Table 1-1. HP Model 5370A Specifications

INPUT AMPLIFIERS

SEPARATE INPUTS

Sensitivity: 100 mV p-p, 35 mV rms sine wave times attenuator setting.

Impedance: Selectable 1 MΩ || 30 pF or 50Ω nominal.

Trigger Level: Adjustable from –1.3V to 0.5V with 10 mV displayed resolution.

Trigger Slope: Independent selection of + or – slope.

Attenuators: ÷1 and ÷10 nominal.

Dynamic Range (preset):

50Ω ÷1	100 mV to 1V p-p pulse
÷10	1V to 7V p-p pulse
1 MΩ ÷1	100 mV to 1V p-p pulse
÷10	1V to 10V p-p pulse

Dynamic range for rms sine wave is one-third of the above values.

For precise time interval measurements the input signal (V_S) must be at least 150 mV (but not greater than 700 mV) above or below the trigger voltage (V_{TL}):

$$0.15V < | V_S - V_{TL} | < 0.7V$$

Signal Operating Range:

50Ω ÷1	–2.5V to 1V
÷10	–7V to 7V
1 MΩ ÷1	–2.5V to 1V
÷10	–25V to 10V

Coupling: AC or DC switch selectable.

Minimum Pulse Width: 5 ns

Maximum Input:

50Ω ÷1	±7V DC 7V rms below 5 MHz 3.5V rms (+24 dBm) above 5 MHz
÷10	±7V DC, 7V rms (+30 dBm)
1 MΩ ÷1	±350V DC 250V rms to 20 kHz decreasing to 3.5V rms above 5 MHz
÷10	±350V 250V rms to 20 kHz decreasing to 35V rms above 5 MHz.

COMMON INPUT

All specifications are the same as for separate operation with the following differences:

Impedance: 1 MΩ becomes 500 KΩ shunted by <60 pF. 50Ω same as in separate.

Sensitivity (preset):

50Ω ÷1	200 mV p-p, 70 mV rms
÷10	2V p-p, 700 mV rms
1 MΩ	Same as in separate

Dynamic Range (preset):

50Ω ÷1	200 mV to 2V p-p pulse
÷10	2V to 5V p-p pulse
1 MΩ	Same as in separate

Maximum Input:

50Ω ±5V DC or 5V rms

1 MΩ same as in separate

Attenuators: Becomes ÷2 and ÷20 for 50Ω.

FREQUENCY AND PERIOD MEASUREMENTS

FREQUENCY RANGE: 0.1 Hz to 100 MHz

PERIOD RANGE: 10 ns to 10 seconds

RESOLUTION: $\frac{20 \text{ ps}}{\text{gate time}}$

INTERNAL GATE TIME: 1 period, 0.01, 0.1, 1.0 seconds.

ACCURACY:

$$\frac{100 \text{ ps rms} \pm \text{trigger error}}{\text{gate time}} \pm \text{time base}$$

PERIOD/FREQUENCY STATISTICS: (1 period gate only) mean, standard deviation, maximum, minimum.

Sample Size: 1, 100, 1000, 10,000, 100,000

External Gate Input: 20 ns to 10 s.

TIME INTERVAL MEASUREMENTS

TIME INTERVAL RANGE:

±T.I. Mode –10 seconds to +10 seconds.

+T.I. Only Mode 10 ns to 10 seconds.

TIME INTERVAL STATISTICS: Mean, standard deviation, maximum, minimum.

SAMPLE SIZE: 1, 100, 1000, 10,000, 100,000

MINIMUM TIME BETWEEN MEASUREMENTS: 330 μs (165 μs in the Fast Binary mode).

RESOLUTION: $\frac{\pm 20 \text{ ps}}{\sqrt{\text{sample size}}} \pm 2 \text{ ps}$

Displayed resolution also depends on trigger error.

ACCURACY: Jitter ±700 ps systematic ± time base† ± trigger error/$\sqrt{N}$

JITTER: 35 ps rms typical 100 ps rms maximum. The effect of jitter on the mean of a time interval measurement reduces as the $\sqrt{N}$ increases where N is the number of times averaged.

TRIGGER ERROR:

$$\frac{\sqrt{(150\ \mu V)^2 + e_n^2}}{\text{Input voltage slew rate at trigger points (V/s)}} \text{ sec rms}$$

where 150 μV is the typical input amplifier noise on the 5370A and e_n is the rms noise of the input signal for a 500 MHz bandwidth.

Trigger error due to input signal noise is usually the limiting factor in high resolution frequency measurements at low frequencies. If peak noise amplitude is greater than 10 mV, additional miscounting may occur. (This situation can arise when measuring high-level outputs of broadband synthesized signal sources.)

GENERAL

EXTERNAL GATE

Input Impedance: 1 MΩ || 10 pF nominal.

Slope: Selectable + or –

Level: Continuously adjustable –2V to +2V, preset ØV.

Sensitivity: 100 mV rms

Minimum Pulse Width: 20 ns

External Gate Range: 20 ns to 10 s/sample size

TRIGGER OUTPUTS (rear panel)

Start: Edge going from Ø to –0.7V nominal into 50Ω in sync with the opening of the start channel.

Stop: Ø to 0.7V edge into 50Ω in sync with the closing of the stop channel.

†For time intervals greater than 10 ms the High Stability Time Base Option 001 is recommended.

Table 1-1. HP Model 5370A Specifications (Continued)

FREQUENCY STANDARD INPUT (rear panel)
5 or 10 MHz >1.0V p-p into 1 KΩ. Maximum Input 10V.
FREQUENCY STANDARD OUTPUT (rear panel)
10 MHz
1V p-p into 50Ω in sync with time base chosen (INT or EXT)
DISPLAY: 16 digits + sign, suppressed leading zeros.
DISPLAY RATE: 10 ms to 5 s or hold.
OPERATING TEMPERATURE: 0° to 50°C.
POWER REQUIREMENTS: 100, 120, 220, or 240V ac +5% -10%, 48 to 66 Hz, less than 220 VA.
DIMENSIONS: 425 mm (16¾") wide, 133 mm (5¼") high, 457 mm (18") deep
WEIGHT: 14.55 kg (32 lbs.).
TIME BASE: Crystal Frequency 10 MHz.

STABILITY:
Aging Rate: $<3 \times 10^{-7}$ per month
Short Term: $<2 \times 10^{-9}$ rms for 1 s average
Temperature: $<2 \times 10^{-8}$ 25°C to 35°C
$<5 \times 10^{-8}$ 0°C to 55°C
Line Voltage: $<1 \times 10^{-8}$, ±10% from nominal.
OPTION 001: HIGH STABILITY TIME BASE (HP MODEL 10544A)
Crystal Frequency: 10 MHz
Stability:
Aging Rate: $<5 \times 10^{-10}$* per day
Short Term: $<1 \times 10^{-11}$ for 1 s average
Temperature: $<7 \times 10^{-9}$ 0°C to 50°C
Line Voltage: $<1 \times 10^{-10}$**, ±10% from nominal.

*For oscillator off time less than 24 hours.
**15 minutes after change.

1-12. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to the manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-13. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-14. HP-IB INTERFACING, AND PROGRAMMING INFORMATION

1-15. Section II of this manual contains instructions for interfacing the Model 5370A with the HP-IB. A brief description of the sequence of events comprising the transfer of data by the HP-IB is provided in Section III, followed by programming information. Information concerning the design criteria of the bus is available in IEEE Standard 488-1975, titled *"IEEE Standard Digital Interface for Programmable Instrumentation"*.

1-16. SAFETY CONSIDERATIONS

1-17. This product is a Safety Class I instrument (provided with a protective earth terminal). Safety information pertinent to the operation and servicing of this instrument is included in appropriate sections of this manual.

1-18. DESCRIPTION

1-19. The Hewlett-Packard Model 5370A Universal Time Interval (T.I.) Counter is capable of making single-shot T.I. measurements with ±20 ps resolution. It uses a phase-locked vernier interpolating technique in which the interpolating oscillators are locked to the time base, thus retaining its basic accuracy at all times. The technique also allows positive, zero, and negative time interval measurements, and a resident microprocessor extends the usefulness of the instrument by offering statistical data such as mean, standard deviation, max, min, etc., for repetitive time intervals.