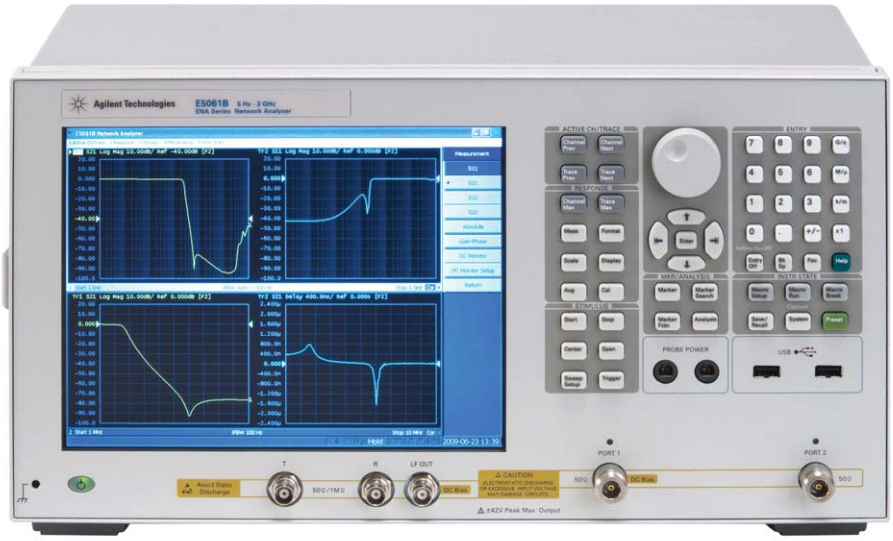
Agilent
E5061B Network Analyzer
5 Hz to 3 GHz

Data Sheet



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Definitions

All specifications apply over a 23 °C ±5 °C range (unless otherwise stated) and 90 minutes after the instrument has been turned on.

Specification (spec.):

Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

Supplemental information is intended to provide information that is helpful for using the instrument but that is not guaranteed by the product warranty.

Typical (typ.):

Describes performance that will be met by a minimum of 80% of all products. It is not guaranteed by the product warranty.

Supplemental performance data (SPD):

Represents the value of a parameter that is most likely to occur; the expected mean or average. It is not guaranteed by the product warranty.

General characteristics:

A general, descriptive term that does not imply a level of performance.

S-Parameter Measurement

Corrected system performance

The specifications in this section apply for measurements made with the Agilent E5061B network analyzer with the following conditions:

- No averaging applied to data
- Environmental temperature of 23 °C ±5 °C, with less than 1 °C deviation from the calibration temperature
- Response and isolation calibration not omitted

Table 1. System dynamic range [1,2]

Description	Specification	SPD
System dynamic range		
100 kHz to 1 MHz, IF bandwidth = 3 kHz	90 dB	
1 MHz to 3 GHz, IF bandwidth = 3 kHz	95 dB	
5 Hz to 100 Hz, IF bandwidth = 2 Hz	90 dB	
100 Hz to 9 kHz, IF bandwidth = 10 Hz	100 dB	
9 kHz to 100 kHz, IF bandwidth = 10 Hz	110 dB	
100 kHz to 1 MHz, IF bandwidth = 10 Hz	115 dB	
1 MHz to 3 GHz, IF bandwidth = 10 Hz	120 dB	130 dB

1. *The test port dynamic range is calculated as the difference between the test port rms noise floor and the source maximum output power. The effective dynamic range must take measurement uncertainty and interfering signals into account.*
2. *The specification might not be met at the frequencies 1.4 MHz, 4.0 MHz, 4.333 MHz, 6.333 MHz, 25MHz and 90 MHz.*

Table 2. Corrected system performance with Type-N 50 Ω connectors, 85032F calibration kit, full 2-port calibration

Network analyzer: E5061B, calibration kit: 85032F (Type-N, 50 Ω), calibration: full 2-port

IF bandwidth = 10 Hz, No averaging applied to data, environmental temperature = 23 °C ±5 °C with < 1 °C deviation from calibration temperature, isolation calibration not omitted

Description	Specification (dB)		
	100 Hz to 100 kHz	**100 kHz to 1 GHz**	**1 GHz to 3 GHz**
Directivity	49	49	46
Source match	41	41	40
Load match	49	49	46
Reflection tracking	0.011	0.011	0.021
Transmission tracking	0.019	0.019	0.026

Figure 1. Transmission uncertainty (specification)

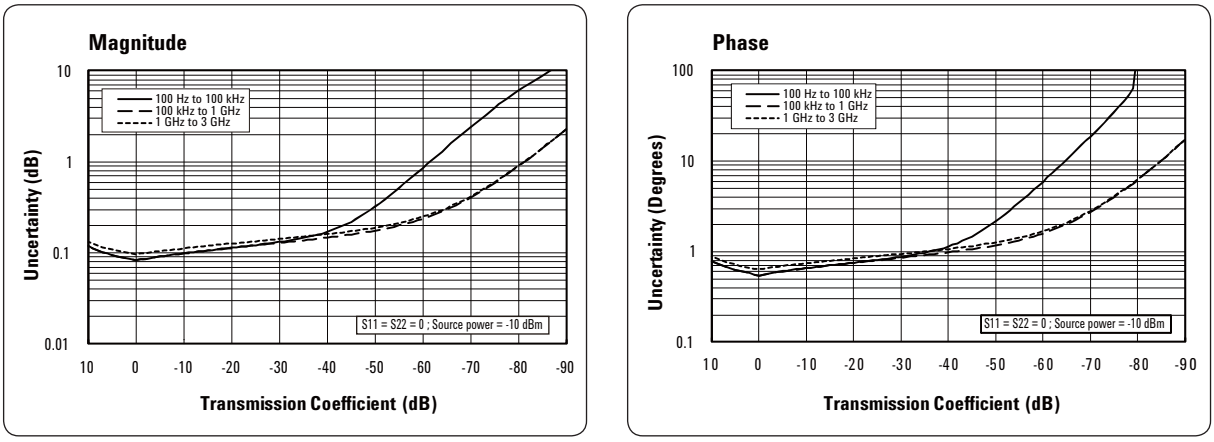


Figure 2. Reflection uncertainty (specification)

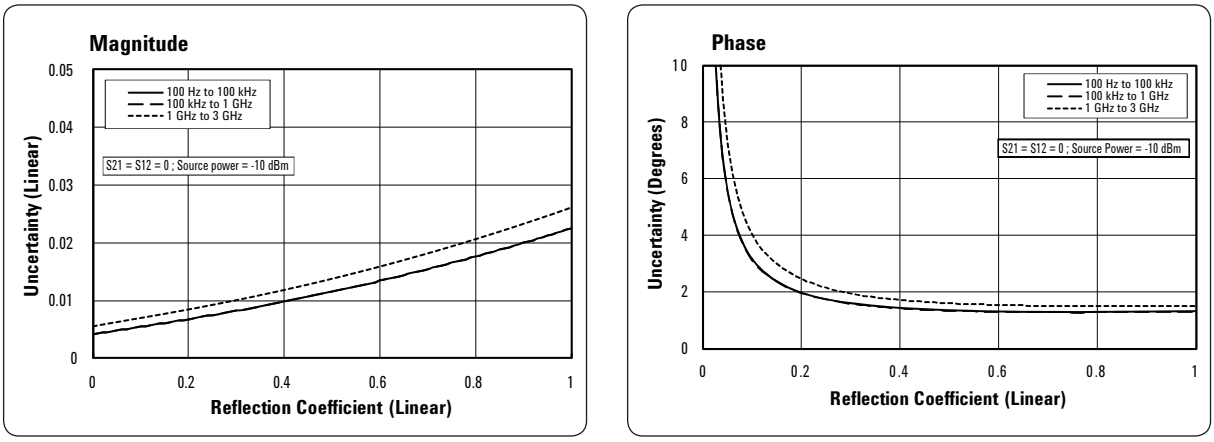


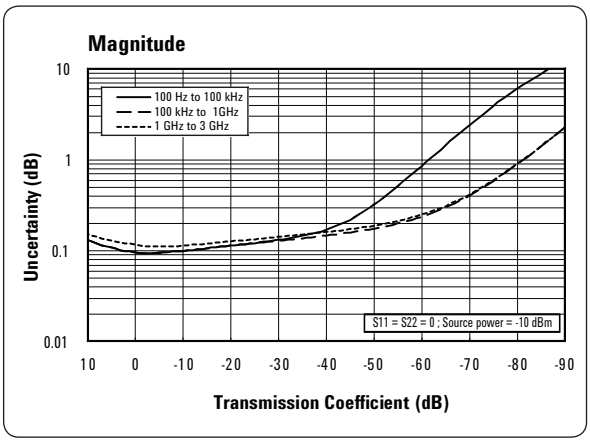
Table 3. Corrected system performance with Type-N 50 Ω connectors, 85032F calibration kit, enhanced response calibration

Network analyzer: E5061B, calibration kit: 85032F (Type-N, 50 Ω), calibration: enhanced response

IF bandwidth = 10 Hz, No averaging applied to data, environmental temperature = 23 °C ±5 °C with < 1 °C deviation from calibration temperature, isolation calibration not omitted

Description	Specification (dB)		
	100 Hz to 100 kHz	**100 kHz to 1 GHz**	**1 GHz to 3 GHz**
Directivity	49	49	46
Source match	41	41	40
Load match	49	49	46
Reflection tracking	0.011	0.011	0.021
Transmission tracking	0.019	0.019	0.033

Figure 3. Transmission uncertainty (specification)



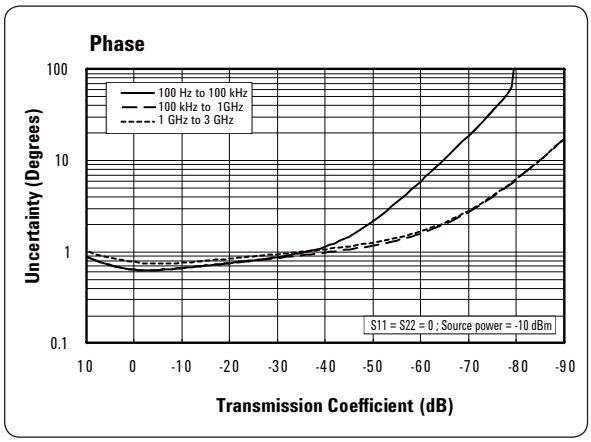
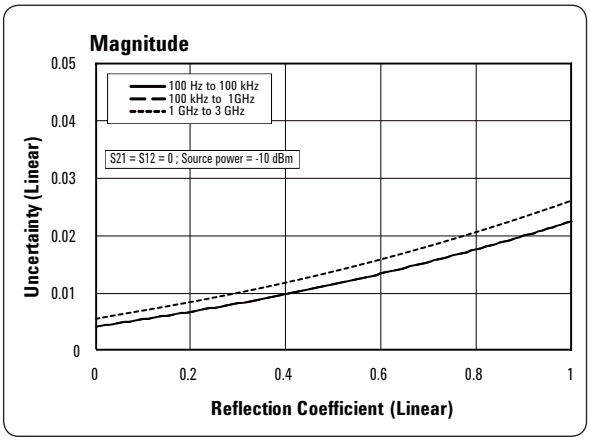


Figure 4. Reflection uncertainty (specification)



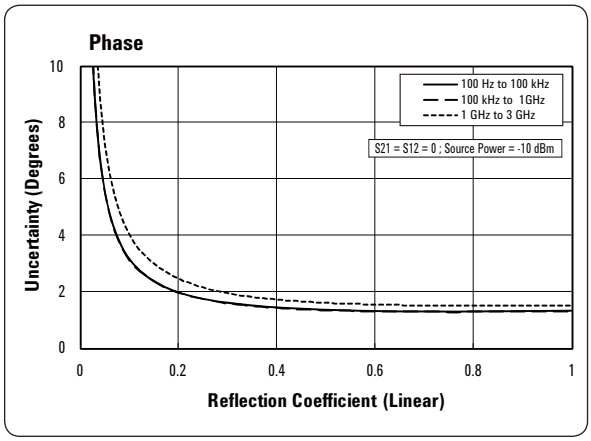
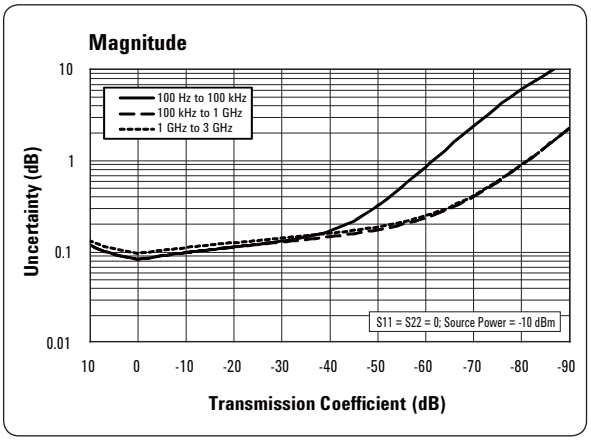


Table 4. Corrected system performance with Type-N 50 Ω connectors, 85092C ECal Module, full 2-port calibration

Network analyzer: E5061B, calibration kit: 85092C (Type-N, 50 Ω), calibration: Full 2 port			
IF bandwidth = 10 Hz, No averaging applied to data, environmental temperature = 23 °C ±5 °C with < 1 °C deviation from calibration temperature, isolation calibration not omitted			
Description	**Specification (dB)**		
	300 kHz to 10 MHz	**10 MHz to 1 GHz**	**1 GHz to 3 GHz**
Directivity	45	52	54
Source match	36	45	44
Load match	41	47	47
Reflection tracking	0.100	0.040	0.040
Transmission tracking	0.056	0.039	0.040

Figure 5. Transmission uncertainty (specification)



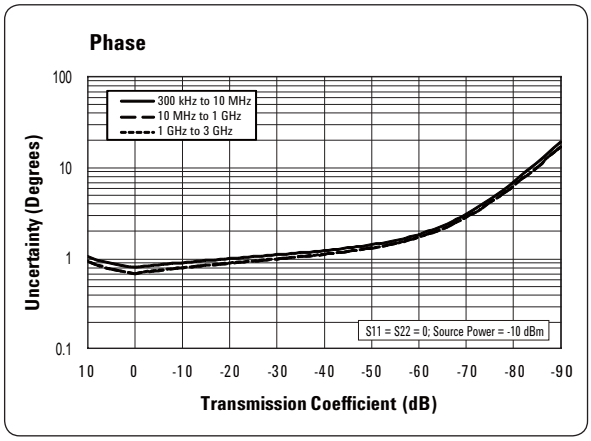
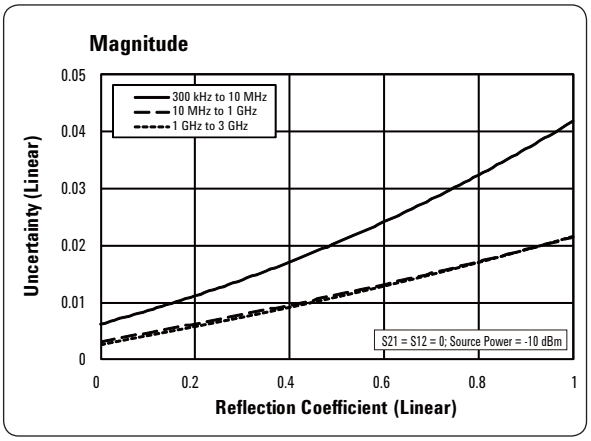
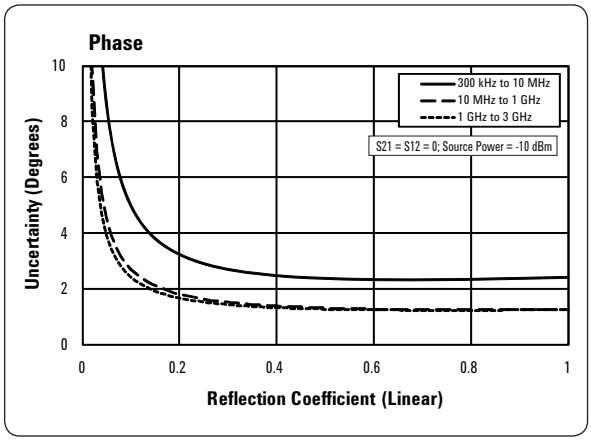


Figure 6. Reflection uncertainty (specification)





Uncorrected system performance

Table 5.Uncorrected system performance (correction: off)

Description	Specification	Typical
Directivity	25 dB	
Source match	25 dB	
Load match	15 dB (at 5 Hz to 2 GHz) 12 dB (at 2 to 3 GHz)	
Load match (Source AC Couple Mode)		10 dB (at 100 kHz to 300 kHz) 15 dB (at 300 kHz to 2 GHz) 12 dB (at 2 to 3 GHz)
Transmission tracking	±1.0 dB (at 100 Hz to 3 GHz)	±1.0 dB (at 5 Hz to 100 Hz)
Reflection tracking	±1.0 dB (at 100 Hz to 3 GHz)	±1.0 dB (at 5 Hz to 100 Hz)

Test port output (Source)

Table 6. Test port output frequency

Description	Specification	Typical
Range	5 Hz to 3 GHz	
Resolution	1 mHz	
Source stability		±5 ppm (5 to 40 °C)
CW accuracy	±5 ppm ±1 mHz	
High stability option (Option 1E5)		
CW accuracy	±1 ppm ±1 mHz	
Stability		±0.05 ppm (5 to 40 °C)
		±0.5 ppm per year

Table 7. Test port output power

Description	Specification	Typical
Level accuracy	±0.8 dB (at 0 dBm, 50 MHz absolute) ±1.0 dB (at 5 Hz to 1.5 GHz, 0 dBm, relative to 50 MHz) ±1.5 dB (at 1.5 GHz to 3 GHz, 0 dBm, relative to 50 MHz)	
Level linearity	±0.75 dB (at –10 to 10 dBm, 0 dBm reference)	
Range (standard)	–45 dBm to 10 dBm	
Sweep range	–45 dBm to 10 dBm	
Level resolution	0.05 dB	

Table 8. Test port output signal purity

Description	Specification	Typical
Harmonics (2nd or 3rd)		< –25 dBc (at 5 dBm)
Non-harmonic spurious		< –25 dBc (at 5 dBm)

Test port input

Table 9. Test port input levels

Description	Specification	Typical
Maximum test port input level	+10 dBm	
Damage level		+20 dBm, ±7 V DC
Absolute Amplitude Accuracy		< ±3 dB (at 0 dBm)
Crosstalk [1]	-85 dB (at 5 Hz to 100 Hz) -100 dB (at 100 Hz to 9 kHz) -110 dB (at 9 kHz to 100 kHz) -115 dB (at 100 kHz to 3 GHz)	

Table 10. Test port input (trace noise)

Description	Specification	Typical
Trace noise magnitude source power level = +10 dBm		
	5 mdB rms 100 Hz to 10 kHz Automatic IF Bandwidth	5 mdB rms 5 Hz to 100 Hz Automatic IF Bandwidth
	5 mdB rms 10 kHz to 3 GHz 3 kHz Bandwidth	
Trace noise phase source power level = +10 dBm		
	0.03° rms 100 Hz to 10 kHz Automatic IF Bandwidth	0.03° rms 5 Hz to 100 Hz Automatic IF Bandwidth
	0.03° rms 10 kHz to 3 GHz 3 kHz Bandwidth	

Table 11. Test port input (stability)

Description	Specification	SPD
Stability magnitude		
3 MHz to 3 GHz		0.01 dB/°C
Stability phase		
3 MHz to 3 GHz		0.1°/°C

1. *The specification might not be met at the frequencies 25MHz and 90 MHz Line and Fan related frequency.*

Table 12. Test port input (dynamic accuracy)

Accuracy of the test port input power reading is relative to –10 dBm reference input power level.

Description	Specification	Typical
Dynamic accuracy magnitude		
Reference = -10 dB	±0.303 dB (at 10 dBm) ±0.087 dB (at -30 dBm) ±2.141 dB (at -100 dBm)	
Dynamic accuracy phase		
Reference = -10 dB		±2.04 ° (at 10 dBm) ±0.58 ° (at -30 dBm) ±16.23 ° (at -100 dBm)

Figure 7. Dynamic Accuracy

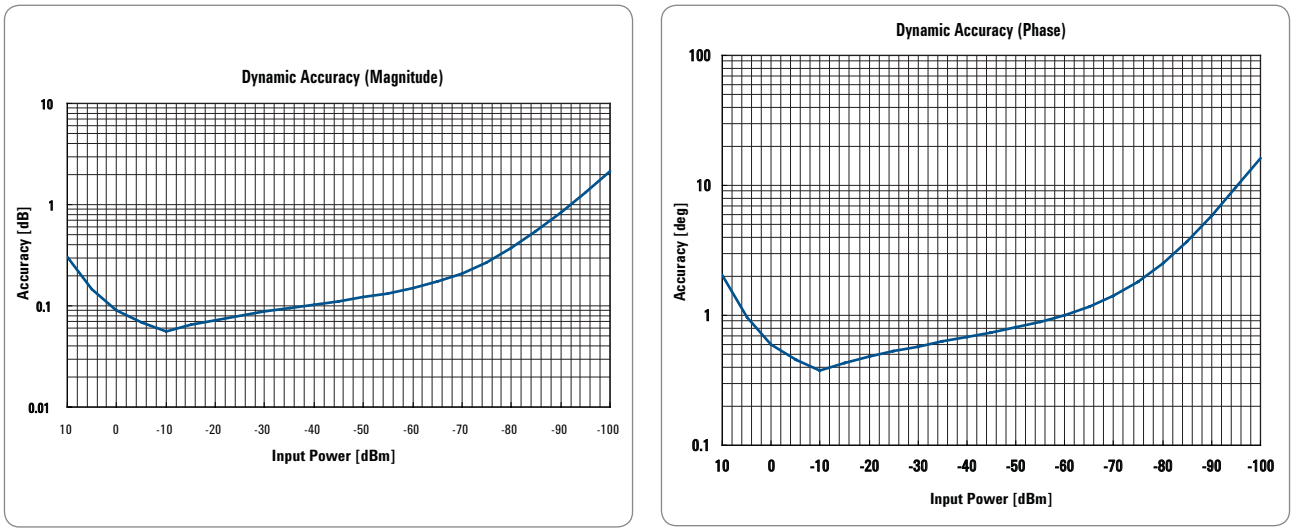
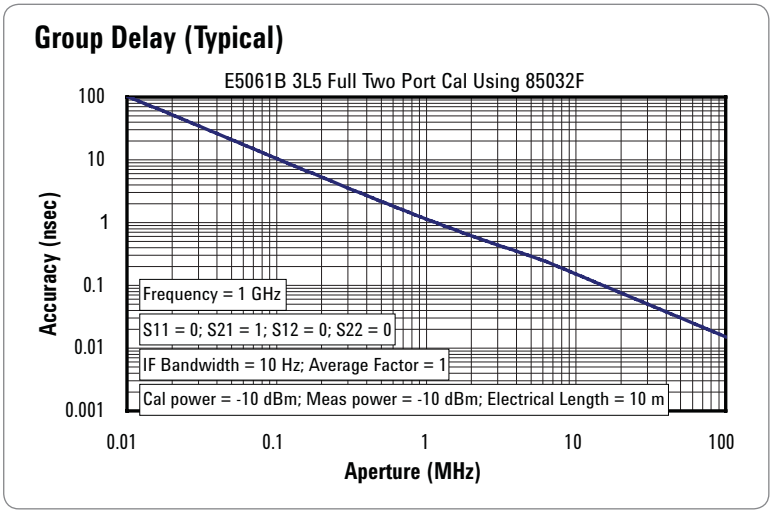


Table 13. Test port input (group delay)

Description	Specification	Supplemental information
Aperture (selectable)	(frequency span)/ (number of points –1)	
Maximum aperture	25% of frequency span	
Minimum delay		Limited to measuring no more than 180° of phase change within the minimum aperture.
Accuracy		See graph below

The following graph shows group delay accuracy with Type-N full 2-port calibration and a 10 Hz IF bandwidth. Insertion loss is assumed to be < 2 dB.

Figure 8. Group delay (typical)



In general, the following formula can be used to determine the accuracy, in seconds, of specific group delay measurement: ±phase accuracy (deg)/[360 x aperture (Hz)]

1. *Group delay is computed by measuring the phase change within a specified step (determined by the frequency span and the number of points per sweep).*

Gain Phase Measurement

Source Characteristics (LF Out)

Table 14. Source characteristics output frequency

Description	Specification	Typical
Range	5 Hz to 30 MHz	
Resolution	1 mHz	
Source stability		±5 ppm (5 °C to 40 °C)
CW accuracy	±5 ppm ±1 mHz	
High stability option (Option 1E5)		
CW accuracy	±1 ppm ±1 mHz	
Source stability		±0.05 ppm (5 °C to 40 °C) ±0.5 ppm per year

Table 15. Source characteristics output power

Description	Specification	SPD
Level accuracy	±1 dB (at 0 dBm absolute 200 Hz) ±2 dB (at 0 dBm, relative to 200 Hz)	
Level	±1 dB (at -10 dBm to 10 dBm, 0 dBm reference)	±1 dB (at -45 dBm to -10 dBm, 0 dBm reference)
Range	–45 dBm to 10 dBm	
Sweep range	–45 dBm to 10 dBm	
Level resolution	0.05 dB	

Table 16. Source characteristics output signal purity

Description	Specification	Typical
Harmonics (2nd or 3rd)		< –20 dBc (at 5 dBm)
Non-harmonic spurious		< –25 dBc (at 5 dBm)

Table 17. Source characteristics output impedance

Description	Specification	Typical
Impedance	50 Ω nominal	
Return loss		> 10 dBc

Test Port Input Characteristics

Table 18. Test port input attenuator

Description	Specification
Input attenuator	0 dB, 20 dB

Table 19. Test port input levels

Description	Specification	Typical
Maximum test port input level	15 dBm (at 20 dB attenuation, 50 Ω) -5 dBm (at 0 dB attenuation, 50 Ω) 1.78 V_{peak} (at 20 dB attenuation, 1 MΩ) 0.18 V_{peak} (at 0 dB attenuation, 1 MΩ)	
Damage level		26 dBm, ±42 V DC (at 1 MΩ) 26 dBm, ±7 V DC (at 50 Ω)
Absolute amplitude accuracy	< ±1.5 dB (at -15 dBm, 0 dB attenuation, 50 Ω input impedance) < ±1.5 dB (at 5 dBm, 20 dB attenuation, 50 Ω input impedance)	
Ratio accuracy		
Magnitude (for the same attenuation setting for both inputs)	< ±1 dB at (-15 dBm, 0 dB Att.) or (5 dBm,20 dB Att.) 50 Ω impedance < ±3 dB at (-15 dBm, 0 dB Att) or (5 dBm, 20 dB Att.) 1 MΩ impedance using 50 Ω feedthrough	
Phase (for the same attenuation setting for both inputs)	< ±5 °C at (-15 dBm,0 dB Att) or (5 dBm, 20 dB Att.), 50 Ω impedance	
Noise level (referenced to full scale input level at 23 °C ±5 °C) 0 dB attenuation, 50 Ω, Short termination.	-95 dB (at 5 Hz to 100 Hz, 2 Hz IF bandwidth) -95 dB (at 100 Hz to 9kHz, 10 Hz IF bandwidth) -105 dB (at 9 kHz to 100 kHz, 10 Hz IF bandwidth) -115 dB (at 100 kHz to 10 MHz, 10 Hz IF bandwidth) -110 dB (at 10 MHz to 30 MHz, 10 Hz IF bandwidth)	
Crosstalk [1] (for T/R) For input R: 10 dBm, 20 dB attenuation For input T: 0 dB attenuation, short termination	-110 dB (at 5 Hz to 100 kHz) -120 dB (at 100 kHz to 10 MHz, 10 Hz IF bandwidth) -110 dB (at 10 MHz to 30 MHz, 10 Hz IF bandwidth)	

1. *The specification might not be met at the frequencies 25 MHz, line and fan related frequency.*

Table 20. Test port input (Trace noise)

Description	Specification	Typical
Trace noise		
(at IF automatic bandwidth, <10 kHz)	5 mdB rms	
(at 3 kHz bandwidth, 10 kHz to 30 MHz at -5 dBm, 0 dB attenuation, 50 Ω)	5 mdB rms	
Trace noise phase		
(at IF automatic bandwidth, <10 kHz)	0.03° rms	
(at 3 kHz bandwidth, 10 kHz to 30 MHz at -5 dBm, 0 dB attenuation, 50 Ω)	0.03° rms	

Table 21. Test port input (stability)

Description	Specification	SPD
Stability magnitude		< ±0.02 dB/°C
Stability phase		< ±0.2°/°C

Table 22. Test port input (Dynamic Accuracy) [1]

Description	Specification	Typical
Dynamic accuracy magnitude		
(0 dB attenuation, 50 Ω)	±0.303 dB at -5 dBm ±0.09 dB at -15 dBm ±0.056 dB at -25 dBm ±0.073 dB at -35 dBm ±0.087 dB at -45 dBm ±0.103 dB at -55 dBm ±0.121 dB at -65 dBm ±0.15 dB at -75 dBm ±0.211 dB at -85 dBm ±0.371 dB at -95 dBm ±0.841 dB at -105 dBm ±2.141 dB at -115 dBm	
Dynamic accuracy phase		
(0 dB attenuation, 50 Ω)	±2.04 ° at -5 dBm ±0.6 ° at -15 dBm ±0.37 ° at -25 dBm ±0.48 ° at -35 dBm ±0.58 ° at -45 dBm ±0.68 ° at -55 dBm ±0.81 ° at -65 dBm ±1.00 ° at -75 dBm ±1.41 ° at -85 dBm ±2.5 ° at -95 dBm ±5.83 ° at -105 dBm ±16.23 ° at -115 dBm	±5 ° (+15 dBm, 20 dB attenuation)

1. *Accuracy of the test port input power reading is relative to –25 dBm reference input power level.*

Figure 9. Dynamic Accuracy

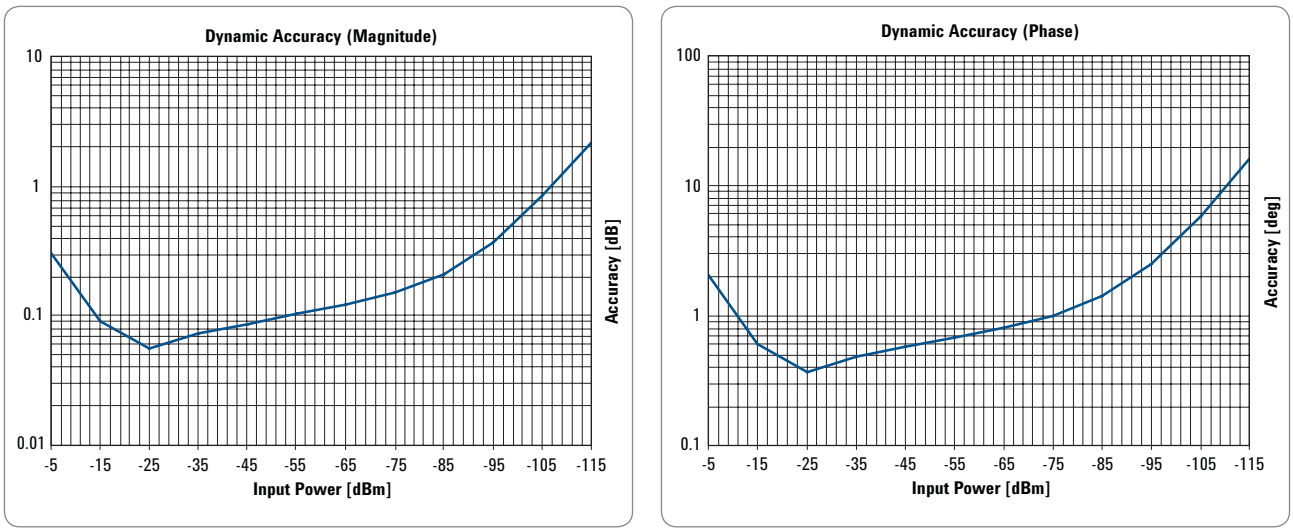


Table 23. Test port input impedance

Description	Specification	Typical
Impedance		50 Ω nominal 1 MΩ // 30 pF
Return loss	> 15 dB at 50 Ω input	

DC Bias

Table 24. DC bias

Description	Specification
DC voltage bias	
Output Port	Port 1, LF Out
Range	0 to ±40 V (100 mA max)
Resolution	1 mV ±(0 V to 10 V) 4 mV ±(10 V to 40 V)
Accuracy [1]	±{0.1 % + 4 mV}
Output Impedance	50 Ω nominal
DC bias monitor	at IFBW = AUTO (=< 100 Hz)
Voltage accuracy	±{0.4 % + 50 mV} (at 23 °C ±5 °C) ±{0.4 % + 50 mV} x4 (at 5 °C to 40 °C)
Current accuracy	±{1 % + 500 µA + (|Vdc[V]|/10 kΩ) } (at 23 ±5 °C) ±{1 % + 500 µA + (|Vdc[V]|/10 kΩ) } x2 (at 5 °C to 40 °C)

1. *DC Switching Transient Noise: ±30 mV (SPD) when port or power switching occur.*

General information

Table 27. System bandwidths

Description	General Specification
IF bandwidth settings	
Range	1 Hz to 300 kHz Nominal settings are: 1, 1.5, 2, 3, 4, 5, 7

Table 28. Front panel information

Description	General Specification	Typical
Connectors		
Type	Type-N, female; 50 Ω (Ports 1 and 2) BNC, female; 50 Ω or 1 M Ω (Ports R and T) BNC, female; 50 Ω (LF Out)	
Probe Power		15 V ±5 % (400 mA) -12.6 V ±5 % (300 mA) (combined load for both probe connections)
Display		
Size	10.4 in TFT color LCD	
Resolution	XGA (1024 x 768) [1]	

1. *Valid pixels are 99.99% and more. Below 0.01% of fixed points of black, blue, green or red are not regarded as failure.*

Table 29. Rear panel information

Description	General Characteristics
External trigger input connector	
Type	BNC female
Input level	Low threshold voltage: 0.5 V High threshold voltage: 2.1 V Input level range: 0 to +5 V
Pulse width	≥ 2 µsec
Polarity	Postitive or negative
External trigger output connector	
Type	BNC, female
Maximum output current	50 mA
Output level	Low level voltage: 0 V High level voltage: 5 V Adjustable (1 µsec to 1 sec)
Polarity	Positive or negative
External reference signal input connector	
Type	BNC, female
Input frequency	10 MHz ±10 ppm (Typical)
Input level	0 dBm ±3 dB (Typical)
Internal reference signal output connector	
Type	BNC, female
Output frequency	10 MHz ±10 ppm (Typical)
Signal type	Sinewave
Output level	0 dBm ±3 dB into 50 Ω
Output impedance	50 Ω nominal
VGA video output	15-pin mini D-Sub; female; drives VGA compatible monitors
GPIB	24-pin D-Sub (type D-24), female; compatible with IEEE-488
USB port	Universal serial bus jack, type A configuration (4 contacts inline, contact 1 on left); female; provides connection to printer, ECal module, USB/GPIB interface
USB (USBTMC) interface port	Universal serial bus jack, Type B configuration (4 contacts inline); female; provides connection to an external PC; compatible with USBTMC-USB 488 and USB 2.0.
LAN	10/100/1000 BaseT Ethernet, 8-pin configuration; auto selects between the two data rates
24 bit I/O port	36-pin Centronics, female; provides connection to handler system
Line power [1]	
Frequency	47 Hz to 63 Hz
Voltage	90 to 132 VAC, or 198 to 264 VAC (automatically switched)
VA max	300 VA max

1. *A third-wire ground is required.*

Table 30. EMC and safety

Description	General Characteristics
EMC	
CE ISM 1-A	European Council Directive 2004/108/EC IEC 61326-1:2005 EN 61326-1:2006 CISPR 11:2003+A1:2004 EN 55011:2007 Group 1, Class A IEC 61000-4-2:1995 +A2:2000 EN 61000-4-2:1995 +A2:2001 4 kV CD / 8 kV AD IEC 61000-4-3:2006 EN 61000-4-3:2006 1-3 V/m, 80-1000 MHz/1.4 GHz - 2.7 GHz, 80% AM IEC 61000-4-4:2004 EN 61000-4-4:2004 1 kV power/0.5 kV signal lines IEC 61000-4-5:2005 EN 61000-4-5:2006 0.5 kV line-line/1 kV line-ground IEC 61000-4-6:2003 + A1:2004+ A2:2006 EN 61000-4-6:2007 3 V, 0.15-80 MHz, 80% AM IEC 61000-4-11:2004 EN 61000-4-11:2004 0.5-300 cycle, 0%/70%
ICES/NMB-001	ICES-001:2006 Group 1, Class A
N10149	AS/NZS CISPR11:2004 Group 1, Class A
Safety	
CE ISM 1-A	European Council Directive 2006/95/EC IEC 61010-1:2001 / EN 61010-1:2001 Measurement Category I Pollution Degree 2 Indoor Use
LR95111C	CAN/CSA C22.2 No. 61010-1-04 Measurement Category I Pollution Degree 2 Indoor Use
Environment	
	This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product. Do not dispose in domestic household waste. To return unwanted products, contact your local Agilent office, or see **www.agilent.com/environment/product/** for more information.

Table 31. Analyzer environment and dimensions

Description	General Characteristics
Operating environment	
Temperature	+5 °C to +40 °C
Error-corrected temperature range	23 °C ±5 °C with < 1 °C deviation from calibration temperature
Humidity	20% to 80% at wet bulb temperature < +29 °C (non-condensing)
Altitude	0 to 2,000 m (0 to 6,561 feet)
Vibration	0.21 G maximum, 5 Hz to 500 Hz
Non-operating storage environment	
Temperature	–10 °C to +60 °C
Humidity	20% to 90% at wet bulb temperature < 40 °C (non-condensing)
Altitude	0 to 4,572 m (0 to 15,000 feet)
Vibration	0.5 G maximum, 5 Hz to 500 Hz
Dimensions	Height = 235 mm, Width = 432 mm, Depth = 296 mm. See figures 10 to 12.
Weight	14.0 kg
Magnetic Susceptibility	Degradation of some product specifications can occur in the presence of ambient power frequency magnetic fields of 30 A/m or greater. The product self-recovers and operates as specified when removed or shielded from the ambient magnetic field. When the analyzer tuned frequency is identical to the immunity test signal frequency, there may be signals of up to –80 dB of full-scale response displayed on the screen.
Magnetic Emission	Emission of magnetic field may occur at the left side of the where two cooling fans are installed. Its magnitude can be as much as 160A/m and 25A/m at 0cm and 1cm apart from the center of the fan, respectively. It is recommended to have enough clearance between the cooling fans and magnetically sensitive device or instruments.

Figure 10. Dimensions (front view, in millimeters)

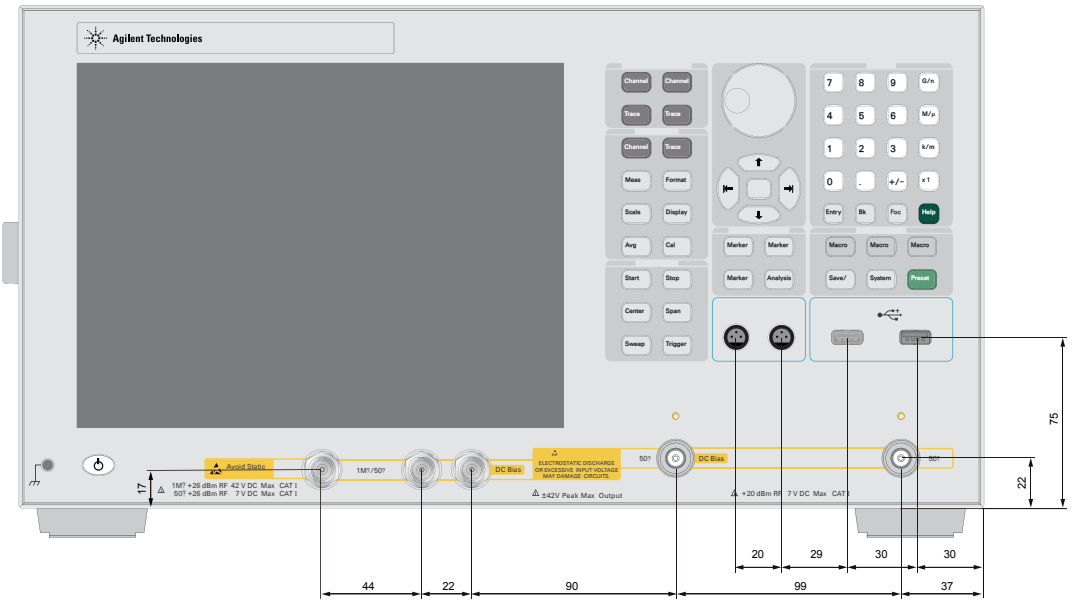


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Figure 11. Dimensions (rear view, in millimeters)

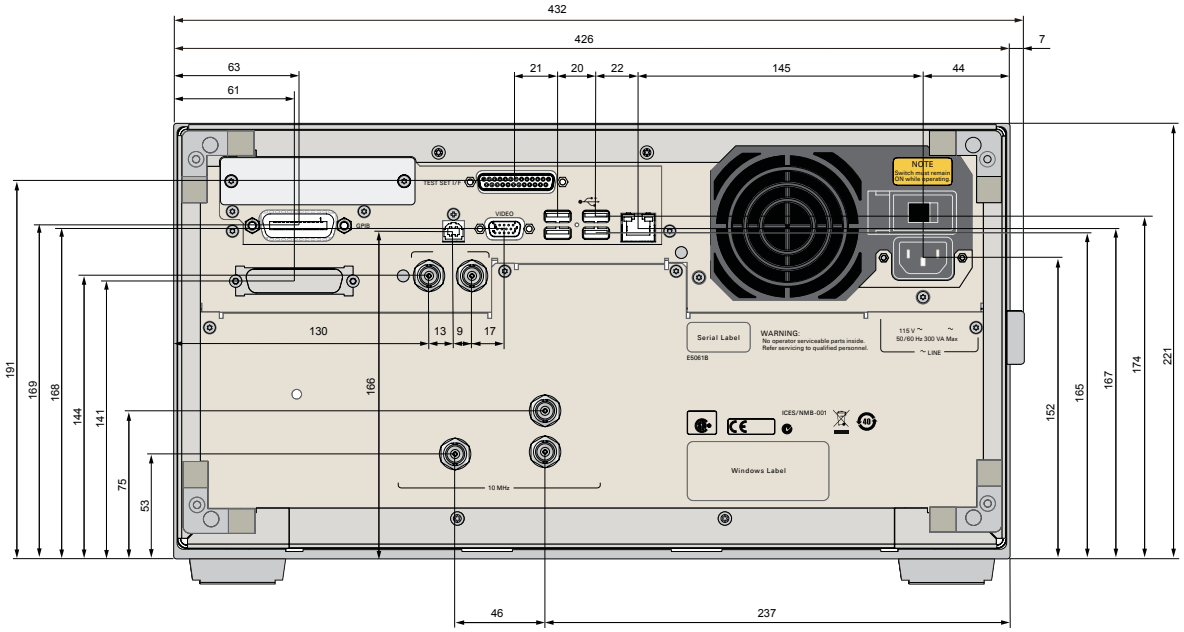

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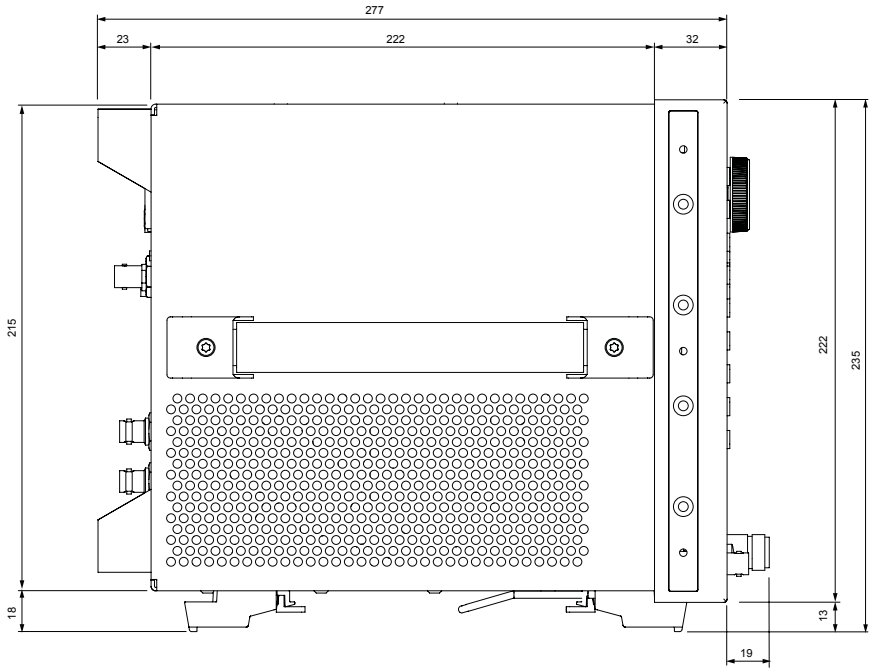
Figure 12. Dimensions (side view, in millimeters)



e5061bside

Measurement throughput summary

Table 32. Typical cycle time for measurement completion [1] (ms) (Display update: off)

Number of points				
	51	201	401	1601
Start 1 GHz, stop 1.2 GHz, 30 kHz IF bandwidth				
Uncorrected	5	14	26	88
2-port cal	11	30	53	177
Start 1 GHz, stop 1.2 GHz, 300 kHz IF bandwidth				
Uncorrected	3	8	14	42
2-port cal	8	18	30	85
Start 1 MHz, stop 3 GHz, 30 kHz IF bandwidth				
Uncorrected	9	21	36	117
2-port cal	19	44	73	235
Start 1 MHz, stop 3 GHz, 300 kHz IF bandwidth				
Uncorrected	7	15	24	70
2-port cal	16	32	50	142

Table 33. Typical cycle time for measurement completion [1] (ms) (Display update: on)

Number of points				
	51	201	401	1601
Start 1 GHz, stop 1.2 GHz, 30 kHz IF bandwidth				
Uncorrected	34	35	38	100
2-port cal	41	45	64	190
Start 1 GHz, stop 1.2 GHz, 300 kHz IF bandwidth				
Uncorrected	34	36	38	55
2-port cal	41	45	50	97
Start 1 MHz, stop 3 GHz, 30 kHz IF bandwidth				
Uncorrected	34	36	46	129
2-port cal	41	54	84	247
Start 1 MHz, stop 3 GHz, 300 kHz IF bandwidth				
Uncorrected	34	36	38	63
2-port cal	41	45	61	155

1. *Typical performance.*

Table 34. Data transfer time [1] (ms)

Number of points				
	51	201	401	1601
SCPI over GPIB [2]				
REAL 64	6	16	29	112
ASCII	29	109	215	848
SCPI over GPIB/USB (82357B)				
REAL 64	8	14	23	77
ASCII	73	282	563	2247
SCPI over 100 Mbps LAN (SICL-LAN) [2]				
REAL 64	5	5	6	8
ASCII	4	8	13	41
SCPI over 100 Mbps LAN (Socket) [2]				
REAL 64	2	2	3	4
ASCII	20	72	142	562
SCPI over USB [2]				
REAL 64	3	3	4	5
ASCII	4	10	19	69
COM (program executed in the analyzer) [2]				
Variant type	1	1	1	1

1. *Typical performance.*
2. *Measured using a VEE Pro 9.0 program running on a 2.4 GHz Pentium ® 4, Transferred complex S_{11} data, using :CALC:DATA?SDATA.*

Measurement capabilities

Number of measurement channels	Up to 4 independent measurement channels. A measurement channel is coupled to stimulus response settings including frequency, IF bandwidth, power level, and number of points.
Number of display windows	Each measurement channel has a display window. Up to 4 display windows (channels) can be displayed.
Number of traces	4 data traces and 4 memory traces per channel
Measurement choices	S11, S21, S12, S22, T/R, T, R, Absolute.
Measurement parameter conversion	Available to convert S-parameters into reflection impedance, transmission impedance, reflection admittance, transmission admittance, and 1/S.
Data formats	Log magnitude, linear magnitude, phase, expanded phase, positive phase, group delay, SWR, real, imaginary, Smith chart, polar.
Data markers	10 independent markers per trace. Reference marker available for delta marker operation. Smith chart format includes 5 marker formats: linear magnitude/phase, log magnitude/phase, real/imaginary, R + jX, and G + jB. Polar chart format includes 3 marker formats: linear magnitude/phase, log magnitude/phase, and real/imaginary.
Marker functions	
Marker search	Max value, min value, multi-peak, multi-target, peak, peak left, peak right, target, target left, target right, and width parameters with user-defined bandwidth values.
Marker-to functions	Set start, stop, center to active marker stimulus value; set reference to active marker response value; set electrical delay to group delay at active marker.
Search range	User definable.
Tracking	Performs marker search continuously or on demand.
Fault location functions (Option 010)	
Transformation to distance and time domain	Selectable transformation type from bandpass, lowpass impulse, lowpass step. Selectable window from maximum, normal and minimum.
LXI compliance	Class C

Source control

Measured number of points per sweep	User definable from 2 to 1601.
Sweep type	Linear sweep, segment sweep, log sweep , power sweep and DC bias sweep.
Segment sweep	Define independent sweep segments. Set number of points, test port power levels, IF bandwidth, delay time, sweep time independently for each segment.
Sweep trigger	Set to continuous, hold, or single, sweep with internal, external, manual, or bus trigger.
Power	Set source power from -45 dBm to 10 dBm. The power slope function compensates source power error.

Trace functions

Display data	Display current measurement data, memory data, or current measurement and memory data simultaneously.
Trace math	Vector addition, subtraction, multiplication or division of measured complex values and memory data.
Title	Add custom title to each channel window. Titles are printed on hardcopies of displayed measurements
Autoscale	Automatically selects scale resolution and reference value to vertically center the trace.
Electrical delay	Offset measured phase or group delay by a defined amount of electrical delay, in seconds.
Phase offset	Offset measured phase or group delay by a defined amount in degrees.
Statistics	Calculates and displays mean, standard deviation and peak-to-peak deviation of the data trace.

Data accuracy enhancement

Measurement calibration	Measurement calibration significantly reduces measurement uncertainty due to errors caused by system directivity, source and load match, tracking and crosstalk. Full 2-port calibration removes all the systematic errors for the related test ports to obtain the most accurate measurements.
Calibration types available	
Response	Simultaneous magnitude and phase correction of frequency response errors for either reflection or transmission measurements.
Response and isolation	Compensates for frequency response and crosstalk errors of transmission measurements.
Enhanced response	Compensates for frequency response and source match errors.
One-port calibration	Compensates for directivity, frequency response and source match errors.
Full 2-port calibration	Compensates for directivity, source match, reflection tracking, load match, transmission tracking and crosstalk. Crosstalk calibration can be omitted.
Interpolated error correction	With any type of accuracy enhancement applied, interpolated mode recalculates the error coefficients when the test frequencies are changed. The number of points can be increased or decreased and the start/stop frequencies can be changed.
Velocity factor	Enter the velocity factor to calculate the equivalent physical length.
Reference port extension	Redefine the measurement plane from the plane where the calibration was done.

Storage

Internal hard disk drive	Store and recall instrument states, calibration data, and trace data into internal hard drive. Trace data can be saved in CSV (comma separated value) format. All files are MS-DOS ®-compatible. Instrument states include all control settings, limit lines, segment sweep tables, and memory trace data.
File sharing	Internal hard disk drive (D:) can be accessed from an external Windows ® PC through LAN.
Screen hardcopy	Printouts of instrument data are directly produced on a printer through USB interfaces.
System capabilities	
Familiar graphical user interface	The ENA analyzer employs a graphical user interface based on Windows ® operating system. There are three ways to operate the instrument manually: you can use a hardkey interface, touch screen interface or a mouse interface.
Limit lines	Define the test limit lines that appear on the display for pass/fail testing. Defined limits may be any combination of horizontal/sloping lines and discrete data points.

Automation

	GPIB/LAN/USB	Internal
SCPI	×	×
COM		×
Methods		
Internal analyzer execution	Applications can be developed in a built-in VBA ® (Visual Basic for Applications) language. Applications can be executed from within the analyzer via COM (component object model) or using SCPI.	
Controlling via GPIB	The GPIB interface operates to IEEE 488.2 and SCPI protocols. The analyzer can be controlled by a GPIB external controller. The analyzer can control external devices using a USB/GPIB interface.	
LAN		
Protocol	TCP/IP	
Function	Telnet, SICL-LAN	
USB		
Protocol	USB Test and Measurement Class (TMC) interface that communicates over USB, complying with the IEEE 488.1 and IEEE 488.2 standards.	

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LXI

www.lxistandard.org
LXI is the LAN-based successor to GPIB, providing faster, more efficient connectivity. Agilent is a founding member of the LXI consortium.

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