Agilent
4396B 1.8 GHz Network/Spectrum/Impedance Analyzer
Data Sheet

Specifications describe the instrument's warranted performance over the temperature range of 0 °C to 40 °C (except as noted). Supplemental characteristics are intended to provide information that is useful in applying the instrument by giving non-warranted performance parameters. These are denoted as *typical, typically, nominal,* or *approximate*. Warm-up time must be greater than or equal to 30 minutes after power on for all specifications.

Network Measurement

Source characteristics

Frequency characteristics (Option 4396B-800)

- **Range** . . . . . 100 kHz to 1.8 GHz
- **Resolution** . . . . . ≤ 1 mHz
- **Frequency reference**
  - **Accuracy**
    - 23 ±5 °C, referenced to 23 °C . . . . . < ±5.5 ppm/year
  - **Aging** . . . . . < ±2.5 ppm/year typically
  - **Initial achievable accuracy** . . . . . < ±1.0 ppm typically
  - **Temperature stability**
    - 23 ±5 °C, referenced to 23 °C . . . . . < ±2 ppm typically
- **Precision frequency reference (Option 4396B-1D5)**
  - **Accuracy**
    - 0 °C to 40 °C, referenced to 23 °C . . . . . < ±0.13 ppm/year
  - **Aging** . . . . . < ±0.1 ppm/year typically
  - **Initial achievable accuracy** . . . . . < ±0.02 ppm typically
  - **Temperature stability**
    - 0 °C to 40 °C, referenced to 23 °C . . . . . < ±0.01 ppm typically

Output Characteristics

Power range . . . . . –60 dBm to +20 dBm
Power sweep range . . . . . 20 dB
Power sweep linearity
23 ±5 °C, 50 MHz, relative to stop power . . . . . ±0.5 dB
Resolution . . . . . 0.1 dB
Flatness
23 ±5 °C, relative to 50 MHz, 0 dBm output . . . . . ±1.0 dB
Level accuracy
23 ±5 °C, 50 MHz, 0 dBm output . . . . . < ± 0.5 dB

Level linearity

Output power	Linearity[1]
–20 dBm ≤ power ≤ +20 dBm	±0.7 dB
–40 dBm ≤ power < –20 dBm	±1.0 dB
–60 dBm ≤ power < –40 dBm	±1.5 dB

Spectral purity characteristics
Harmonics
+15 dBm output . . . . . < –30 dBc
Non-harmonics spurious
+15 dBm output . . . . . < –30 dBc
Noise sidebands
SPAN = 0, IFBW (or RBW) ≤ 3 kHz
frequency ≤ 1 GHz
≥ 10 kHz offset from carrier . . . . . < –105 dBc/Hz typically
≥ 1 MHz offset from carrier . . . . . < –110 dBc/Hz typically
frequency > 1 GHz . . . . . Add [20 log(*frequency(GHz*))] typically
Impedance . . . . . 50 Ω nominal
Return loss
≤ 0 dBm,100 MHz < frequency ≤ 1.8 GHz . . . . . > 14 dB typically
≤ 0 dBm, 100 kHz ≤ frequency ≤ 100 MHz . . . . . > 23 dB typically
Connector . . . . . Type-N female

1. At 23 ±5 °C, relative to 0 dBm output

Receiver Characteristics

Input characteristics

Frequency range

IFBW ≤ 3 kHz . . . . . .100 kHz to 1.8 GHz

IFBW = 10 kHz, 40 kHz . . . . . .1 MHz to 1.8 GHz

Full scale input level

R input . . . . . .+20 dBm

A, B inputs . . . . . .–5 dBm

IF bandwidth (IFBW) . . . . . .10, 30, 100, 300, 1 k, 3 k, 10 k, 40 kHz

Noise level

Frequency	Input port	Noise level IFBW = 10 Hz	Noise level IFBW = 40 kHz
100 k ≤ freq. < 10 MHz	R	< –85 dBm	< –50 dBm
100 k ≤ freq. < 10 MHz	A, B	< –110 dBm	< –75 dBm
10 MHz ≤ freq.	R	< [–100 + 3 f] dBm[1]	< [–65 + 3 f] dBm[1]
10 MHz ≤ freq.	A, B	< [–125 + 3 f] dBm[1]	< [–90 + 3 f] dBm[1]

Input crosstalk

≥ 300 kHz

A to/from B . . . . . .< –100 dB

R to A, B . . . . . .< –120 dB

A, B to R . . . . . .< –80 dB

Source crosstalk (A, B)

≥ 300 kHz . . . . . .< –124 dB typically

Maximum safe input level . . . . . .+20 dBm or ±25 Vdc typically

Connector . . . . . .Type-N female

Impedance . . . . . .50 Ω nominal

Return loss

frequency ≥ 500 kHz . . . . . .> 20 dB

100 kHz ≤ frequency < 500 kHz . . . . . .> 12 dB typically

3 MHz ≤ frequency ≤ 50 MHz . . . . . > 35 dB typically

Multiplexer switching impedance change . . . . . .< 1 Ω typically

1. f is measurement frequency (GHz).

Magnitude Characteristics

Absolute amplitude accuracy (R, A, B)

–20 dBm input, 23 ±5 °C . . . . . .< ±1.5 dB (±0.9 dB typically)

Ratio accuracy (A/R, B/R)

–20 dBm input, 23 ±5 °C, IFBW ≤ 3 kHz

100 k ≤ frequency < 1 MHz . . . . . .< ±1 dB (±0.6 dB typically)

frequency ≥ 1 MHz . . . . . .< ±0.5 dB (±0.3 dB typically)

Dynamic accuracy (A/R, B/R)

Input level (relative to full scale input level) [1]	Dynamic accuracy [2]
0 dB	< ±0.3 dB
–10 dB to –70 dB	< ±0.05 dB
–80 dB	< ±0.1 dB
–90 dB	< ±0.3 dB
–100 dB	< ±1.0 dB
–110 dB	< ±0.8 dB typically
–120 dB	< ±2.5 dB typically

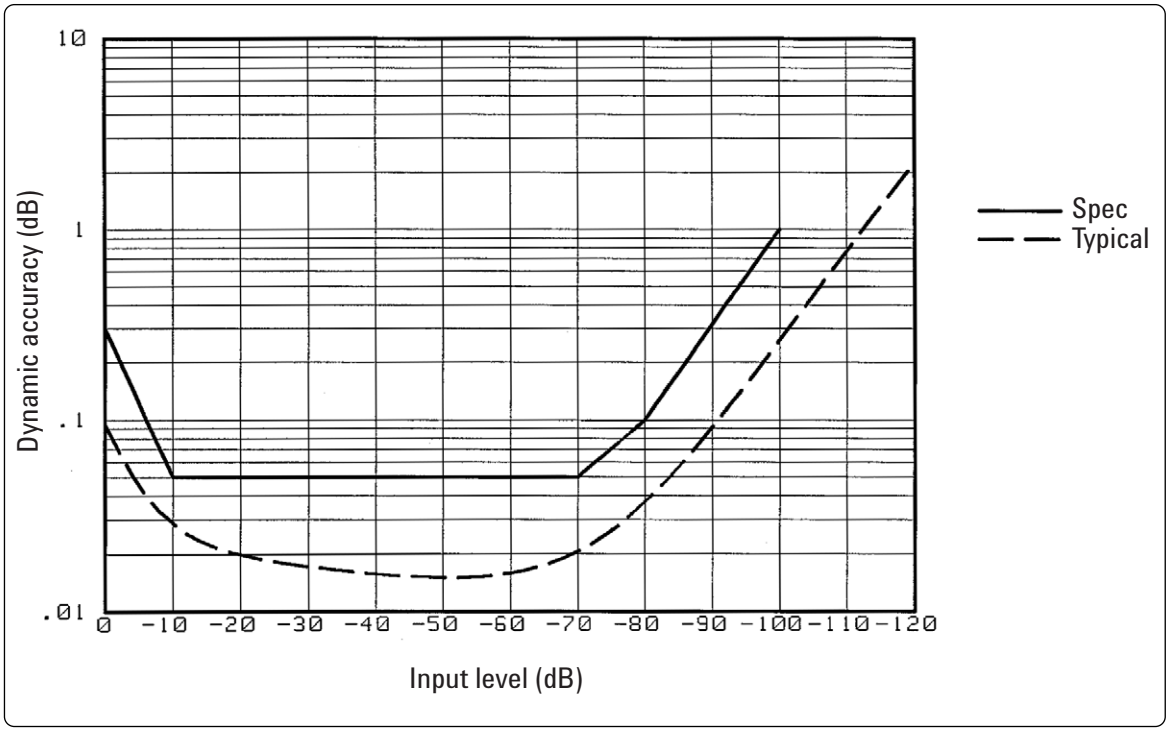


Figure 1. Magnitude dynamic accuracy

Residual responses

A, B inputs, frequency ≥ 3 MHz . . . . . .< –95 dBm typically

R input, frequency ≥ 3 MHz . . . . . .< –70 dBm typically

See "EMC" under "Others" in "Common Specifications for Network and Spectrum Measurement."

Trace noise

A/R, B/R measurement,

–10 dBm input, IFBW = 300 Hz . . . . . .< 0.002 dB rms typically

Stability 0.01 dB/°C typically

1. Full scale input level = –5 dBm
2. At 23 ±5 °C, IFBW = 10Hz, R input = –35 dBm, Reference power level = –35 dBm

Phase Characteristics

Measurements format . . . . . .Phase format, expanded phase format

Frequency response (deviation from linear phase) (A/R, B/R)

–20 dBm input, 23 ±5 °C, IFBW ≤ 3 kHz

100 k ≤ frequency < 1 MHz . . . . . .< ±6 deg (±4 deg typically)

frequency ≥ 1 MHz . . . . . < ±3 deg (±2 deg typically)

Dynamic accuracy (A/R, B/R)

Input level (relative to full scale input level) [1]	Dynamic accuracy [2]
0 dB	< ±3 deg
–10 dB	< ±0.6 deg
–20 dB to –70 dB	< ±0.3 deg
–80 dB	< ±0.7 deg
–90 dB	< ±2.3 deg
–100 dB	< ±7 deg
–110 dB	< ±8 deg typically
–120 dB	< ±25 deg typically

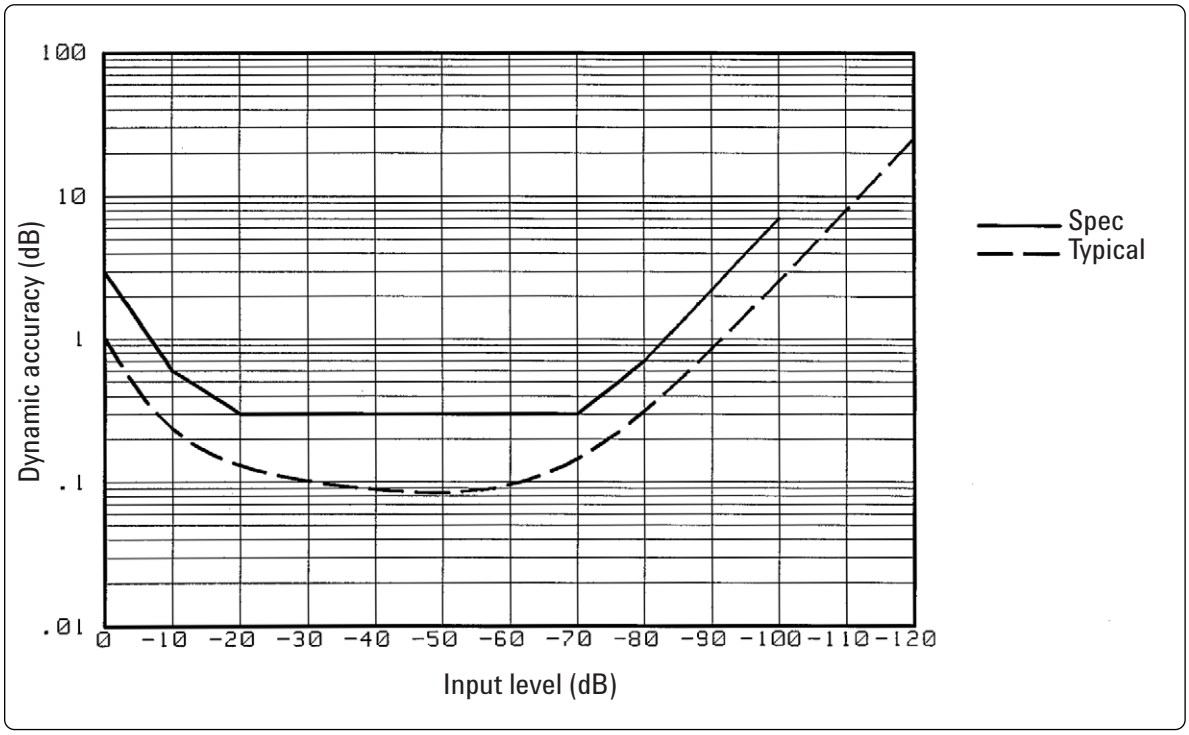


Figure 2. Phase dynamic accuracy

Trace noise

A/R, B/R measurement,

–10 dBm input, IFBW = 300 Hz . . . . . .< 0.04 deg rms typically

Stability . . . . . 0.1 deg/°C typically

1. Full scale input level = –5 dBm
2. At 23 ±5 °C, IFBW = 10 Hz, R input = –35 dBm, Reference power level = –35 dBm

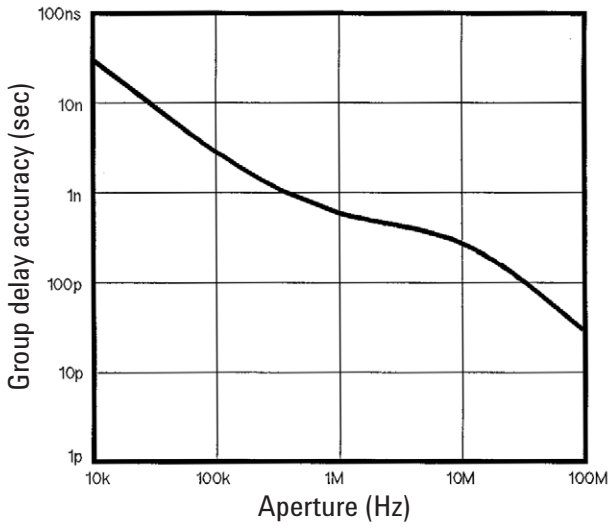
Group Delay Characteristics

Accuracy

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

23 ±5 °C . . . . . $\frac{phaseAccuracy(deg)}{Aperture(Hz) \times 360\ deg)}$

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



@ 1.8 GHz
with 7 mm full 2-port calibration
Device electrical length 10 m
with insertion loss of less than 1 dB

Figure 3. Typical group delay accuracy

Sweep Characteristics

Sweep type . . . . . .Linear frequency, log frequency, power, list frequency
Trigger type . . . . . .Hold, single, number of groups, continuous
Trigger source . . . . . .Free run, external, manual, GPIB (bus)
Event trigger . . . . . .On point, On sweep

Spectrum Measurement

Specifications in this section describe the instrument's warranted performance for spectrum measurement using S input (except as noted).

Frequency Characteristics

Frequency range . . . . . .2 Hz to 1.8 GHz

Frequency readout accuracy

. . . . . .±((*freq readout*) x (*freq ref accuracy*) + *RBW* + $\frac{SPAN}{NOP}$))

where NOP means number of display points

Frequency reference (Option 4396B-800)

Accuracy

23 ±5 °C, referenced to 23 °C . . . . . .< ±5.5 ppm/year

Aging . . . . . .< ±2.5 ppm/year typically

Initial achievable accuracy . . . . . .< ±1 ppm typically

Temperature stability

23 ±5 °C, referenced to 23 °C . . . . . .< ±2 ppm typically

Precision frequency reference (Option 4396B-1D5)

Accuracy

0 °C to 40 °C, referenced to 23 °C . . . . . < ±0.13 ppm/year

Aging . . . . . .< ±0.1 ppm/year typically

Initial achievable accuracy . . . . . .< ±0.02 ppm typically

Temperature stability

0 °C to 40 °C, referenced to 23 °C . . . . . .< ±0.01 ppm typically

Resolution bandwidth (RBW)

Range . . . . . .1 Hz to 3 MHz, 1-3-10 step

Selectivity (60 dB BW/3 dB BW)

RBW ≥ 10 kHz . . . . . .< 10

RBW ≤ 3 kHz . . . . . .< 3

Accuracy

RBW ≥ 10 kHz . . . . . .< ±20%

RBW ≤ 3 kHz . . . . . .< ±10%

Video bandwidth

Range . . . . . .0.003 Hz to 3 MHz, 1-3-10 step, 1 ≤ RBW/VBW ≤ 300

Noise sidebands

Offset from carrier	Noise sidebands[1]
≥ 1 kHz	< –95 dBc/Hz
≥ 10 kHz	< –105 dBc/Hz
≥ 1 MHz	< –110 dBc/Hz

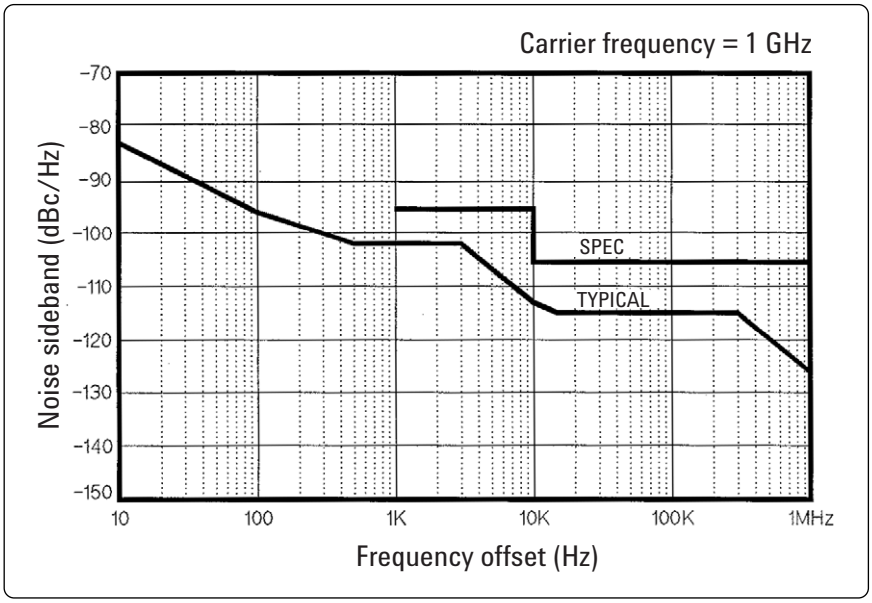


Figure 4. typical noise sidebands (with Option 4396B-1D5)

Residual FM

RBW ≤ 10 Hz

Option 4396B-800 . . . . . .< 1 x *f* (*GHz*) $Hz_{pk\text{-}pk}$ in 10 sec typically

Frequency = 1 GHz . . . . . .< 1 $Hz_{pk\text{-}pk}$ typically

Option 4396B-1D5 . . . . . .< 0.1 x *f* (*GHz*) $HZ_{pk\text{-}pk}$ in 10 sec typically

Frequency = 1 GHz . . . . . < 0.1 $Hz_{pk\text{-}pk}$ typically

RBW ≤ 1 kHz . . . . . .< 3 $Hz_{pk\text{-}pk}$ in 100 msec typically

1. Center frequency ≤ 1 GHz. Add [20log(frequency(GHz))] for frequency > 1 GHz.

On-screen dynamic range

1 GHz center frequency, may be limited by average noise level.

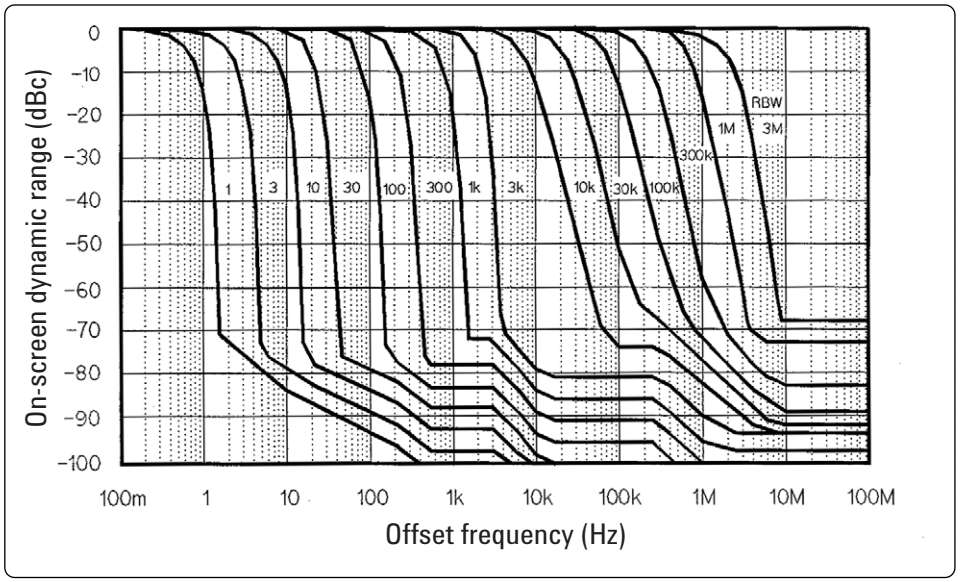


Figure 5. Typical on-screen dynamic range

Amplitude characteristics

Amplitude range . . . . . .Displayed average noise level to +30 dBm
Reference level range . . . . . .–100 dBm to +30 dBm
(or equivalent in dBµV, dBV, V, W)

Scale
Log . . . . . .0.1 dB/div to 20 dB/div
Linear
Watt . . . . . .1.0 x 10^{-12} W/div
Volt . . . . . .1.0 x 10^{-9} V/div
Measurement format . . . . . .SPECTRUM or NOISE (/HZ)
Display unit . . . . . .dBm, dBµV, dBV, Volts, Watts

Typical Dynamic Range

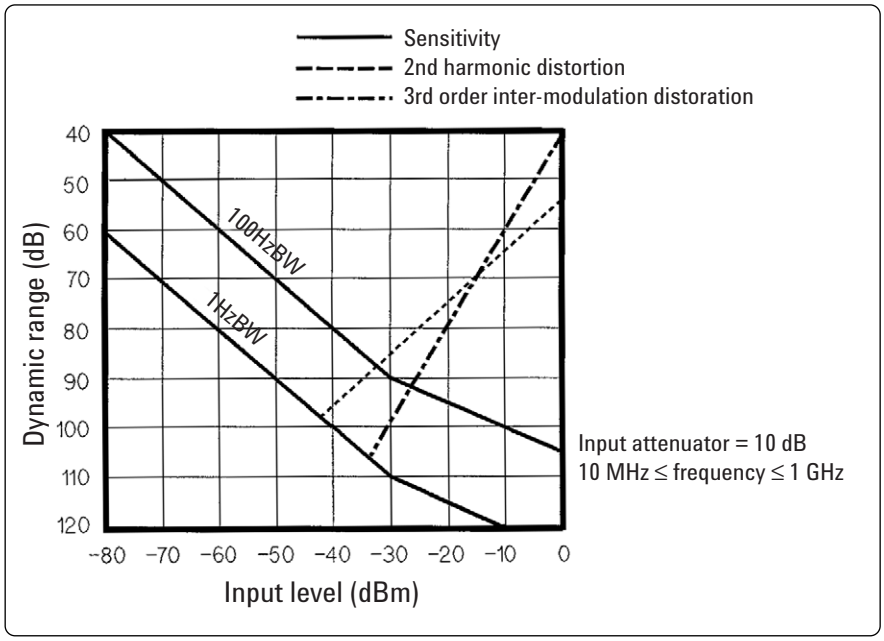


Figure 6. Typical dynamic range at S input

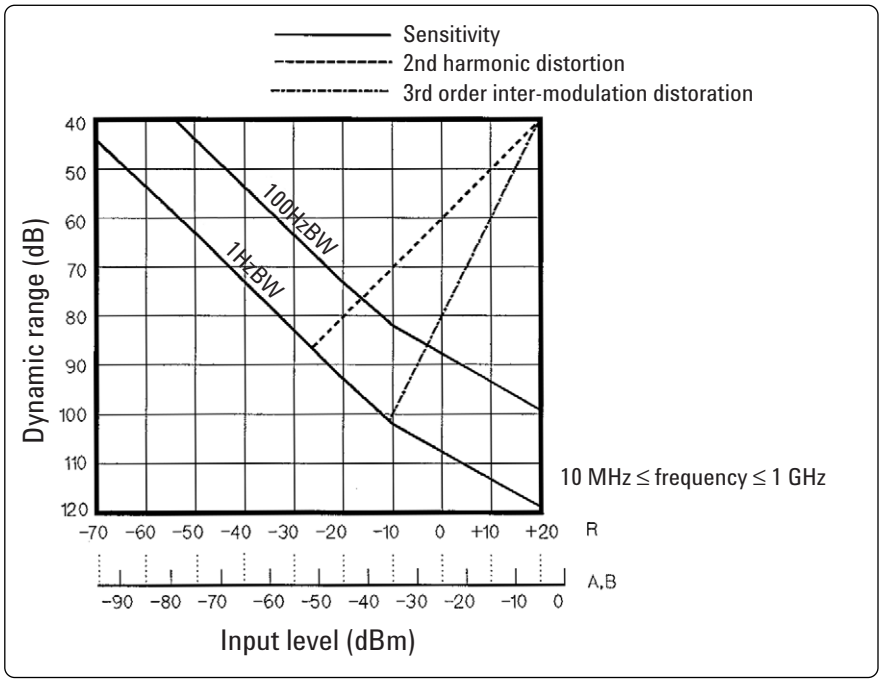


Figure 7. Typical dynamic range at R, A, and B inputs

Spurious responses

Second harmonic distortion

≥ 10 MHz, –35 dBm mixer input . . . . . .< –70 dBc

< 10 MHz, –35 dBm mixer input . . . . . .< –60 dBc

Third order intermodulation distortion

each input mixer level of two tones = –30 dBm, separation ≥ 20 kHz

≥ 10 MHz . . . . . .< –75 dBc

< 10 MHz . . . . . .< –65 dBc

Other spurious

–30 dBm mixer input, offset ≥ 1 kHz . . . . . .< –70 dBc

Residual response

≥ 3 MHz, 0 dB attenuator . . . . . .< –100 dBm

1 kHz ≤ frequency < 3 MHz, 0 dB attenuator . . . . . .< –90 dBm

See "EMC" under "Others" in "Common Specifications for Network . . . . . and Spectrum Measurement."

Local oscillator feedthrough . . . .< –25 dBm input mixer level equivalent typically

Gain compression

≥ 10 MHz, input mixer level < –10 dBm . . . . . .< 0.3 dB typically

Displayed average noise level

frequency ≥ 10 MHz,

ref. level ≤ –40 dBm, att. = 0 dB . . . . . < [–150 + 3*f* (*GHz)*] dBm/Hz

10 kHz ≤ frequency < 10 MHz,

ref. level ≤ –40 dBm, att. = 0 dB . . . . . .< –125 dBm/Hz

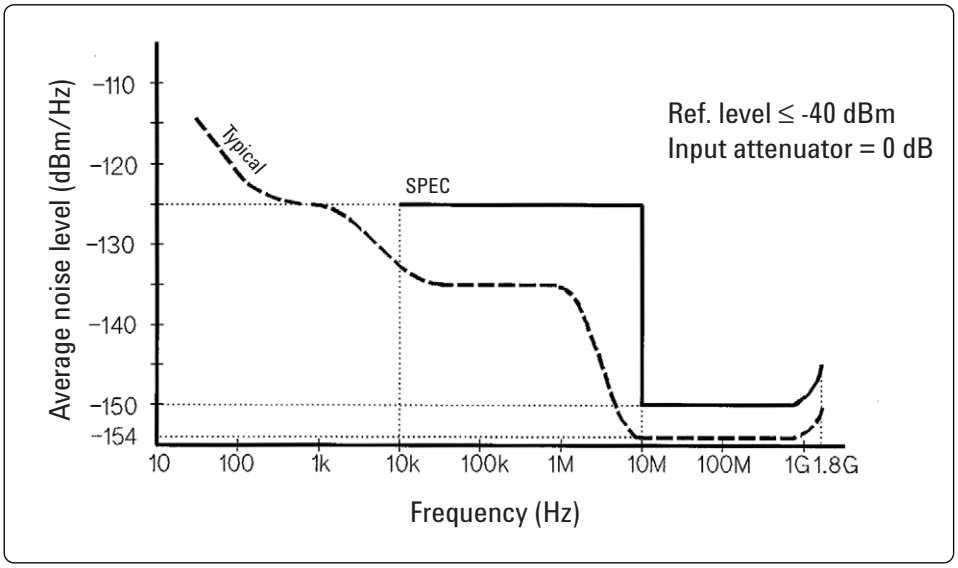


Figure 8. Typical displayed average noise level

Maximum safe input level

Average continuous power . . . . . .+30 dBm (1 W)

Peak pulse power

Pulse width < 10 µs,

duty cycle < 1%, input attenuator ≥ 30 dB . . . . . .+50 dBm (100 W)

dc voltage . . . . . .0 Vdc

Input attenuator

Range . . . . . .0 dB to 60 dB, 10 dB step

Level accuracy

Calibrator accuracy (–20 dBm 20 MHz) . . . . . .< ±0.4 dB (±0.2 dB typically)

Frequency response

2 ±5 °C, aft. = 10 dB, referenced to level at 20 MHz

10 MHz ≤ frequency ≤ 1.8 GHz . . . . . .< ±0.5 dB (±0.3 dB typically)

2 Hz ≤ frequency < 10 MHz . . . . . .< ±1.5 dB (±0.8 dB typically)

Amplitude fidelity

Log scale

Range (dB from ref. level)	Amplitude fidelity @ 1 Hz ≤ RBW ≤ 3 kHz Spec.	Typical	Amplitude fidelity [1] @ 10 kHz ≤ RBW ≤ 300 kHz Spec.	Typical	Amplitude fidelity [1] @ 1 MHz ≤ RBW ≤ 3 MHz Spec.	Typical
0 dB ≥ range ≥ –30 dB	±0.05 dB	±0.02 dB	±0.3 dB	±0.12 dB	±1.0 dB	±0.4 dB
–30 dB > range ≥ –40 dB	±0.07 dB	±0.03 dB	±0.3 dB	±0.12 dB	±1.0 dB	±0.4 dB
–40 dB > range ≥ –50 dB	±0.12 dB	±0.05 dB	±0.4 dB	±0.15 dB	±1.2 dB	±0.5 dB
–50 dB > range ≥ –60 dB	±0.4 dB	±0.12 dB	±0.7 dB	±0.3 dB	±1.4 dB	±0.6 dB
–60 dB > range ≥ –l0 dB	±1.2 dB	±0.8 dB	±1.5 dB	±0.6 dB	±2.2 dB	±0.8 dB
–10 dB > range ≥ –80 dB	±4 dB	±1 dB	±4.3 dB	±1.2 dB	–	–
–80 dB > range ≥ –90 dB	–	+3 dB	–	–	–	–
–90 dB > range ≥ –100 dB	–	±10 dB	–	–	–	–

For small signal measurement, fidelity is degraded by noise floor according to below formula:

$20\log_{10}(1 \pm 10^{\frac{-x}{20}} \times 3.5)$ dB typically

where x is signal to noise floor ratio in dB.

This fidelity error can be reduced by narrower video bandwidth or sweep averaging.

Linear scale

23 ±5 °C, –10 dBm ≥ [*ref level – input att*] ≥ –50 dBm except for gain compression

RBW ≤ 300 kHz . . . . . .< ±3% of reference level

RBW ≥ 1 MHz . . . . . .< ±10% of reference level

IF gain switching uncertainty

input att. fixed, referenced to –20 dBm [*ref. level – input acct*] . . .< ±0.3 dB

Input attenuator switching uncertainty

20 dB to 40 dB, referenced to 10 dB . . . . . .< ±1.0 dB

50 dB to 60 dB, referenced to 10 dB . . . . . .< ±1.5 dB

RBW switching uncertainty

SPAN < 100 x RBW for RBW ≥10 kHz,

23 ±5 °C, referenced to 10 kHz RBW . . . . . < ±0.5 dB

Temperature drift

S input . . . . . .0.05 dB/°C typically

R, A, B inputs . . . . . 0.1 dB/°C typically

1. At 23 ±5 °C, 10 dBm ≥ [ref. level input att] > –50 dBm except for gain compression

Sweep characteristics

Sweep type . . . . . .Linear, zero span, list
Trigger type . . . . . .Hold, single, number of groups, continuous
Trigger source . . . . . .Free run, external, video, manual, gate

Sweep time

RBW	SPAN	Typical sweep time
3 MHz	1.8 GHz	40 ms
1 MHz	1 GHz	60 ms
300 kHz	1 GHz	340 ms
100 kHz	100 MHz	100 ms
30 kHz	100 MHz	460 ms
10 kHz	10 MHz	400 ms
3 kHz	10 MHz	2.4 s
1 kHz	1 MHz	651 ms
300 Hz	1 MHz	3 s
100 Hz	100 kHz	1.4 s
30 Hz	100 kHz	3.2 s
10 Hz	10 kHz	1.5 s
3 Hz	10 kHz	12 s
1 Hz	1 kHz	11 s
–	Zero Span	–[1]

Zero span

Normal zero span . . . . . .≥ 25 µs/display point
Repetitive zero span . . . . . ≥ 0.5 µs/display point

Number of display points

span ≠ zero
RBW ≥ 10 kHz
Sweep time = auto . . . . . .801 points (fixed)
Sweep time = manual . . . . . ≤ 801 points (automatically set)
RBW ≤ 3 kHz . . . . . .≤ 801 points (automatically set)
span = zero . . . . . .2 to 801 points (selectable)

1. See the next item for sweep time at zero span.

Input and Output Characteristics

RF input

Connector . . . . . .Type-N female

Impedance . . . . . .50 Ω nominal

Return Loss

S input

> 50 MHz, input att. ≥ 10 dB . . . . . .> 14 dB typically

≤ 50 MHz, input att. ≥ 10 dB . . . . . .> 25 dB typically

R, A, B inputs . . . . . same as network measurement

Coupling

S input . . . . . .DC

R, A, B inputs . . . . . .AC

Crosstalk

S Input, input att = 10 dB

S input to A, B inputs . . . . . .< –30 dB typically

A, B inputs to S input . . . . . .< –22 dB typically

Cal output

Connector . . . . . .BNC female

Impedance . . . . . .50 Ω

Output frequency . . . . . .20 MHz

Output level . . . . . .–20 dBm ±0.4 dB

Return loss . . . . . .> 26 dB typically

Specifications when Option 4396B-1D6 time-gated spectrum analysis is installed

Gate length

Range . . . . . .2 µs to 3.2 s

Resolution

Range of gate length (T_g)	Resolution
2 µs ≤ T_g ≤ 32 ms	0.5 µs
32 ms < T_g ≤ 64 ms	1 µs
64 ms < T_g ≤ 160 ms	2.5 µs
160 ms < T_g ≤ 320 ms	5 µs
320 ms < T_g ≤ 1.28 s	20 µs
1.28 ms < T_g ≤ 3.2 s	100 µs

Gate delay

Range . . . . . .2 µs to 3.2 s

Resolution

Range of gate delay (T_d)	Resolution
2 µs ≤ T_d ≤ 32 ms	0.5 µs
32 ms < T_d ≤ 64 ms	1 µs
64 ms < T_d ≤ 160 ms	2.5 µs
160 ms < T_d ≤ 320 ms	5 µs
320 ms < T_d ≤ 1.28 s	20 µs
1.28 ms < T_d ≤ 3.2 s	100 µs

Additional amplitude error

Log scale . . . . . < 0.3 dB typically

Linear scale . . . . . < 3% typically

Gate control modes . . . . . Edge pos, Edge neg, or level

Gate trigger input (external trigger input is used)

Connector . . . . . BNC female

Trigger level . . . . . TTL

Gate output

Connector . . . . . BNC female

Output level. . . . . TTL

Specifications with Option 4396B-1D7 50 Ω to 75 Ω input impedance conversion

All specifications are identical to the standard 4396B except the following items.

Amplitude range . . . . . Displayed average noise level to 24 dBm

Displayed average noise level

≥ 10 MHz . . . . . < [–148 + 3*f* (*GHz*)] dBm/Hz typically

Level accuracy

20 MHz, after level cal . . . . . < ±0.4 dB typically

Frequency response

input attenuator = 10 dB . . . . . < ±0.5 dB typically

Impedance Measurement (Option 4396B-010)

Measurement functions

Measurement parameters . . . . . .Z, Y, L, C, Q, R, X, G, B, θ
Display parameters . . . . . .[Z], θ_z, R, X, [Y], θ_y, G, B,
[Γ], θ_g, Γ_x, Γ_y, Cp, Cs, Lp, Ls, Rp, Rs, D, Q

Display formats

- Vertical lin/log scale
- Complex plane
- Polar/Smith/admittance chart

Sweep parameters

- Linear frequency sweep
- Logarithmic frequency sweep
- List frequency sweep
- Linear power sweep (dBm)

IF bandwidth

- 10, 30, 100, 300,1 k, 3 k, 10 k, 40 k [Hz]

Calibration

- OPEN/SHORT/LOAD 3 term calibration
- Fixture compensation
- Port extension correction

Unknown port

- 7-mm connector

Output characteristics[1]

Frequency range . . . . . 100 kHz to 1.8 GHz
Frequency resolution . . . . . .1 mHz
Output level . . . . . –60 to +20 dBm (@RF OUT port)
Output level accuracy . . . . . A + B + 6 [dB] x F/(1.8 x 10^9)

Where,
A = 2 dB (±5 °C)
B = 0 dB(GSC ≤ 0 dBm), or 1 dB (–40 ≤ GSC < 0 dBm),
or 2 dB (–60 ≤ GSC < –40 dBm)

F is output frequency.

Output level resolution . . . . . .0.1 dB
Measurement port impedance . . . . . .Nominal 50 Ω

1. Signal level at the measurement port is 6 dB lower than the RF GUT port when the measurement port is terminated by 50 Ω.

External DC bias input[1]

Maximum voltage . . . . . .±40 V
Maximum current . . . . . .20 mA

Measurement Basic Accuracy (Supplemental Performance Characteristics)

Measurement accuracy is specified at the connecting surface of the 7-mm connector of the 43961A under the following conditions:

Warm-up time . . . . . .> 30 minutes
Ambient temperature . . . . . .23 °C ±5 °C
(at the same temperature at which calibration was performed)
Signal level (@50 Ω terminated) . . . . . –6 to 14 dBm
Correction . . . . . .ON
IFBW . . . . . .≤ 300 Hz
Averaging (cal) . . . . . ≥ 8

1. 2 kΩ ±5% resistor is inserted for DC bias current limitation.

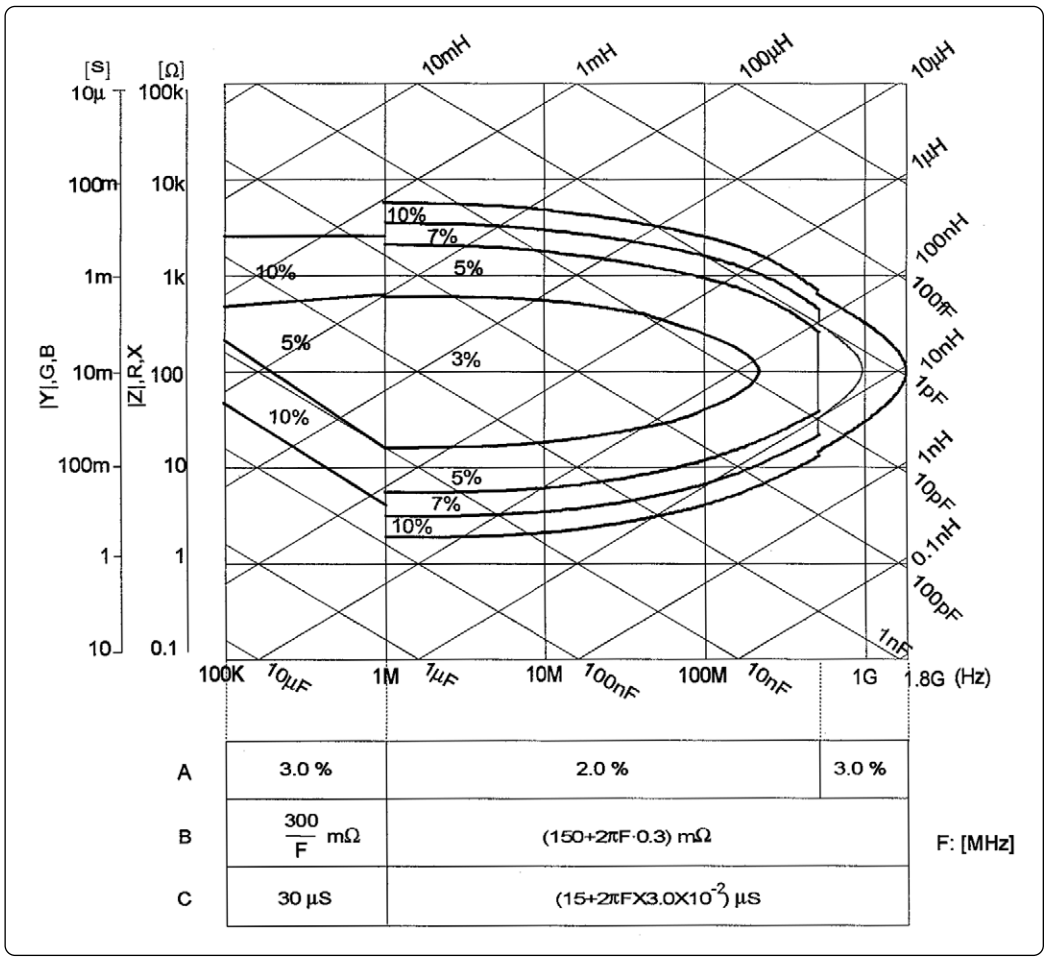


Figure 9. Impedance measurement accuracy

|Z| – θ accuracy

|Z| accuracy $Z_a = A + (B/|Z_m| + C \times |Z_m|) \times 100[\%]$

θ accuracy $\theta_a = sin^{-1}(Za/100)$

Where, is $|Z_m|$ is |Z| measured. A, B, and C are obtained from Figure 9.

|Y| – θ accuracy

|Y| accuracy $Y_a = A + (B \times |Y_m| + C/|Y_m|) \times 100[\%]$
θ accuracy $\theta_a = \sin^{-1}(Y_a/100)$

Where, $|Y_m|$ is |Y| measured. A, B, and C are obtained from Figure 9.

R – X accuracy (depends on D)

Accuracy	D ≤ 0.2	0.2 < D ≤ 5	5 < D
R_a	$\pm X_m \times X_a/100[\Omega]$	$R_a/\cos\theta$ [%]	R_a[%]
X_a	X_a[%]	$X_a/\sin\theta$ [%]	$\pm R_m \times X_a/100[\Omega]$

Where,

D can be calculated as: R/X, or
$R/(2\pi f \times L_s)$, or
$R \times 2\pi f \times C_s$

θ can be calculated as: $\tan^{-1}(X/R)$, or
$\tan^{-1}(2\pi f \times L_s/R)$, or
$\tan^{-1}(1/(R \times 2\pi f \times C_s))$

$R_a = A + (B/|R_m| + C \times |R_m|) \times 100$ [%]
$X_a = A + (B/|X_m| + C \times |X_m|) \times 100$ [%]
R_m and X_m are the measured R and X, respectively. A, B, and C are obtained from Figure 9.

G – B accuracy (depends on D)

Accuracy	D ≤ 0.2	0.2 < D ≤ 5	5 < D
G_a	$\pm B_m \times B_a/100[S]$	$G_a/\cos\theta$ [%]	G_a[%]
B_a	B_a[%]	$B_a/\sin\theta$ [%]	$\pm G_m \times G_a/100[S]$

Where,

D can be calculated as: G/B, or
$G/(2\pi f \times C_p)$, or
$G \times 2\pi f \times L_p$

θ can be calculated as: $\tan^{-1}(B/G)$, or
$\tan^{-1}(2\pi f \times C_p/G)$, or
$\tan^{-1}(1/(G \times 2\pi f \times L_p))$

$G_a = A + (B/|G_m| + C \times |G_m|) \times 100$ [%]
$B_a = A + (B/|B_m| + C \times |B_m|) \times 100$ [%]
G_m and B_m are the measured R and B, respectively. A, B, and C are obtained from Figure 9.

D accuracy

Accuracy	D ≤ 0.2	0.2 < D
D_a	$z_a/100$	$(z_a/100) \times (1 + D^2)$

Where Z_a is |Z| accuracy.

L accuracy (depends on D)

Accuracy	D ≤ 0.2	0.2 < D
L_a	$L_a/100$	$L_a(1 + D^2)$

Where,
L_α = A + (B/|Z_1| + C x |Z_1| x 100[%]
|Z_1| = $2\pi f$ x L_m, f is frequency in Hz, and L_m is measured L. A, B, and C are obtained from Figure 9.

C accuracy (depends on D)

Accuracy	D ≤ 0.2	0.2 < D
C_a	C_a	$C_a(1 + D^2)$

Where,
C_α = A + (B/|Z_c| + C x |Z_c| x 100[%]
|Z_c| = $2\pi f$ x C_m, f is frequency in Hz, and C_m is measured C. A, B, and C are obtained from Figure 9.

Common Specifications for Network and Spectrum Measurement

Display

TFT LCD

Size/type . . . . . .8.4 inch color LCD
Resolution . . . . . .640 x 480
Effective display area . . . . . .115 mm x 160 mm (430 x 600 dots)
Number of display channels 2
Format . . . . . .Single, dual split or overwrite, graphic, and tabular
Number of traces
For measurement . . . . . .2 traces
For memory . . . . . .2 traces
Data math . . . . . .*Gain* x *data* – *offset*,
gain x *memory* – *offset*,
gain x *(data memory)* – *offset*,
gain x (*data* + *memory*) – *offset*,
gain x (*data*/*memory*) – *offset*
Data hold . . . . . .Maximum hold, minimum hold

Marker

Number of markers
Main marker . . . . . .1 for each channel
Submarker . . . . . .7 for each channel
Δ **marker** . . . . . .1 for each channel

Storage

Type . . . . . Built-in flexible disk drive, volatile RAM disk memory
Disk format . . . . . .LIF, DOS

GPIB

Interface . . . . . .IEEE 488.1-1987, IEEE 488.2-1987,
IEC 625, and JIS C 1901-1987 standards compatible
Interface function SH1, AH1, T6, TE0, L4, LE0, SR1, RL1,
PP0, DC 1, DT1, C1, C2, C3, C4, C11, E2
Data transfer formats . . . . . .ASCII,
32 and 64 bit IEEE 754 Floating point format,
DOS PC format (32 bit IEEE With byte order reversed)

Printer

Interface . . . . . .Centronics interface, PCL, and ESC/P

Probe power

Output voltage . . . . . +15 V (300 mA), –12.6 V (160 mA), GND nominal

Keyboard

Connector . . . . . Mini Din (IBM PS/2 style)

I/O port (4 bit in 1 S bit out port)

Connector . . . . . D sub 15 pins

Level TTL Level

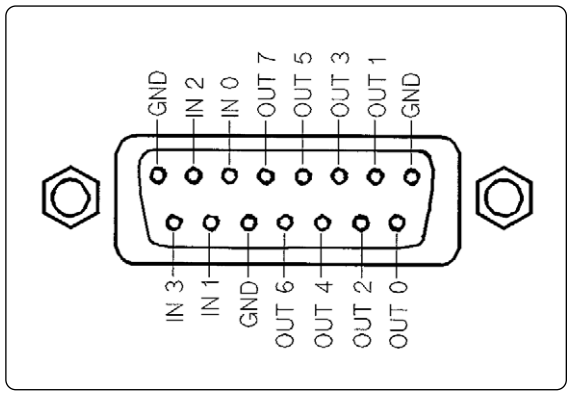


Figure 10. 1/O port pin assignments

General Characteristics

Input and output characteristics

External reference input

Frequency . . . . . 10 MHz ±100 Hz typically

Level . . . . . > –6 dBm typically

Input impedance . . . . . 50 Ω nominal

Connector . . . . . BNC female

Internal reference output

Frequency . . . . . 10 MHz nominal

Level . . . . . 2 dBm typically

Output impedance . . . . . 50 Ω nominal

Connector . . . . . BNC female

Reference oven output (Option 4396B-1D5)

Frequency . . . . . 10 MHz nominal

Level 0 dBm typically

Output impedance . . . . . 50 Ω nominal

Connector . . . . . BNC female

2nd IF output

Frequency . . . . . .21.42 MHz nominal
output impedance . . . . . .50 Ω nominal
Connector . . . . . .BNC female

External trigger input

Level . . . . . .TTL level
Pulse width (T_p) . . . . . .≥ 2 µs typically
Polarity . . . . . .positive/negative selective
Connector . . . . . .BNC female

External program Run/Cont input

Level . . . . . .TTL level
Connector . . . . . .BNC female

Gate output (Option 4396B-1D6)

Level . . . . . .TTL level
Connector . . . . . BNC female

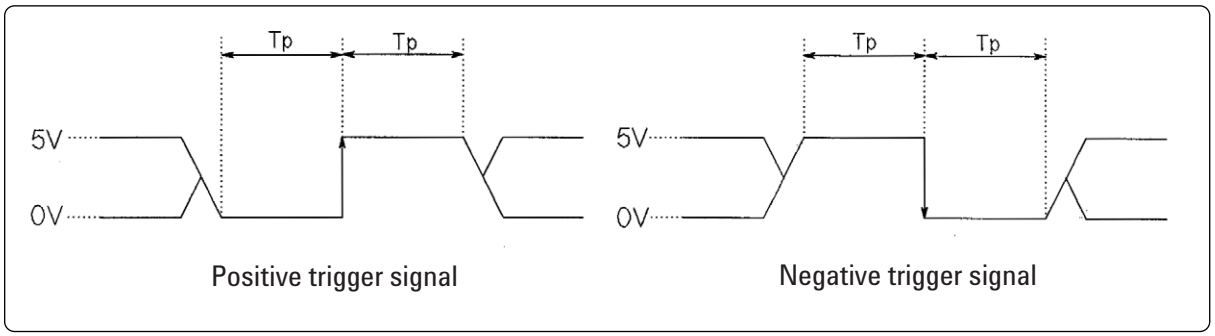


Figure 11. Trigger signal

S-parameter test set interface

Connector . . . . . D-SUB (25 pin)

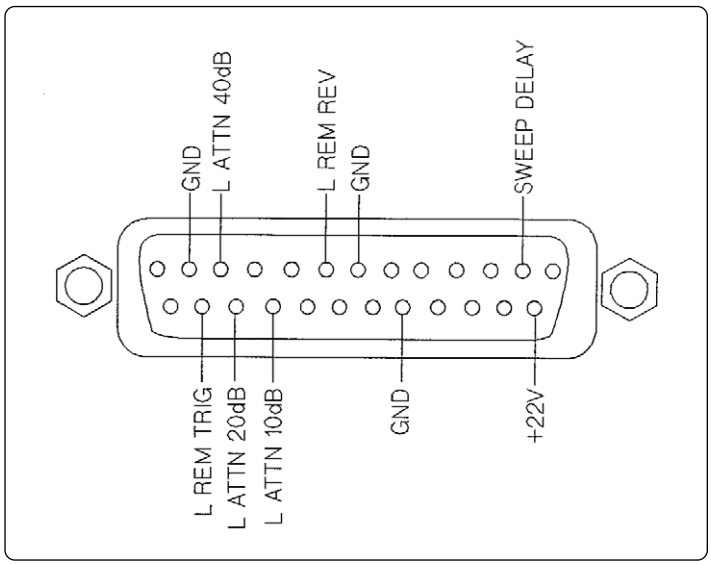


Figure 12. S-parameter test set interface pin assignments

External monitor output

Connector . . . . . D-Sub 15 pins HD
Resolution . . . . . 640 x 480 VGA

Operation Conditions

Temperature

Disk drive non-operating condition . . . . . 0 °C to 40 °C
Disk drive operating condition . . . . . 10 °C to 40 °C

Humidity

Wet bulb temperature ≤ 29 °C, without condensation

Disk drive non-operating condition . . . . . 15% to 95% RH
Disk drive operating condition . . . . . 15% to 80% RH

Altitude . . . . . 0 to 2,000 meters
Warm-up time . . . . . 30 minutes

Non-Operation Conditions

Temperature . . . . . –20 °C to 60 °C

Humidity

Wet bulb temperature ≤ 45°C, without condensation . . . . 15% to 95% RH

Altitude . . . . . 0 to 4,572 meters

Others

EMC[1] . . . . . Complies with CISPR 11(1990) / EN 55011 (1991): Group 1, Class A
Complies with IEC 801-2 (1991) / EN 50082-1 (1992): 4 kV CD, 8 kV AD
Complies With IEC 1000-3-2 (1995) / EN 61000-3-2 (1995)
Complies With IEC 1000-3-3 (1994) / EN 61000-3-3 (1995)
Complies With IEC 801-3 (1984) / EN 50082-1 (1992): 3 V/m
Complies With IEC 801-4 (1988) / EN 50082-1 (1992):
1 kV / Main, 0.5 kV / Signal Line

Power requirements . . . 90 V to 132 V, or 198 V to 264 V, 47 to 63 Hz, 300 VA max
Weight . . . . . 21.5 kg max
Dimensions . . . . . 425(W) x 235(H) x 553(D) mm

1. When tested at 3 V/m according to IEC 8013/1984, the residual response will be within specifications over the full immunity test frequency range of 26 MHz to 1000 MHz, except when the analyzer frequency is identical to the transmitted interference signal test frequency, the residual response may be up to -95 dBm from 300 MHz to 1000 MHz.

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