

# Agilent 85106D

## Millimeter-wave Network Analyzer System

### Product Overview

#### 33 GHz to 110 GHz

The Agilent Technologies 85106D millimeter-wave network analyzer system extends the performance of the 8510C network analyzer to the millimeter-wave frequencies. This system can be configured for measurements in the 33 to 50 GHz, 40 to 60 GHz, 50 to 75 GHz, and 75 to 110 GHz waveguide bands.

The 85106D network analyzer system provides the best performance to meet your new design and test challenges, with high accuracy, dynamic range and frequency resolution for measurements at the millimeter-wave frequencies. The impressive accuracy of the 85106D system can be attributed to the “thru, reflect, line” TRL calibration standards which are used to characterize and remove systematic errors from the measurement. With a TRL calibration, the residual system

uncertainties can be reduced to 46 to 50 dB directivity and source match.

For millimeter-wave components that require the measurement of a wide range of power levels, a specified high dynamic range of 87 to 75 dB can be achieved with the 85106D.

#### Fully integrated for your convenience

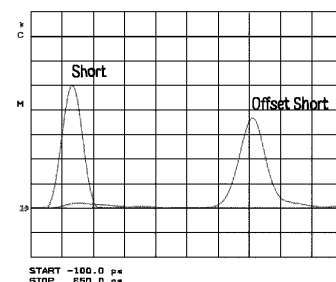
The millimeter-wave network analyzer system setup is extremely easy, so you can begin making measurements immediately. All of the necessary amplification and switching for millimeter-wave S-parameter measurements are integrated into the Agilent 85105A millimeter-wave test set controller. The waveguide test set hardware is integrated into two 85104A series millimeter-wave test set modules. Each module contains

one-half of a full S-parameter test set, including the frequency multiplier, directional couplers, harmonic mixers, and isolators. These test set modules are easily maneuverable on work surfaces during calibration and measurement.

#### Distortion-free measurements in frequency and time

Option 010 of the 85106D system adds time-domain capability to the network analyzer, enabling transformations from frequency domain data to the time domain. Time domain is an extremely powerful tool that allows you to gain further insight into the behavior of a component or circuit.

In addition to correcting for the non-linear phase shift versus frequency of standard rectangular waveguide, the 85106D also corrects for the dispersion in the time domain. Using the “waveguide delay” function, the time-domain response can be corrected for any dispersive effects.



Accurately evaluate the response of your device in the time domain by removing the dispersive effects of the waveguide.



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## Microwave and millimeter-wave coverage

A combination microwave/millimeter-wave S-parameter system can be configured in the same rack by adding a microwave test set to the 85106D system. No reconnections are required when switching between millimeter-wave and microwave operation. The Agilent 85105A millimeter-wave controller is equipped with the IF and RF switching capability for routing millimeter-wave or microwave test set. No external switches or switch drivers are necessary. The RF and IF signals are automatically switched to the appropriate test set and system states are quickly and easily recalled from the external disc drive with a few front panel keystrokes.

## Economical upgrade path

It is both economical and convenient to add other waveguide bands to the 85106D. Simply disconnect the 85104A test set modules from the millimeter-wave controller, and connect the new test set modules. The appropriate configuration is easily recalled from the disc drive with a few front panel keystrokes.

It is also possible to expand an existing 8510B or 8510C microwave network analyzer system to millimeter-wave to meet new design or test challenges. A single 8510 can control multiple test sets, which means that you can continue to use your microwave test set along with your millimeter-wave system with no degradation in performance.

## Precision waveguide flanges improve performance

All millimeter-wave standards and adapters from Agilent Technologies utilize the precision waveguide flange design. This design uses precision locating pins, a lip around the perimeter of the flange, and tighter tolerances of the alignment pin locations and pin diameters to minimize the possible misalignment of the waveguide apertures.

The millimeter-wave precision waveguide flange makes its greatest contribution by improving flange connection repeatability, which is the biggest source of error after calibration.

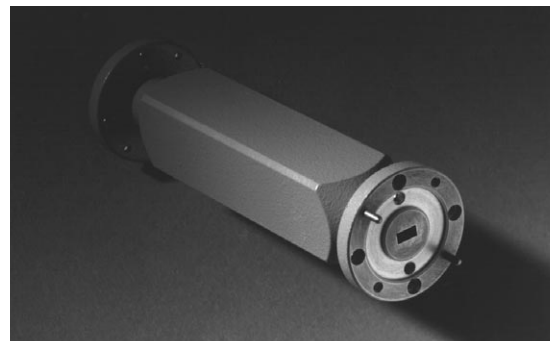
Flange repeatability can be improved by three orders of magnitude when compared to the standard waveguide

flange. This repeatability error is considerably less than the residual system errors after error correction.

## Waveguide calibration and verification kits

The Agilent 11644A series waveguide calibration kits provide the standards necessary to take full advantage of the built-in accuracy enhancement capability of the 8510C network analyzer. Each calibration kit contains two straight waveguide test port sections, a flush short circuit, a precision quarter-wavelength shim, and a fixed-load or sliding load termination. In addition to providing the "offset" for the offset short and offset load standards, the precision shim in the 11644A series calibration kits is also used as the "line" standard for a TRL calibration.

The Agilent 11645A series waveguide verification kit contains a standard section, a standard mismatch, and 20 dB and 50 dB attenuators. Each device in the verification kit is supplied with data and measurement uncertainties that are traceable to the National Institute of Standards and Technology (NIST). As with all Agilent verification kits, the automated system verification process compares the device data with the data that your system actually measured.



## Agilent 85106D System performance

The following specifications describe the system performance of the 8510C network analyzer in the 85106D configuration for measurements from 33 to 110 GHz in four waveguide bands. The system hardware includes the following:

**Test set:** Agilent 85104A series

**RF sources** (Two each): Agilent 83621B synthesized source

**Calibration kit:** Agilent 11644A series waveguide calibration kit

**Calibration technique:** TRL two-port calibration

**Dynamic range<sup>1</sup>** (for transmission measurements)

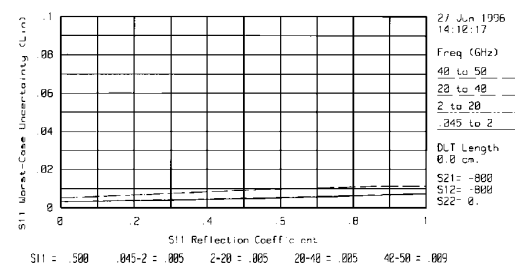
	Frequency Range (GHz)			
	35 to 50	40 to 60	50 to 75	75 to 110
Maximum power (measured at port 2)	+12 dBm	+10 dBm	+10 dBm	0 dBm
Reference power (at port 1, nominal)	0 dBm	0 dBm	0 dBm	-3 dBm
Minimum power (measured at port 2)	-87 dBm	-87 dBm	-75 dBm	-79 dBm
Receiver dynamic range	99 dB	97 dB	85 dB	79 dB
System dynamic range	87 dB	87 dB	75 dB	76 dB

## Measurement port characteristics

	Frequency Range (GHz)			
	33 to 50	40 to 60	50 to 75	75 to 110
RESIDUAL				
Directivity	50 dB	50 dB	50 dB	46 dB
Source match	50 dB	50 dB	50 dB	46 dB
Load match	50 dB	50 dB	50 dB	46 dB
Reflection tracking	±0 dB	±0 dB	±0 dB	±0 dB
Transmission tracking	±0.002 dB	±0.002 dB	±0.002 dB	±0.003 dB
Crosstalk <sup>2</sup>	110 dB	110 dB	98 dB	99 dB

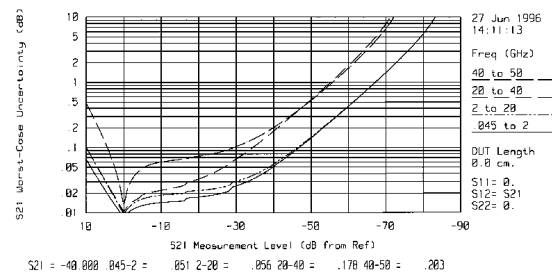
## Measurement uncertainty

### Reflection measurements



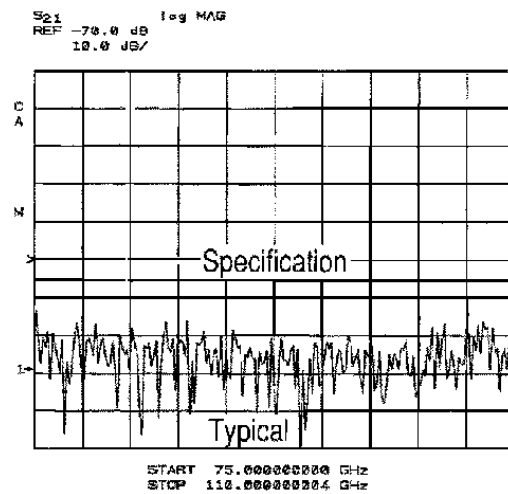
### Magnitude<sup>3</sup>

### Transmission measurements



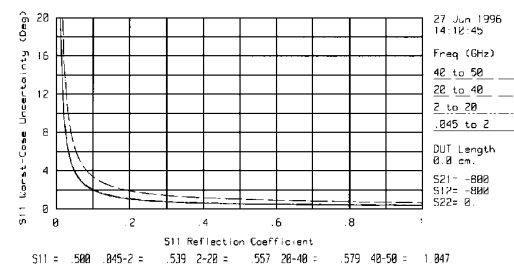
### Magnitude<sup>4</sup>

Specifications describe the instrument's warranted performance over the temperature range of 23° C ±3° C (except where noted). Supplemental characteristics are intended to provide useful instrument applications information by giving typical but non-warranted performance parameters. These are denoted as "typical," "nominal," or "approximately."

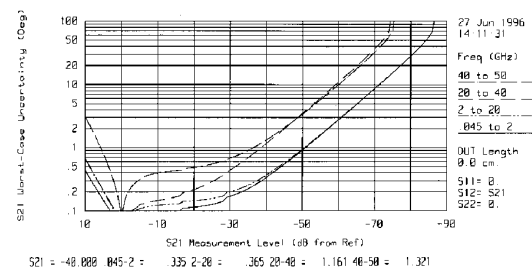


## System dynamic range

	Frequency Range (GHz)			
	33 to 50	40 to 60	50 to 75	75 to 110
RAW (Typical)				
Directivity	36 dB	34 dB	33 dB	33 dB
Source match	31 dB	27 dB	31 dB	29 dB
Load match	31 dB	27 dB	31 dB	29 dB



### Phase<sup>5</sup>



### Phase<sup>5</sup>

- Limited by compression level and system noise floor. Noise floor is measured with full two-port error correction, 1024 averages.
- Does not include noise.
- The graph for reflection measurement uncertainty applies to a one-port device.
- The graph for transmission measurement uncertainty assumes a well-matched device.
- Phase detector accuracy is better than +0.02 degrees, useful for measurements where only phase changes.

## Ordering Information

### Agilent 85106D Millimeter-wave network analyzer

The system consists of:

**8510C** network analyzer

**85105A** millimeter-wave controller

**83621B** synthesized source (RF source)

**83621B** synthesized source (LO source)

1600 mm system rack

Two Agilent 85104A series millimeter-wave test set modules and appropriate 11644A series calibration kit must be ordered to complete the system.

Installation and one year on-site service are included at no additional charge.

**Option 001** Add an 8517B (45 MHz to 50 GHz) S-parameter test set, 85056A 2.4 mm calibration kit, and 85133F 2.4 mm test port cable set. Replace an 83621B (RF) with an 83651B synthesized source.

**Option 007** Add high power and high dynamic range configuration to the 8517B test set (must also order Option 001)

**Option 010** Add time-domain capability to the 8510C

**Option 230** 220V/240V line voltage operation

**Option W31** Add two years additional on-site service

### Other system components required but not supplied with the 85106D system:

**85104A series** test set modules

**11644A series** calibration kits

### Waveguide Hardware

To complete a millimeter-wave system, also order two Agilent 85104A series test set modules and an 11644A series waveguide calibration kit. An 11645A series waveguide verification kit is strongly recommended for system installation and performance verification.

#### 33 to 50 GHz (WR-22)

**Q85104A** WR-22 test set module (two are required)

**Q11644A** WR-22 calibration kit (required)

**Q11645A** WR-22 verification kit (strongly recommended)

#### 40 to 60 GHz (WR-19)

**U85104A** WR-19 test set module (two are required)

**U11644A** WR-19 calibration kit (required)

**U11645A** WR-19 verification kit (strongly recommended)

#### 50 to 75 GHz (WR-15)

**V85104A** WR-15 test set module (two are required)

**V11644A** WR-15 calibration kit (required)

**V11645A** WR-15 verification kit (strongly recommended)

#### 75 to 110 GHz (WR-10)

**W85104A** WR-10 test set module (two are required)

**W11644A** WR-10 calibration kit (required)

**W11645A** WR-10 verification kit (strongly recommended)

## Related Literature

*Agilent 8510C Family Network Analyzer Configuration Guide*

*Agilent 8510 System Solutions Brochure*

## Pub. Number

5091-8967E

5965-8837E

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