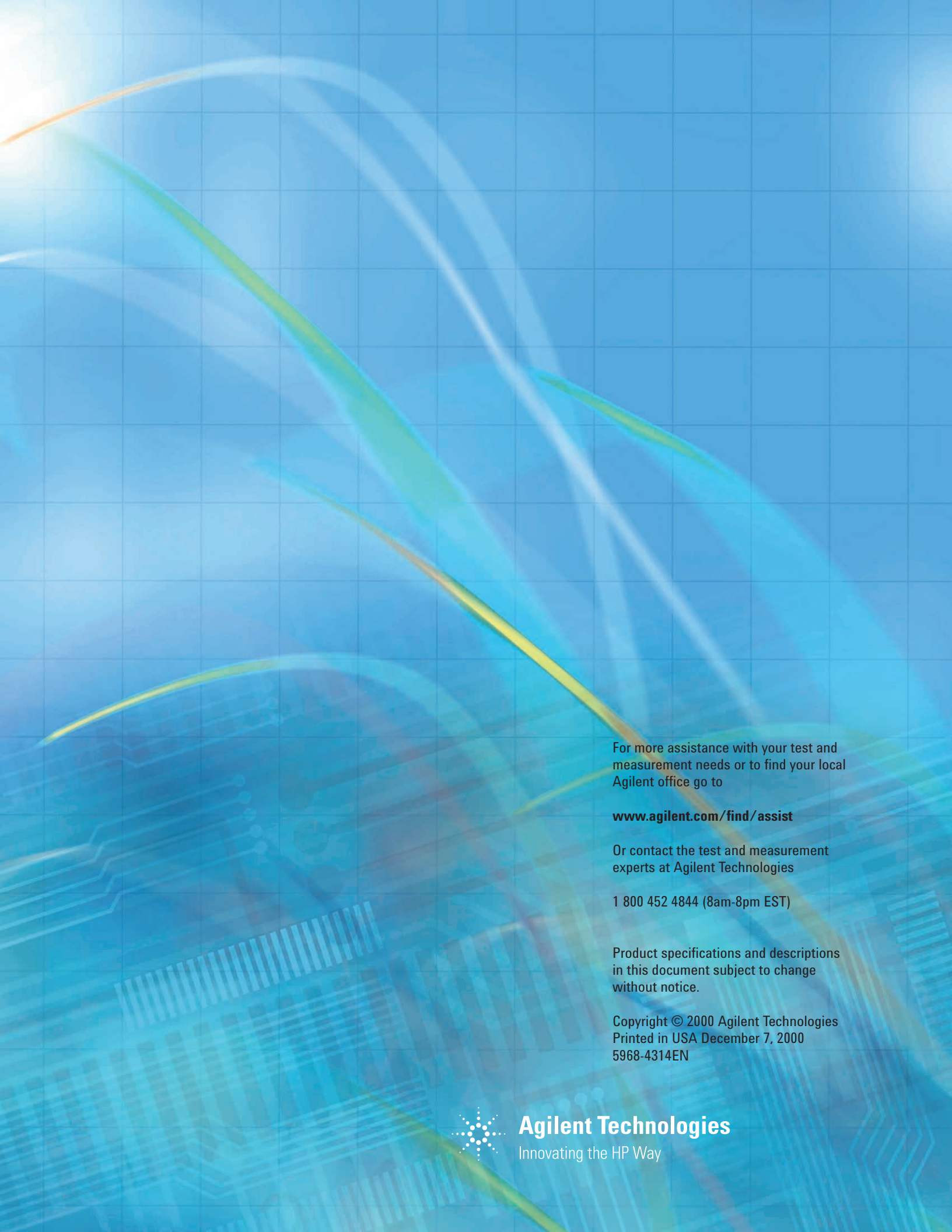

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