

E5100A/B Network Analyzer

Technical Data

Specifications

These specifications are the performance standards or limits against which the instrument is tested. When shipped from the factory, the E5100A/B meets the specifications listed in this section.

Values followed by (SPC): are Supplemental Performance Characteristics.

Source

Frequency Characteristics

Range	10 kHz to 300 MHz
Accuracy (at $23 \pm 5^\circ\text{C}$)	
.....	± 20 ppm
with option 1D5 (at 0 to 55°C , 20 minutes after power on)	± 1 ppm
Stability (at $23 \pm 5^\circ\text{C}$)	
.....	$\pm 5 \times 10^{-6}/\text{day}$ (SPC)
with option 1D5 (48 hours after power on)	$\pm 2.5 \times 10^{-9}/8$ hours (SPC)
Resolution	1 mHz

Output Power Characteristics

(measured at RF OUT 1, RF OUT 2 is terminated with 50Ω termination)

Range (Nominal)	
with option 001	-9 dBm to +11 dBm
with option 002	-15 dBm to +5 dBm
with option 003	-12 dBm to +8 dBm
with both option 001 and 010	-48 dBm to +22 dBm
with both option 002 and 010	-54 dBm to +16 dBm
with both option 003 and 010	-51 dBm to +19 dBm
with option 600 (at RF OUT 1)	-52 dBm to +18 dBm
with option 600 (at RF OUT 2)	-65 dBm to +5 dBm
Resolution	0.1 dB
Level Accuracy (at $23 \pm 5^\circ\text{C}$, 0 dBm output level, 50 MHz)	± 1 dB
Flatness (at $23 \pm 5^\circ\text{C}$, relative to 0 dBm output level at 50 MHz)	
.....	+2 dB, -4 dB
with option 003 and without option 010	+2.5 dB, -4.5 dB

with option 010	
10 kHz $\leq$ freq. $<$ 50 kHz	+1.5 dB, -6 dB (SPC)
50 kHz $\leq$ freq. $\leq$ 100 MHz	+2.5 dB, -4.5 dB
100 MHz $<$ freq. $\leq$ 300 MHz	+3 dB, -5 dB
with option 600	
10 kHz $\leq$ freq. $<$ 50 kHz	+1.5 dB, -7 dB (SPC)
50 kHz $\leq$ freq. $\leq$ 100 MHz	+2.5 dB, -4.5 dB
100 MHz $<$ freq. $\leq$ 300 MHz	+3 dB, -5 dB

Linearity (at $23 \pm 5^\circ\text{C}$, relative to 0 dBm output level at 50 MHz)

.....	± 1 dB
with option 010	
maximum power level -70 dB $\leq$ power level $<$ maximum power level -60 dB ..	± 1.5 dB
maximum power level -60 dB $\leq$ power level $\leq$ maximum power level	± 1 dB

Power Splitter

(When the analyzer is equipped with option 001 or 003, delete this section.)

Insertion Loss (When the analyzer is equipped with option 600, delete this item.)

.....	6 dB (nominal)
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Output Tracking

without option 600	
10 kHz $\leq$ freq. $\leq$ 100 MHz	0.1 dB (SPC)
100 MHz $<$ freq. $\leq$ 300 MHz	0.2 dB (SPC)
with option 600	
10 kHz $\leq$ freq. $\leq$ 100 MHz	13 dB $\pm$ 0.3 dB (SPC)
100 MHz $<$ freq. $\leq$ 300 MHz	13 dB $\pm$ 0.5 dB (SPC)

Equivalent Output SWR

without option 600	
10 kHz $\leq$ freq. $<$ 100 MHz	≤ 1.2 (SPC)
100 MHz $\leq$ freq. $\leq$ 300 MHz	≤ 1.4 (SPC)
with option 600	
10 kHz $\leq$ freq. $<$ 50 kHz	≤ 2.5 (SPC)
50 kHz $\leq$ freq. $\leq$ 100 MHz	≤ 1.2 (SPC)
100 MHz $<$ freq. $\leq$ 300 MHz	≤ 1.4 (SPC)

Spectral Purity Characteristics

Harmonics (these are supplemental performance characteristics for the HP 5100B)

with option 001 (at -4 dBm output level)	< -35 dBc
with option 002 (at -10 dBm output level)	< -35 dBc
with option 003 (at -7 dBm output level)	< -35 dBc
with option 600 (at +15 dBm output level)	< -20 dBc
with both option 001 and 010 (at +21 dBm output level)	< -20 dBc
with both option 002 and 010 (at +15 dBm output level)	< -20 dBc
with both option 003 and 010 (at +18 dBm output level)	< -20 dBc

Non-harmonic Spurious Signals (at < 300 MHz)

with option 001 (at -4 dBm output level)	< -45 dBc
with option 002 (at -10 dBm output level)	< -45 dBc
with option 003 (at -7 dBm output level)	< -45 dBc

with option 600 (at 0 dBm output level) < -45 dBc
 with both option 001 and 010 (at +6 dBm output level) < -45 dBc
 with both option 002 and 010 (at 0 dBm output level) < -45 dBc
 with both option 003 and 010 (at +3 dBm output level) < -45 dBc
Phase Noise (at 10 kHz offset from 0 dBm fundamental) < -90 dBc/Hz

Other Source Information

Reverse Power Protection 20 dBm, 25 Vdc (SPC)
Output Connector BNC female
Output Impedance 50 Ω (nominal)

Receiver

Input Characteristics

Frequency Range

..... 10 kHz to 300 MHz
 1 M Ω input for option 101 or 301 10 kHz to 5 MHz

IF Bandwidth (IF BW) 10 Hz to 30 kHz, 1, 1.5, 2, 3, 4, 5, 8 step (nominal)

Impedance

..... 50 Ω (nominal)
 1 M Ω input for option 101 or 301 1 M Ω // 30 pF (nominal)

Return Loss (at 50 Ω input)

10 kHz $\leq$ freq. < 100 MHz 20 dB (SPC)
 100 MHz $\leq$ freq. $\leq$ 300 MHz 15 dB (SPC)

Maximum Input Level

50 Ω Input

Frequency	RF attenuator	Maximum Input Level
10 kHz $\leq$ freq. < 200 kHz	25 dB	0 dBm
10 kHz $\leq$ freq. < 200 kHz	0 dB	-25 dBm
200 kHz $\leq$ freq. $\leq$ 300 MHz	25 dB	+5 dBm
200 kHz $\leq$ freq. $\leq$ 300 MHz	0 dB	-20 dBm

1 M Ω Input for option 102 or 302

Frequency ¹	RF attenuator	Maximum Input Level
10 kHz $\leq$ freq. < 200 kHz	25 dB	0.22 Vrms
10 kHz $\leq$ freq. < 200 kHz	0 dB	0.013 Vrms
200 kHz $\leq$ freq. $\leq$ 300 MHz	25 dB	0.40 Vrms
200 kHz $\leq$ freq. $\leq$ 300 MHz	0 dB	0.022 Vrms

¹ Measurement Frequency $\leq$ 5 MHz)

Damage Level

DC	25 Vdc
AC	20 dBm

Averaging Noise Level (at magnitude measurement, $23 \pm 5^\circ\text{C}$, RF attenuator: 0 dB, 50 Ω input)

■ E5100A

IF BW 30 kHz (at > 1 MHz)	-100 dBm
IF BW 10 kHz (at > 300 kHz)	-105 dBm
IF BW 3 kHz (at > 100 kHz)	-110 dBm
IF BW 1 kHz	
30 kHz $\leq$ freq. < 100 kHz	-95 dBm
100 kHz $\leq$ freq. $\leq$ 300 MHz	-115 dBm
IF BW 300 Hz	
10 kHz $\leq$ freq. < 100 kHz	-100 dBm
100 kHz $\leq$ freq. $\leq$ 300 MHz	-120 dBm
IF BW 100 Hz	
10 kHz $\leq$ freq. < 100 kHz	-105 dBm
100 kHz $\leq$ freq. $\leq$ 300 MHz	-125 dBm

■ E5100B

IF BW 30 kHz (at > 1 MHz)	-100 dBm
IF BW 10 kHz (at > 300 kHz)	-105 dBm
IF BW 3 kHz (at > 100 kHz)	-110 dBm
IF BW 1 kHz	
30 kHz $\leq$ freq. < 100 kHz	-95 dBm
100 kHz $\leq$ freq. $\leq$ 300 MHz	-115 dBm

■ When the analyzer frequency is identical to the transmitted interference signal frequency, refer to "EMC" in "General Characteristics".

Input Crosstalk (When the analyzer is equipped with option 100, delete this section.)

reference input (0 dBm input level at 10 kHz to 200 kHz and +5 dBm input level at 200 kHz to 300 MHz, RF attenuator: 25 dB, 50 Ω input)

test input (RF attenuator: 0 dB, terminated with 50 Ω termination)

■ E5100A

10 kHz $\leq$ freq. < 100 kHz	< -110 dB
100 kHz $\leq$ freq. $\leq$ 300 MHz	< -120 dB

■ E5100B

10 kHz $\leq$ freq. < 100 kHz	< -85 dB
100 kHz $\leq$ freq. < 250 MHz	< -105 dB
250 MHz $\leq$ freq. $\leq$ 300 MHz	< -95 dB

Source Crosstalk

(all RF OUT and input connectors are terminated with 50 Ω terminations)

■ E5100A

without option 010 (at +5 dBm output level, RF attenuator: 0 dB, 50 Ω input)

10 kHz $\leq$ freq. < 100 kHz	< -110 dB(SPC)
100 kHz $\leq$ freq. < 250 MHz	< -125 dB(SPC)
250 MHz $\leq$ freq. $\leq$ 300 MHz	< -120 dB(SPC)

with option 010 (at +16 dBm output level, RF attenuator: 0 dB, 50 Ω input)

10 kHz $\leq$ freq. < 100 kHz	< -120 dB(SPC)
100 kHz $\leq$ freq. < 250 MHz	< -135 dB(SPC)

250 MHz $\leq$ freq. $\leq$ 300 MHz	< -130 dB(SPC)
■ E5100B	
without option 010 (at +5 dBm output level, RF attenuator: 0 dB, 50 Ω input)	
10 kHz $\leq$ freq. < 100 kHz	< -85 dB(SPC)
100 kHz $\leq$ freq. < 250 MHz	< -100 dB(SPC)
250 MHz $\leq$ freq. $\leq$ 300 MHz	< -95 dB(SPC)
with option 010 (at +16 dBm output level, RF attenuator: 0 dB, 50 Ω input)	
10 kHz $\leq$ freq. < 100 kHz	< -95 dB(SPC)
100 kHz $\leq$ freq. < 250 MHz	< -110 dB(SPC)
250 MHz $\leq$ freq. $\leq$ 300 MHz	< -105 dB(SPC)

Residual Response (RF attenuator: 0 dB, except for the following points) < -80 dBm

50 kHz, 100 kHz, 95.825 MHz, 95.875 MHz, 159.791667 MHz, 159.825 MHz, 159.841667 MHz, 159.875 MHz, 239.75 MHz, and 239.875 MHz

Input Connector

.....	BNC female
with option 102 or 302	BNC female, Type-N female (for A, B inputs)

Measurement Mode

with option 100	A
with option 200 or 600	A/R, A/R, R, A
with option 300	A/R, B/R, R/A, B/A, R/B, A/B, R, A, B
with option 400	A/R, B/R, C/R, R/A, B/A, C/A, R/B, A/B, C/B, R/C, A/C, B/C, R, A, B, C

(When the Measurement Mode is either R/A, B/A, C/A, R/B, A/B, C/B, R/C, or A/C, the specification is SPC.)

Magnitude Characteristics

Absolute Characteristics

Absolute Amplitude Accuracy

(at $23 \pm 5^\circ\text{C}$, -30 dBm input level for RF attenuator: 0 dB or -5 dBm input level for RF attenuator: 25 dB, 50 Ω input)

E5100A	± 1 dB
E5100B	± 2 dB (SPC)

Ratio Characteristics

Frequency Response

(at $23 \pm 5^\circ\text{C}$, -30 dBm input level for RF attenuator: 0 dB or -5 dBm input level for RF attenuator: 25 dB, the same RF attenuator setting for both inputs)

50 Ω input

■ E5100A	
10 kHz $\leq$ freq. < 100 kHz	± 1 dB
100 kHz $\leq$ freq. $\leq$ 100 MHz	± 0.5 dB
100 MHz < freq. $\leq$ 300 MHz	± 1 dB
■ E5100B	
100 kHz $\leq$ freq. < 100 kHz	± 2 dB (SPC)
100 kHz $\leq$ freq. $\leq$ 100 MHz	± 1 dB (SPC)
100 MHz < freq. $\leq$ 300 MHz	± 2 dB (SPC)

1 M Ω input for option 101 or 301

(using 50 Ω feedthrough) ± 3 dB

Note Frequency response can be improved by calibration.



Dynamic Accuracy

(at $23 \pm 5^\circ\text{C}$, 10 Hz IF BW, -10 dBm reference input level relative to maximum input level, -20 dBm test input level relative to maximum input level, except for ramp frequency sweep)

Test Channel Input Level RF Attenuator		Dynamic Accuracy Frequency	
25 dB	0 dB	Other	10 kHz to 50 kHz
+5 to -5 dBm ¹	-20 to -30 dBm ²	± 0.4 dB	± 0.4 dB (SPC)
-5 to -15 dBm	-30 to -40 dBm	± 0.09 dB	± 0.09 dB (SPC)
-15 to -45 dBm	-40 to -70 dBm	± 0.05 dB	± 0.05 dB (SPC)
-45 to -55 dBm	-70 to -80 dBm	± 0.06 dB	± 0.1 dB (SPC)
-55 to -65 dBm	-80 to -90 dBm	± 0.1 dB	± 0.3 dB (SPC)
-65 to -75 dBm	-90 to -100 dBm	± 0.3 dB	± 0.9 dB (SPC)
-75 to -85 dBm	-100 to -110 dBm	± 0.9 dB	± 3 dB (SPC)
-85 to -95 dBm	-110 to -120 dBm	± 3 dB	N/A

1 0 to -5 dBm at 10 kHz to 200 kHz

2 -25 to -30 dBm at 10 kHz to 200 kHz

with option 100

(at $23 \pm 5^\circ\text{C}$, 10 Hz IF BW, -20 dB input-A level relative to maximum input level, except for ramp frequency sweep, right after measuring reference)

Test Channel Input Level RF Attenuator		Dynamic Accuracy Frequency	
25 dB	0 dB	Other	10 kHz to 50 kHz
+5 to -5 dBm ¹	-20 to -30 dBm ²	± 0.4 dB	± 0.4 dB (SPC)
-5 to -45 dBm	-30 to -70 dBm	± 0.1 dB	± 0.1 dB (SPC)
-45 to -55 dBm	-70 to -80 dBm	± 0.1 dB	± 0.2 dB (SPC)
-55 to -65 dBm	-80 to -90 dBm	± 0.2 dB	± 0.6 dB (SPC)
-65 to -75 dBm	-90 to -100 dBm	± 0.6 dB	± 1.8 dB (SPC)

1 0 to -5 dBm at 10 kHz to 200 kHz

2 -25 to -30 dBm at 10 kHz to 200 kHz

Trace Noise

(at 1 kHz IF BW, frequency > 305 kHz, -5 dBm input level for RF attenuator: 25 dB or -30 dBm input level for RF attenuator: 0 dB) < 10 mdB rms

Stability

..... 0.02 dB/ $^\circ\text{C}$ (SPC)

with option 100

(at $23 \pm 5^\circ$) 0.05 dB/ $^\circ\text{C}$ (SPC)

Phase Characteristics

(When the analyzer is equipped with option 100, delete this section.)

Measurement Mode Normal/Expanded

Frequency Response

(at $23 \pm 5^\circ\text{C}$, -30 dBm input level for RF attenuator: 0 dB or -5 dBm input level for RF attenuator: 25 dB , the same RF attenuator setting for both inputs, $50\ \Omega$ input)

- E5100A
 - $10\text{ kHz} \leq \text{freq.} < 100\text{ kHz}$ $\pm 5^\circ$
 - $100\text{ kHz} \leq \text{freq.} \leq 100\text{ MHz}$ $\pm 2.5^\circ$
 - $100\text{ MHz} < \text{freq.} \leq 300\text{ MHz}$ $\pm 5^\circ$
- E5100B
 - $100\text{ kHz} \leq \text{freq.} < 100\text{ kHz}$ $\pm 10^\circ$ (SPC)
 - $100\text{ kHz} \leq \text{freq.} \leq 100\text{ MHz}$ $\pm 5^\circ$ (SPC)
 - $100\text{ MHz} < \text{freq.} \leq 300\text{ MHz}$ $\pm 10^\circ$ (SPC)

Note This frequency response is only for the deviation from linear phase. Frequency response can be improved by calibration.



Dynamic Accuracy

(at $23 \pm 5^\circ\text{C}$, 10 Hz IF BW, -10 dBm reference input level relative to maximum input level, -20 dBm test input level relative to maximum input level, except for ramp frequency sweep)

Test Channel Input Level RF Attenuator		Dynamic Accuracy Frequency	
25 dB	0 dB	Other	10 kHz to 50 kHz
+5 to -5 dBm ¹	-20 to -30 dBm ²	$\pm 3^\circ$	$\pm 3^\circ$ (SPC)
-5 to -15 dBm	-30 to -40 dBm	$\pm 0.6^\circ$	$\pm 0.6^\circ$ (SPC)
-15 to -45 dBm	-40 to -70 dBm	$\pm 0.3^\circ$	$\pm 0.3^\circ$ (SPC)
-45 to -55 dBm	-70 to -80 dBm	$\pm 0.3^\circ$	$\pm 0.6^\circ$ (SPC)
-55 to -65 dBm	-80 to -90 dBm	$\pm 0.6^\circ$	$\pm 1.8^\circ$ (SPC)
-65 to -75 dBm	-90 to -100 dBm	$\pm 1.8^\circ$	$\pm 6^\circ$ (SPC)
-75 to -85 dBm	-100 to -110 dBm	$\pm 6^\circ$	$\pm 18^\circ$ (SPC)
-85 to -95 dBm	-110 to -120 dBm	$\pm 18^\circ$	N/A

1 0 to -5 dBm at 10 kHz to 200 kHz

2 -25 to -30 dBm at 10 kHz to 200 kHz

Trace Noise

(at 1 kHz IF BW, frequency $> 305\text{ kHz}$, -5 dBm input level for RF attenuator: 25 dB or -30 dBm input level for RF attenuator: 0 dB) $< 50\text{ mdeg rms}$

Stability $0.15\text{ deg}/^\circ\text{C}$ (SPC)

Delay Characteristics

Aperture Frequency $\frac{200}{N-1}$ % to 100% of span, where N is Number of Points

Accuracy (at 23 ±5°C, SPC)

In general, the following formula can be used to determine the accuracy, in seconds, of a specific group delay measurement:

$$\frac{PhaseAccuracy[deg]}{360[deg] \times Aperture[Hz]} (sec)$$

Depending on the aperture, input level, and device length, the phase accuracy used in either incremental phase accuracy or worst case phase accuracy.

General Characteristics

Operating Conditions

When disk drive is in operation

Temperature 10 to 40 °C

Humidity (at wet bulb ≤ 29°C, without condensation) 15% ≤ RH ≤ 80%

When disk drive is not in operation

Temperature 5 to 40 °C

Humidity (at wet bulb ≤ 29°C, without condensation) 15% ≤ RH ≤ 80%

Altitude 0 to 2,000 meters

Warm Up Time 30 minutes

Non-operating Conditions

Temperature -20 to 60 °C

Humidity (at wet bulb ≤ 40°C, without condensation) 15 % ≤ RH ≤ 90 %

Altitude 0 to 4,572 meters

Safety Certified by CSA-C22.2 No. 1010.1-92, Based on IEC 1010-1(1990) including Amendment 1 (1992)

EMC Complies with CISPR 11 (1990)/EN 55011(1991): Group 1, Class A

Complies with IEC 801-2 (1991)/EN 55082-1(1992): 4 kV CD, 8 kV AD

Complies with IEC 801-3 (1984)/EN 55082-1(1992): 3 V/m

Complies with IEC 801-4 (1988)/EN 55082-1(1992): 1 kV power lines, 0.5 kV signal lines

Note: When tested at 3 V/m according to IEC 801-3/1984, the averaging noise level will be within specifications over the full immunity test frequency range of 26 to 1000 MHz except when the analyzer frequency is identical to the transmitted interference signal test frequency.

Power Requirement 90 to 132 V or 198 to 264 V, 47 to 63 Hz, 400 VA max

Weight (depending on option) 12 kg (SPC)

Cabinet Dimensions 425(W) × 177(H) × 425(D) mm (SPC)

Supplemental Characteristics

Measurement Function

Number of Measurement Channels	1 to 4
Display Format	Cartesian
Sweep Parameter	frequency, power
Sweep Type	
E5100A	linear (step, ramp), list
E5100B	linear (step, ramp)
Measurement Point per Sweep	
E5100A	2 to 1601
E5100B	2 to 401

Others

Measurement Calibration	Response, Response & Isolation, 1-Port 3-term
Display	
.....	6.3 inch monochrome LCD, 640×480 dots
option 030	6.5 inch color LCD, 640×480 dots
Flexible Disk Drive	720 Kbytes/1.2 Mbytes/1.44 Mbytes, DOS format, binary or ASCII format
Flash Disk	256 Kbytes
Ram Disk	256 Kbytes
Programming	HP Instrument BASIC
HP-IB	ANSI/IEEE 488.2 compatible.
Parallel I/O Port	
.....	16 bit output, 8 bit input/output, TTL level
option 005	8 bit output, 4 bit input, TTL level
option 006	16 bit output, 8 bit input/output, TTL level
option 007	16 bit output, 8 bit input, open collector, opto-isolated
Printer	Parallel I/F (Centronics compatible), HP PCL
Keyboard	DIN (IBM PC compatible)
External Video Monitor Output	VGA

Connectors

Probe Power	+15 V(300 mA max.), −12.6 V(160 mA max.), GND nominal
(the maximum current values are total values of each probe connector)	
EXT REF INPUT 10 MHz	
Frequency	10 MHz ±5 ppm
Amplitude	0 ±5 dBm (SPC)
Nominal Impedance	50 Ω
REF OVEN (OPTION 1D5)	

Frequency (at 0 to 55 °C, 20 minutes after power ON)..... 10 MHz $\pm$ 1.0 ppm
 Amplitude 2 $\pm$ 5 dBm (SPC)
 Nominal Impedance 50 Ω

INT REF OUTPUT

Frequency (at 23 $\pm$ 5 °C)..... 10 MHz $\pm$ 20 ppm
 Amplitude 0 $\pm$ 5 dBm (SPC)
 Nominal Impedance 50 Ω

EXT TRIGGER and EXT PROG RUN/CONT

(Positive edge trigger)

V_{ih} +2 V to +5 V (SPC)
 V_{il} 0 V to +0.5 V (SPC)
 Sink current (I_s) I_s $\leq$ 0.4 mA (SPC)
 Pulse width (T_p) T_p $\geq$ 20 μ sec (SPC)

Furnished Accessories

Accessory	HP part number	Accessory	HP part number
Function Reference	E5100-90000	BNC Adapter ¹	1250-1859
User's Guide	E5100-90001	HP Instrument BASIC Manual Set ²	E2083-90005
Programming Manual	E5100-90007	DIN Keyboard ³	HP C1405B #ABA
Sample Program Disk	E5100-61001		

1 Only option 1D5.

2 Option UKR, delete this item.

3 Only option 1F0

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