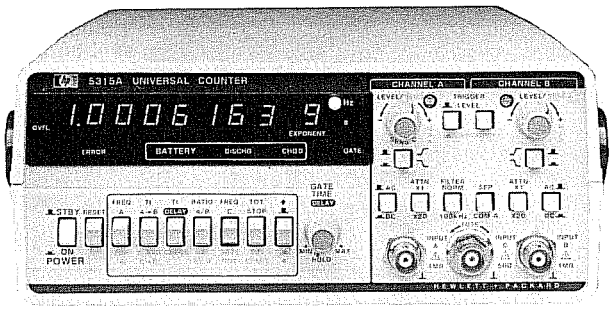
# ELECTRONIC COUNTERS

## Universal Counters

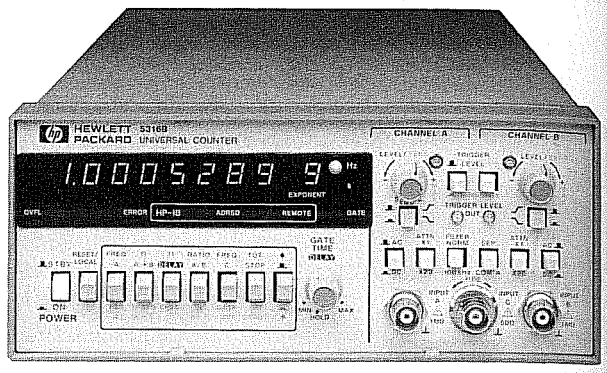
**Models 5315A, 5316B**

- Frequency, period, ratio, and totalize to 100 MHz
- Portable, and HP-IB models
- 1 GHz capability available




HP 5315A

- Uses reciprocal technique for full low-frequency resolution
- 100 ns time interval, 10 ps T.I. averaging
- Oven option for increased accuracy




HP 5316B

DESIGNED FOR HP-IB SYSTEMS

## HP 5315A and HP 5316B Universal Counters

### A Quiet Revolution in Capability . . .

HP's economical HP 5315A and HP 5316B counters provide all the universal counter capability you've come to expect at much higher prices. That's because they use a unique custom circuit called the MRC (Multiple Register Counter) which packs counting and computing power into this popular counter series. To a user, the differences in operation from conventional direct models can be listed quickly: low frequency resolution is an outstanding 7 digits per second of gate time and reliability is extremely good due to the counter's low chip count. Also, the continuously adjustable gate time allows automatic selection of sample size for easy trade-offs between measurement time and resolution.

Much of the counter's performance is based on reciprocal counting techniques first pioneered in HP's high-performance HP 5360A computing counter, and the current HP 5345A Universal Counter. The use of these techniques coupled with HP's MRC and a microprocessor provides a quiet but powerful revolution in counter performance within the HP 5315A and HP 5316B. For example, this counter gives you its full 7-digits/second resolution over the range from 1 Hz to 100 MHz. This, simply stated, shows the power of the MRC and reciprocal counting.

### High Performance, Low Price

In addition to its economy, the MRC counter offers a full set of universal counter measurements, and there are very few limitations to this capability. Increased accuracy in low-cost portable and system counters is also available with the oven oscillator option through improved temperature stability and lower aging rates.

### Frequency to 100 MHz, C-Channel to 1.0 GHz

The MRC counter measures frequency to 100 MHz. Additionally the optional C-Channel measures to 1.0 GHz for both CW and pulsed RF signals as narrow as 60 ms. The C-Channel option is particularly useful in navigation and communications equipment testing due to this pulsed RF measurement feature.

### Time Interval to 100 ns, T.I. Averaging to 10 ps

The MRC counter provides three time measurement modes. Single-shot time interval allows measurements over a range of 100 ns to 100,000 seconds. This capability can be used to measure pulse width. Time interval averaging provides greater resolution for repetitive events. Finally, time interval delay avoids measurement of spurious signals by holding off the counter's trigger point by a precise, operator-selectable amount of time.

### A Full Set of Measurements

Besides the frequency and time functions mentioned above, the MRC counter has other measurement functions that make it a truly impressive value:

**Period A**—allows single period measurements via Channel A.
**Ratio A/B**—allows frequencies to 100 MHz into both Channel A and B.
**A By B**—totalizes the A input between 2 events on B channel.
**Totalize**—a manually gated totalize mode of operation.

### Input Signal Conditioning Versatility

A full complement of input signal conditioning controls are provided for both channels. These include ± slope, ±2.5 Vdc trigger level, and ac/dc coupling. Other controls are a Separate/Common switch, and a 100 kHz low-pass filter for Channel A.

### A Choice of Portable or System Models

**HP 5315A:** a portable, light-weight unit best suited for field applications. This unit has a convenient carrying handle and optional battery power is available for up to 4 hours continuous operation.

**HP 5316B:** this model possesses all the characteristics of the HP 5315A, and it has HP-IB capability built-in as standard equipment. It has low RFI, it is rackable, and it is functionally identical to the HP 5315A. In addition to programmable measurement functions, the user can also select dc trigger level and ± slope under HP-IB control. Channel A and B trigger levels are brought out to the front panel on this unit for easy measurement with a DVM.

## HP 5315A, 5316B Condensed Specifications

### Input Characteristics (channel A and channel B)

**Range:** dc coupled, 0 to 100 MHz.
ac coupled, 30 Hz to 100 MHz.
**Sensitivity:** 10 mV rms sine wave to 10 MHz. 25 mV rms sine wave to 100 MHz. 75 mV peak-to-peak pulse at minimum pulse width of 5 ns.
Sensitivity can be varied continuously up to 500 mV rms *NOMINAL* by adjusting sensitivity control. In sensitivity mode, trigger level is automatically set to 0 V *NOMINAL*.
**Dynamic Range**
30 mV to 5 V peak-to-peak, 0 to 10 MHz.
75 mV to 5 V peak-to-peak, 10 to 100 MHz.
**Coupling:** ac or dc, switchable.
**Filter:** low pass, switchable in or out of Channel A. 3 dB point of 100 kHz *NOMINALLY*.
**Impedance:** 1 MΩ *NOMINAL* shunted by less than 40 pF.
**Signal operating range:** +2.5 Vdc to −2.5 Vdc.
**Attenuator:** ×1 or ×20 *NOMINAL*.
**Trigger level:** variable between +2.5 Vdc and −2.5 Vdc.
**Slope:** independent selection of + or − slope.
**Common input:** all specifications are the same for Common A except the following:
**Sensitivity:** 20 mV rms sine wave to 10 MHz; 50 mV rms to 100 MHz; 150 mV peak-to-peak at a minimum pulse width of 5 ns.
**Dynamic range:** 60 mV to 5 V peak-to-peak to 10 MHz; 150 mV to 5V peak-to-peak, 10–100 MHz.
**Impedance:** 500 kΩ NOMINAL shunted by less than 70 pF.

### Frequency (channel A)

**Range:** 0.1 Hz to 100 MHz.
**Resolution:** See Graph 1
**Accuracy:** ± Resolution ± Time Base Error (Graph 2)

### Period

**Range:** 10 ns to $10^5$ s.
**Resolution:** See Graph 1
**Accuracy:** ± Resolution ± Time Base Error (Graph 2)

### Time Interval

**Range:** 100 ns to $10^5$ s.
**LSD displayed:** 100 ns.
**Resolution:** ± LSD ± Noise Trigger Error (Graph 3)
**Accuracy:** ± Resolution ± Time Base Error (Graph 2)

### Time Interval Average

**Range:** 0 ns to $10^5$ s.
**LSD displayed:** 100 ns/$\sqrt{N}$, 10 ps maximum.
**Number of intervals averaged (N):** N = Gate Time x FREQ.
**Minimum dead time (stop to start):** 200 ns.
**Resolution:** ±LSD ± [Noise Trigger Error (Graph 3)]/$\sqrt{N}$
**Accuracy:** ± Resolution ± Time Base Error (Graph 2) ± 4 ns

### Time Interval Delay (holdoff)

Front panel gate time knob inserts a variable delay of *NOMINALLY* 200 μs to 20 ms between START (Channel A) and enabling of STOP (Channel B). Electrical inputs during delay time are ignored. Delay time may be digitally measured by simultaneously pressing T.I. Average, T.I. Delay and blue key. Other specifications are identical to Time Interval

### Ratio

**Range:** 0.1 Hz to 100 MHz, both channels.
**LSD:** [(2.5 x Period A)/Gate Time] x Ratio.

### Totalize

**Manual**
Range: 0 to 100 MHz.
**A gated by B**
Totalizes input A between two events of B. Instrument must be reset to make new measurement. Gate opens on A slope, closes on B slope.
Range: 0 to 100 MHz.

### General

**Standard Time Base**
**Frequency:** 10 MHz.
**Aging rate:** $< 3\times 10^{-7}$/mo.
**Temperature:** $\pm 5 \times 10^{-6}$, 0° to 50°C.
**Line voltage:** $<1 \times 10^{-7}$ for a ± 10% variation.
**Check:** counts internal 10 MHz reference frequency.
**Error light:** LED warning light activated if logic error is found during instrument turn-on self-check.
**Display:** 8-digit LED display, with engineering units annunciator.
**Overflow:** only frequency and totalize measurements will overflow. In case of overflow, eight least significant digits will be displayed and front panel overflow LED will be actuated. All other measurements which would theoretically cause a display of more than 8 digits will result in the display of the 8 most significant digits.
**Gate time:** continuously variable, *NOMINALLY* from 60 ms to 10 s or 1 period of the input, whichever is longer.
**Sample rate:** up to 7 readings per second *NOMINAL* except in time interval mode, where it is continuously variable *NOMINALLY* from 250 ms to 10 s via Gate Time Control.
**Operating temperature:** 0° to 50°C.
**Power requirements:** 100, 120, 220, 240 V (+5%, −10%) 48–66 Hz; 15 VA maximum or 30 VA maximum (HP 5316B).
**Weight:** net, 2.2 kg (4 lb 12 oz). Shipping, 4.1 kg (9 lb).
**Dimensions:** 238 mm W x 98 mm H x 276 mm D (9⅜ in. x 3⅞ in. x 10⅞ in.).

## Additional HP 5316B Specifications

Rack and stack metal case with rear panel, switchable ac power line module, Specifications same as HP 5315A except as follows:
**Rack mount kit:** HP 5061-9672 recommended.
**Oscillator output:** 10 MHz, 50 mV p-p into 50 Ω load on rear panel.
**External frequency standard input:** 1, 5, 10 MHz, 1 V rms into 500 Ω, or rear panel.
**Trigger level output:** ±5%, ±15 mV, over ±2.0 Vdc range at front panel connectors.
**Dimensions:** 212 mm W x 88 mm H x 415 mm D (8 3/8 in. x 3 1/2 in. x 16 1/2 in.).
**Weight:** net, 3.7 kg (8 lb 2 oz). Shipping, 6.3 kg (14 lb).

### Hewlett-Packard Interface Bus

**Programmable functions:** Frequency A and C, Frequency A Armed by B, Period A, Totalize A Gated by B, Ratio A/B, Time Interval A→B, Time Interval Average A→B, Time Int. Delay, Read Gate Time.
**Programmable controls:** Gate Time Command which sets long (60 ms to 10 s) or short (500 μs to 30 ms) range; Trigger Level Commands which set Channel A and/or B slope (±) and Channel A and/or B trigger from − 2.50 Vdc to + 2.50 Vdc in steps of .01V.
**HP-IB Interface Functions:** SH1, AH1, T1, L2, SR1, RL1, PP0, DC1, DT1, C0, E1 (see page 556).

## Options

**Opt. 001:** High Stability Time Base (TCXO).
**Frequency:** 10 MHz.
**Aging rate:** $< 1 \times 10^{-7}$/mo.
**Temperature:** $\pm 1 \times 10^{-6}$, 0° to 40°C.
**Line voltage:** $< 1 \times 10^{-8}$ for ± 10% variation.

# ELECTRONIC COUNTERS
## Universal Counters (cont'd)
### Models 5315A, 5316B

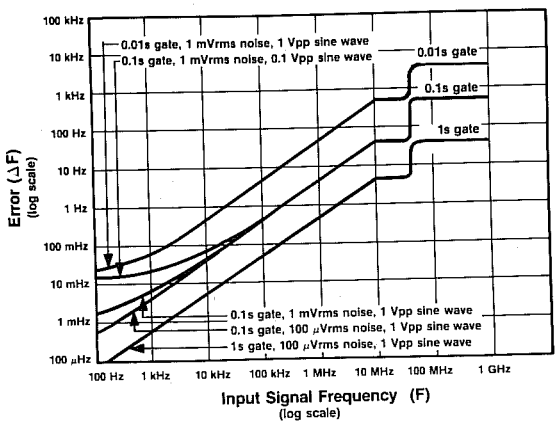
**Opt. 002:** Battery (HP 5315A only).
**Type:** rechargeable lead-acid (sealed).
**Capacity:** TYPICALLY 4 hours of continuous operation at 25 °C.
**Recharging time:** TYPICALLY 16 hours to 98% of full charge, instrument non-operating. Charging circuitry included with Option. Batteries not charged during instrument operation.
**Low voltage indicator:** instrument turns itself off automatically when low battery condition exists. *Discharge* LED flashes slowly when this happens. *Discharge* LED is on whenever battery is supplying power to instrument. *Charge* LED indicates state of charge of battery during charging only and is on whenever battery is charged to 95% *NOMINAL* of capacity. *Charge* LED flashes when 90% *NOMINAL* of charge taken out is replaced. *Charge* LED is off if charge is less than 70% *NOMINAL* of capacity.
**Line failure protection:** instrument automatically switches to battery in case of line failure.
**Weight:** Opt 002 adds 1.4 kg (3 lb) to weight of instrument.

**Option 003:** C Channel.

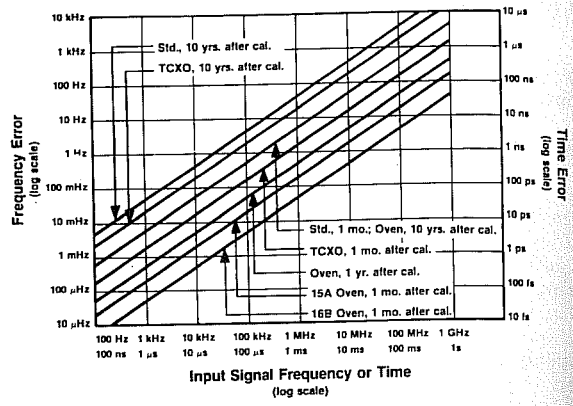
**Input Characteristics**
**Range:** 50 to 1000 MHz, prescaled by 10.
**Sensitivity:** 15 mV rms sinewave (−23.5 dBm) to 650 MHz. 75 mV rms sinewave (−9.5 dBm) to 1000 MHz. Sensitivity can be decreased continuously by up to 20 dB *NOMINAL* , 50 to 500 MHz and 10 dB *NOMINAL*, 500 to 1000 MHz by adjusting sensitivity control. Trigger level is fixed at 0 V *NOMINAL*.
**Dynamic range:** 15 mV to 1 V rms (36 dB), 50 to 650 MHz. 75 mV to 1 V rms (20 dB), 650 to 1000 MHz.
**Signal operating range:** +5 Vdc to −5 Vdc.
**Coupling:** ac.
**Impedance:** 50 Ω *NOMINAL* (VSWR, < 2.5:1 TYPICAL).
**Damage level:** ±8 V (dc + ac peak), fuse protected. Fuse located in BNC connector.
**Resolution and Accuracy:** same as Frequency A.

**Option 004:** High Stability OVEN Time Base
(HP 5315A only).
**Frequency:** 10 MHz.
**Aging rate:** $<3 \times 10^{-8}$/mo*.
**Temperature:** $\pm 1 \times 10^{-7}$, 0° to 50°C.
**Line voltage:** $<1 \times 10^{-8}$, for a 10% variation.
Oven will operate continuously off of a fully charged battery for > 24 hours, typically, when in standby mode (no power applied, instrument OFF, and Freq. A button depressed).

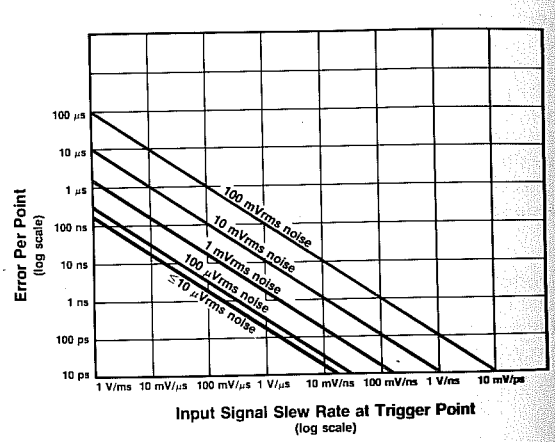
(HP 5316B)
**Frequency:** 10 MHz.
**Aging rate:** $<3 \times 10^{-8}$/mo.**
**Temperature:** $\pm 2 \times 10^{-8}$, 0° to 50°C.
**Line Voltage:** $<1 \times 10^{-9}$, for a 10% variation.




**Graph 1. Frequency Resolution Error:** Noise on the input signal and internal uncertainties affect Frequency and Period measurements. For Period, invert the period (P) of the input signal, and find frequency uncertainty (ΔF). Period uncertainty (ΔP) = (ΔF/F) x P.




**Graph 2. Timebase Error:** Environment and aging of the crystal affects all measurements.




**Graph 3. Input Noise Trigger Error:** Noise on the input signal affects both the Start and Stop points of all Time Interval measurements.

*After 30 days continuous operation (ac power applied, in OFF or ON position).
**After 30 days continuous operation. <5 × 10−8/ mo., after 7 days continuous operation.

### Ordering Information

**HP 5315A** Universal Counter — **$1250**☎

**HP 5316B** Universal Counter — **$1475**☎

| | | HP 5315A | HP 5316A | Price |
|---|---|---|---|---|
| Opt 001 | TCXO Time Base | X | X | + $180 |
| Opt 002 | Battery Pack | X | | + $300 |
| Opt 003 | C-Channel (1.0 GHz) | X | X | + $400 |
| Opt 004 | High Stability Time Base | X | X | + $600 |

All HP 5315A orders must include one (1) of these line power options: — Price

**Opt 100** 90-105 VAC — N/C
**Opt 120** 108-126 VAC — N/C
**Opt 220** 198-231 VAC — N/C
**Opt 240** 216-252 VAC — N/C

☎ Fast-Ship product—see page 766.