



# ELECTRONIC COUNTERS

## Low-Cost, High-Performance Microwave Frequency Counters

Models 5350A, 5351A, 5352A

- 10 Hz - 40 GHz
- 5-year calibration interval
- 80 outputs per second
- -30 dBm sensitivity
- 8-year mean-time-between-failures



HP's lowest cost 20 GHz, 26.5 GHz and 40 GHz Microwave Counters

### Description

**Performance, ease of use and quality** are key in the design of these new products. All the basic capability you will need for less cost.

**Sensitivity** is outstanding at -30 dBm through the use of Gallium Arsenide sampling circuits and integration of the microwave elements.

**High speed data output**, with over 80 readings-per-second, is ideal for systems applications, making increased productivity a reality.

**Low cost of ownership** comes from low parts count, high reliability and a design that reduces the temperature effects on components.

**Extended calibration and long MTBF** ensure maximum up time for your test station or engineering bench.

### HP 5350A/5351A/5352A Specifications:

#### Input 1:

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

#### Sensitivity:

**HP 5350A/5351A:** 500 MHz to 12.4 GHz; -25 dBm (-30 dBm typ @ 25°C);

Option 002 -24 dBm; Option 006 -22 dBm.

**HP 5350/5351A:** 12.4 GHz to 20 GHz -20 dBm (-25 dBm typical @ 25°C);

Option 002 -18 dBm; Option 006 -16 dBm.

**HP 5351A:** 20 GHz to 26.5 GHz -15 dBm (-20 dBm typical @ 25°C);

Option 002 -12 dBm; Option 006 -10 dBm.

**HP 5352A:** 500 MHz to 26.5 GHz -25 dBm (-30 dBm typ @ 25°C); 26.5 GHz to 40 GHz linear decrease to -15 dBm (-20 dBm @ 25°C).

**Maximum input:** +7 dBm.

**Damage level:** +25 dBm; HP 5350A/5351A 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 50 ohm termination, AC to instrument.

**Accuracy:**  $\pm 1$  count  $\pm$  time base X frequency.

**Residual stability:** when counter and source use common 10 MHz time base or counter uses external higher stability time base, 1 LSD (.3 LSD typical) rms for resolution 1 Hz - 1 kHz at 25 degrees C; HP 5352A 1.4 LSD (.7 LSD typical) 26.5 - 40 GHz; LSD = least significant digit.

**Resolution:** selectable 1 Hz to 1 MHz.

**FM Tolerance:**

**Maximum deviation:** 20 MHz p-p; HP 5352A: 12 MHz.

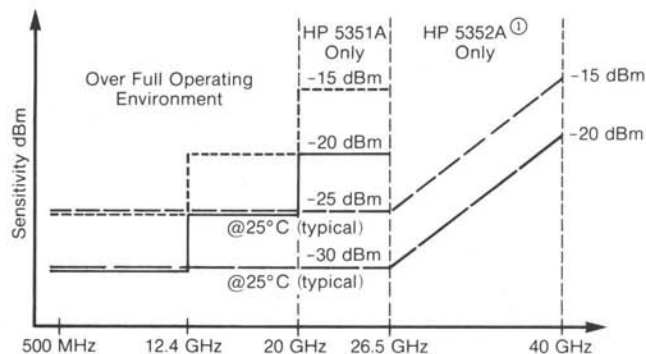
**Maximum FM rate:** 10 MHz.

**FM rate tolerance:** Normal/low (see data sheet).

**Normal:** 1 MHz/s maximum drift rate.

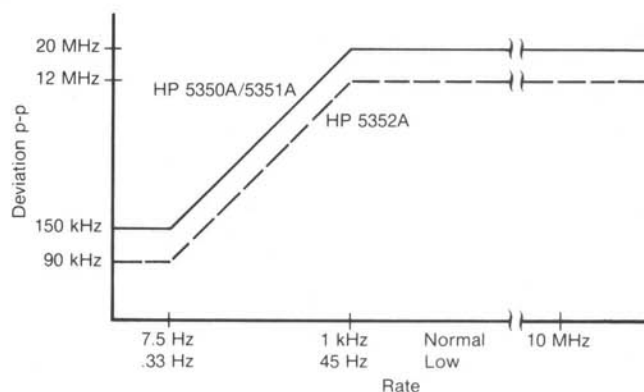
**Low:** 80 kHz/s maximum drift rate.

### Sensitivity Graph



① HP 5352A Sensitivity dBm =  $0.741 f(\text{GHz}) - 44.6$   
 @ 25°C Sensitivity dBm =  $0.741 f(\text{GHz}) - 49.6$

### FM Rate Tolerance Graph





**AM tolerance:** any modulation index provided the minimum signal level is not less than the sensitivity specification.

**Modes of Operation:**

**Automatic:** automatic amplitude discrimination is used to determine and display the frequency.

**Manual:** center frequency must be entered to within  $\pm 20$  MHz of input frequency;  $\pm 3$  MHz 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:**

**Normal FM rate:** 200 ms.

**Low FM rate:** 1300 ms.

**Manual Mode:** 40 ms after entering center frequency.

**Input 2:** HP 5350A/5351A/5352A.

**Frequency range:** 10 Hz to 525 MHz.

**Mode of Operation:**

**50 ohm:** 10 MHz to 525 MHz.

**1M ohm:** 10 Hz to 80 MHz.

**Sensitivity:** full operating environment:

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

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

Gate Time = 1/resolution: 1 ms minimum.

**Resolution:** selectable 1 Hz to 1 MHz.

**High resolution:** 1M ohm 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.

**Accuracy:**  $\pm 1$  count

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

**Impedance:** selectable 1M ohm nominal shunted by  $< 70$  pF or 50 ohm nominal.

**Coupling:** AC.

**Connector:** replaceable fuse, type BNC female.

**Maximum input:** 50 ohm:  $+10$  dBm; 1M ohm: 1V rms.

**Damage level:** 50 ohm or 1M ohm DC  $- 5$  kHz: 250V (DC + AC peak);  $> 5$  kHz: 5.5V rms ( $+ 28$  dBm) +  $1.25 \times 10^6$  V rms/FREQ.

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

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

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

## Time Base (10 MHz)

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

## 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.

**Manual mode:**  $> 80$  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:** 1-2/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 ohm, AC coupled.

**HP-IB:** 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.

**Reset/local:** returns to local control.

**Operation temperature:** 0 degrees C to 50 degrees C.

**Power requirements:** 100 VA max

**Line select:** 100V (90-105 VAC rms; 47.5 - 440 Hz)

115/120 (104/126 VAC rms; 47.5 - 440 Hz)

220V (198-231 VAC rms; 47.5 - 66 Hz)

230/240V (207-252 VAC rms; 47.5 - 66 Hz)

**Accessories furnished:** power cord, manual

Size:  $5\frac{1}{4}$ "H X 16"W X 14"D/33 mmH X 407 MMW X 358 mmD.

**Weight:** 24 lbs, / 11 kg.

## Ordering Information

Option 001 Oven Time Base \$750

Option 002 Rear Panel Inputs (HP 5350A/51A only) \$300

Option 006 Microwave Level Limiter (HP 5350A/51A only) \$500

Option 010 High Stability Oven Time Base \$1,500

Option 910 Additional Operating & Service Manual \$40

Option 908 Rack Mount Kit for use with front handles removed \$55

Option 913 Rack Mount Kit for use with supplied front handles \$55

Option 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 05356-20216

WR42-APC3.5

Adapter - In series APC 3.5 Male to Male 1250-1748

Adapter - In series APC 3.5 Female to female 1250-1749

**HP 5350A 20 GHz Microwave \$5,000**

**Frequency Counter**

**HP 5351A 26.5 GHz Microwave \$6,000**

**Frequency Counter**

**HP 5352A 40 GHz Microwave \$10,000**

**Frequency Counter**

$$(1) \text{ Trigger Error } \sqrt{e_i^2 + e_n^2} \text{ s rms}$$

Input Slew Rate in V/s at Trigger Point

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

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