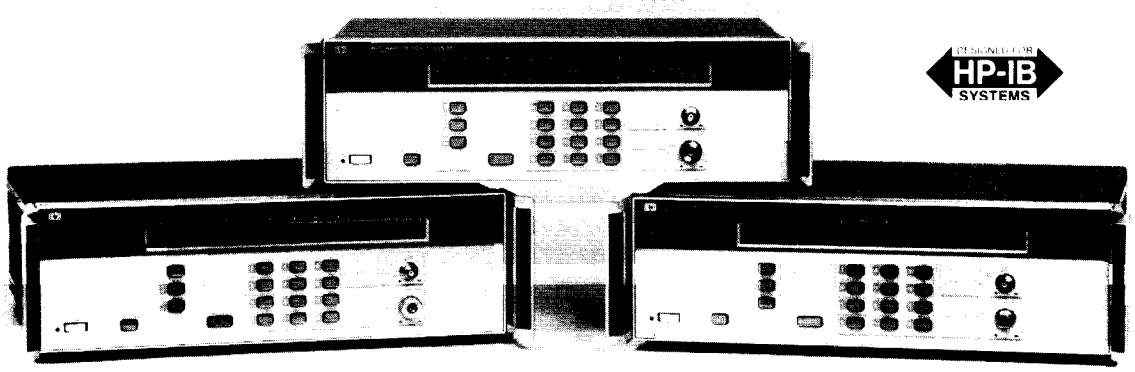
ELECTRONIC COUNTERS

Low-Cost, High-Performance CW Microwave Frequency Counters

Models 5350B, 5351B, 5352B

- Frequency coverage from 10 Hz to 40 GHz, direct inputs
- Exceptional sensitivity to −40 dBm
- 1 GHz/second tracking speed
- 60-millisecond acquisition time
- 100 measurements/second over HP-IB in automatic mode
- Two years of extended hardware support with Option W30



HP 5350B, HP 5351B, HP 5352B

HP 5350B/5351B/5352B Microwave Frequency Counters

The HP 5350B/5351B/5352B are automatic CW Microwave Frequency Counters that measure to 20, 26.5, and 40 GHz respectively. With resolution as fine as 1 Hz, these counters provide you with fast and precise frequency measurements.

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

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

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

Direct Inputs to 40 GHz, Providing Low-cost Solutions for your Expanding Needs

The HP 5350B/5351B/5352B provide a full range of high-performance, low-cost products to meet your expanding measurement needs. The HP 5350B and HP 5351B measure frequency from 10 Hz to 20 GHz and 26.5 GHz respectively. The HP 5352B, which extends input capability to 40 GHz, now lets you make measurements in the millimeter-wave range directly – without having to purchase expensive mixers.

Exceptional Sensitivity, Making Direct Measurement of Low-Level Signals Possible

As 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.

Reduced Acquisition Time, Significantly Improving Your Measurement Throughput

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

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

In systems environments, the counters' fast measurement throughput also contributes to your overall system efficiency. Delivering more than 100 measurements/second over HP-IB in automatic mode, the counters' systems performance saves you money by reducing test time.

1 GHz/second Tracking Speed, Accurately Measuring Your Fast-Moving Signals

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

Option W30 Provides you with Convenient Service and Support For the Second and Third Year of Ownership

In addition to the one-year service that HP normally provides for all of its instruments, Option W30 gives you two additional years of support at the time of purchase. This optional support reflects HP's commitment to product reliability and customer satisfaction.

HP 5350B/5351B/5352B Specifications

Input 1

Frequency range: HP 5350B: 10 Hz to 20 GHz
HP 5351B: 10 Hz to 26.5 GHz
HP 5352B: 10 Hz to 40 GHz

Sensitivity, in dBm (specification/typical performance @ 25°C)

HP 5350B/5351B: 500 MHz to 12.4 GHz: −32/−40; Option 002: −31/−39; Option 006: −29/−37.

HP 5350B/5351B: 12.4 GHz to 20 GHz: −27/−35; Option 002: −25/−33; Option 006: −23/−31.

HP 5351B: 20 GHz to 26.5 GHz: −16/−28; Option 002: −13/−25; Option 006: −11/−23.

HP 5352B: 500 MHz to 26.5 GHz: −25/−30; 26.5 GHz to 40 GHz, linear decrease to −15/−20.

Maximum input: +7 dBm.

Damage level: +25 dBm; HP 5350B/5351B Option 006: 500 MHz to 6 GHz + 39 dBm; 6 GHz to 18 GHz + 36 dBm; 18 GHz to 26.5 GHz + 34.8 dBm.

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 40 GHz 3.5:1.

Coupling: dc to 50Ω termination, ac to instrument.

Accuracy: ± 1 LSD ± time-base error × frequency. (See Graphs 3 & 5).

Residual stability: when counter and source use common 10 MHz time base or counter uses external higher stability time base, .3 LSD rms typical for resolution 1 Hz - 1 kHz at 25°C; HP 5352B .7 LSD typical 26.5 - 40 GHz; LSD = least significant digit.

Resolution: selectable 1 Hz to 1 MHz.

FM Tolerance (see Graph 2: FM Rate Tolerance)

Maximum deviation: Auto: 20 MHz p-p (12 MHz 5350B).
Manual: 60 MHz p-p (55 MHz 5352B).

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 ± 20 MHz or input frequency; ± 3 MHz worst case below 1 GHz; increases measurement and data output rate.

Automatic amplitude discrimination: automatically measures the largest of all signals 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 (40) GHz.

Acquisition time

Automatic mode: fast-acquisition track: <60 ms.
normal FM rate: <125 ms.
low RM rate: <1.25 s

Manual mode: <20 ms.

	TCX0	Option 001	Option 010
Aging Rate	1×10^{-7} per month	5×10^{-10} per day	2×10^{-8} per year
Short Term	1×10^{-9} per s	1×10^{-10} per s	1×10^{-10} per s
Temperature 0 - 50	1×10^{-6}	1×10^{-9}	1×10^{-9}
Line 10% change	1×10^{-7}	1×10^{-10}	1×10^{-10}
Warm up to $<5 \times 10^{-9}$ @ 25°C		10 minutes	10 minutes

Figure 1. Time Base (10 MHz).

Input 2:

Frequency range: 10 Hz to 525 MHz.

Mode of Operation

50 Ω: 10 MHz to 525 MHz.

1M Ω: 10 Hz to 80 MHz.

Sensitivity: full operating environment:

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

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

Gate Time = 1/resolution: 1 ms minimum.

Resolution: selectable 1 Hz to 1 MHz.

High resolution: 1M Ω 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 >10MHz input: 1 second gate.

Accuracy: (See Graphs 4 & 5). ±1 LSD

$$\left(\frac{\pm 1.4 \times \text{Trigger Error}^{(1)} \pm \text{Time Base}}{\text{Gate Time}} \right) \times \text{Frequency}$$

Impedance: selectable 1M Ω nominal shunted by <70 pF or 50 Ω nominal.

Coupling: ac.

Connector: replaceable fuse, type BNC female.

Maximum input: 50 Ω: +10 dBm; 1M Ω: 1V rms.

Damage level: 50 Ω or 1M Ω dc − 5 kHz: 250 V (dc + ac peak); >5 kHz: 5.5 V rms (+ 28 dBm) + 1.25 X 10^6 V rms/FREQ.

Panel label: 5.5 V rms (+ 28 dBm).

Time base output: 10 MHz and 1 MHz, 2.4 V square wave AC coupled into 1k Ω: 1.5V p-p into 50 Ω; available from rear panel BNC connectors whenever the instrument has AC power connected.

External time base: 1, 2, 5 or 10 MHz, 0.7 V min to 8 V max. p-p sine wave or square wave into > 1K Ω shunted by < 30 pF, via rear-panel BNC connector. External reference automatically selected when signal is present.

General

Display: segmented 24-character alphanumeric LCD (backlighted).

Keyboard: set-up stored in STBY mode.

Self-check: tests for correct circuit operation.

Diagnostics: front-panel or HP-IB selectable, Display and Keyboard Lockout, Service Diagnostics and User Information.

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 per second formatted at 10 kHz resolution, no math functions "DUMP MODE".

Math functions: result = measurement x scale + offset.

Offset: measurement is offset by entered value.

Scale: measurement is multiplied by entered value.

Smooth: displayed resolution is determined using exponential averaging; displays only stable digits.

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.

Overload indication: "OVRLOAD" A user message.

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 down-converted microwave signal at >−20 dBm into 50 Ω, ac coupled.

HP-IB interface functions: functions and diagnostics are programmable; address-set at front panel, default switches on rear panel; teach/learn programming; IEEE 728 compatible command structure; function subset SH1, AH1, T5, RF1, RL1, PP0, DC1, DT1, C0, E1 (see page 542).

Reset/local: returns to local control.

Operation temperature: 0° C to 50° C.

Power requirements: 100 VA max.

Line select: 100 V (90–105 VAC rms; 47.5 − 440 Hz).
115/120 V (104/126 VAC rms; 47.5 − 440 Hz).
220 V (198-231 VAC rms; 47.5 − 66 Hz).
230/240 V (207–252 VAC rms; 47.5 − 66 Hz).

Accessories furnished: power cord, manual.

Size: 33mmH × 407 mmW × 358 mmD (5¼ in. H × 16 in. W × 14 in. D)

Weight: 11 kg (24 lb).

(1) Trigger Error $\frac{\sqrt{e_i^2 + e_n^2}}{\text{Input Slew Rate in V/s at Trigger Point}}$ s rms

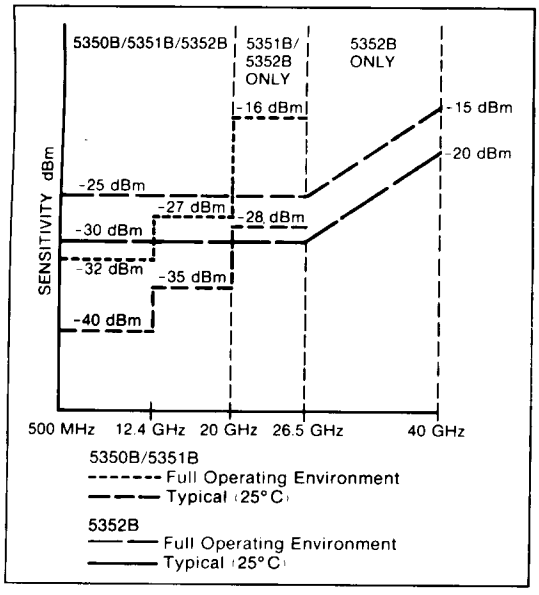
Where e_i = effective rms noise of counter's input channel (100 μV typical)

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

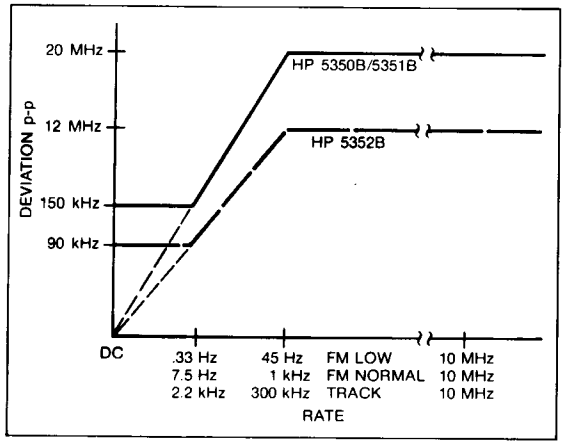
ELECTRONIC COUNTERS

Low-Cost, High-Performance CW Microwave Frequency Counters (cont'd)

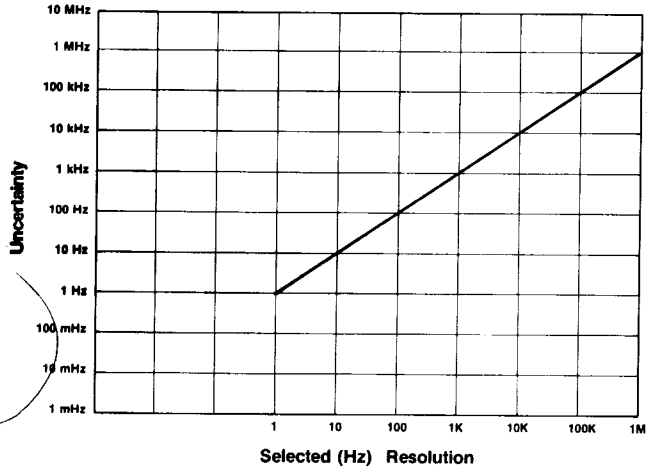
Models 5350B, 5351B, 5352B



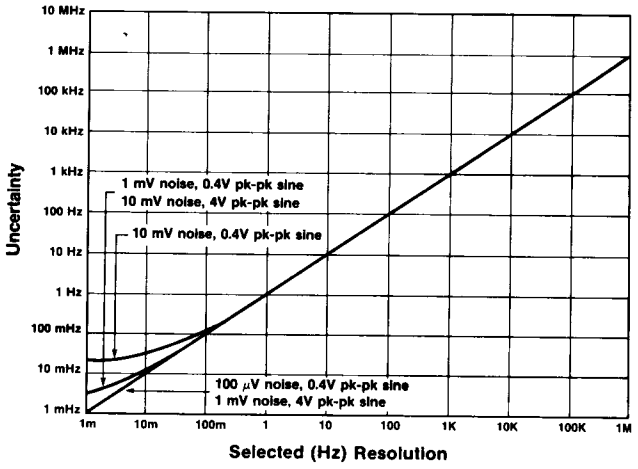
Graph 1. Sensitivity



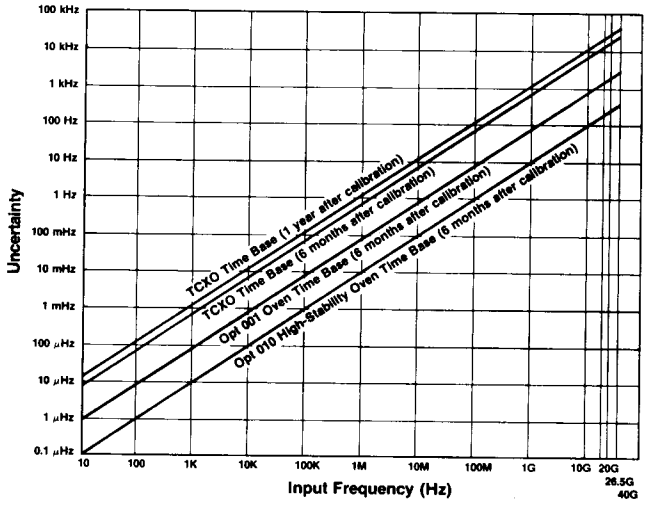
Graph 2. FM Rate Tolerance



Graph 3. Input 1 uncertainty due to selected resolution



Graph 4. Input 2 uncertainty due to selected resolution and trigger error.



Graph 5. Uncertainty due to time-base error. Time-base error can be reduced by calibrating the time base more frequently, or by using a time base with a slower aging rate.

Ordering Information	Price
HP 5350B 20 GHz Microwave Frequency Counter	$ 5,000
HP 5351B 26.5 GHz Microwave Frequency Counter	$ 6,000
HP 5352B 40 GHz Microwave Frequency Counter	$10,000
Opt 001 Oven Time Base	+$750
Opt 002 Rear Panel Inputs (HP 5350B/51B only)	+$300
Opt 006 Microwave Level Limiter (HP 5350B/51B only)	+$500
Opt 010 High Stability Oven Time Base	+$1,500
Opt 910 Additional Operating & Service Manual	+$40
Opt 908 Rack Mount Kit for use with front handles removed	+$55
Opt 913 Rack Mount Kit for use with supplied front handles	+$55
Opt W30 2-year extended hardware support	+$160
Additional Equipment Available:	
Transit Case	9211-2643
Waveguide (3″ straight) adapter WR28-APC3.5	05356-20217
Waveguide (3″ straight) to coaxial adapter WR42-APC3.5	05356-20216
Adapter - In series APC 3.5 Male to Male	1250-1748
Adapter - In series APC 3.5 Female to Female	1250-1749