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)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Resolution</th>
<th>Frequency reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 kHz to 1.8 GHz</td>
<td>≤ 1 mHz</td>
<td>Accuracy</td>
</tr>
<tr>
<td></td>
<td>23 ±5 °C, referenced to 23 °C</td>
<td>≤ ±5.5 ppm/year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23 ±5 °C, referenced to 23 °C</td>
<td>≤ ±2.5 ppm/year typically</td>
<td></td>
</tr>
<tr>
<td>Initial achievable accuracy</td>
<td>≤ ±1.0 ppm typically</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature stability</td>
<td>23 ±5 °C, referenced to 23 °C</td>
<td>≤ ±2 ppm typically</td>
<td></td>
</tr>
</tbody>
</table>

Precision frequency reference (Option 4396B-1D5)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 °C to 40 °C, referenced to 23 °C</td>
</tr>
<tr>
<td></td>
<td>0 °C to 40 °C, referenced to 23 °C</td>
</tr>
<tr>
<td>Initial achievable accuracy</td>
<td>≤ ±0.02 ppm typically</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>0 °C to 40 °C, referenced to 23 °C</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Output power</th>
<th>Linearity</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20 dBm ≤ power ≤ +20 dBm</td>
<td>±0.7 dB</td>
</tr>
<tr>
<td>-40 dBm ≤ power &lt; -20 dBm</td>
<td>±1.0 dB</td>
</tr>
<tr>
<td>-60 dBm ≤ power &lt; -40 dBm</td>
<td>±1.5 dB</td>
</tr>
</tbody>
</table>

Spectral purity characteristics

- **Harmonics**: +15 dBm output, < –30 dBc
- **Non-harmonics spurious**: +15 dBm output, < –30 dBc

#### Noise sidebands

<table>
<thead>
<tr>
<th>SPAN = 0, IFBW (or RBW)</th>
<th>≤ 3 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency ≤ 1 GHz</td>
<td>&lt; –105 dBc/Hz typically</td>
</tr>
<tr>
<td>≥ 10 kHz offset from carrier</td>
<td>&lt; –105 dBc/Hz typically</td>
</tr>
<tr>
<td>≥ 1 MHz offset from carrier</td>
<td>&lt; –110 dBc/Hz typically</td>
</tr>
<tr>
<td>frequency &gt; 1 GHz</td>
<td>Add [20 log(frequency(GHz))] typically</td>
</tr>
</tbody>
</table>

- **Impedance**: 50 Ω nominal
- **Return loss**: ≤ 0 dBm, 100 MHz < frequency ≤ 1.8 GHz, > 14 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**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Input port</th>
<th>Noise level IFBW = 10 Hz</th>
<th>Noise level IFBW = 40 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 k ≤ freq. &lt; 10 MHz</td>
<td>R</td>
<td>&lt; -85 dBm</td>
<td>&lt; -50 dBm</td>
</tr>
<tr>
<td>100 k ≤ freq. &lt; 10 MHz</td>
<td>A, B</td>
<td>&lt; -110 dBm</td>
<td>&lt; -75 dBm</td>
</tr>
<tr>
<td>10 MHz ≤ freq.</td>
<td>R</td>
<td>&lt; [-100 + 3 (f)] dBm 1</td>
<td>&lt; [-85 + 3 (f)] dBm 1</td>
</tr>
<tr>
<td>10 MHz ≤ freq.</td>
<td>A, B</td>
<td>&lt; [-125 + 3 (f)] dBm 1</td>
<td>&lt; [-90 + 3 (f)] dBm 1</td>
</tr>
</tbody>
</table>

**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 kHz ≤ 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)

<table>
<thead>
<tr>
<th>Input level (relative to full scale input level)</th>
<th>Dynamic accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 dB</td>
<td>&lt; ±0.3 dB</td>
</tr>
<tr>
<td>-10 dB to -70 dB</td>
<td>&lt; ±0.05 dB</td>
</tr>
<tr>
<td>-80 dB</td>
<td>&lt; ±0.1 dB</td>
</tr>
<tr>
<td>-90 dB</td>
<td>&lt; ±0.3 dB</td>
</tr>
<tr>
<td>-100 dB</td>
<td>&lt; ±1.0 dB</td>
</tr>
<tr>
<td>-110 dB</td>
<td>&lt; ±0.8 dB typically</td>
</tr>
<tr>
<td>-120 dB</td>
<td>&lt; ±2.5 dB typically</td>
</tr>
</tbody>
</table>

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 kHz ≤ frequency < 1 MHz ........................................ < ±6 deg (±4 deg typically)
frequency ≥ 1 MHz ........................................ < ±3 deg (±2 deg typically)

Dynamic accuracy (A/R, B/R)

<table>
<thead>
<tr>
<th>Input level (relative to full scale input level)</th>
<th>Dynamic accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 dB</td>
<td>&lt; ±3 deg</td>
</tr>
<tr>
<td>–10 dB</td>
<td>&lt; ±0.6 deg</td>
</tr>
<tr>
<td>–20 dB to –70 dB</td>
<td>&lt; ±0.3 deg</td>
</tr>
<tr>
<td>–80 dB</td>
<td>&lt; ±0.7 deg</td>
</tr>
<tr>
<td>–90 dB</td>
<td>&lt; ±2.3 deg</td>
</tr>
<tr>
<td>–100 dB</td>
<td>&lt; ±7 deg</td>
</tr>
<tr>
<td>–110 dB</td>
<td>&lt; ±8 deg typically</td>
</tr>
<tr>
<td>–120 dB</td>
<td>&lt; ±25 deg typically</td>
</tr>
</tbody>
</table>

Trace noise

A/R, B/R measurement,
–10 dBm input, IFBW = 300 Hz ................. < 0.04 deg rms typically

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

Figure 2. Phase dynamic accuracy

---

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:

\[ \text{Group delay accuracy (sec)} = \frac{\text{phase accuracy (deg)}}{\text{Aperture (Hz)} \times 360 \text{ deg}} \]

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

![Figure 3. Typical group delay accuracy](image)

**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** .............................................. \( \pm \left( \text{freq readout} \times \text{freq ref accuracy} + \frac{\text{RBW}}{\text{NOP}} \right) \)

  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

<table>
<thead>
<tr>
<th>Offset from carrier</th>
<th>Noise sidebands</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 1 kHz</td>
<td>&lt; -85 dBc/Hz</td>
</tr>
<tr>
<td>≥ 10 kHz</td>
<td>&lt; -105 dBc/Hz</td>
</tr>
<tr>
<td>≥ 1 MHz</td>
<td>&lt; -110 dBc/Hz</td>
</tr>
</tbody>
</table>

---

![Carrier frequency = 1 GHz](Figures/Carrier_frequency_1GHz.png)

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

### Residual FM

**RBW ≤ 10 Hz**

- Option 4396B-800: \(< 1 \times f(GHz) \text{ Hz}_{\text{pk-pk}}\) in 10 sec typically
- Frequency = 1 GHz: \(< 1 \text{ Hz}_{\text{pk-pk}}\) typically
- Option 4396B-1D5: \(< 0.1 \times f(GHz) \text{ Hz}_{\text{pk-pk}}\) in 10 sec typically
- Frequency = 1 GHz: \(< 0.1 \text{ Hz}_{\text{pk-pk}}\) typically

**RBW ≤ 1 kHz**: \(< 3 \text{ Hz}_{\text{pk-pk}}\) in 100 msec typically

---

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

\[ \geq 10 \text{ MHz, } -35 \text{ dBm mixer input } \leq -70 \text{ dBC} \]
\[ < 10 \text{ MHz, } -35 \text{ dBm mixer input } \leq -60 \text{ dBC} \]

Third order intermodulation distortion

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

\[ \geq 10 \text{ MHz } \leq -75 \text{ dBC} \]
\[ < 10 \text{ MHz } \leq -65 \text{ dBC} \]

Other spurious

–30 dBm mixer input, offset ≥ 1 kHz \[ \leq -70 \text{ dBC} \]

Residual response

\[ \geq 3 \text{ MHz, } 0 \text{ dB attenuator } \leq -100 \text{ dBm} \]
\[ 1 \text{ kHz } \geq \text{ frequency } < 3 \text{ MHz, } 0 \text{ dB attenuator } \leq -90 \text{ dBm} \]

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

Local oscillator feedthrough \[ \ldots \leq -25 \text{ dBm input mixer level equivalent typically} \]

Gain compression

\[ \geq 10 \text{ MHz, input mixer level } < -10 \text{ dBm } \leq 0.3 \text{ dB typically} \]

Displayed average noise level

\[ \text{frequency } \geq 10 \text{ MHz}, \]
\[ \text{ref. level } \leq -40 \text{ dBm, att. } = 0 \text{ dB } \leq 0 \text{ dBm/Hz } \]
\[ 10 \text{ kHz } \leq \text{ frequency } < 10 \text{ MHz}, \]
\[ \text{ref. level } \leq -40 \text{ dBm, att. } = 0 \text{ dB } \leq 0 \text{ dBm/Hz} \]

---

**Figure 8. Typical displayed average noise level**

Maximum safe input level

Average continuous power \[ \ldots \leq +30 \text{ dBm (1 W)} \]

Peak pulse power

Pulse width < 10 µs,

\[ \text{duty cycle } < 1\%, \text{ input attenuator } \geq 30 \text{ dB } \leq +50 \text{ dBm (100 W)} \]

dc voltage \[ \ldots \leq 0 \text{ Vdc} \]

Input attenuator

Range \[ \ldots \leq 0 \text{ dB to 60 dB, 10 dB step} \]

Level accuracy

Calibrator accuracy \[ (-20 \text{ dBm 20 MHz } \leq \pm 0.4 \text{ dB (±0.2 dB typically)}) \]
**Frequency response**

- At 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**

<table>
<thead>
<tr>
<th>Range (dB from ref. level)</th>
<th>Amplitude fidelity @ 1 Hz ≤ RBW ≤ 3 kHz</th>
<th>Amplitude fidelity @ 10 kHz ≤ RBW ≤ 300 kHz</th>
<th>Amplitude fidelity @ 1 MHz ≤ RBW ≤ 3 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spec.</td>
<td>Typical</td>
<td>Spec.</td>
</tr>
<tr>
<td>0 dB ≥ range ≥ –30 dB</td>
<td>±0.05 dB</td>
<td>±0.02 dB</td>
<td>±0.3 dB</td>
</tr>
<tr>
<td>–30 dB &gt; range ≥ –40 dB</td>
<td>±0.07 dB</td>
<td>±0.03 dB</td>
<td>±0.3 dB</td>
</tr>
<tr>
<td>–40 dB &gt; range ≥ –50 dB</td>
<td>±0.12 dB</td>
<td>±0.05 dB</td>
<td>±0.4 dB</td>
</tr>
<tr>
<td>–50 dB &gt; range ≥ –60 dB</td>
<td>±0.4 dB</td>
<td>±0.12 dB</td>
<td>±0.7 dB</td>
</tr>
<tr>
<td>–60 dB &gt; range ≥ –80 dB</td>
<td>±1.2 dB</td>
<td>±0.8 dB</td>
<td>±1.5 dB</td>
</tr>
<tr>
<td>–80 dB &gt; range ≥ –90 dB</td>
<td>±4 dB</td>
<td>±1 dB</td>
<td>±4.3 dB</td>
</tr>
<tr>
<td>–90 dB &gt; range ≥ –100 dB</td>
<td>–</td>
<td>+3 dB</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>±10 dB</td>
<td>–</td>
</tr>
</tbody>
</table>

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

\[
20 \log_{10} \left(1 \pm 10^x \times 3.5\right) \text{dB typically}
\]

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**

- At 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

<table>
<thead>
<tr>
<th>RBW</th>
<th>SPAN</th>
<th>Typical sweep time</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 MHz</td>
<td>1.8 GHz</td>
<td>40 ms</td>
</tr>
<tr>
<td>1 MHz</td>
<td>1 GHz</td>
<td>60 ms</td>
</tr>
<tr>
<td>300 kHz</td>
<td>1 GHz</td>
<td>340 ms</td>
</tr>
<tr>
<td>100 kHz</td>
<td>100 MHz</td>
<td>100 ms</td>
</tr>
<tr>
<td>30 kHz</td>
<td>100 MHz</td>
<td>460 ms</td>
</tr>
<tr>
<td>10 kHz</td>
<td>10 MHz</td>
<td>400 ms</td>
</tr>
<tr>
<td>3 kHz</td>
<td>10 MHz</td>
<td>2.4 s</td>
</tr>
<tr>
<td>1 kHz</td>
<td>1 MHz</td>
<td>651 ms</td>
</tr>
<tr>
<td>300 Hz</td>
<td>1 MHz</td>
<td>3 s</td>
</tr>
<tr>
<td>100 Hz</td>
<td>100 kHz</td>
<td>1.4 s</td>
</tr>
<tr>
<td>30 Hz</td>
<td>100 kHz</td>
<td>3.2 s</td>
</tr>
<tr>
<td>10 Hz</td>
<td>10 kHz</td>
<td>1.5 s</td>
</tr>
<tr>
<td>3 Hz</td>
<td>10 kHz</td>
<td>12 s</td>
</tr>
<tr>
<td>1 Hz</td>
<td>1 kHz</td>
<td>11 s</td>
</tr>
<tr>
<td>–</td>
<td>Zero Span</td>
<td>–</td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>Range of gate length ($T_g$)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 µs ≤ $T_g$ ≤ 32 ms</td>
<td>0.5 µs</td>
</tr>
<tr>
<td>32 ms &lt; $T_g$ ≤ 64 ms</td>
<td>1 µs</td>
</tr>
<tr>
<td>64 ms &lt; $T_g$ ≤ 160 ms</td>
<td>2.5 µs</td>
</tr>
<tr>
<td>160 ms &lt; $T_g$ ≤ 320 ms</td>
<td>5 µs</td>
</tr>
<tr>
<td>320 ms &lt; $T_g$ ≤ 1.28 s</td>
<td>20 µs</td>
</tr>
<tr>
<td>1.28 ms &lt; $T_g$ ≤ 3.2 s</td>
<td>100 µs</td>
</tr>
</tbody>
</table>

### Gate delay

**Range**
- 2 µs to 3.2 s

**Resolution**

<table>
<thead>
<tr>
<th>Range of gate delay ($T_d$)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 µs ≤ $T_d$ ≤ 32 ms</td>
<td>0.5 µs</td>
</tr>
<tr>
<td>32 ms &lt; $T_d$ ≤ 64 ms</td>
<td>1 µs</td>
</tr>
<tr>
<td>64 ms &lt; $T_d$ ≤ 160 ms</td>
<td>2.5 µs</td>
</tr>
<tr>
<td>160 ms &lt; $T_d$ ≤ 320 ms</td>
<td>5 µs</td>
</tr>
<tr>
<td>320 ms &lt; $T_d$ ≤ 1.28 s</td>
<td>20 µs</td>
</tr>
<tr>
<td>1.28 ms &lt; $T_d$ ≤ 3.2 s</td>
<td>100 µs</td>
</tr>
</tbody>
</table>

### 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: < $[-148 + 3f (GHz)]$ 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: \( Z, Y, L, C, Q, R, X, G, B, \theta \)
Display parameters: \([Z], \theta, R, X, [Y], \theta_y, G, B, [\Gamma], \theta_x, \Gamma_x, \Gamma_y, C_p, C_s, L_p, L_s, R_p, R_s, D, Q\)

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 characteristics¹
- Frequency range: 100 kHz to 1.8 GHz
- Frequency resolution: 1 mHz
- Output level: -60 to +20 dBm (@RF OUT port)
- Output level accuracy: \( A + B + 6 \text{ [dB]} \times F/(1.8 \times 10^9) \)

Where,
- \( A = 2 \text{ dB (±5 °C)} \)
- \( B = 0 \text{ dB (GSC ≤ 0 dBm)}, \text{ or } 1 \text{ dB (-40 ≤ GSC < 0 dBm)}, \text{ or } 2 \text{ dB (-60 ≤ GSC < -40 dBm)} \)

\( F \) 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

- 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.
\[ Z_a = A + \frac{B}{|Z_m|} + C \times |Z_m| \times 100[\%] \]

Where, is \(|Z_m|\) is \(|Z|\) measured. A, B, and C are obtained from Figure 9.
IY - θ accuracy

IY accuracy

\[ Y_a = A + \left( \frac{B \times |Y_m| + C \times |Y_m|}{|Y_m|} \right) \times 100\% \]

θ accuracy

\[ \theta_a = \sin^{-1}\left(\frac{Y_a}{100}\right) \]

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

R - X accuracy (depends on D)

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>D ≤ 0.2</th>
<th>0.2 &lt; D ≤ 5</th>
<th>5 &lt; D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ra</td>
<td>± Rx \times X/100[Ω]</td>
<td>Ra/cosθ [%]</td>
<td>Ra [%]</td>
</tr>
<tr>
<td>Xa</td>
<td>Xa [%]</td>
<td>Xa/sinθ [%]</td>
<td>±Ra \times Xa/100[Ω]</td>
</tr>
</tbody>
</table>

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:

\[ \tan^{-1}(X/R), \quad \tan^{-1}(2\pi f \times L_s/R), \quad \tan^{-1}(1/(R \times 2\pi f \times C_s)) \]

\[ R_a = A + \left( \frac{B \times |R_m| + C \times |R_m|}{|R_m|} \right) \times 100 \% \]

\[ X_a = A + \left( \frac{B \times |X_m| + C \times |X_m|}{|X_m|} \right) \times 100 \% \]

\( R_m \) 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)

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>D ≤ 0.2</th>
<th>0.2 &lt; D ≤ 5</th>
<th>5 &lt; D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ga</td>
<td>± Ga \times B/100[S]</td>
<td>Ga/cosθ [%]</td>
<td>Ga [%]</td>
</tr>
<tr>
<td>Ba</td>
<td>Ba [%]</td>
<td>Ba/sinθ [%]</td>
<td>±Ba \times B/100[S]</td>
</tr>
</tbody>
</table>

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:

\[ \tan^{-1}(B/G), \quad \tan^{-1}(2\pi f \times C_p/G), \quad \tan^{-1}(1/(G \times 2\pi f \times L_p)) \]

\[ G_a = A + \left( \frac{B \times |G_m| + C \times |G_m|}{|G_m|} \right) \times 100 \% \]

\[ B_a = A + \left( \frac{B \times |B_m| + C \times |B_m|}{|B_m|} \right) \times 100 \% \]

\( G_m \) and \( B_m \) are the measured R and B, respectively. A, B, and C are obtained from Figure 9.
### D accuracy

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>D ≤ 0.2</th>
<th>0.2 &lt; D</th>
</tr>
</thead>
<tbody>
<tr>
<td>$D_a$</td>
<td>$z_x/100$</td>
<td>$(z_x/100) \times (1 + D^2)$</td>
</tr>
</tbody>
</table>

Where $Z_a$ is $|Z|$ accuracy.

### L accuracy (depends on D)

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>D ≤ 0.2</th>
<th>0.2 &lt; D</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L_a$</td>
<td>$L_x/100$</td>
<td>$L_x(1 + D^2)$</td>
</tr>
</tbody>
</table>

Where,

$L_a = A + (B/|Z_x|) + C \times |Z_x| \times 100[\%]$

$|Z_x| = 2\pi f \times L_m$, $f$ is frequency in Hz, and $L_m$ is measured $L$. $A$, $B$, and $C$ are obtained from Figure 9.

### C accuracy (depends on D)

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>D ≤ 0.2</th>
<th>0.2 &lt; D</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_a$</td>
<td>$C_x$</td>
<td>$C_x(1 + D^2)$</td>
</tr>
</tbody>
</table>

Where,

$C_a = A + (B/|Z_x|) + C \times |Z_x| \times 100[\%]$

$|Z_x| = 2\pi f \times C_m$, $f$ 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
  - ∆ 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. I/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

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>21.42 MHz nominal</td>
</tr>
<tr>
<td>Output impedance</td>
<td>50 Ω nominal</td>
</tr>
<tr>
<td>Connector</td>
<td>BNC female</td>
</tr>
</tbody>
</table>

External trigger input

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>TTL level</td>
</tr>
<tr>
<td>Pulse width ($T_p$)</td>
<td>≥ 2 µs typically</td>
</tr>
<tr>
<td>Polarity</td>
<td>Positive/negative</td>
</tr>
<tr>
<td>Connector</td>
<td>BNC female</td>
</tr>
</tbody>
</table>

External program Run/Cont input

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>TTL level</td>
</tr>
<tr>
<td>Connector</td>
<td>BNC female</td>
</tr>
</tbody>
</table>

Gate output (Option 4396B-1D6)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>TTL level</td>
</tr>
<tr>
<td>Connector</td>
<td>BNC female</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Positive trigger signal</th>
<th>Negative trigger signal</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Positive trigger signal" /></td>
<td><img src="image" alt="Negative trigger signal" /></td>
</tr>
</tbody>
</table>

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**

Complies with CISPR 11(1990) / EN 55011 (1991): Group 1, Class A
Complies With IEC 1000-3-3 (1994) / EN 61000-3-3 (1995)
  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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