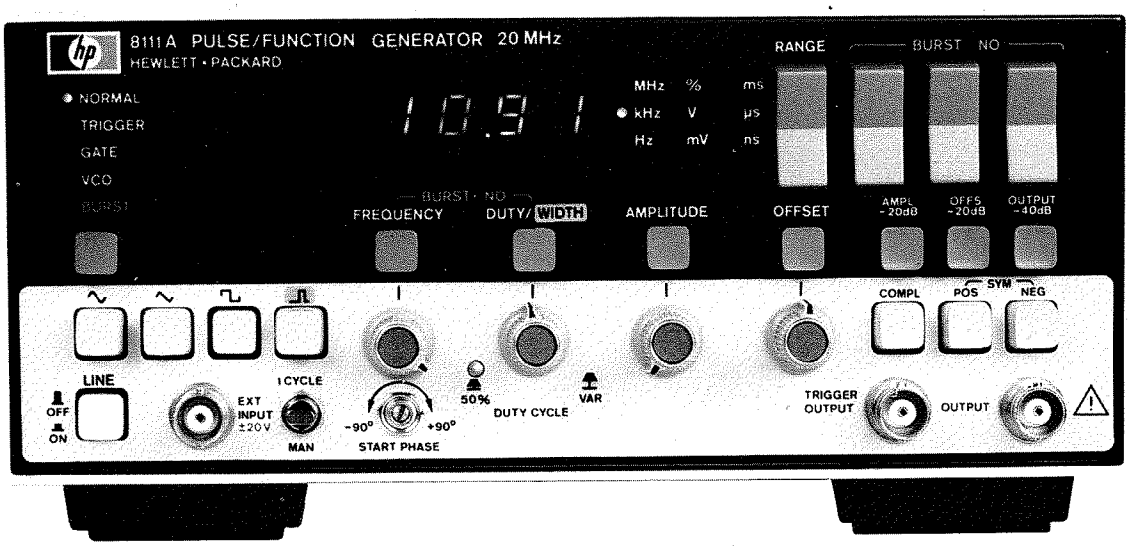
# OPERATING AND SERVICE MANUAL

PHYSICS 191/247 LABORATORY
HARVARD SCIENCE CENTER
June '93

# 8111A PULSE/FUNCTION GENERATOR 20 MHz

S/N 2849 G 07891




HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

# 8111A PULSE/FUNCTION GENERATOR 20 MHz

## (Including Option 001)

### SERIAL NUMBERS

This manual applies directly to instrument with serial number 2215G01841 and higher. Any change made in instruments having serial numbers higher than the above number will be found in a "Manual Changes" supplement supplied with this manual. Be sure to examine the supplement for changes which apply to your instrument and record these changes in the manual. Backdating information for instruments with lower serial numbers can be found in Section 7 (yellow pages).


HERRENBERGER STR. 130, D-7030 BOBLINGEN
FEDERAL REPUBLIC OF GERMANY

MANUAL PART No. 08111-90002
MICROFICHE PART No. 08111-95002

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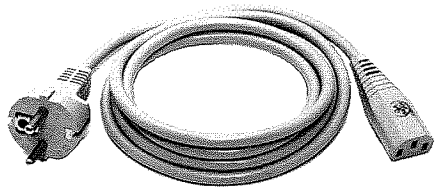
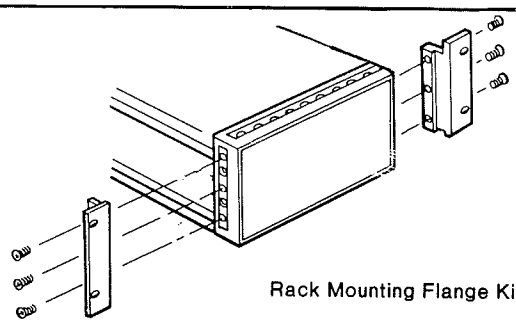
8111A



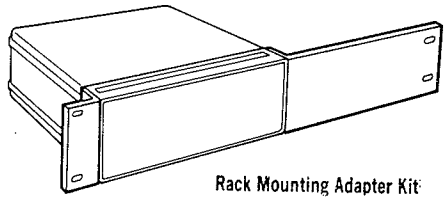
POWER CORD

FUSE F1 or F2
375 mA 750 mA

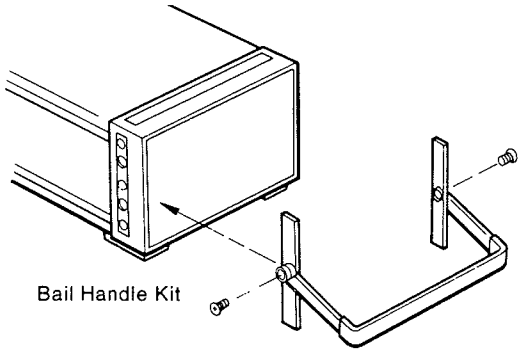
Figure 1–1. 8111A and Supplied Accessories (Instrument shown with Option 001 fitted).



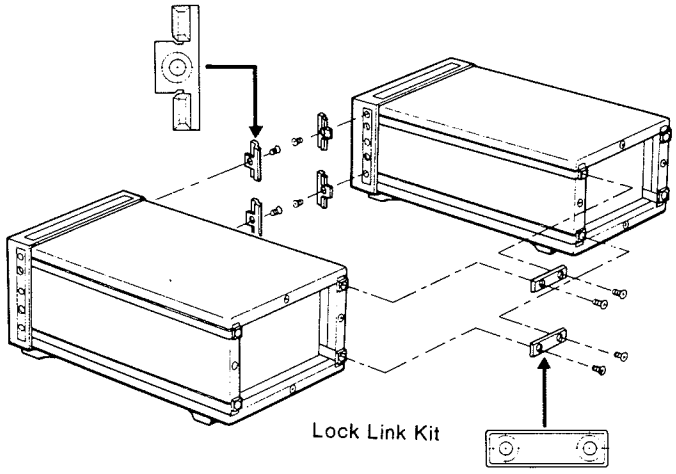
Rack Mounting Flange Kit



Rack Mounting Adapter Kit



Bail Handle Kit



Lock Link Kit

Figure 1–2. Available Rack Mounting Accessories

# SECTION I
# GENERAL INFORMATION

## 1–1 INTRODUCTION

1–2 This Operating and Service Manual contains information required to install, operate, test, adjust and service the Hewlett-Packard Model 8111A. 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 8111A is a Safety Class 1 instrument (it has an exposed metal chassis that is directly connected to earth via the power supply cable). 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.

## 1–8 INSTRUMENTS COVERED BY MANUAL

1–9 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 correcting 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 the 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.

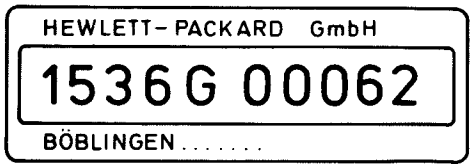



Figure 1–3. Serial Number Plate

## 1–10 DESCRIPTION

1–11 The 8111A is a 20 MHz, pulse/function generator suited to bench, production or service applications. It is available as either a standard instrument or, when fitted with option 001, as a pulse/function generator complete with counted burst mode capability. A carrying handle can be fitted and rackmounting adaptors are available.

1–12 The combination of front panel controls – pushbuttons and verniers – together with the digital display enables quick and easy setting up of complete waveforms with minimum (if any) requirement for additional test equipment.

## 1–13 8111A OPTIONS

1–14 **Option 001**. The standard 8111A can have its versatility further increased by the addition of option 001 which provides a counted burst mode capability. **Option 910** provides an extra copy of the Operating and Service Manual.

## 1–15 ACCESSORIES SUPPLIED

1–16 The 8111A is supplied complete with the following items:

| ITEM | HP PART NUMBER |
|---|---|
| 375 mA fuse for 220/240 V operation or, | 2110–0421 |
| 750 mA fuse for 100/120 V operation | 2110–0360 |
| Power cable | See Figure 2–2 |

## 1–17 ACCESSORIES AVAILABLE

| ITEM | HP PART NUMBER |
|---|---|
| Carrying handle - Bail Handle Kit | 5061–2001 |
| Rack mounting adaptors: Rack mounting flange and filler panel for rack mounting a single 8111A | 5061–0072 |
| Rack mounting flange and lock link kit for rack mounting two 8111As | 5061–0074<br>5061–0094 |

## 1–18 RECOMMENDED TEST EQUIPMENT

1–19 Equipment required to maintain the 8111A 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 1–1. Recommended Test Equipment

| INSTRUMENT | RECOMMENDED MODEL | REQUIRED CHARACTERISTICS | ADEQUATE SUBSITUTE | USE * |
|---|---|---|---|---|
| Counter | HP 5328A | 20 MHz, Start/Stop | HP 5345A | P, A |
| DMM | HP3466 | 0.1mA - 10mA, DC | HP3465A | T |
| DVM | HP3455A | 0.1V - 32V, AC, DC | HP3456A | P,A,T |
| Real Time Scope | HP 1740A | 100 MHz Bandwidth | HP 1743A | P, A, T |
| Sampling Scope | Tek 7603 with 7T11/7S11 and S–3A | Dual channel | HP 140A/ 1410A | P, A, T |
| Spectrum Analyzer or Distortion Analyzer | HP 3580A<br>HP 339A | 1 kHz – 10 kHz<br>1 kHz – 10 kHz | <br>HP 3585A | P, A<br>P, A |
| Spectrum Analyzer | HP 181T 8557A | 500 kHz – 20 MHz | | P |
| Pulse Generator | HP 8012B | 1 Hz – 20 MHz | HP 8011A | P, A |
| Logic Probe | HP 545A | TTL, CMOS | | T |
| Logic Probe | HP 10525E | ECL | | T |
| BNC 50 Ohm Term. | 10100C | 50 Ohm, 2 W, 1 % Feedthrough | | |
| Power Supply | HP 6237B | 0 – 20 V | HP 6205B | A |
| Service Accessory | | | | |
| Extender board | 5060–5983 | 2x18 pin | | T |
| Extender brd | 5061-2160 | 2 x 25 pin | | T |
| Extender cble | 5180-2432 | | | T |

* P = Performance Test; A = Adjustments; T = Troubleshooting

Table 1–2. Specifications

# SPECIFICATIONS

(Specifications describe the instrument's warranted performance)
The following specifications apply with 50 Ohm load resistance in a temperature range of 0° to 55°C. Output levels double when driving into high impedance (up to 32 Vpp).

## WAVEFORMS

Sine, Triangle, Ramp, Square, Pulse, Haversine, Havertriangle

## TIMING CHARACTERISTICS

**Frequency**
Range: 1.00 Hz to 20.0 MHz
Resolution: 3 digits
Accuracy: ± 5% of setting (10.0 Hz to 20.0 MHz)
(50% duty cycle) ± 10% of setting ( 1.00 Hz to 9.99 Hz)
Repeatability: Factor 2.5 better than accuracy
Jitter: < 0.1% + 50 ps
Stability: ± 0.2% (1 hour)
± 0.5% (24 hours)

**Duty Cycle** (sine, triangle, square)
Range: 10% to 90% (1 Hz to 999 kHz)
50% fixed (1 Hz to 20 MHz)
Resolution: 1%
Accuracy (1 Hz to 999 kHz): ± 1 digit, 50% fixed
± 3 digits, 20% to 80%
± 6 digits, 10% to 20% and 80% to 90%

**Pulse Width**
Range: 25 ns to 100 ms
Resolution: 3 digits
Accuracy: ± 5% of setting ± 2 ns
Repeatability: Factor 2.5 better than accuracy
Jitter: < 0.1% + 50 ps
Max. duty cycle: > 75% (1 Hz to 1 MHz), decreasing to
> 50% at 20 MHz

## OUTPUT CHARACTERISTICS

**Output Impedance:** 50 Ohm ± 5%. Reflection < 10%

**Amplitude/Offset**
Amplitude and offset are independently variable within the following two level windows.

| Level window | ± 80.0 mV | ± 8.00V |
|---|---|---|
| Ampl. range | 1.60 mVpp to 159.9 mVpp | 160 mVpp to 16.00 Vpp |
| Ampl. resolution | 3 1/2 digits | 3 1/2 digits |
| Ampl. accuracy* | ± 5% [0.45 dB] | ± 5% [0.45 dB] |
| Ampl. repeatability | Factor 2.5 better than accuracy | |
| Offset range | 0 to ± 80.0 mV | 0 to ± 8.00V |
| Offset resolution | 3 digits (best case 10 μV) | 3 digits (best case 1 mV) |
| Offset accuracy | ± 5% of setting ± 2% of amplitude ± 1 mV | ± 5% of setting ± 2% of amplitude ± 20 mV |
| Offset repeatability | Factor 2.5 better than accuracy | |

*The amplitude accuracy for sine and triangle is specified at 1 kHz. For other frequencies see the following flatness specifications.

| Amplitude Flatness (50% duty cycle) | Sine | Triangle |
|---|---|---|
| 1.00 Hz to 999 kHz | ± 3% [0.26 dB] | ± 3% |
| 1.00 MHz to 20.0 MHz | ± 10% [0.92 dB] | + 10% / − 15% |

## WAVEFORM CHARACTERISTICS

**Sine** (normal mode, 50% duty cycle, symmetrical mode)
Total Harmonic Distortion (THD):
< 1% [-40 dB], (10 Hz - 99.9 kHz)
< 3% [-30 dB], (100 kHz - 999 kHz)
Harmonic Signals: more than 26 dB below fundamental (1 MHz – 20 MHz) for amplitudes > 10 mVpp
THD and Harmonic Signal Distorsion may increase by 3 dB below 10°C and above 45°C

**Triangle, Ramp**
Non-linearity: < ± 1% (10 Hz to 99.9 kHz)
< ± 3% (1 Hz to 9.9 Hz and 100 kHz to 1 MHz)
(measured between 10% to 90% of amplitude)

**Square, Pulse**
Rise/Fall time: < 10 ns (10% to 90% of amplitude)
Pulse Perturbations: < ± 5% of amplitude (≥ 0.16 Vpp)
< ± 10% of amplitude (< 0.16 Vpp)

**Output Modes**
Switchselectable POSITIVE, NEGATIVE, SYMMETRICAL and NORMAL/COMPLEMENT output signal.

## OPERATING MODES

**Normal:** Continuous waveform is generated
**Trigger:** Each input cycle generates a single output cycle
**Gate:** External signal enables oscillator. First output cycle synchronous with active trigger slope. Last cycle always completed.
**VCO:** External voltage linearly sweeps 2 full frequency decades. The actual frequency is displayed.
Modulation range: 1:100 with 0.1V to 10V
Modulation bandwidth: dc to 1 kHz
**Burst:** Each input cycle generates a preprogrammed number (1 to 1999) of periods. Minimum time between bursts is 200 ns. (Option 001)

# SUPPLEMENTARY PERFORMANCE CHARACTERISTICS

(Description of non-warranted typical performance parameters)

**Ext Input:** Threshold Level: 1.4V fixed
Max input voltage: ± 20V
Sensitivity: 500 mVpp
Min pulse width: 25 ns
Input impedance: 10 kOhm
Trigger slope: positive

**Start Phase:** Adjustable from -90° to +90°.
Usable range may decrease to -90° to 0° at 20 MHz.
Haversine and Havertriangle can be generated.

**Trigger Output:** TTL compatible output signal.

**Man:** Simulates external input.

**1 Cycle:** Provides a single output period in TRIG, GATE and BURST mode.

# GENERAL

**Warm-up Time:** 15 min to meet all specifications.
**Environmental:** Storage temperature: -40° C to 75° C
Operating temperature: 0° C to 55° C
Humidity range: 95% R.H., 0° C to 40° C
**Power:** 100/120/220/240 V rms + 5%, -10%, 48-440 Hz; 70 VA max.
**Weight:** Net 4.6 kg (10 lbs), Shipping 6.6 kg (15 lbs)
**Dimensions:** 89 mm high, 213 mm wide, 375 mm deep (3.5 x 8.4 x 14.8 in)

**Options:** 001 Counted Burst
910 Additional Operating & Service Manual

Data subject to change

# SECTION II
# INSTALLATION

## 2–1 INTRODUCTION

2–2 This section provides installation instructions for the instrument and its accessories. It also includes information about initial inspection and damage claims, preparation for use, and packaging, storage and shipment.

## 2–3 INITIAL INSPECTION

2–4 Inspect the shipping container for damage. If the container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1–1 plus any accessories that were ordered with the instrument. Procedures for checking the electrical operation are given in Section 4. If the contents are incomplete, if there is a mechanical damage or defect, or if the instrument does not pass the operator's checks, notify the nearest Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for settlement.

## 2–5 PREPARATION FOR USE

**WARNING**

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, meters).

## 2–6 Power Requirements

2–7 The instrument requires a power source of 100/120/220 or 240 Vrms (+5 % – 10 %) at a frequency of 48–440 Hz single phase. The maximum power consumption is 70 VA.

## 2–8 ⚠ Line Voltage Selection

**CAUTION**

BEFORE SWITCHING ON THIS INSTRUMENT make sure that the instrument is set to the local line voltage. The line voltage selector switches an be seen through the lefthand side of the instrument cover to the rear. The correct setting for the country of destination will have been made at the factory. The instrument power fuse is located behind a metal plate which can also be seen when the switches are viewed. To access the fuse and line selector switches, first DISCONNECT the power cord, then remove instrument top cover by releasing the captive securing screw at rear and sliding cover off. The fuse is accessed by removing the metal cover plate held by two securing screws (non-captive).

**CAUTION**

Do no change the LINE SELECTOR switch settings with the instrument on or with power connected to the rear panel.

2–9 Figure 2–1 provides information for line voltage and fuse selection:

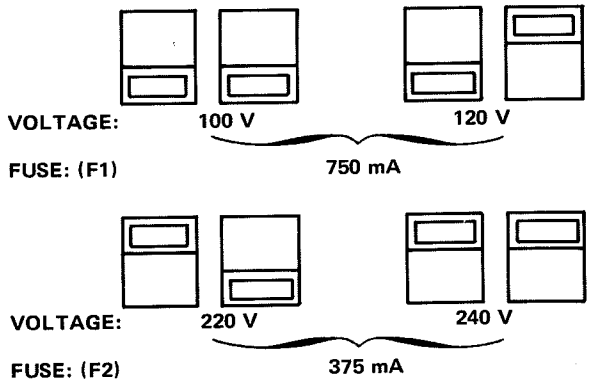



Figure 2–1. Sliding Switches Positions for different Line Voltages

## 2–10 Power Cable

**WARNING**

To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on:

a. If this instrument is to be energized via an autotransformer for voltage reduction, make sure that the common terminal is connected to the grounded pole of the power source.

b. The power cable plug shall only be inserted into a socket outlet provided with a protective ground contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

c. Before switching on the instrument, the protective ground terminal of the instrument must be connected to a protective conductor of the power cable. This is verified by checking that the resistance between the instrument chassis and the front panel and the ground pin of the power cable plug is zero ohms.

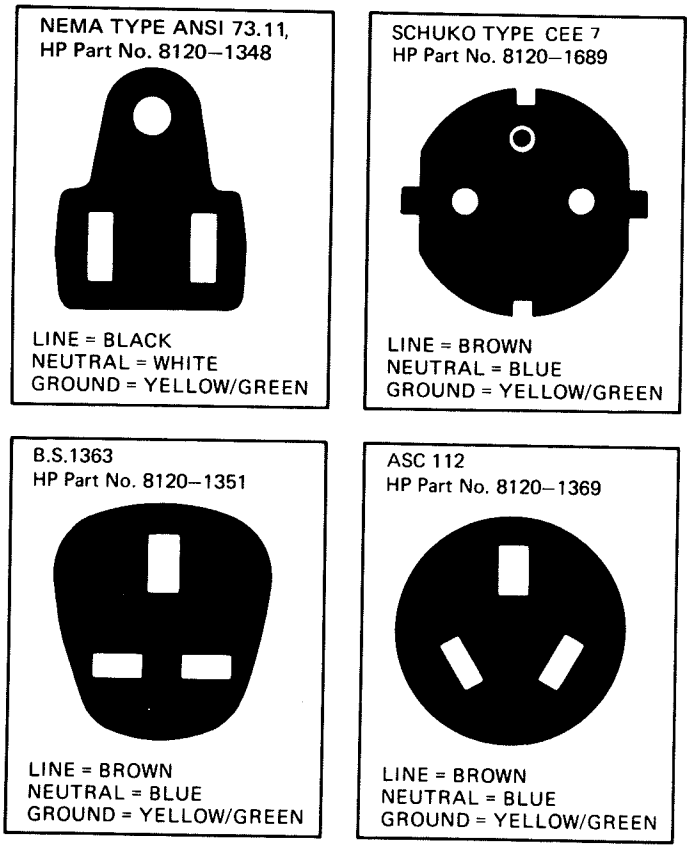



Figure 2–2. Power Cables Available: Plug Identification

2–11 In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 2–2 for the part number of the power cords available.

2–12 The following work should be carried out by a qualified electrician and all local electrical codes must be observed. If the plug on the cable supplied does not fit your power outlet, or if the cable is to be attached to a terminal block, then cut the cable at the plug end and re-wire it. The colour coding used in the cable will depend on the cable supplied (see Figure 2–2). If a new plug is to be connected, the plug should meet local safety requirements and include the following features:

adequate load-carrying capacity (see table of specifications in Section 1)

ground connection

cable clamp

## 2–13 Operating Environment

The operating temperature limits are 0°C to 55°C. The specifications also apply over this temperature range.

## 2–14 CLAIMS AND REPACKAGING

## 2–15 Claims for Damage

2–16 If physical damage is evident or if the instrument does not meet specification when received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office. The Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

## 2–17 Storage and Shipment

2–18 The instrument can be stored or shipped at temperatures between −40°C and 75°C. The instrument should be protected from temperature extremes which cause condensation within it.

2–19 If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag showing owner, return address, model number and full serial number and the type of service required. The original shipping carton

and packaging material may be re-usable but the Hewlett-Packard Sales/Service Office will also provide information and recommendations on materials to be used if the original packing is not available or re-usable. General instructions for re-packing are as follows:

1. Wrap instrument in heavy paper or plastic.

2. Use strong shipping container. A double wall carton made of 200-pound test material is adequate.

3. Use enough shock-absorbing material (3 to 4-inch layer) around all sides of instrument to provide firm cushion and prevent movement inside container. Protect control panel with cardboard.

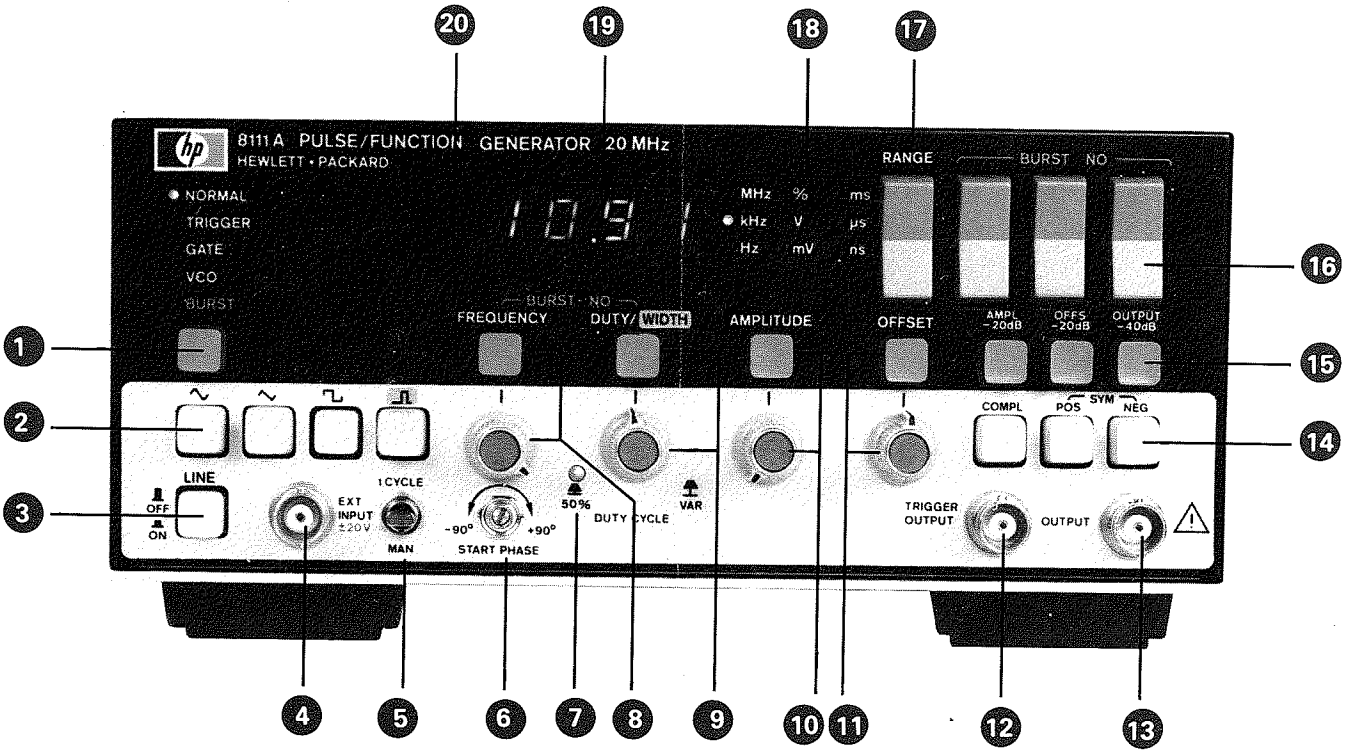
4. Seal shipping container securely.

5. Mark shipping container FRAGILE to encourage careful handling.

6. In any correspondance, refer to instrument by model number and serial number.

## 8111A PULSE/FUNCTION GENERATOR

### Controls and Connectors (Option 001 fitted)




**1** The pushbutton on the left-hand side of the front panel selects the operation mode. The selected mode is indicated by an LED. Each successive operation of the pushbutton changes the mode, starting from NORMAL, running through to BURST and back to NORMAL.

The operating modes are:

NORMAL – 8111A's internal rate generator free running

TRIGGER – trigger signal, either via EXT INPUT or toggle switch **5** initiates one output cycle

GATE – gate signal, either via EXT INPUT or toggle switch **5** initiates an output which is maintained as long as gate signal is present

VCO – signal applied to EXT INPUT determines the output frequency

BURST – (Option 001 only) a burst trigger either via the EXT INPUT or toggle switch initiates burst of output cycles

Figure 3–1. Controls and Connectors

**2** Function pushbuttons select one of 4 possible functions: sine, triangle, square or pulse.

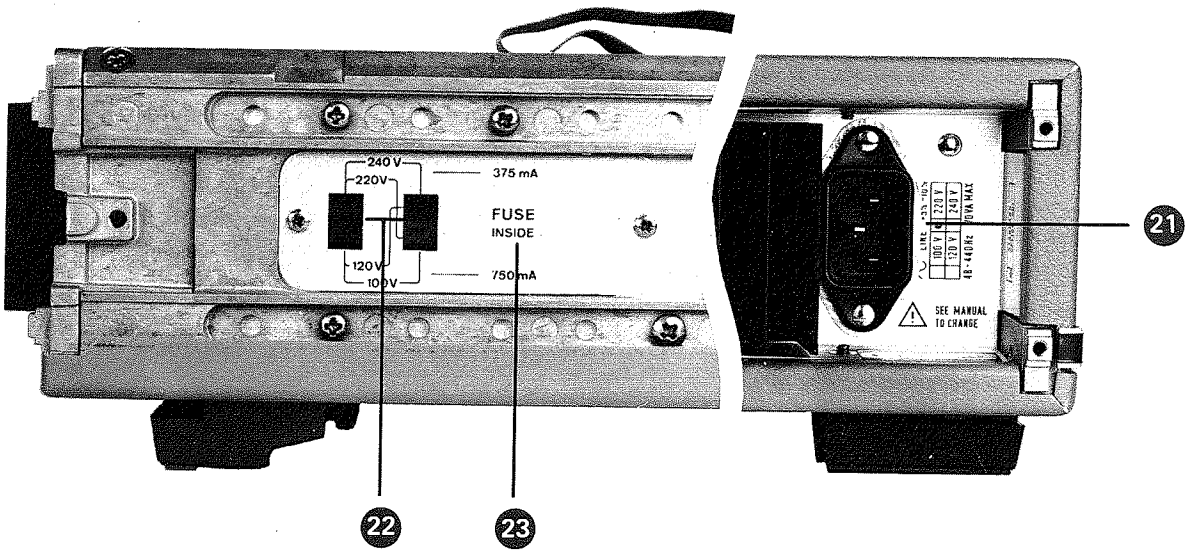
**3** LINE ON/OFF. Primary ac power switch.

**4** EXT INPUT. Connector for external signal in TRIGGER, GATE, VCO and BURST (Option 001 only) modes.

**5** 1 CYCLE/MANUAL switch produces a single trigger pulse when switched to MAN in the TRIGGER, GATE and BURST modes or, initiates a single cycle when switched to 1 CYCLE.

**6** START PHASE. Vernier control enables variation of output signal start phase with respect to external trigger, gate or burst signal.

**7** 50 % DUTY CYCLE indicator, either automatically selected when frequency in MHz range or manually by pushing DUTY CYCLE vernier in. Inoperative in pulse mode.




8 9 10 & 11 Parameter select pushbuttons and corresponding vernier controls which enable display and variation of the required parameter. In BURST mode, both the FREQUENCY and DUTY/WIDTH buttons must be pushed in. In sine, triangle and squarewave modes, the DUTY/WIDTH button and associated vernier (when pulled out) enable duty cycle variation (vernier pushed in and LED on for 50 % duty cycle). In pulse mode, they enable pulse width variation.

12 TRIGGER OUTPUT. BNC connector providing a TTL compatible output signal.

13 OUTPUT. BNC connector providing signal output (50 ohm source impedance.

14 Output mode pushbuttons select POSitive or NEGative polarity, SYMmetrical (both buttons pushed or released) and normal or COMPLement output signal.

15 Amplitude and Offset attenuation controls. Pushbuttons select AMPlitude –20 dB, OFFset –20 dB and OUTPUT –40 dB attenuators.

16 BURST NO. Rocker switches which enable setting up of number of pulses in a burst (Opt. 001).

17 RANGE. Rocker switch enables range change of FREQUENCY or WIDTH parameters.

18 Unit indicator. Indicates unit of currently selected pararneter.

19 Display. 3 1/2 digit LED display.

20 ERROR indicator. LED out of limits indicator for incompatible period/width ratio settings or external trigger/8111A frequency setting.

21 Line receptacle. Power Cord to be plugged in here. Chassis ground for operator protection provided through cord.

22 Line voltage select sliding switches to be set to local line voltage.

23 Fuse (under metal plate) protects instrument in case of current overload. 750 mA for 100/120 V operation, 375 mA for 220/240 V operation.

# SECTION III
# OPERATING INSTRUCTIONS

## 3–1 INTRODUCTION

3–2 The following sections describe the various operating modes and operation of the front panel controls. Pushbutton and/or vernier adjustment is described only where a more detailed description than that accompanying Figure 3–1 is considered necessary.

Numbers within circles – (1) – in text are for cross-reference to Figure 3–1.

## 3–3 SPECIAL OPERATING CONSIDERATIONS

3–4 Read the following sections (a, b, c & d) before applying power to the 8111A.

a. Read the safety summary (red page) at the front of this manual.

b. Ensure that the power selector switches are set properly for the power source being used to avoid instrument damage.

**CAUTION**

Do not change the LINE SELECTOR switch settings with the instrument on or with power connected to the rear panel.

c. Ensure load is not overdriven (up to 16 Vpp into 50 Ohm or 32 Vpp into high impedance).

d. Do not apply external voltage to the output connectors.

## 3–5 OPERATING INSTRUCTIONS

## 3–6 Mode Selection (1)

### 3–7 NORMAL Mode

3–8 In normal mode, (automatically selected on instrument switch-on), the internal rate generator is free running, the frequency being determined by the FREQUENCY setting and the output is continuous (Figure 3–2).

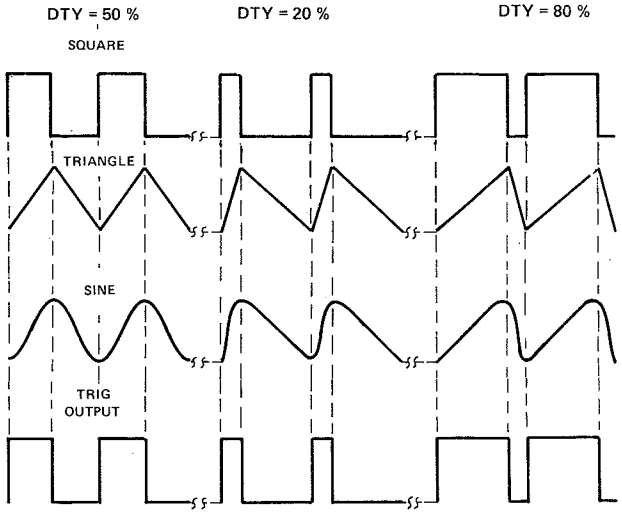



Figure 3–2. Normal Mode–various DUTY CYCLE values

### 3–9 TRIGGER/GATE/BURST Input Modes (1)

3–10 In all three modes you can generate the trigger/gate signal either by applying an external signal to the EXT INPUT BNC connector or by switching the MAN/1 CYCLE switch to MAN. The external trigger signal frequency should not exceed the 8111A's frequency setting. If it does, the ERROR indicator will flash.

NOTE: For all three triggered modes see § 3–30 (first trigger output signal pulse width)

### 3–11 External Trigger Mode (TRIGGER) (1)

3–12 In this mode the trigger signal initiates one complete output cycle (Figure 3–3).

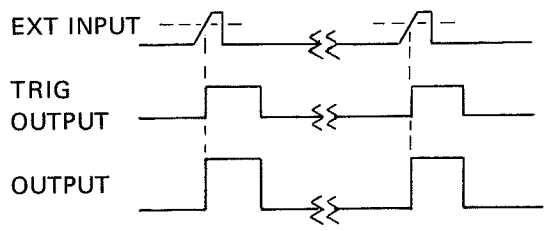



Figure 3–3. Trigger Mode (Squarewave, 50 % DUTY CYCLE)

### 3–13 Gate Mode (GATE) 1

3–14 In gate mode the leading edge of the gate signal enables the 8111A's rate generator and the trailing edge disables it (Figure 3–4). The first and last cycles are always complete.

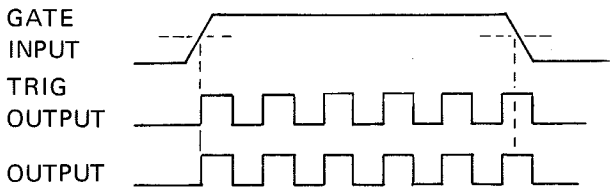



Figure 3–4. Gate Mode (Squarewave, 50 % DUTY CYCLE)

### 3–15 Burst Mode (BURST) 1

3–16 In burst mode, a preset number of cycles is generated on each leading edge of a positive-going trigger signal applied to EXT INPUT when BURST mode is selected (Figure 3–5). The burst length may be set from 1 to 1999 pulses by pressing both the FREQUENCY and DUTY/WIDTH pushbuttons and operating the BURST NO rocker switches as necessary, (single digit increment by individual pushes or continuous by constant pressure) until the required burst number is displayed.

Frequency and duty cycle/pulse width selection in BURST mode is as described in 3–21—3–25.

NOTE: At the end of a triggered burst length, single pulses can be added by operation of the 1 CYCLE/MAN switch in the 1 CYCLE mode.

See §3–30 for Start Phase variation details if applicable.

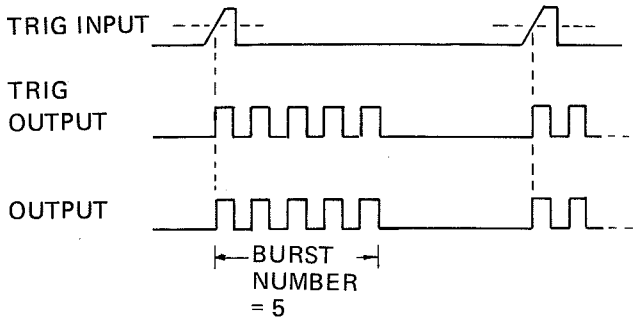



Figure 3–5. Burst Mode (Squarewave, 50 % DUTY CYCLE)

### 3–17 Voltage-controlled Oscillator Mode (VCO)

3–18 In VCO mode, a signal applied to the EXT INPUT connector determines the output frequency. The working range of input voltage (0.1 V to 10 V or 0.1 V to 2 V for 1.0 to 20 MHz range) sweeps the output frequency linearly over a maximum range of 2 decades. The actual range swept depends, as shown in Table 3–2, on the 8111A's frequency setting. The applied signal may change at up to 1 kHz. An example of the VCO mode is given in Table 3–1:

8111A Frequency range setting: 100 kHz – 1000 kHz

NOTE: Frequency range setting is easier to make in NORMAL mode than VCO mode.

Table 3–1. VCO Mode Example Values

| EXT INPUT VOLTAGE | OUTPUT FREQUENCY |
|---|---|
| 0.1 V | 10 kHz |
| 1.0 V | 100 kHz |
| 10.0 V | 1000 kHz |

Table 3–2 shows the relationship between external control voltage and output frequency for all ranges.

Table 3–2. Sweepable Bands in VCO Mode

| 8111A FREQUENCY range setting | Sweepable band | | | |
|---|---|---|---|---|
| | From | | To | |
| | $V_{in}$ min | $f_{out}$ min | $V_{in}$ max | $f_{out}$ max |
| 1 Hz – 10 Hz | 0.1 V | 0.1 Hz | 10 V | 10 Hz |
| 10 Hz – 100 Hz | 0.1 V | 1 Hz | 10 V | 100 Hz |
| 100 Hz – 1000 Hz | 0.1 V | 10 Hz | 10 V | 1000 Hz |
| 1 kHz – 10 kHz | 0.1 V | 0.1 kHz | 10 V | 10 kHz |
| 10 kHz – 100 kHz | 0.1 V | 1 kHz | 10 V | 100 kHz |
| 100 kHz – 1000 kHz | 0.1 V | 10 kHz | 10 V | 1000 kHz |
| 1 MHz – 10 MHz | 0.1 V | 0.1 MHz | 10 V | 1 MHz |
| 10 MHz – 20 MHz | 0.1 V | 1 MHz | 2 V | 20 MHz |

### 3–19 Function, FREQUENCY and DUTY cycle/ WIDTH Selection 2 8 & 9

NOTE: Adjustment of any of the four vernier controls can be made without the corresponding display enable pushbutton being pressed. This allows a waveform which is displayed on an oscilloscope to be quickly and easily varied merely by vernier adjustment at any time.

3–20 Selection of the required function (sine, triangle, square wave or pulse) is by pressing the appropriately labelled front panel pushbutton.

### 3–21 FREQUENCY display and adjustment 8

NOTE: Frequency controls are non-functional in pulse mode.

3–22 This is enabled by pressing the FREQUENCY pushbutton. Adjustment of the FREQUENCY vernier will change the displayed value, range changing is accomplished by operating the RANGE rocker switch to change either the decimal point position and/or the frequency unit.

NOTE: Selection of a MHz range will cause the 50 % DUTY CYCLE LED to illuminate when sine, triangle or square wave function selected.

### 3–23 DUTY CYCLE display and adjustment 9

3–24 This is enabled by pressing the DUTY/WIDTH pushbutton. Duty cycle for sine, triangle or square-wave functions can be either a fixed 50 % over the frequency range 1 Hz to 20 MHz, or 10 % to 90 % variable over 1 Hz to 999 kHz. When the DUTY CYCLE vernier is in the "pushed in" position a constant 50 % duty cycle is obtained (indicated by the 50 % LED). By pulling the vernier out, adjustment of the duty cycle within the limits detailed above is possible.

### 3–25 WIDTH display and adjustment 9

3–26 This is made (in pulse mode) by first pressing the DUTY/WIDTH pushbutton to display the width value and then adjusting the DUTY/CYCLE/width vernier (now functioning as a width vernier). Variation from 25 ns to 100 ms is possible (see Specification) by vernier adjustment and RANGE rocker switch operation.

### 3–27 ERROR Signal 20

3–28 In pulse mode, the flashing ERROR signal can be caused by either adjustment of the FREQUENCY or DUTY CYCLE/width verniers or RANGE changing, which results in the FREQUENCY/WIDTH settings being incompatible – width of pulse exceeds period (WIDTH $\geqslant$ 1/FREQUENCY).

3–29 In TRIGGER mode, the ERROR signal will occur if the external trigger frequency is incompatible with the 8111A pulse width setting (internal rate generator disabled in pulse mode) or, if it exceeds the 8111A frequency setting in function mode.

### 3–30 START PHASE Variation 6

3–31 In sine and triangular functions, the waveform start phase can be varied (with respect to an external trigger, gate or burst signal) by +90° to –90° by the appropriate front panel vernier. (Haversine and Haver-triangle waveforms can be generated).

NOTE: See Specification for usable range details. (At +90° first trigger output signal pulse width is reduced to minimum at high frequencies, this may affect Burst mode)

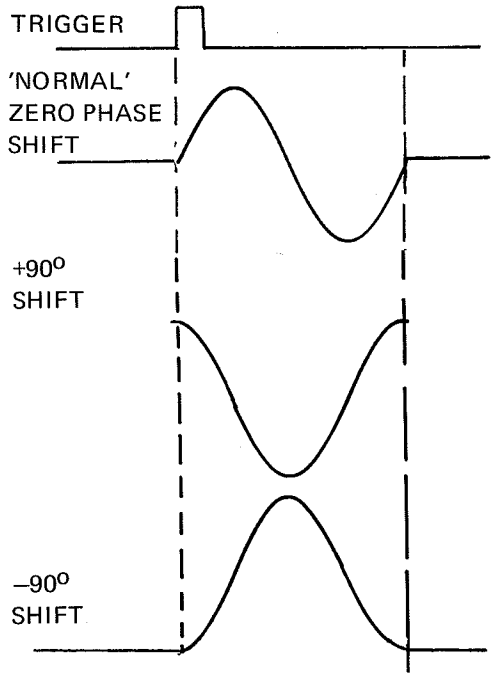



Figure 3–6. Start Phase Variation (Sinewave)

### 3–32 AMPLITUDE and OFFSET display and adjustment 10 & 11

3–33 Amplitude and offset values are displayed by pressing the AMPLITUDE or OFFSET pushbuttons. To vary either value, adjust the corresponding vernier until the desired figure is displayed. Range changing of either AMPLITUDE or OFFSET is made by pressing one of the three attenuator control pushbuttons as detailed in the following section (the RANGE rocker switch has no control over voltage ranges). Ensure that the maximum amplitude and offset settings do not result in the output signal exceeding the output window levels of ± 8.00 V into 50 Ohm.

### 3–34 AMPLITUDE, OFFSET and OUTPUT Attenuation 15

3–35 The three pushbutton controlled attenuators (AMPL–20 dB, OFFS–20 dB and OUTPUT–40 dB) can be enabled individually , or if necessary together. The two –20 dB attenuators attenuate either amplitude or offset and the –40 dB one attenuates both, so providing a maximum value of 60 dB attenuation for amplitude and offset.

### 3–36 OUTPUT MODE Selection 14

3–37 Three output mode pushbuttons enables normal/COMPLementary, Positive/negative or SYMmetrical output waveforms. If none of the buttons are pressed a normal symmetrical waveform will be output.

Examples of output mode differences are shown in Figure 3–7.

NOTE: Positive or negative offset can be added (or subtracted) irrespective of the selected output mode.

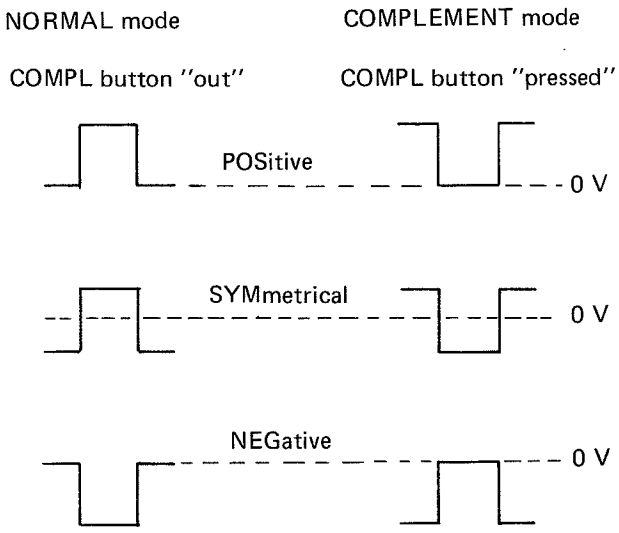



Figure 3–7. Output Mode Differences (no offset applied) (Squarewave, 50 % DUTY CYCLE)