

# Condensed Specifications

## Input Characteristics (channel A and B)

### Range

DC coupled, 0 to 100 MHz.  
AC 1 MΩ, 30 Hz to 100 MHz.  
AC 50 Ω, 200 kHz to 100 MHz.  
NOTE: Channel A range 200 MHz when in Frequency A and Ratio modes.

### Sensitivity (X1)

25 mV rms sinewave.  
75 mV peak-to-peak pulse at minium pulse width of 5 ns.

### Dynamic Range (X1)

75 mV to 5 V peak-to-peak, to 100 MHz.  
75 mV to 2.5 V peak-to-peak, >100 MHz.

### Signal Operating Range (X1, DC)

-5 V dc to +5 V dc.

### Trigger Level Range (X1)

#### Auto Trigger OFF

Preset: set to 0 V dc NOMINAL.  
Adjustable: -5 V dc to +5 V dc.

#### Auto Trigger ON

Preset: set to nominal 50% point of input signal.  
Adjustable: nominally between + and - peaks of input signal.

### Auto Trigger (X1)

#### Range (50% duty cycle)

DC coupled, 30 Hz to 200 MHz.  
AC 1 MΩ, 30 Hz to 200 MHz.  
AC 50 Ω, 200 kHz to 200 MHz.

**Minimum signal:** 100 mV rms.

**Duty cycle range:** 10% to 90%.

**Response time:** 3 seconds, typical.

NOTE: Auto Trigger requires a repetitive signal.

Coupling: ac or dc, switchable.

**Impedance:** 1 MΩ, nominal, shunted by <35 pF or 50 Ω nominal, switchable. In COMMON A, 1 MΩ is shunted by <50 pF.

**Attenuator:** X1 or X10 nominal, switchable.

**Slope:** independent selection of + or - slope.

**Channel input:** SEPARATE or COMMON A, switchable.

### Frequency A

**Range:** 0 to 200 MHz, prescaled by 2.

### LSD Displayed

$$\frac{1 \text{ ns}}{\text{Gate Time}} \times \text{FREQ. (e.g. 9 digits in a second).}$$

### Resolution

$$\pm (2 \times \text{LSD}) \pm 1.4 \times \frac{\text{Trigger Error}}{\text{Gate Time}} \times \text{FREQ.}$$

**Accuracy:**  $\pm (\text{Resolution}) \pm (\text{Time Base Error}) \times \text{FREQ.}$

### Period A

**Range:** 10 ns to 10<sup>7</sup> s.

### LSD Displayed

$$\frac{1 \text{ ns}}{\text{Gate Time}} \times \text{PER. (e.g. 9 digits in a second).}$$

**Period average:** user selects MEAN function, and n = 100, or n = 1,000.

### Time Interval A→B

**Range:** 0 ns to 10<sup>7</sup> s.

**LSD displayed:** 1 ns (100 ps using MEAN).

**Resolution:**  $\pm (2 \times \text{LSD}) \pm (\text{START Trigger Error}) \pm (\text{STOP Trigger Error}).$

**Accuracy:**  $\pm (\text{Resolution}) \pm (\text{Time Base Error}) \times \text{TI} \pm (\text{Trigger Level Timing Error}) \pm (2 \text{ ns}).$

**Gate mode:** MIN only.

**Time internal average:** user selects MEAN function, and n = 100, or n = 1,000.

### Time Interval Delay (holdoff)

Front panel Gate Adjust control inserts a variable delay between START and enabling of STOP. Electrical inputs during delay are ignored. Delay ranges are same as gate time ranges (100 μs, to 4 s NOMINAL) for gate modes of Fast, Norm, and Manual.

### Inverse Time Interval A→B

**Range:** 10<sup>-7</sup> to 10<sup>9</sup> units/second.

LSD Displayed, Resolution, and Accuracy are inverse of Time Interval A→B specifications.

### Rise and Fall Time A

**Range:** 20 ns to 10 ms transition with 50 Hz to 25 MHz repetition rates (50% duty cycle).

**Minimum pulse height:** 500 mV peak-to-peak.

**Minimum pulse width:** 20 ns.

**Duty cycle range:** 20% to 80%.

LSD Displayed and Resolution are same as Time Interval A→B Specifications.

### Pulse Width A

**Range:** 5 ns to 10<sup>7</sup> s.

**Trigger point range:** 40% to 60% of pulse height.

LSD Displayed and Resolution are same as Time Interval A→B specifications.

### Duty Cycle A

**Range:** 1% to 99%, 0 to 100 MHz.

**Trigger point range:** 40% to 60% of pulse height.

$$\text{LSD displayed: } \frac{1 \text{ ns}}{\text{PER}} \times 100\%$$

NOTE: Constant duty cycle required during measurement.

### Slew Rate A

**Range:** 50 V/s to 10<sup>8</sup> V/s slew rate with 50 Hz to 25 MHz repetition rates (50% duty cycle). Minimum Pulse Height, Width, and Duty Cycle Range are same as Rise and Fall Time A.

**Input mode:** automatically set to COMMON A with 10% and 90% trigger levels.

### Ratio A/B

**Range:** Channel A, 0 to 200 MHz (prescaled by 2).  
Channel B, 0 to 100 MHz.

$$\text{LSD displayed: } \frac{\text{RATIO}}{\text{FREQ} \times \text{Gate Time}} \text{ where FREQ is higher frequency after prescaling.}$$

### Totalize A

**Range:** 0 to 100 MHz.

**LSD displayed:** 1 count of input.

**HP-IB output:** at end of gate.

### Manual

**Count reset:** via RESET key.

**HP-IB output:** totalize data on-the-fly sent if Cycle mode set to Single. Input frequency range in this mode is 0 to 50 Hz nominal.

### Gated

**Count reset:** automatic after measurement.

### Phase A Rel B

**Range:** -180° to 360°, Range Hold off, or 0° to 360°, Range Hold on, with signal repetition rates of 30 Hz to 1 MHz.

**Minimum signal:** 100 mV rms.

**LSD displayed:** 0.1°.

### Gate Time

**Range:** 100 ns to 10<sup>7</sup> s.

**LSD displayed:** up to three digits with Ext. Arm Enable OFF, 100 ns when ON. MIN Gate Mode display zero.

### Trigger Level

**Range:**  $\times 1$ , +5 to -5 V;  $\times 10$ , +50 to -50 V.

**Resolution:**  $\times 1$ , 10 mV;  $\times 10$ , 100 mV.

**Accuracy ( $\times 1$ ):**  $\pm 20$  mV,  $\pm 0.5\%$  of reading.

### Time Base

#### Standard Crystal

**Frequency:** 10 MHz.

**Aging rate:**  $< 3 \times 10^{-7}$ /month.

**Temperature:**  $< 4 \times 10^{-6}$ , 0 to 50°C.

**Line voltage:**  $< 1 \times 10^{-7}$  for 10% change.

**High stability crystal:** see Option 010.

**External time base input:** rear panel BNC accepts 5 or 10 MHz, 200 mV rms into 1 k $\Omega$ ; 5 V rms maximum.

**Time base out:** 10 MHz,  $> 1$  V p-p into 50  $\Omega$  via rear panel.

### Statistics

**Sample size:** selectable between either  $n = 100$  or  $n = 1,000$  samples.

**Std. dev.:** displays a standard deviation of selected sample size.

**Mean:** displays mean estimate of selected sample size.

**Smooth:** performs a weighted running average and truncates unstable least significant digits from display.

### Math

All measurement functions, with exception of GATE TIME, Totalize in Scale Mode, and TRIG LVL, may be operated upon by Math functions. Offset, Normalize, and Scale may be used independently or together as follows:

$$\text{Display} = \frac{\text{Measurement} + \text{Offset}}{\text{Normalize}} \times \text{Scale.}$$

**Number value range:**  $\pm 1 \times 10^{-9}$  to  $\pm 9 \times 10^9$ .

**Last display:** causes value of previous display to Offset (negative value), Normalize, or Scale all subsequent measurements.

**Measurement t-1:** causes each new measurement to be Offset (negative value), Normalized, or Scaled by each immediately preceding measurement.

### Hewlett-Packard Interface Bus

**Programmable controls:** all measurement functions, Math, Statistics, Reset, Range Hold, Ext. Arm Enable/Slope, Check, Gate Adj. ( $\sim 1$  ms to 1 s), Gate Open/Close (gate times to  $\infty$ ), Gate Mode, Cycle, Preset, Slope, Common A, Auto Trigger.

**Special functions:** FREQ B, PULSE B, TIME B $\rightarrow$ A, TOT A-B, LEARN, MIN, MAX, all internal diagnostic routines.

**Interface functions:** SH1, AH1, T5, TE $\emptyset$ , L4, LE $\emptyset$ , SR1, RL1, PP $\emptyset$ , DC1, DT1, C0, (see page 579).

**Data output:** fixed output format consisting of 19 characters plus CR and LF output in typically 8 ms.

**Option 040:** adds complete systems programmability; see column at right.

### General

**Gate:** minimum, manual, or continuously variable (NORM/FAST) via Gate Adj. control.

**NORM:** 20 ms to 4 s NOMINAL.

**FAST:** 100  $\mu$ s to 20 ms NOMINAL.

**MIN:** minimum gate time. Actual time depends on function.

**MANUAL:** each press opens or closes gate.

**Cycle:** determines delay between measurements.

**NORM:** no more than 4 readings per second, nominal.

**MIN:** updates display as rapidly as possible ( $\sim 15$  readings per second, depending on function).

**SINGLE:** one measurement taken with each press of button.

**Arming:** Ext. Arm Enable key allows rear panel input to determine Start and/or Stop point of a measurement. External gate defined by both Start and Stop armed. All measurements are armable except Manual Totalize, Phase, and Trigger Level.

**Start arm:** + or - slope of arm input signal starts measurement.

**Stop arm:** + or - slope of arm input signal stops measurement. When used, Start Arm must occur before Stop Arm.

**Ext. arm input:** rear panel BNC accepts TTL into 20 k $\Omega$ . Minimum Start To Stop Time: 200 ns.

**Trigger level out:** dc output into 1 M $\Omega$  via rear panel BNCs for Channel A and B; not adjusted for attenuators.

**Accuracy at dc ( $\times 1$ ):**  $\pm 15$  mV  $\pm 0.5\%$  of TRIG LVL reading.

**Gate out:** TTL level into 50  $\Omega$ ; goes low when gate open; rear panel BNC.

**Range hold:** freezes decimal point and exponent of display.

**Reset:** starts a new measurement cycle when pressed.

**Check:** performs internal self test and lamp test.

**Display:** 12-digit LED display in engineering format; exponent range of +18 to -18.

**Operating temperature:** 0 to 50°C.

**Power requirements:** 100, 120, 220, 240 VAC (+5%, -10%), 48-66 Hz; 130 VA max.

**Weight:** net, 8.8 kg (19 lb 8 oz). Shipping, 13.6 kg (30 lb).

**Dimensions:** 425.5 mm W x 132.6 mm H x 345.4 mm D (16 $\frac{3}{4}$  in. x 5 $\frac{1}{4}$  in. x 13 $\frac{1}{2}$  in.), not including removable handles.

### Options

#### Option 010: High Stability Time Base (oven)

**Frequency:** 10 MHz.

**Aging rate:**  $< 5 \times 10^{-10}$ /day after 24-hour warm up.

**Short term:**  $< 1 \times 10^{-10}$  rms for 1s average.

**Temperature:**  $< 7 \times 10^{-9}$ , 0 to 50°C.

**Line voltage:**  $< 1 \times 10^{-10}$  for 10% change.

**Warm-up:** within  $5 \times 10^{-9}$  of final value in 20 minutes.

#### Option 020: DC Digital Voltmeter

**Range:** 4 digits, autoranging, autopolarity, in  $\pm 10$ ,  $\pm 100$ ,  $\pm 1000$  V ranges.

**Sensitivity:** 100  $\mu$ V, 1 mV, 10 mV, 100 mV for  $\pm 1$  V,  $\pm 10$  V,  $\pm 100$  V,  $\pm 1000$  V readings.

**LSD displayed:** same as sensitivity.

**Input type:** floating pair.

**Input impedance:** 10 M $\Omega$   $\pm 1\%$ .

#### Option 030: 1.3 GHz C Channel

##### Input Characteristics

**Range:** 150 MHz to 1.3 GHz.

**Sensitivity:** 10 mV rms sinewave (-27 dBm) to 1 GHz. 100 mV rms sinewave (-7 dBm) to 1.3 GHz.

##### Frequency C

**Range:** 150 MHz to 1.3 GHz, prescaled by 20. LSD Displayed, Resolution, and Accuracy are same as Frequency A.

##### Ratio C/A

**Range:** channel A, 0 to 200 MHz.  
channel C, 150 to 1300 MHz.

#### Option 040: Complete Systems Programmability

Adds remote selection of low pass filter, ac/dc coupling,  $\times 1$ - $\times 10$  attenuation, dc trigger level and input impedance for both Channel A and B.

### Definitions

**Duty cycle:** percentage of time a signal is high or low, depending on Slope A setting. Trigger point is high/low dividing point.

$$\text{DUTY CY} = \frac{\text{PULSE}}{\text{PER}} \times 100\%.$$

**Slew rate:** effective slope between 10% and 90% points of rising or falling signal depending on Slope A setting.

$$\text{SLEW} = \frac{V_B - V_A}{T_I}$$

**Phase:** angle, with respect to B signal, between 50% points of channel A and B signals, trigger slopes selected by Channel A and B slope switches.

$$\text{PHASE} = \frac{(T_{I1} + T_{I2}) 360^\circ}{2 \text{ PER}}$$

$T_{I1}$  is time between 50% points of A then B signals using slopes defined during Phase measurement.

$T_{I2}$  is time between 50% points of A then B signals using complement slopes to  $T_{I1}$ .

**Front handles:** supplied with instrument.