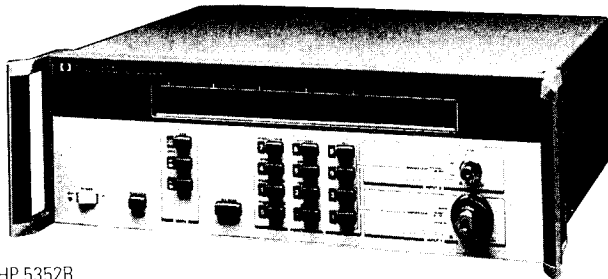


# ELECTRONIC COUNTERS

## CW Microwave Frequency Counters

HP 5350B, 5351B, 5352B

- 10 Hz to 46 GHz without an external mixer
- Exceptional sensitivity to  $-40$  dBm
- 1 GHz/s tracking speed
- 60 ms acquisition time
- 100 measurements/s (HP-IB) in automatic mode
- Three years of hardware support with Option W30



HP 5352B



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### HP 5350B, 5351B, 5352B Microwave Counters

The HP 5350B/5351B/5352B are automatic CW microwave frequency counters that measure to 20, 26.5, and 40 GHz (46 GHz with Option 005), respectively. With resolution as fine as 1 Hz, these counters provide fast and precise frequency measurements.

By integrating all microwave components onto a single hybrid GaAs circuit, these counters offer high performance at low prices. Wide frequency coverage, exceptional sensitivity, fast tracking speed, high-measurement throughput, and wide FM tolerance are a few of the high-performance features of these counters.

With a built-in microprocessor, the HP 5350B/5351B/5352B have math capabilities such as measurement scaling and offset. These functions are useful for indirect measurements. Automatic amplitude discrimination automatically measures the frequency of the highest-amplitude signal in a multi-signal environment. Other convenience features include diagnostic routines that perform tests on the counter for general information and troubleshooting.

With high measurement throughput, the HP 5350B/5351B/5352B are ideal components for test systems. Their English-like commands simplify systems integration by reducing programming time and effort. In automatic test systems, the programmable alphanumeric liquid-crystal display (LCD) can serve as a message center; if operational security is a concern, keyboard and display lockout can be activated. In noise-sensitive environments, you can put these counters in SLEEP mode to reduce kickback noise to as low as  $-70$  dBm.

#### Direct Inputs to 46 GHz: Low-Cost, Versatile Solutions

The HP 5350B/5351B/5352B can meet expanding measurement needs. The HP 5350B/5351B measure frequency from 10 Hz to 20 GHz and 26.5 GHz, respectively. The HP 5352B, which extends input capability to 40 GHz (46 GHz with Option 005), measures in the millimeter-wave range directly—without expensive mixers.

#### Exceptional Sensitivity: Direct Measurement of Low-Level Signals

Because these counters have input sensitivity to  $-40$  dBm ( $-30$  dBm for HP 5352B), accurately measuring your low-energy signals becomes a simple task. For example, you no longer need expensive microwave amplifiers to make low-level measurements. Also, you no longer have to worry about signal attenuation by the probe when you make frequency measurements at different nodes within your circuit. These conveniences simplify measurements in applications such as receiver front end testing.

#### Low Acquisition Time: High Throughput

With acquisition time reduced to 60 ms in automatic, fast-acquisition tracking mode (20 ms in manual mode), these high-speed counters can significantly improve your measurement throughput.

In bench-top applications, this high-speed throughput gives you fast measurement response. The LCD will update measurements rapidly to shorten evaluation time. For applications that require fast response to source tuning, these counters are ideal solutions.

In systems environments, fast measurement throughput contributes to overall system efficiency. Delivering more than 100 measurements/s over HP-IB in automatic mode, these counters save money by reducing test time.

#### 1 GHz/s Tracking: Measuring Fast-Moving Signals

Fast acquisition offers fast tracking speed. With acquisition time below 60 ms, these counters can track source drift to 1 GHz/s effortlessly. For example, when measuring the response of a voltage-controlled oscillator (VCO) to voltage-source tuning, these counters track the changing frequency rapidly to measure transfer characteristics.

### HP 5350B/5351B/5352B Specifications

#### Input 1

**Frequency Range:** HP 5350B: 500 MHz to 20 GHz  
 HP 5351B: 500 MHz to 26.5 GHz  
 HP 5352B: 500 MHz to 40 GHz  
 Option 005: 500 MHz to 46 GHz

**Sensitivity:** See Graph 1, Sensitivity

**Maximum Input:** +7 dBm

**Damage Level:** +25 dBm; HP 5350B/5351B Option 006: +39 dBm (500 MHz to 6 GHz), +36 dBm (6 GHz to 18 GHz), +34.8 dBm (18 GHz to 26.5 GHz)

**SWR (typical):** 500 MHz to 10 GHz: 2:1; Option 002/006, 2.5:1  
 10 GHz to 26.5 GHz: 3:1; Option 002/006, 3.5:1  
 26.5 GHz to 46 GHz: 3.5:1

**Coupling:** DC to 50  $\Omega$  termination, ac to instrument

**Connector:** Precision type-N (female) (HP 5350B)  
 APC-3.5 (male) with collar (HP 5351B/HP 5352B)  
 APC-2.4 (male) with collar (Option 005)

**Accuracy:**  $\pm 1$  LSD  $\pm$  Timebase Error  $\times$  Frequency. High-stability timebase (Option 010) has timebase uncertainties that are 1/10 of the values for the oven timebase (Option 001). LSD = least significant digit.

**Residual Stability:** Counter and source using common 10 MHz timebase or counter using external higher-stability timebase: .3 LSD rms typical for resolution 1 Hz to 1 kHz at 25° C; HP 5352B: .7 LSD typical 26.5 to 40 GHz.

**Resolution:** Selectable, 1 Hz to 1 MHz

**FM Tolerance:** See Graph 2, FM Rate Tolerance

**Maximum Deviation:** Auto: 20 MHz p-p (HP 5350B/51B),  
 12 MHz p-p (HP 5352B),  
 9 MHz p-p (Option 005)  
 Manual: 60 MHz p-p (HP 5350/51B),  
 55 MHz p-p (HP 5352B),  
 55 MHz p-p (Option 005)

**Maximum FM Rate:** 10 MHz

#### Tracking Speed

**Fast-acquisition Track:** 1 GHz/s

**Normal FM Rate:** 1 MHz/s

**Low FM Rate:** 80 kHz/s

**AM Tolerance:** Any modulation index, provided the minimum signal level is not less than the sensitivity specification.

#### Modes of Operation

**Automatic:** Counter automatically acquires and displays highest-level signal within sensitivity range

**Manual:** Center frequency must be entered to within  $\pm 20$  MHz or input frequency;  $\pm 3$  MHz worst case below 1 GHz

**Automatic Amplitude Discrimination:** Measures largest signal present, providing that signal is 6 dB (typical) above any signal within: 500 MHz;  $>20$  dB (typical) above any signal within 500 MHz to 20 (46) GHz

#### Acquisition Time

**Automatic Mode:** Fast-acquisition track:  $<60$  ms  
 Normal FM rate:  $<125$  ms  
 Low FM rate:  $<1.25$  s

**Manual Mode:**  $<20$  ms

	TCX0	Option 001	Option 010
Aging Rate	1 x 10 <sup>-7</sup> /month	5 x 10 <sup>-10</sup> /day	1 x 10 <sup>-10</sup> /day
Short Term	1 x 10 <sup>-9</sup> /s	2.5 x 10 <sup>-10</sup> /s	2.5 x 10 <sup>-10</sup> /s
Temperature 0° to 50° C	1 x 10 <sup>-6</sup>	7 x 10 <sup>-9</sup>	7 x 10 <sup>-9</sup>
Line 10% change	1 x 10 <sup>-7</sup>	1 x 10 <sup>-10</sup>	1 x 10 <sup>-10</sup>
Warmup to <5 10 <sup>-9</sup> @ 25° C		10 min.	10 min.

Timebase (10 MHz)

## Input 2

**Frequency Range:** 10 Hz to 525 MHz

**50 Ω:** 10 MHz to 525 MHz

**1 MΩ:** 10 Hz to 80 MHz

**Sensitivity:** Full operating environment:

**50 Ω:** 10 MHz to 525 MHz, 25 mV rms; 15 mV typical @ 25° C

**1 MΩ:** 10 Hz to 80 MHz, 25 mV rms; 15 mV typical @ 25° C

Gate Time = 1/resolution; 1 ms min.

**Maximum Input:** 50 Ω: +10 dBm; 1 MΩ: 1V rms

**Damage Level:** 50 Ω or 1 MΩ dc to 5 kHz: 250 V (dc + ac peak);

>5 kHz: 5.5 V rms (+ 28 dBm) + 1.25 x 10<sup>6</sup> V rms/freq.

**Coupling:** ac

**Connector:** Replaceable fuse, type BNC (female)

**Accuracy:**

$$\pm 1 \text{ LSD} \pm \left( \frac{1.4 \times \text{Trigger Error}^1}{\text{Gate Time}} \pm \text{Timebase Error} \right) \times \text{Freq.}$$

Gate time = 1/resolution = 1 ms minimum

**Impedance:** 1 MΩ nominal shunted by <70 pF or 50 Ω nominal

**Resolution:** Selectable, 1 Hz to 1 MHz

**High Resolution:** 1 MΩ mode: 0.001 Hz for <100 kHz input;

0.01 Hz for <1 MHz input; 0.1 Hz for <10 MHz input;

1 Hz for >10 MHz input: 1-second gate

**Timebase Output:** 10 MHz and 1 MHz, 2.4 V square wave ac coupled into

1 kΩ; 1.5 V peak-to-peak into 50 Ω; rear-panel BNC connectors

**External Timebase:** 1, 2, 5, or 10 MHz, 0.7 V min. to 8 V max. peak-to-peak sine wave or square wave into > 1 kΩ shunted by <30 pF, via rear-panel BNC connector

## General

**Display:** Segmented 24-character alphanumeric LCD (backlighted)

**Built-in Features:** Self-check, diagnostics, display and keyboard lockout, overload indicator, HP-IB teach-learn mode

**Data Output:** Over HP-IB bus; varies with frequency and resolution

**Auto Mode:** >100 readings/s, 10 kHz resolution, no math functions, "DUMP" mode

**Manual Mode:** >120 readings/s, 10 kHz resolution, no math functions, "DUMP" mode

**Math Functions:** Scale, offset, smooth (exponential averaging)

**Sample Rate:** Variable from less than 50 ms between measurements to HOLD, which holds the display indefinitely or until trigger occurs.

**Display Rate:** 5/s, variable over HP-IB

**Sleep Mode:** Input 1 emissions reduced to < -70 dBm typical when sleep mode or Input 2 is selected

**IF Output:** Rear-panel BNC provides 30-110 MHz downconverted microwave signal at > -20 dBm into 50 Ω, ac-coupled.

**HP-IB Interface Functions:** SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E1 (see page xxx)

**Operation Temperature:** 0° to 50° C

**Power Requirements:** 100 VA max.

**Line Select:** 100 V (90 to 105 Vac rms; 47.5 to 440 Hz)

115/120 V (104/126 Vac rms; 47.5 to 440 Hz)

220 V (198 to 231 Vac rms; 47.5 to 66 Hz)

230/240 V (207 to 252 Vac rms; 47.5 to 66 Hz)

Accessories Furnished: power cord, manual

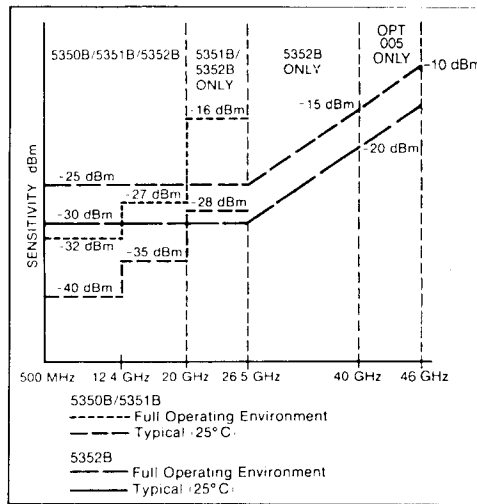
**Size:** 425 mm W x 133 mm H x 358 mm D (16.75 in x 5.25 in x 14 in)

**Weight:** 11 kg (24 lb)

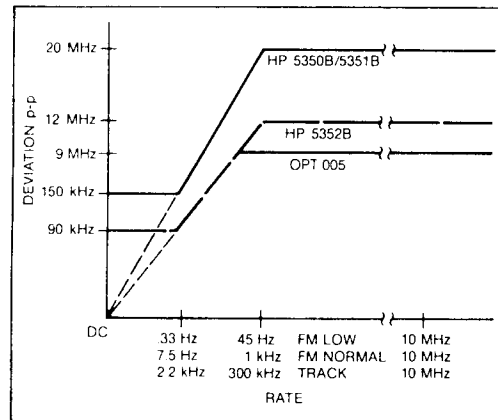
$$\text{Trigger error} = \frac{\sqrt{e_i^2 + e_n^2}}{\text{Input slew rate in V/S at trigger point}} \text{ rms}$$

Where  $e_i$  = effective rms noise of counter's input channel (100 μV typical)

$e_n$  = rms noise of the input signal for a 500 MHz bandwidth



Graph 1. Sensitivity



Graph 2. FM Rate Tolerance

## Ordering Information

**HP 5350B** 20 GHz Microwave Frequency Counter

**HP 5351B** 26.5 GHz Microwave Frequency Counter

**HP 5352B** 40 GHz Microwave Frequency Counter

**Options for HP 5350B/5351B/5352B:**

**Opt 001** Oven Timebase

**Opt 002** Rear-Panel Inputs (HP 5350B/51B only)

**Opt 005** Frequency Extension to 46 GHz (HP 5352B only)

**Opt 006** Microwave Level Limiter (HP 5350B/51B only)

**Opt 010** High-Stability Oven Timebase

**Opt 908** Rack-mount Kit for Use with Front Handles removed

**Opt 910** Additional Operating and Service Manual

**Opt 913** Rack-mount Kit for Use with Supplied Front Handles

**Opt 1A3** Bellcore CLEI Barcode Sticker

**Opt W30** Extended Repair Service (see page 592)

**Opt W32** Calibration Service (see page 592)

## Additional Equipment Available:

Transit Case (HP 9211-2643)

Waveguide (3 inch straight) Adapter WR28-APC3.5 (HP 05356-20217)

Waveguide (3 inch straight) to Coaxial Adapter

WR42-APC3.5 (HP 05356-20216)

Adapter: In series APC-3.5 male-to-male (HP 1250-1748)

Adapter: In series APC-3.5 female-to-female (HP 1250-1749)