

SECTION I GENERAL INFORMATION

1-1 INTRODUCTION

1-2 This Operating Manual contains information required to install, operate and test the Hewlett-Packard Model 8160A. Figure 1-1 shows the mainframe and accessories supplied. This section covers instrument identification, description, accessories, specifications, and other basic information.

1-3 A Microfiche version of this manual is available on 4 x 6 inch microfilm transparencies (order number on title page). Each microfilm contains up to 60 photoduplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-4 SPECIFICATIONS

1-5 Instrument specifications are listed in Table 1-2. These specifications are the performance standards or limits against which the instrument is tested.

1-6 SAFETY CONSIDERATIONS

1-7 The Model 8160A is a Safety Class 1 instrument (it has an exposed metal chassis that is directly connected to earth via the power supply cable).

1-8 Before operation, the instrument and manual, including the red safety page, should be reviewed for safety markings and instructions. These must then be followed to ensure safe operation and to maintain the instrument in a safe condition.

1-9 INSTRUMENTS COVERED BY MANUAL

1-10 Attached to the rear of this instrument is a serial number plate (Figure 1-3). The first four digits of the serial number only change when there is a significant change to the instrument. The last five digits are assigned to instruments sequentially. The contents of this manual apply directly to the instrument serial number quoted on the title page. For instruments with lower serial numbers, refer to the backdating information in Section VII of this manual. For instruments with higher serial numbers, refer to the Manual Change sheets at the end of this manual. In addition to change information, the Manual Change sheets may contain information for correct-

ing errors in the manual. To keep this manual as up-to-date and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Change supplement. The supplement for this manual is identified with this manual's print date and part number, both of which appear on this manual's title page. Complimentary copies of the supplement are available from Hewlett-Packard.

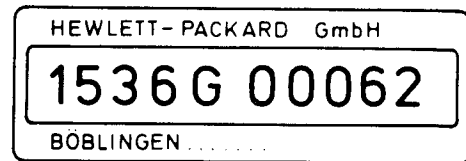


Figure 1-3. Serial Number Plate

1-11 DESCRIPTION

1-12 The 8160A is a programmable pulse generator with applications as a bench instrument or part of an automatic test system. It is available with one (standard) or two (option 020) independent channels and can be rack-mounted with input/output connectors on the rear panel if required.

1-13 All parameters are indicated by an alphanumeric display above the keyboard. This eliminates both the need for an oscilloscope to monitor the output and the associated problem of misreading a parameter. All front panel controls are pushbuttons, thus outputs can be very easily and quickly set up and repeatability problems disappear.

1-14 All operations within the 8160A are microprocessor-controlled which further simplifies operation whether performed from the front panel controls or programmed over the HP-IB*. The microprocessor also enables sophisticated error detection routines to detect and display any incompatible pulse settings.

1-15 The output frequency of the 8160A is 1 Hz to 50 MHz if the output amplifier is being used. All specifications are given in Table 1-2 at the end of this section.

1-16 8160A OPTIONS

1-17 **Option 020.** The standard 8160A has one channel. Option 020 provides a second channel with all parameters variable. Both channels are completely independent except for repetition rate and burst.

1-18 **Option 001** is a standard 8160A with the four BNC input/output connectors taken to the rear panel instead of the front panel. Blanking plugs are then fitted to the front panel. This option is most useful in system applications where the 8160A is rack mounted and all connections must be inside the rack.

1-19 **Options 907, 908, 909** provide handles and/or rack mounting flanges (see Figure 1-2).

1-20 **Option 910** provides an extra copy of the Operating and Service Manual.

1-21 All options will be delivered with the instrument if ordered at the same time as the instrument.

1-22 ACCESSORIES SUPPLIED

1-23 The 8160A is supplied complete with the following items (see figure 1-1).

ITEM	HP PART NUMBER
4A fuse for 230V operation	2110-0036
8A fuse for 115V operation	2110-0055
Power cable	see figure 2-2

1-24 ACCESSORIES AVAILABLE

1-25 Equipment slides are recommended when rack mounting the 8160A. Slide kits available are as follows:

ITEM	HP PART NUMBER
Standard slide kit – includes two slides for installation into HP rack enclosures (see figure 1-2).	1494-0017
Standard tilt slide kit – same as standard slide kit plus permits tilting instrument up or down 90°.	1494-0026
Slide adaptor bracket kit – brackets for adapting the standard slides above for use in non-HP rack system enclosures of adequate depth.	1494-0023

1-26 RECOMMENDED TEST EQUIPMENT

1-27 Equipment required to maintain the model 8160A is listed in Table 1-1. Alternative equipment can be substituted provided that it meets or exceeds the critical specifications listed in the table.

Table 1—2. Specifications

Specifications are for 50 Ω source and load resistances unless stated otherwise.

Incompatible values prevented by microprocessor which monitors all pulse parameters. Refer to § 3–13 in Manual for further information.

TIMING

PERIOD (PER)

- Range: 20.0 ns to 999 ms (see table 2).
- Resolution: 3 digits (best case 100 ps).
- Accuracy: 3% of progr. value ± 0.3 ns (PER < 100 ns).
2% of progr. value (PER ≥ 100 ns).
- Max. Jitter: 0.1% of programmed value + 50 ps.

WIDTH (WID)

- Range: 10.0 ns to 999 ms (see table 2).
- Resolution: 3 digits (best case 100 ps).
- Accuracy: 1% of programmed value ± 1 ns.
- Max. Jitter: 0.1% + 50 ps (WID ≤ 999 ns).
0.05% (999 ns < WID ≤ 9.99 μs).
0.005% (WID > 9.99 μs).

DELAY (DEL)

- Range: 0.00 ns to 999 ms (measured from 50% point of leading edge of trigger output to 50% point of 3 ns LEE).
- Resolution: 3 digits (best case 100 ps).
- Accuracy: 1% of progr. value ± 1 ns (see table 2).
- Max. Jitter: 0.1% + 50 ps (DEL ≤ 999 ns).
0.05% (999 ns < DEL ≤ 9.99 μs).
0.005% (DEL > 9.99 μs).

DOUBLE PULSE (DBL)

- Range: 20.0 ns to 999 ms. (Spacing between leading edges of double pulse).
- Resolution: 3 digits (best case 100 ps).
- Accuracy: 1% of programmed value ± 1 ns.
- Max. Jitter: 0.1% + 50 ps (DBL ≤ 999 ns).
0.05% (999 ns < DBL ≤ 9.99 μs).
0.005% (DBL > 9.99 μs).

OUTPUT SIGNALS

OUTPUT LEVELS

- High level (HIL) Range: -9.89 V to 9.99 V.
- Low Level (LOL) Range: -9.99 V to 9.89 V.
- Resolution: 3 digits (10 mV).
- Amplitude: 0.10 V min, 9.99 V max. (increase with hi-z source or load, see table 1).
- Accuracy: 1% of programmed value ± 50 mV ± 1% of ampl.
- Settling Time: 40 ns to specified accuracy.
- Note: In 2 channel instruments, the difference between highest upper level and lowest lower level may not exceed 20 V.

cont'd.

OUTPUT SIGNALS (cont'd)

TRANSITION TIMES (10 – 90% ampl.)

- Leading Edge (LEE): 06.0 ns to 9.99 ms (see table 2).
 - Trailing Edge (TRE): 06.0 ns to 9.99 ms (see table 2).
 - Leading and trailing edge transition times are independently programmable within a common range.
 - Ranges are overlapping as shown below:
- | | |
|-------------------|-------------------|
| 06.0 ns – 99.9 ns | 05.0 μs – 99.9 μs |
| 050 ns – 999 ns | 050 μs – 999 μs |
| 0.50 μs – 9.99 μs | 0.50 ms – 9.99 ms |
- Resolution: 3 digits (best case 100 ps).
 - Accuracy: 3% of progr. value ± 1 ns (see table 2).
 - Linearity: 3% for transition times longer than 30 ns.

PRESHOOT, OVERSHOOT, RINGING: 5% amp. ± 10 mV.

A ADD B: Adds Channel A and B outputs (option 020).

OUTPUT FORMAT: Normal or complement.

SOURCE IMPEDANCE: See table 1.

Table 1. Output Levels (8160A into 50 Ω)

OUTPUT MODE	Typical Z _s	HIL min max	LOL min max	HIL/LOL accuracy	AMPL. min max
A SEP B 50 Ω	50 Ω 25 pF	-9.89 V +9.99 V	-9.99 V +9.89V	1% ± 1% ampl. ± 50 mV	100 mV 9.99 V
A SEP B 1 k Ω	1 k Ω 25 pF	-19.7 V +19.9 V	-19.9 V +19.7 V	1% ± 1% ampl. ± 100 mV	200 mV 19.9 V
A ADD B 50 Ω	48 Ω 60 pF	-9.89 V +9.99 V	-9.99 V +9.89 V	2 (A SEP B, 50 Ω) -2.5%	100 mV 100 mV 19.5 V
A ADD B 1 k Ω	500 Ω 60 pF	-19.7 V +19.9 V	-19.9 V +19.7 V	2 (A SEP B, 1 k Ω) 5%	200 mV 20.0 V

Table 2: Output Modes/Timing (8160A into 50 Ω)

OUTPUT MODE	PER min	WID min	DEL accuracy	LEE/TRE min accuracy
A SEP B, 50 Ω	20 ns	10 ns	1% ± 1 ns	6.0 ns 3% ± 1 ns
A SEP B, 1 k Ω	25 ns	12.5 ns	1% ± 2.5 ns	8.0 ns 3% ± 2 ns
A ADD B, 50 Ω	50 ns	25 ns	1% ± 8 ns	15 ns 3% ± 4 ns
A ADD B, 1 k Ω	50 ns	25 ns	1% ± 10 ns	15 ns 3% ± 4 ns

OPERATING MODES

- NORM:** Continuous pulse stream.
- GATE:** External Signal enables rate generator. First output pulse sync with leading edge. Last pulse always complete.
- TRIG:** Each input cycle generates a single output pulse.
- BURST:** Each input cycle generates a programmable number (0 to 9999) of pulses. Min time between bursts is 1 period.

cont'd

OPERATING MODES (cont'd)

MAN: Simulates ext signal when EXT INPUT switched OFF.

SINGLE PULSE: Provides a single pulse independent of input and period settings.

AUXILIARY INPUTS AND OUTPUTS**EXTERNAL INPUT**

Trigger Level: +10 to -10 V.

Max. Input: ± 12 V in 50 Ω , ± 20 V in 10 k Ω .

Minimum Amplitude: 500 mVpp.

Slope: Positive or negative.

Min. Pulse Width: 3 ns.

Typical Input Resistance: 50 Ω or (also in OFF) 10 k Ω .

Delay from Trigger Input to Trigger Output: 90 ns \pm 10 ns.

TRIGGER OUTPUT

Output Amplitude: ≥ 2.5 V into 50 Ω ,
 ≥ 5 V into open circuit.

Typical Source Resistance: 50 Ω .

Typical Pulse Width: 8 ns (PER < 100 ns),
40 ns (100 ns < PER < 1 μ s),
400 ns (PER ≥ 1 μ s).

HP-IB CAPABILITY

Code	Interface Function
SH 1	Source Handshake Capability.
AH 1	Acceptor Handshake Capability.
T 6	Talker (basic talker, serial poll, unaddress to talk if addressed to listen).
L 4	Listener (basic listener, unaddress to listen if addressed to talk).
SR 1	Service Request Capability
RL 1	Remote/Local Capability (incl. Local Lockout to prevent interference with a running progr.)
PP 0	No Parallel Poll Capability.
DC 0	No Device Clear Capability.
DT 1	Device Trigger Capability (Trig, Burst modes).
C 0	No Controller Capability.

All modes and parameters can be programmed.

EXT SLOPE POS/NEG programming can simulate Gate mode.

TRIG LEVEL adjustment, 50 Ω /10 k Ω /OFF switch and vernier keys are not programmable.

PROGRAMMING TIMES (time for 8160A to receive, verify and execute message) typical
Period, Delay, Double Pulse Spacing, Width: 140 ms.
Transition Times: 110 ms.
Output Levels: 150 ms.
Burst, Input Modes: 100 ms (existing burst will be interrupted when programming new burst).
Output Modes: 200 ms.

LISTEN TIME (time for 8160A to receive and verify message) typical

Input Modes: 50 ms

Parameters: 140 ms

cont'd

HP-IB CAPABILITY (cont'd)

Output Modes: 5 ms (EN/DISABLE, NORM/COMPL),
70 ms (A SEP/ADD B, 50 Ω /1 k Ω).

Device Trigger: 30 ms (EXT TRIG),
80 ms (BURST).

TALK TIME (time for 8160A to transmit a message) message)

Status: 1 byte (indicates nature of programming error),
< 5 ms typical.

Learn: 11 lines (18 in option 020) up to 14 characters plus CRLF. 10 ms/line av.

MEMORY: 9 addressable locations plus one for existing operating state.

Capacity: 1 complete operating state per location.

Access Time: < 20 ms (store).
< 1.2 s (recall).

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REPEATABILITY: 50% of specified accuracy.

POWER-OFF STORAGE: Batteries maintain all stored data for up to 2 weeks with instrument switched off. Hardwired addressable location contains a fixed operating state for confidence check (standard parameter set).

POWER: 115/230 V AC \pm 10%, -22%; 48-66 Hz;
675 VA max.

ENVIRONMENTAL

Temperature Range: 15 - 35 $^{\circ}$ C as specified.

Accuracy Derating Factors for Temp: 0 - 15 $^{\circ}$ C or 35 - 50 $^{\circ}$ C:

Delay, Width, Double Pulse: 0.07%/ $^{\circ}$ C, typical.

Period, High Level, Low Level: 0.14%/ $^{\circ}$ C, typical.

Leading Edge, Trailing Edge: 0.21%/ $^{\circ}$ C, typical.

WEIGHT: Net 20.8 kg (46 lbs), Shipping 25 kg (55 lbs).

DIMENSIONS: 178 mm high, 426 mm wide, 430 mm deep
(7 x 16.8 x 17 in).

OPTIONS

- 001 Rear Panel Input and Outputs
- 020 Second Channel. Includes delay, width, double pulse, transition times, and output amplifier
- 907 Front Handle Kit (Part No. 5061-0090)
- 908 Rack Flange Kit (Part No. 5061-0078)
- 909 Rack Flange and Front Handle Combination Kit (Part No. 5061-0084)
- 910 Additional Operating and Service Manual (Part No. 08160-90002)

Specifications describe the instrument's warranted performance. Supplemental characteristics - identified by the word "typical" - are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.