

Keysight Technologies

Full-featured CW Microwave Counters for Field, Factory or Lab

53150A 20 GHz Counter

53151A 26.5 GHz Counter

53152A 46 GHz Counter

Technical Overview



High performance microwave counters: at home, in the field, bench or ATE environment

- Ultrawide range, single input (from 50 MHz up to 46 GHz)
- Simultaneous power and frequency measurement with analog peaking indicator
- GPIB and RS-232 standard
- Lightweight and rugged
- Battery optional

Convenience, portability and outstanding performance

The innovative designs of the Keysight Technologies, Inc. 53150 Series microwave counters offer an uncluttered, feature-laden front panel. These designs present no-compromise performance and quality in a surprisingly small, light, battery operated product.

The convenience of a single microwave input

The Keysight 53150 Series has an advanced sampler that integrates a separate zero bias Schottky diode for the accurate measurement of input power. This allows measurement of both frequency and power with a single connection. No compromise in frequency coverage is required for this capability. The ultrawideband microwave input covers the entire RF and microwave spectrum, from intermediate frequencies (IFs) of 50 MHz to millimeter waves.

The power measurement accuracy and repeatability of these counters rivals power meters with diode sensors. Since frequency and power of the input signal are measured simultaneously, adjustment for the diode's frequency response is done automatically. And like the latest in diode sensors, compensation is also made for deviation from square law.

Field tough but ready for benchtop or ATE applications

The Keysight 53150 Series is as comfortable in the field as in the laboratory. The rugged case with an integrated tilting handle can tolerate the vibration and shock expected in field use. The backlit LCD display ensures visibility in all environments, from dark to full sunlight, at distances exceeding 15 feet.

If AC power is unavailable, the internal, replaceable camcorder batteries provide at least 2.5 hours of continuous operation. The unit can also be powered from an external 11-18 VDC source.

For benchtop and ATE applications, the Keysight 53150 Series delivers full functionality and high measurement speed. The fully programmable RS-232 interface and high speed GPIB interface are standard features.

No compromise performance

The Keysight 53150 Series offers exceptional sensitivity by utilizing a single board design with low phase noise PLL circuitry. Despite their simple appearance, these counters retain all the powerful functions one expects in precision instrumentation: measurement averaging, arbitrary as well as nulling offsets for both frequency and power, display of power in either dBm or Watts.

Additional capabilities include full control of resolution, sampling rate, and GPIB address, plus extensive self-diagnostics, fast acquisition times and full programmability. Performance surpasses the industry standard Keysight 5350 Series, in virtually every aspect, in a package less than half the weight and size.

Measurement Specifications and Characteristics

All measurement specifications are over the full signal and temperature ranges unless otherwise noted.

| Input characteristics | 53150A | 53151A | 53152A |
|--|--|--|--|
| Frequency range | | | |
| Channel 1 (Normal mode) | 10 Hz - 125 MHz | 10 Hz - 125 MHz | 10 Hz - 125 MHz |
| (Low pass filter enabled) | 10 Hz - 50 kHz | 10 Hz - 50 kHz | 10 Hz - 50 kHz |
| Channel 2 | 50 MHz - 20 GHz | 50 MHz - 26.5 GHz | 50 MHz - 46 GHz |
| Sensitivity | | | |
| Channel 1 | | | |
| 10-30 Hz | 40 mVrms | 40 mVrms | 40 mVrms |
| 30 Hz-125 MHz | 25 mVrms | 25 mVrms | 25 mVrms |
| Channel 2 | | | |
| 50-300 MHz | -20 dBm | -20 dBm | -20 dBm |
| 0.3-12.4 GHz | -33 dBm | -33 dBm | -33 dBm |
| 12.4-18 GHz | -33 dBm | -33 dBm | -30 dBm |
| 18-20 GHz | -29 dBm | -29 dBm | -27 dBm |
| 20-26.5 GHz | N/A | -25 dBm | -27 dBm |
| 26.5-40 GHz | N/A | N/A | -23 dBm |
| 40-46 GHz | N/A | N/A | -17 dBm |
| Maximum input | | | |
| Channel 1 | 2 Vrms | 2 Vrms | 2 Vrms |
| Channel 2 | | | |
| 50 MHz - 2 GHz | +5 dBm | +5 dBm | +5 dBm |
| 2-46 GHz | +13 dBm | +13 dBm | +13 dBm |
| Damage level | | | |
| Channel 1 | 120 V (dc + ac pk) linearly derated to 5 Vrms at 125 MHz | 120 V (dc + ac pk) linearly derated to 5 Vrms at 125 MHz | 120 V (dc + ac pk) linearly derated to 5 Vrms at 125 MHz |
| Channel 2 | +27 dBm | +27 dBm | +27 dBm |
| Impedance (Nominal) | | | |
| Channel 1 | 1 M Ω /60 pF | 1 M Ω /60 pF | 1 M Ω /60 pF |
| Channel 2 | 50 Ω | 50 Ω | 50 Ω |
| Connector | | | |
| Channel 1 | BNC female | BNC female | BNC female |
| Channel 2 | SMA/APC-3.5 compatible female | SMA/APC-3.5 compatible female | 2.92 mm removable, SMA/APC-3.5 compatible female |
| SWR (Typical) | | | |
| Channel 2 | | | |
| 50-300 MHz | 1.5:1 typical | 1.5:1 typical | 1.5:1 typical |
| 0.3-10 GHz | 2.0:1 typical | 2.0:1 typical | 2.0:1 typical |
| 10-20 GHz | 3.0:1 typical | 3.0:1 typical | 3.0:1 typical |
| 20-26.5 GHz | N/A | 3.0:1 typical | 2.5:1 typical |
| 26.5-46 GHz | N/A | N/A | 2.5:1 typical |
| Coupling | | | |
| Channel 1 | AC | AC | AC |
| Channel 2 | AC | AC | AC |
| Emissions (Typical) ("kickback noise") | | | |
| Channel 1 | N/A | N/A | N/A |
| Channel 2 (measuring/no input) | -40 dBm/< -70 dBm | -40 dBm/< -70 dBm | -40 dBm/< -70 dBm |
| Resolution | | | |
| Channel 1/Channel 2 | 1 Hz to 1 MHz | 1 Hz to 1 MHz | 1 Hz to 1 MHz |

Measurement Specifications and Characteristics *Continued...*

| Input characteristics | 53150A | 53151A | 53152A |
|--|--|--|--|
| Accuracy | | | |
| Channel 1/Channel 2 (LSD = resolution selection) | $\pm 1 \text{ LSD} \pm \text{residual stability}$ $\pm(\text{timebase error} \times \text{frequency})$ | $\pm 1 \text{ LSD} \pm \text{residual stability}$ $\pm(\text{timebase error} \times \text{frequency})$ | $\pm 1 \text{ LSD} \pm \text{residual stability}$ $\pm(\text{timebase error} \times \text{frequency})$ |
| Residual stability* | | | |
| Channel 1 | N/A | N/A | N/A |
| Channel 2 | 0.6 LSD rms | 0.8 LSD rms | 1.25 LSD rms |
| <i>*Counter and source tied to same timebase</i> | | | |
| Measurement time (Typical) | | | |
| Channel 1 | 1/Resolution + 20 ms | 1/Resolution + 20 ms | 1/Resolution + 20 ms |
| Channel 2 | 1/Resolution + Acquisition time + 20 ms | 1/Resolution + Acquisition time + 20 ms | 1/Resolution + Acquisition time + 20 ms |
| Acquisition time (Typical) (1 MHz FM rate, power measurement off) | | | |
| Channel 1 | N/A | N/A | N/A |
| Channel 2 (FM Auto/FM Off) | 125 ms/100 ms | 125 ms/100 ms | 140 ms/115 ms |
| FM tolerance | | | |
| Channel 1 | N/A | N/A | N/A |
| Channel 2 (FM Auto) | 20 MHz p-p max @ 10 MHz rate | 20 MHz p-p max @ 10 MHz rate | 20 MHz p-p max to 26.5 GHz, 12 MHz p-p max above 26.5 GHz @ 10 MHz rate |
| (FM Off) | 1 MHz p-p @ 10 MHz rate | 1 MHz p-p @ 10 MHz rate | 1 MHz p-p @ 10 MHz rate |
| AM tolerance | | | |
| Channel 1, Channel 2 | Any index provided minimum signal level is not less than sensitivity | Any index provided minimum signal level is not less than sensitivity | Any index provided minimum signal level is not less than sensitivity |
| Amplitude discrimination | | | |
| Channel 1 | N/A | N/A | N/A |
| Channel 2 | N/A | N/A | N/A |
| below 300 MHz | Automatically measures the largest signal present provided signal is > 10 dB(typical) above any signal separated by less than 75 MHz; > 20 dB (typical) above any signal separated by more than 75 MHz | Automatically measures the largest signal present provided signal is > 10 dB(typical) above any signal separated by less than 75 MHz; > 20 dB (typical) above any signal separated by more than 75 MHz | Automatically measures the largest signal present provided signal is > 10 dB(typical) above any signal separated by less than 75 MHz; > 20 dB (typical) above any signal separated by more than 75 MHz |
| above 300 MHz | | | |
| Power measurement | | | |
| Channel 1 | N/A | N/A | N/A |
| Channel 2 | N/A | N/A | N/A |
| Range | Counter sensitivity to +7 dBm | Counter sensitivity to +7 dBm | Counter sensitivity to +7 dBm |
| Accuracy at input connector** (0 dBm to -20 dBm) | | | |
| 0.05-12.4 GHz | $\pm 1.5 \text{ dB}$ | $\pm 1.5 \text{ dB}$ | $\pm 1.0 \text{ dB}$ |
| 12.4-20 GHz | $\pm 1.5 \text{ dB}$ | $\pm 1.5 \text{ dB}$ | $\pm 1.5 \text{ dB}$ |
| 20-26.5 GHz | N/A | $\pm 2.0 \text{ dB}$ | $\pm 1.5 \text{ dB}$ |
| 26.5-46 GHz | N/A | N/A | $\pm 2.0 \text{ dB}$ |
| Resolution | 0.01 dB | 0.01 dB | 0.01 dB |
| Display | dBm or millwatts/microwatts | dBm or millwatts/microwatts | dBm or millwatts/microwatts |
| **see graphs for typical data | | | |

Typical* power measurement uncertainty at 25 °C for various input levels

*Typical means approximately 2/3 of all units will meet these characteristics.

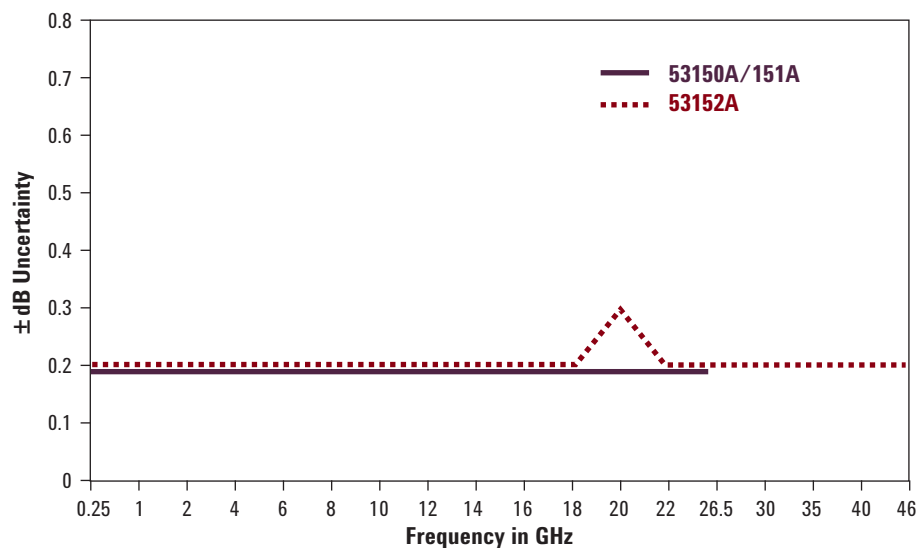


Figure 1. -10 dBm input level at 25 °C

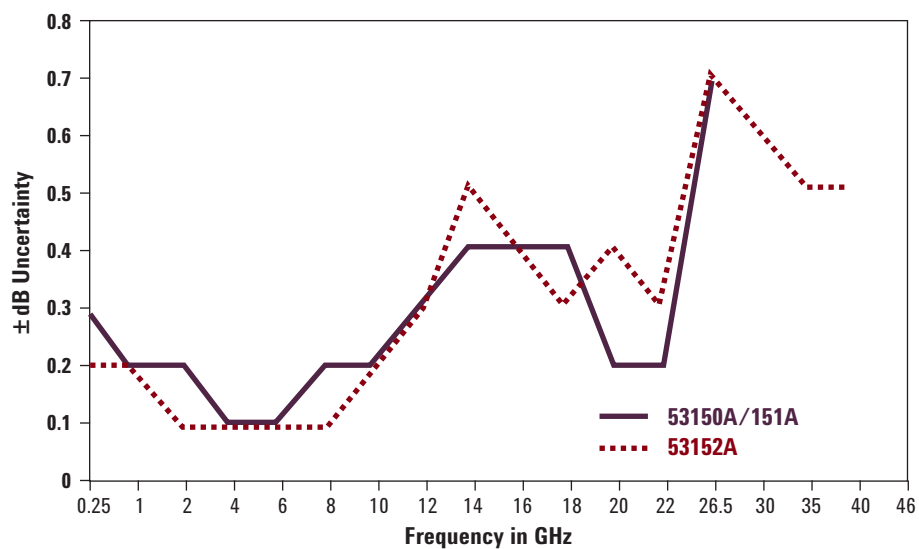


Figure 2. 0 dBm and -20 dBm input level at 25 °C

Typical* power measurement uncertainty at -25 dBm input level

*Typical means approximately 2/3 of all units will meet these characteristics.

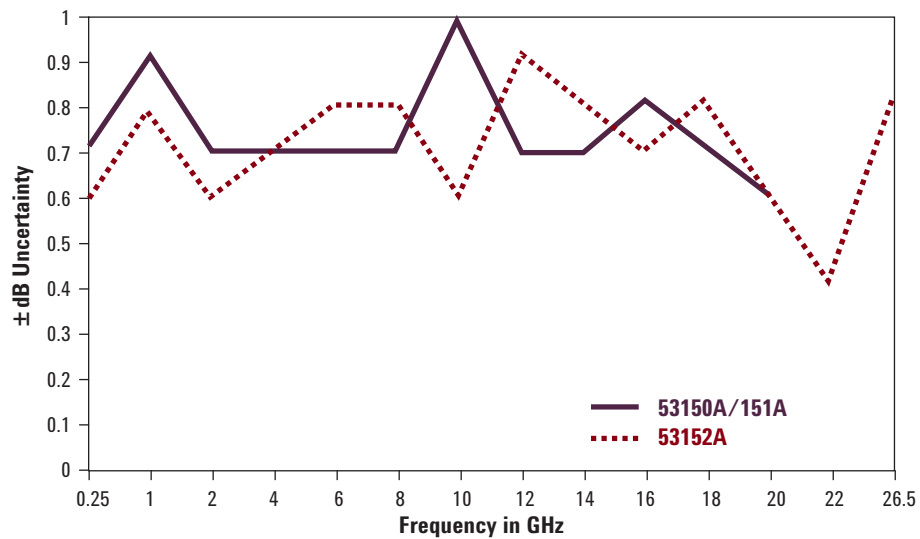


Figure 3. -25 dBm input level at 25 °C

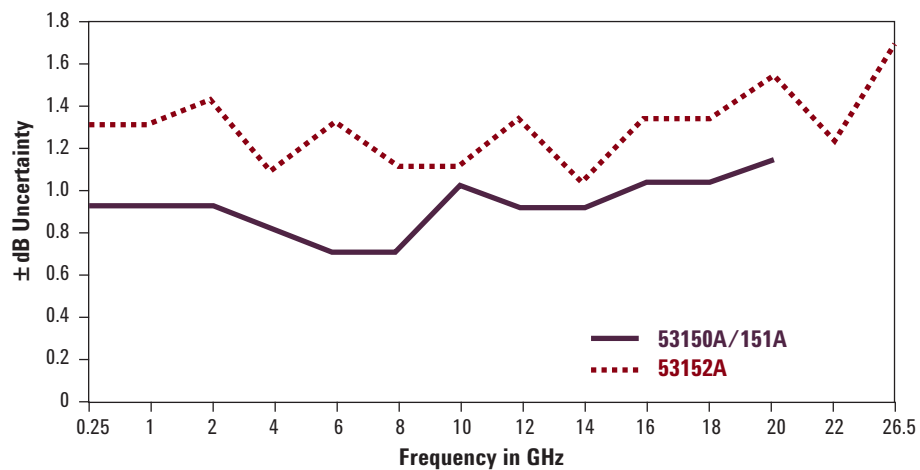


Figure 4. -25 dBm input level from 0 to 55 °C

Timebase

Frequency: 10 MHz

Output: 10 MHz sine wave, 1 Vrms into 50 Ω

External timebase input: 1, 2, 5, 10 MHz; 1 to 5 Vrms into 50 Ω

Connector: BNC female located on rear panel

Internal timebase stability

| | TCXO (Standard) | Oven (Option 001) |
|---------------------------------------|----------------------|--|
| Aging rate | | |
| Per day | — | $< 5 \times 10^{-10}$ |
| Per month | $< 1 \times 10^{-7}$ | $< 1.5 \times 10^{-8}$ |
| Short term (1 s avg. time) | $< 1 \times 10^{-9}$ | $< 2 \times 10^{-10}$ |
| Line variation ($\pm 10\%$) | $< 1 \times 10^{-7}$ | $< 1 \times 10^{-10}$ |
| Warm-up | — | $< 1 \times 10^{-8}$ within 5 min. after turn-on at 25 °C |
| Temperature stability (0-55 °C) | $< 1 \times 10^{-6}$ | $< 1 \times 10^{-8}$ |

General information

Save and recall: Up to 9 complete instrument setups may be saved and later recalled. These setups are retained when power is removed.

Sample rate: User-selectable
Fast (nominally 20 ms between readings), Medium (nominally 250 ms between readings), Slow (nominally 1 s between readings) and Hold.

Self test: Internal memory and count circuitry automatically tested at startup, via menu selection, or remotely. Error messages displayed to indicate failed tests.

Size: 213 mm W x 88.5 mm H x 300 mm D

Operating temperature: 0-55 °C
With battery option: 0-40 °C

Weight: 4 kg without battery option, 6.4 kg with battery option

Programming: GPIB (IEEE-488.1-1987, IEEE 488.2-1987) or RS-232C

Language: SCPI-1992.0 (Standard Commands for Programmable Instruments)

RS-232C rates: User-selectable
2400 to 19200 baud

Power supply:

AC: 90-132 Vac; 47.5-66 Hz or 360-440 Hz 216-264 Vac; 47.5-66 Hz line selection: automatic
power requirements: 75 VA max. (25 W typ.)

DC: (Option 002 only): 11-18 Vdc; 2A max.

Battery (Option 002):

Type: VHS camcorder, lead acid (2 each) Charge time: 8 hours in unit
Capacity: 2.5 hours min. at 25 °C

Math functions:

Offset: Last reading and/or entered offset to reading for either power or frequency

Averaging: 1 to 99 measurement running average

Cable loss compensation: Offsets power reading via linear interpolation of user-entered attenuations with up to 9 independent frequency points.

Display: Backlit LCD. Backlight can be turned on or off via front panel control.

Sleep mode (Option 002 only):

Automatically activated if no input is present for 5 minutes.

Safety: Designed in compliance with IEC-1010, CAN/CSA 1010.1

EMC: Designed in compliance with IEC-11, EN50082-1, IEC801-2, -3, -4.

Accessories supplied

Operating, programming, and service manuals and ac power cord.

Ordering information

| | |
|--------|------------------|
| 53150A | 20 GHz counter |
| 53151A | 26.5 GHz counter |
| 53152A | 46 GHz counter |

Options

| | |
|------------|--------------------------------|
| Option 001 | Oven Timebase |
| Option 002 | Battery and DC input |
| Option 1CM | (53150-67001) Rackmount kit |

53153A (Option 007) Soft carrying case for 5315xA microwave counters

Option A6J ANSI 7540 Compliant Calibration

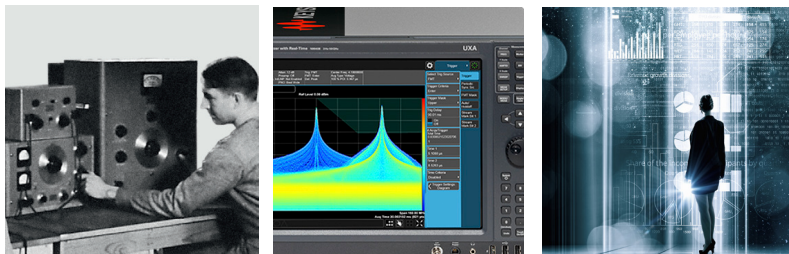
Option W30 Three years of Return Repair Service

Option W50 Five years of Return Repair Service

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