

# DUAL DIRECTIONAL COUPLER

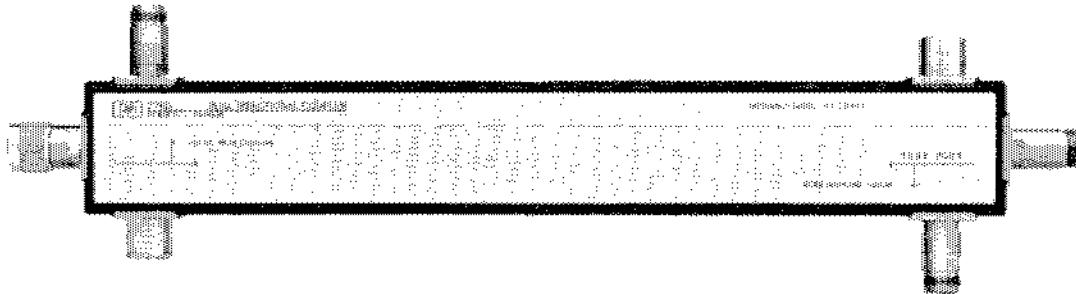
100-2000 MHz

model  
778D

TECHNICAL DATA 15 DEC 74

• MULTI-OCTAVE FREQUENCY RANGE:  
100 to 2000 MHz

• HIGH DIRECTIVITY: 36 dB to 1 GHz,  
32 dB to 2 GHz



Over 4 octaves with 1 coupler

### Broadband 20 dB Dual Directional Coupler

This dual directional 20 dB coupler has a frequency range extending over 4 octaves from 100 MHz to 2 GHz. This multi-octave capability makes measurements easier—setup and calibration time are reduced, since normally several couplers are required over this frequency band. The coupling factor increases about 6 dB per octave below 100 MHz; thus, usefulness below this frequency is restricted only by the amount of signal source power and/or the sensitivity of the RF detector connected to the coupler. Figure 1 shows typical coupling and directivity characteristics of the 778D.

### Simultaneous Reflection and Transmission Measurements

The 778D is ideal for measuring the reflection and transmission characteristics of a device from 100 MHz

to 2000 MHz. Figure 2 shows a test configuration in which a 778D dual directional coupler is used to separate and isolate the incident, reflected, and transmitted signals in a swept-frequency measurement. These signals are detected and their ratio displayed on a CRT. This coupler is an ideal companion for the HP 8755 Frequency Response Test Set, a detection and display system operating from 15 MHz to 18 GHz.

The high directivity and close tracking of the auxiliary arms of this coupler make it particularly useful for this type of broadband measurement. The high directivity insures accurate measurements by a true separation of the forward and reflected signals. Close tracking of signal variation from the auxiliary arms gives a flat frequency response that makes display readings easy to interpret.

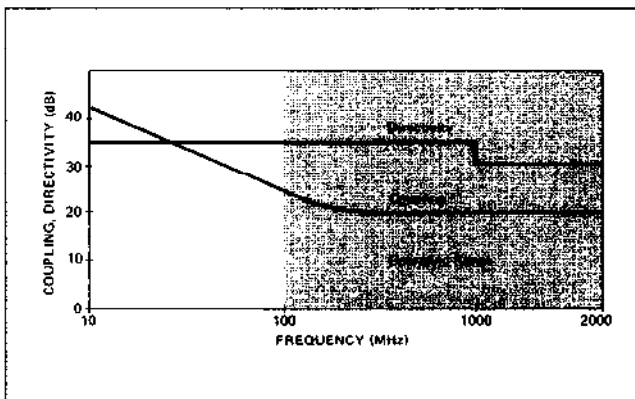


Figure 1. Coupling and directivity characteristics of the 778D coupler.

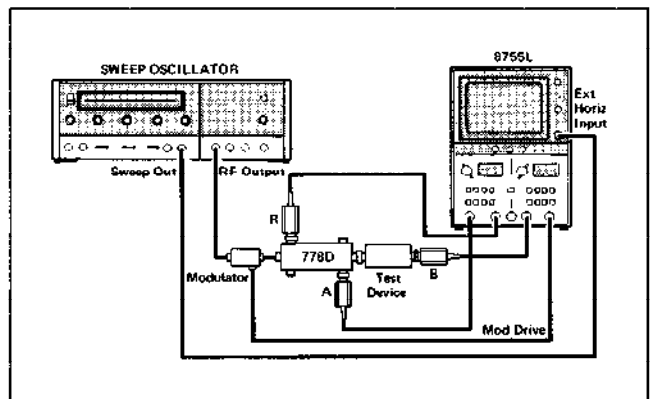


Figure 2. Setup diagram for simultaneous measurement of insertion and return loss.

Maximum amplitude errors in a reflection measuring system are shown in the following table:

Freq. Range (GHz)	Maximum Magnitude Error $\Delta\Gamma_L$	
	Swept Frequency	Fixed Frequency
0.1-1	$\pm(0.015 + 0.02  \Gamma_L  + 0.05  \Gamma_L ^2)$	$\pm(0.015 + 0.05  \Gamma_L ^2)$
1-2	$\pm(0.025 + 0.02  \Gamma_L  + 0.05  \Gamma_L ^2)$	$\pm(0.025 + 0.05  \Gamma_L ^2)$

Maximum phase error =  $\pm \sin^{-1} (\Delta \Gamma_L / \Gamma_L)$ .  
 $|\Gamma_L|$  = reflection coefficient of unknown.

Error components include a fixed term due to coupler directivity, and several  $\Gamma_L$ -dependent terms relating to source match and reference setting (detection errors are not included). These errors apply over broad swept-frequency bands. Somewhat improved accuracy can be achieved by simple recalibration at the frequency of interest.

### Impedance Measurements

The 778D is also well suited for measurements of impedance when used with the HP 8405A Vector Voltmeter. The technique is described in Application Note 77-3, "Measurement of Complex Impedance," available at your nearest HP sales office. Again, a reflectometry technique is used. With the vector voltmeter, however, both magnitude and phase angle of the reflection coefficient can be measured. This setup is shown in Figure 3.

Data can be read from the two meters of the vector voltmeter and transferred directly to a Smith Chart to provide impedance of such devices as antennas or other passive components. In addition, with an appropriate bias supply, active components, such as transistors, can also be quickly measured and characterized with this setup. The 778D is well-suited for these types of measurements since both the phase and the magnitude variation between the two coupling arms have been closely controlled in the design of the coupler.

### System Monitoring

Because of the high power capability of the dual directional coupler, it can be permanently installed in coaxial systems to monitor the power traveling in both directions simultaneously. This enables a system to be continually monitored to indicate whether the system is

in need of adjustment or maintenance due to excessive standing-wave ratios on the transmission lines.

### Choice of Output Connector

To achieve its broad frequency coverage, the 778D's directivity is optimized for mainline energy flowing in one direction. Thus, 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 the options outlined in the specifications below.

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

The Type N connectors are stainless steel for long wear and are compatible with connectors whose dimensions conform to MIL-C-39012, or MIL-C-71.

\* Amphenol RF Division, Danbury, Conn.

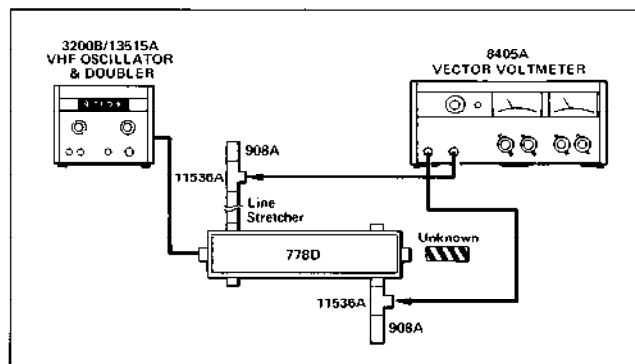
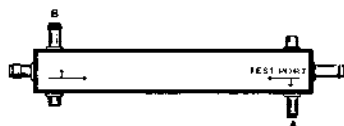


Figure 3. Setup of impedance measurement of coaxial devices from ~10 to 1000 MHz.

## SPECIFICATIONS

**Frequency Range:** 100 MHz to 2000 MHz (usable below 100 MHz).

**Directivity:**



Auxiliary Arm	0.1 - 1.0 GHz	1.0 - 2.0 GHz
A	36 dB	32 dB
B	30 dB	30 dB

**Coupling Factor:** 20 dB nominal.  $\pm 1$  dB cyclic variation with frequency (coupling  $\sim 23$  dB at 100 MHz. 6 dB rolloff per octave below 100 MHz).

**Tracking:** Auxiliary outputs typically track within 0.7 dB. Phase tracking typically  $4^\circ$ .

**SWR:** Primary line: 1.1; auxiliary arms: 1.1.

**Maximum Power:** 50 W average; 500 W peak.

**Connectors:** Choice of mainline connectors (see options); auxiliary arms have Type N female connectors. All Type N connectors stainless steel, compatible with MIL-C-39012 and MIL-C-71.

**Dimensions:** 16 $\frac{3}{4}$  in. long, 4 $\frac{3}{8}$  in. high, 1-3/16 in. wide (425 x 111 x 30 mm).

**Weight:** Net, 3 $\frac{3}{4}$  lb (1.5 kg). Shipping, 5 lb (2.3 kg).

### Accessories Available:

Adapters	Acc. No.
APC-7 to OSM <sup>®</sup> male	11533A
APC-7 to OSM female	11534A
APC-7 to N male	11525A
APC-7 to N female	11524A

(Adapters from APC-7 to TNC, GR-900, GR-874 as well as the above are available from Amphenol RF Division, Danbury, Conn.)

778D (N female output, N male input connectors)

Option 11 (APC-7 output, N female input connectors)

Option 12 (N male output, N female input connectors)

<sup>®</sup> Omni-Spectra, Inc., Detroit, Mich.