

Keysight 778D Dual Directional Coupler

Notices

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Safety Information

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

	Caution, risk of danger (refer to this manual for specific Warning or Caution information)		Caution, risk of electric shock
	Caution, laser radiation		Alternating current (AC)
	On (mains supply)		Off or Standby (mains supply)
	Earth (ground) terminal		

Safety Considerations

Read the information below before using this product.

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards for design, manufacture, and intended use of the product. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

Safety earth ground

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Before applying power

Verify that the product is configured to match the available main power source as described in the input power configuration instructions in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Regulatory Markings

	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.		The CSA mark is a registered trademark of the Canadian Standards Association.
	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives. ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada. ISM GRP.1 Class A indicates that this is an Industrial Scientific and Medical Group 1 Class A product.		This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit <http://about.keysight.com/en/companyinfo/environment/takeback.shtml> for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/mta
(product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
(worldwide contact information for repair and service)

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1 Overview

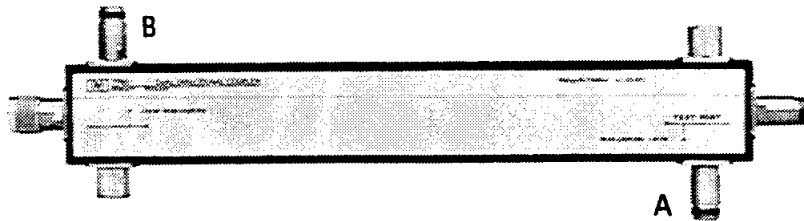
Description 14

This chapter provides an overview of the 778D dual directional coupler.

Description

This coaxial dual directional coupler has a frequency range extending over four octaves from 100 MHz to 2 GHz. Although the coupling factor increases 6 dB/octave below 100 MHz, directivity remains above 36 dB. Thus, the coupler can be used below 100 MHz as well as above. The usefulness below 100 MHz is restricted only by the amount of signal source power and/or the sensitivity of the RF detector connected to the coupler.

The unidirectional characteristic of the Keysight 778D dual directional coupler makes it an important tool in microwave measurement systems. The 778D has the property of inducing, in an auxiliary line, a contra-directional flow of power which is proportional to the power flowing in the main guide. This coupler may be used in the measurement of reflection coefficients or SWR over a very wide frequency range. The relatively constant coupling across several frequency bands and the stability of coupling with time make the 778D useful, also, as a wideband attenuator or for power monitoring applications.



To achieve its broad frequency coverage, the 778D's directivity is optimized for mainline energy flowing in one direction. This means that there is a preferred orientation for the 778D. To achieve the measurement accuracies in the specifications, the test device or system should be connected where the 778D is labeled TEST PORT. To accommodate test devices with Type N or APC-7 connectors, a choice of connectors is available on the TEST PORT (see Options outlined in [Chapter 2, "Specifications"](#)).

With the APC-7 precision sexless connector on the output, the coupler can be conveniently converted to other types of connectors by the use of an adapter. Adapters are available to the SMA (OSM), TNC, GR900, and others, so that the coupler becomes a versatile device for making measurements on many different types of connectors. The Amphenol APC-7 is a sexless connector with very low SWR. This precision connector makes possible the construction of adapters with low SWR.

2 Specifications

Specifications 16

This chapter provides the specifications of the 778D dual directional coupler.

Specifications

Specifications for the 778D are shown in the following table.

Table 2-1 Specifications

Characteristic	Value
Frequency range	100 to 2000 MHz (usable below 100 MHz)
Directivity	See figure on page 14
Auxiliary arm 0.1 to 1.0 GHz	A 36 dB B 30 dB
Auxiliary arm 1.0 to 2.0 GHz	A 32 dB B 30 dB
Coupling attenuation	Nominal coupling above 450 MHz is 20 dB. Nominal coupling below 450 MHz is 20 dB increasing with a slope of 0.006 dB/MHz for decreasing frequency.
Coupling variation	±1.5 dB from nominal
Cyclical variation	Frequency is similar to Figure 2-1 on page 17
Tracking	Auxiliary outputs typically track within 0.7 dB. Phase tracking typically 4°.
SWR	Primary Line ≤1.1 Auxiliary Arms ≤1.1
Insertion loss	0.6 dB
Maximum main line power	50 W average 500 W peak
Accessories available adapters ^[a]	11533A APC-7 to SMA male 11534A APC-7 to SMA female 11525A APC-7 to Type N male 11524A APC-7 to Type N female
Connectors	Choice of main line connectors (see options). Auxiliary Arms have Type N female. All Type N connectors are stainless steel, compatible with MIL-C-39012 and MIL-C-71.
Dimension	16-3/4 in long x 4-3/8 in high x 1-3/16 in wide (425 mm x 111 mm x 30 mm)
Net weight	3-3/4 lb (1.5 kg)
Options available	778D (Type N female output, Type N male input connectors) Option 011 (APC-7 output, Type N female input connectors) Option 012 (Type N male output, Type N female input connectors)

[a] Adapters from APC-7 to TNC, GR-900, GR-874 as well as the above are available from Amphenol RF Division, Danbury, CN)

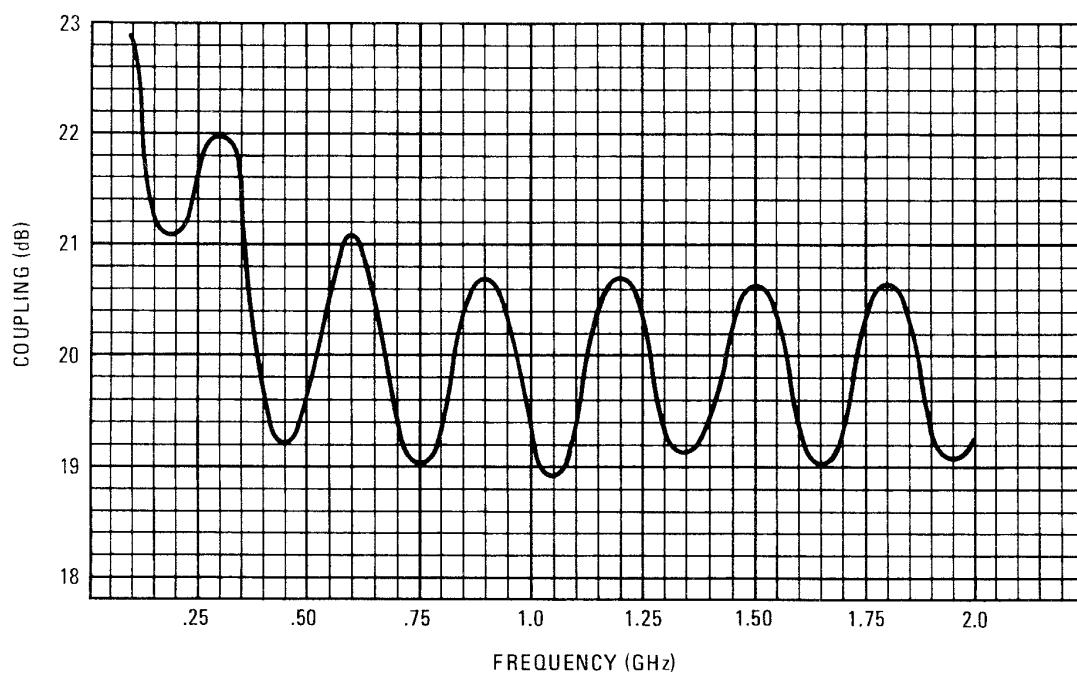


Figure 2-1 Typical coupling variation with frequency

Swept-Frequency Directivity

Directivity (in dB) is equal to:

$$10 \log \frac{(P_{aux}) \text{ when Pmain flows forward}}{(P_{aux}) \text{ when Pmain flows reversed}}$$

where

P = Power

aux = auxiliary arm

main = main arm

NOTE

The power input to the main arm is the same for both measurements.

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3 Installation and Shipping

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This chapter provides the information on how to check, install, and return the 778D dual directional coupler to Keysight Technologies.

Unpacking and Inspection

The coupler was carefully inspected mechanically and electrically prior to shipment. If there is damage or deficiency, notify the carrier and the nearest Keysight Technologies office. In the event of mechanical damage, the packing materials and carton should be held for the carrier's inspection.

CAUTION

Protect the face of the connectors (especially the APC-7) from damage. Any scoring or burring of the mating surfaces causes discontinuity; the resulting increase in SWR degrades performance (see [Figure 3-1](#)).

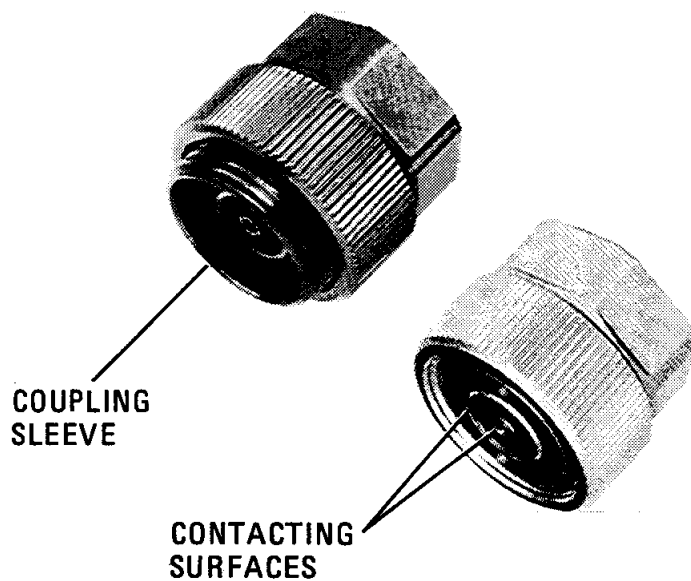


Figure 3-1 Care of APC-7 connectors

Repackaging for Shipment

Using original packaging

The same type of containers and materials used in factory packaging can be obtained through Keysight Technologies.

If the coupler is being returned to Keysight Technologies for servicing, attach a tag indicating the type of service required, return address, and model number. Also, mark the container *FRAGILE* to assure careful handling.

In any correspondence refer to the coupler by full model number.

Using other packaging

The following general instructions should be used when repackaging with commercially available materials:

- 1** Wrap the coupler in heavy paper or plastic. (If shipping to a Keysight Technologies office or service center, attach a tag indicating the type of service required, return address, and model number.)
- 2** Use a strong shipping container. A double wall carton made of 2.4 MPa (350 psi) test material is adequate.
- 3** Use enough shock-absorbing material (3-4-inch layer) around all sides of the coupler to provide firm cushion and prevent movement inside the container.
- 4** Seal the shipping container securely.
- 5** Mark the shipping container *FRAGILE* to assure careful handling.

Load-Bearing

When installing be sure auxiliary equipment supports its own weight. The coupler, particularly the connectors, is not designed to carry weight. Load limits for APC-7 connectors are given in [Figure 3-2](#).

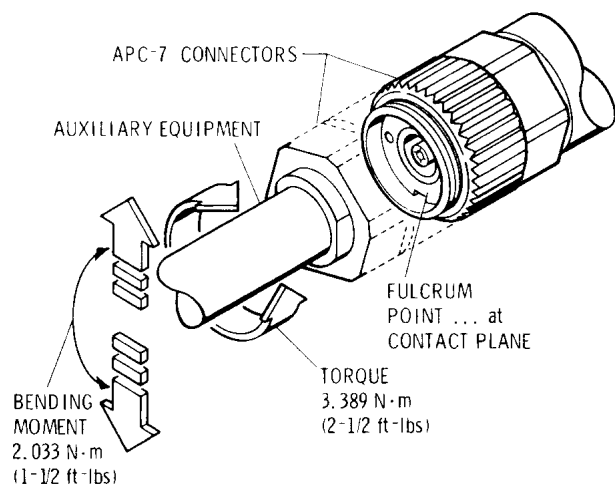


Figure 3-2 Load limits for APC-7 connector

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This chapter provides the information to operate the 778D dual directional coupler.

Signal Flow

Unlike some other dual-directional couplers, this coupler is polarized. For best performance the signal must flow through the coupler as shown in [Figure 4-1](#). Observe the TEST PORT designation on the label. DO NOT reverse the coupler since the directivity may be somewhat lower in the reverse direction. To test devices with other types of connectors, another coupler with the correct mating test port connector is recommended. Using an adapter will degrade the effective directivity of the measurement.

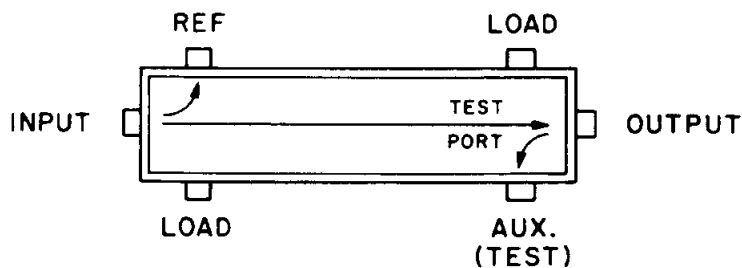


Figure 4-1 Signal flow

Coupler Temperature

Operate the coupler at normal room temperature and do not temperature cycle the coupler in use or storage. Heat cycling may degrade the performance of the coupler.

Power Leveling

The 778D has cyclic coupling variations of up to ± 2 dB. For this reason it is not recommended for power leveling that requires flatness exceeding these tolerances. A typical coupling curve is shown in [Figure 2-1](#) on [page 17](#).

Maintenance

The directional coupler should need very little maintenance besides keeping it clean and protecting the connector faces.

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This information is subject to change without notice. Always refer to the English version at the Keysight website for the latest revision.

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