

HEWLETT  PACKARD

**MODEL 8012A  
PULSE GENERATOR**

This manual corresponds to instruments  
with the serial number prefix:

G1121 and below

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Table 1—1. Specifications.

**PULSE CHARACTERISTICS**(50 $\Omega$  source and load impedance)**Transition Times:**

5nS – 0.5S in four ranges. Ranges are common for rise and fall times but independent verniers provide separate control of rise and fall time within each range upto maximum ratios of 100:1 or 1:100.

**Linearity:**

For transition times  $> 30\text{nS}$  maximum deviation from a straight line between the 10% and 90% points is less than 5% of pulse amplitude.

**Overshoot and Ringing:**

$< \pm 5\%$  of pulse amplitude.

**Preshoot:**

$< \pm 5\%$  of pulse amplitude.

**Pulse Width:**

$< 10\text{nS}$  to 1S in four ranges. Vernier provides continuous adjustment between ranges.

**Width Jitter:**

$< 0.1\% + 50\text{pS}$  on any width setting.

**Maximum Duty Cycle:**

$> 75\%$  from 1Hz to 10MHz, decreasing to  $\geq 40\%$  at 50MHz.

**Maximum Output:**

5V across 50 $\Omega$ , (10V across open circuit). Output circuit protected, cannot be damaged by shorting.

**Attenuator:**

Four-step attenuator provides the ranges: 0.2 – 0.5V, 0.5 – 1V, 1 – 2V and 2 – 5V. Vernier provides continuous adjustment between steps.

**Polarity:**

Positive or negative, selectable.

**Source Impedance:**

50 $\Omega \pm 10\%$ , shunted by (typically) 20pF.

**DC Offset:**

$\pm 2.5\text{V}$  across 50 $\Omega$  load. Independent of attenuator and amplitude vernier settings and may be switched off.

**Pulse Delay:**

$< 35\text{nS}$  to 1S (with respect to trigger output) in four ranges; vernier provides continuous adjustment between ranges.

**Delay Jitter:**

$< 0.1\% + 50\text{pS}$  on any delay setting.

**REPETITION RATE AND TRIGGER****Repetition Rate:**

1Hz to 50MHz in four ranges. Vernier provides continuous adjustment between ranges.

**Period Jitter:**

$< 0.1\% + 50\text{pS}$  on any repetition rate setting.

**Square Wave:**

0.5Hz to 25MHz in four ranges. Duty cycle 50%  $\pm 5\%$  upto 1MHz, tolerance increases to  $\pm 15\%$  at 25MHz.

**Trigger Output:**

Amplitude:  $> +1\text{V}$  across 50 $\Omega$ .

Width: 16nS  $\pm 10\text{nS}$ .

Suitable for triggering another 8012A.

**EXTERNALLY CONTROLLED OPERATION****External Triggering****Repetition Rate:**

0 to 50MHz. For square wave output, frequency divided by factor 2.

**Trigger Input:**

Sinewaves  $> 1.5\text{Vpp}$  (zero dc) or pulses  $> 0.8\text{V}$ , (positive or negative) at least 7nS wide.

**Delay:**

25nS  $\pm 8\text{nS}$  between leading edge of trigger input and trigger output signals.

**Maximum Input Amplitude:**

$\leq \pm 7\text{V}$

**Input Impedance:**

50 $\Omega \pm 10\%$

**Coupling:**

DC-Coupled.

**Manual:**

Front panel push button for single pulse.

Table 1—1. Specifications. Continued.

**Gating****Synchronous Gating:**

Gating signal turns generator "on". First trigger output pulse is coincident with leading edge of gate pulse. Last output pulse is always generated with normal width even if the gate pulse ends during the generation of the output pulse.

**Gate Input:**

DC-coupled; voltage at open circuit gate connector approximately +1.8V. Shorting current  $\leq 12\text{mA}$ . Input impedance approximately  $160\Omega$ .

**Gate Input Signal:**

Voltage  $> +1.5\text{V}$  or resistor  $> 300\Omega$  from gate input to ground enables the repetition rate generator.

Voltage  $< +0.8\text{V}$  or resistor  $< 150\Omega$  disables the repetition rate generator.

Gate input is TTL compatible.

**Maximum Input Signal:**

$< \pm 5\text{V}$

**External Width Input****External Width:**

Output pulse width determined by the width of drive input signal. Transition times and amplitude are selectable. Repetition rate generator running provides trigger

output but these trigger pulses are not related to the pulses at the output connector.

**RZ Mode:**

External input (switched to delay generator) determines pulse period. Transition times, delay, width, and amplitude are selectable. Trigger output is not related to RZ Mode output.

**Input Signal:**

Input Impedance  $50\Omega$ ; DC-coupled. Signal  $> +1\text{V}$ , at least  $7\text{nS}$  wide, provides output signal.

**Maximum Input Signal:**

$< \pm 5\text{V}$ .

**GENERAL****Operating Temperature Range:**

$0^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$

**Power Requirements:**

115 or 230V  $\pm 10\%$ ,  $-15\%$ , 48 to 440 Hz, 70VA maximum.

**Weight:**

Net 91bs. (4kg.), shipping 14.61bs. (6.5kg.)

**Dimensions:**

7.9 in. wide, 5.6 in. high, 13 in. deep.  
(200 x 142 x 30mm.)

## SECTION I GENERAL INFORMATION

### 1-1 INTRODUCTION

1-2 The Hewlett-Packard Model 8012A Pulse Generator is a multi-purpose pulse source, capable of generating a wide variety of output pulse waveforms, either as single pulses or as pulse trains with repetition rates from 1 Hz to 50 MHz. The transition times, amplitude, width and polarity of the output pulse(s) may be varied as required by means of easily identified front panel controls. The pulse width may be determined by the pulse generator's width control (normal mode), by external signals (external width mode), or by switching the width control to the square wave position — this causes the output pulse width to equal one half the pulse period. With the offset control in the off position the square wave is symmetrical above and below zero volts. All the output pulses may have their baseline shifted above and below the zero volt reference line by means of the front panel offset controls. Trigger pulses are available for synchronising external circuits and a delay control enables the delay time between the trigger and output pulses to be varied as required. Synchronous gating of the trigger and output pulses is possible by applying a pulse to the gate input socket.

1-3 Three modes of operation are possible as follows:

- a. Normal Mode: In this mode the internal oscillator determines the repetition rate of the output pulses. The oscillator may be triggered internally, externally, or manually; it may also be gated. A trigger pulse is generated for each output pulse and the delay between them may be varied.
- b. External Width Mode: In this mode external pulses applied to the input socket on the rear panel determine the width and repetition rate of the output pulses. Gating is not possible. Note that the pulse available at the trigger output socket, being derived from the internal oscillator, is not related to the external width output.

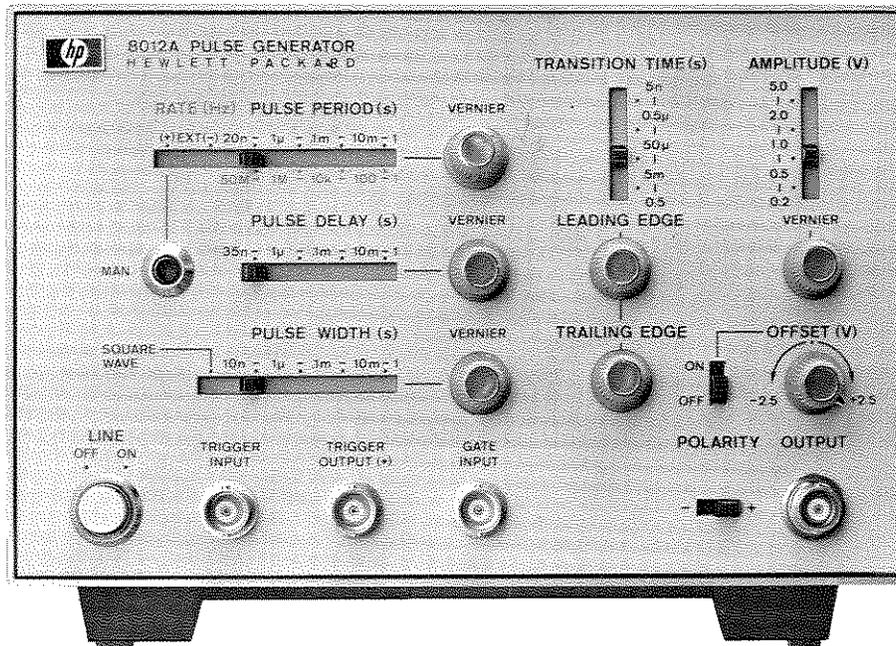


Figure 1-1 HP Model 8012A Pulse Generator

- c. RZ Mode: In this mode external pulses applied to the input socket on the rear panel determine the repetition rate of the output pulses. All other output pulse parameters are determined by the pulse generator's front panel controls, but gating is not possible. Note that the pulse available at the trigger output socket, being derived from the internal oscillator, is not related to the RZ output.

#### 1-4 ACCESSORIES AVAILABLE

1-5 Electronic test equipment, cables, connectors, adapters, and other accessory items are available from Hewlett-Packard. For more information on specific items consult the Hewlett-Packard Catalog or Sales/Service Office.

#### 1-6 MANUAL IDENTIFICATION

1-7 This instrument carries a 10-character serial number on the rear panel, the first 5 characters of which are termed the serial number prefix. If the prefix does not agree with that quoted on the title page, reference should be made to the change sheets supplied with the manual. To obtain further information for any instrument, contact the nearest Hewlett-Packard Sales/Service Office, always specify the model number and complete serial number.

#### 1-8 ORDERING ADDITIONAL MANUALS

1-9 One manual is shipped with each pulse generator. Additional manuals may be purchased from the local Hewlett-Packard field office (see list at rear of this manual for addresses). Specify the model number complete serial number prefix, and HP stock number provided on the title page.



Figure 2-1 Pulse Generator and Supplied Accessories

## SECTION II INSTALLATION

### 2-1 INITIAL INSPECTION

2-2 Inspect the instrument for physical damage and check its operation as soon as possible after delivery. Section IV contains performance check procedures which will verify instrument operation within the published specifications. This check is suitable for incoming quality control inspection. If physical damage is evident, or the instrument does not meet specifications when received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office (see list at rear of this manual). The Sales/Service Office will arrange for repair or replacement without waiting for settlement of a claim with the carrier. The certification and warranty statements for all HP instruments are on the inside front cover of this manual.

2-3 The instrument is delivered complete with the following items:

	HP Stock Numbers
Power Cord	8120-1692
Fuse, 0.5A for 230V operation.	2110-0202
Fuse, 1A for 115V operation	2110-0007

### 2-4 PREPARATION FOR USE

#### 2-5 Power Source Requirements

2-6 The Model 8012A may be operated from an ac source of 115 or 230 volts +10%, -15%, at 48 to 400 Hz. Power dissipation is 70VA maximum. Carry out the following procedure if it is required to change the operating voltage:

- a) Disconnect the power cable from the instrument.
- b) Slide the safety window to the left.
- c) Remove the fuse by pulling the lever marked FUSE PULL; this also releases the voltage selector switch.
- d) Slide the voltage selector switch to the position required (i. e. 115 or 230).
- e) Place the appropriate fuse in the fuse holder and push the lever back into position.
- f) Slide the safety window to the right and insert the power cable.

2-6 cont.,

### CAUTION

Ensure that the number visible on the slide switch and the fuse value correspond to the line voltage used before switching the instrument ON; otherwise, the instrument may be damaged.

#### 2-7 Power Cable

2-8 The Hewlett-Packard Model 8012A is equipped with a 3 - wire power cable, which, when connected to an appropriate receptacle, grounds the instrument, cabinet and panels. To preserve this protection feature when operating the instrument from another type of outlet without ground, use an appropriate adapter and connect the ground lead to an external ground.

#### 2-9 Temperature Requirements

2-10 The Hewlett-Packard Model 8012A uses solid-state components and requires no special cooling. The instrument operates within specifications when the ambient temperature is between 0°C (32°F) and 55°C (131°F). The pulse generator may be stored at temperatures between -40°C (-40°F) and 75°C (167°F).

#### 2-11 REPACKING

2-12 The original shipping carton and packing material can be used for reshipment. The Hewlett-Packard Sales/Service Office will also provide information and recommendations on materials to be used if the original packing material is not available or is damaged. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office for repair, attach a tag showing owner, model, serial number, and repairs required.

## SECTION III OPERATING INSTRUCTIONS

### 3-1 INTRODUCTION

3-2 Figure 5-1 shows the location of the controls and connectors; the reference numbers used appear when appropriate in the following text in **bold** type. As previously explained, there are three operating modes and the necessary operating procedure for each will now be described. Reference may also be made to the block diagram, figure 5-2.

### 3-3 NORMAL MODE

3-4 There are five ways of operating in the normal mode:

1. Where the repetition rate is determined by the internal oscillator, internally triggered.
2. As above, but with the oscillator triggered externally.
3. Manually triggered.
4. In each of the above, square wave output (pulse width = pulse period/2) may be selected instead of the variable pulse width.
5. The outputs obtained above may be gated.

All output pulses are preceded by a trigger pulse (TRIGGER OUTPUT socket 17). The delay is fixed at 35nS for square waves but may otherwise be adjusted by the PULSE DELAY switch 6 and VERNIER 7.

### 3-5 Internal Trigger

3-6 The appropriate circuits and controls are shown in figure 3-1. Use the following procedure to obtain an output similar to that shown in figure 3-2.

- a. Set the Mode Selector 21 to N.
- b. Set the PULSE PERIOD switch 1 to the range required, then adjust the VERNIER 2 to obtain the exact pulse period.

- c. Set the PULSE DELAY switch 6 to the range required, then adjust the VERNIER 7 until the delay time required between the trigger and output pulses is obtained. The delay time must always be less than the pulse period.
- d. Set the PULSE WIDTH switch 10 to the range required, then adjust the VERNIER 11 to obtain the exact pulse width.
- e. Set the AMPLITUDE switch 4 to the range required, then adjust the VERNIER 9 to obtain the exact amplitude.
- f. Set the TRANSITION TIME switch 3 to the range required, then adjust the RISETIME vernier 8 and FALLTIME vernier 12 for the exact risetime and falltime required.
- g. Set the POLARITY switch 19 to the position + to obtain positive output pulses or to - to obtain negative output pulses.
- h. If the baseline of the output pulses is to be zero volts, set the OFFSET switch 13 to OFF.

If the baseline is to be positive or negative, set the OFFSET switch 13 to ON and rotate the vernier 14 until the required offset voltage is obtained.

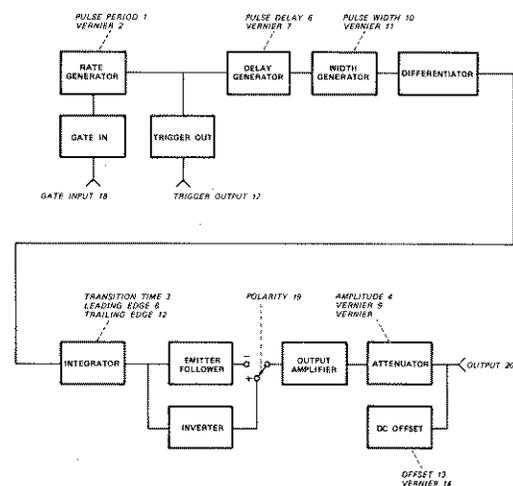


Figure 3-1 Operation Block Diagram: Normal Mode - Internal Trigger

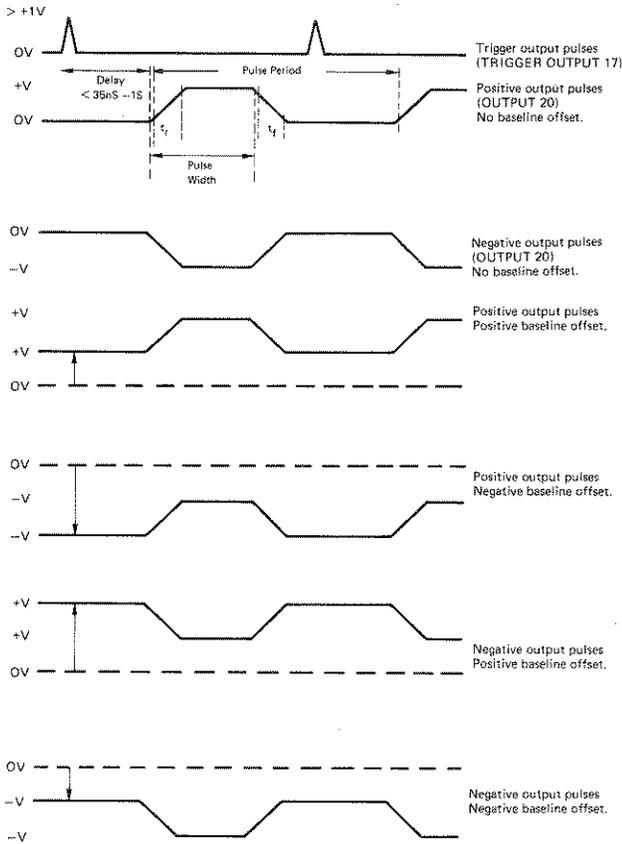


Figure 3-2 Output Waveforms: Normal Mode - Internal Trigger.

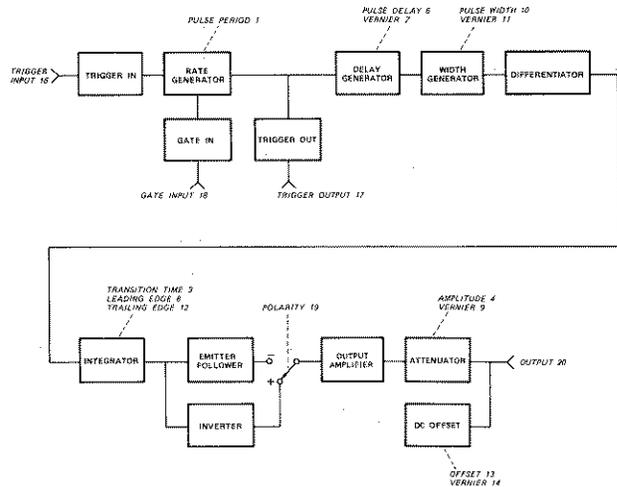


Figure 3-3 Operation Block Diagram: Normal Mode - External Trigger.

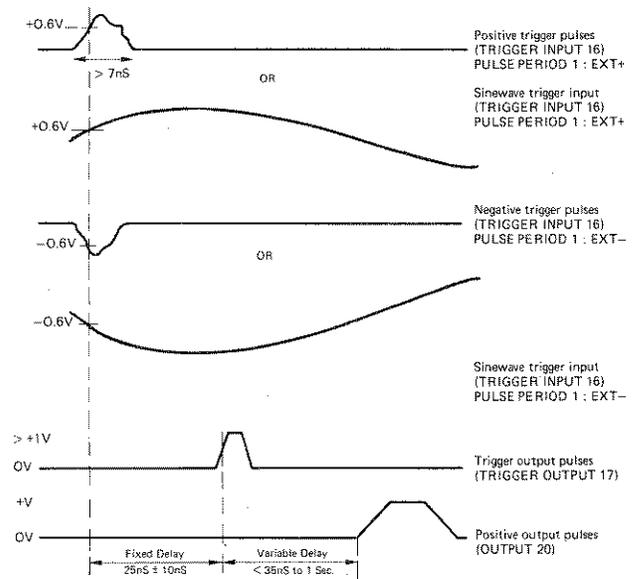


Figure 3-4 Output Waveforms: Normal Mode - External Trigger.

### 3-7 External Trigger

3-8 The appropriate circuits and controls are shown in figure 3-3. Use the following procedure to obtain an output similar to that shown in figure 3-4.

- Set the Mode Selector 21 to N.
- Apply suitable trigger pulses to the TRIGGER INPUT socket 16.
- Set the PULSE PERIOD switch 1 to EXT+ for positive trigger input pulses or to EXT- for negative trigger input pulses.
- Set the delay between the trigger and output pulses as described in paragraph 3-6.
- Set the width, amplitude, risetime, falltime, polarity and offset of the output pulses as described in paragraph 3-6.

3-9 Manual

3-10 The appropriate circuits and controls are shown in figure 3-5. Use the following procedure to obtain an output similar to that shown in figure 3-6:

- Set the Mode Selector 21 to N.
- Set the PULSE PERIOD switch 1 to either EXT+ or EXT-.
- Set the delay between the trigger and output pulse as described in paragraph 3-6.
- Set the width, amplitude, risetime, falltime, polarity and offset of the output pulse as described in paragraph 3-6.
- Press the MAN button 5 once for each output pulse required.

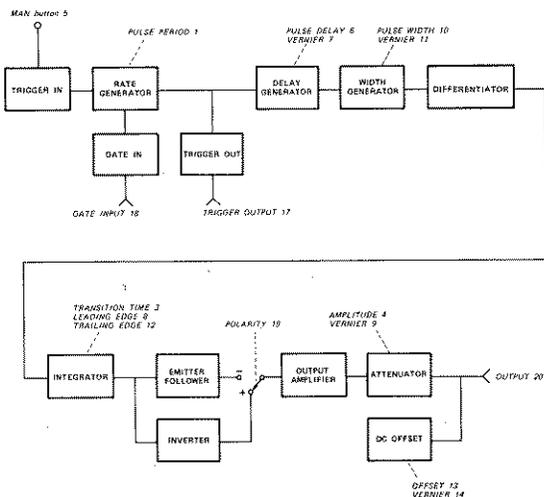


Figure 3-5 Operation Block Diagram: Normal Mode - Manual.

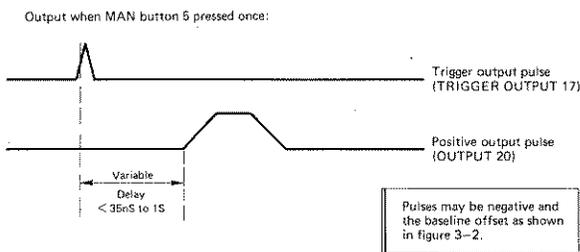


Figure 3-6 Output Waveforms: Normal Mode - Manual.

3-11 Square Wave

3-12 The appropriate circuits and controls are shown in figure 3-7. Use the following procedure to obtain an output similar to that shown in figure 3-8.

- Set the Mode Selector 21 to N.
- Set the PULSE PERIOD switch 1 to an internal range as described in paragraph 3-6 or to EXT as described in paragraph 3-8 and apply external trigger pulses in order to set the repetition rate of the output pulses.
- Set the PULSE WIDTH switch 10 to SQUARE WAVE.
- Set the amplitude, risetime, falltime, polarity and offset of the output pulses as described in paragraph 3-6.

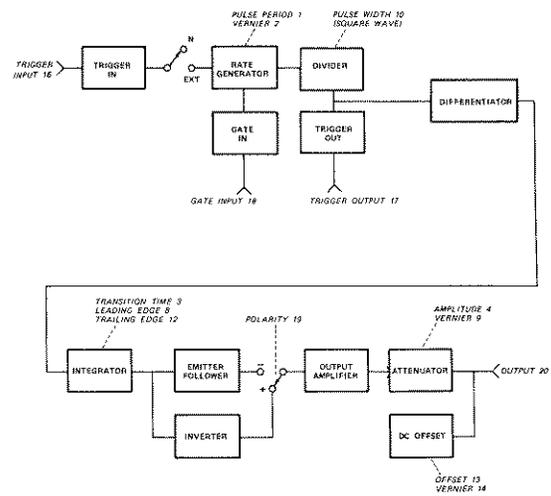


Figure 3-7 Operation Block Diagram: Normal Mode - Square Wave.

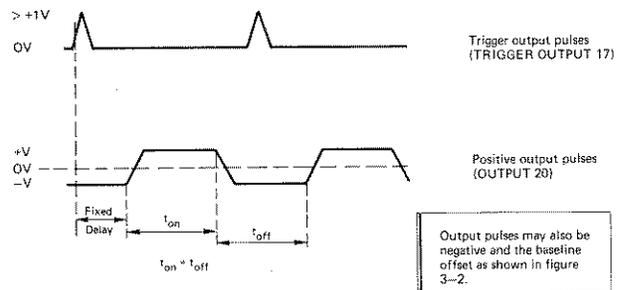


Figure 3-8 Output Waveforms: Normal Mode - Square Wave.

Remember the following points about the square wave output:  
 Output pulse width equals half the selected pulse period,  
 Output pulse rate is one-half that of the rate generator (or input trigger pulse),  
 The delay between input trigger pulse and square wave output is fixed.  
 The output pulse is symmetrical above and below ground.

### 3-13 Gating

3-14 The trigger and output pulses obtained in the normal mode may be gated by applying an appropriate gate pulse (see specifications) to the GATE INPUT socket 18; the operation is indicated in figure 3-9.

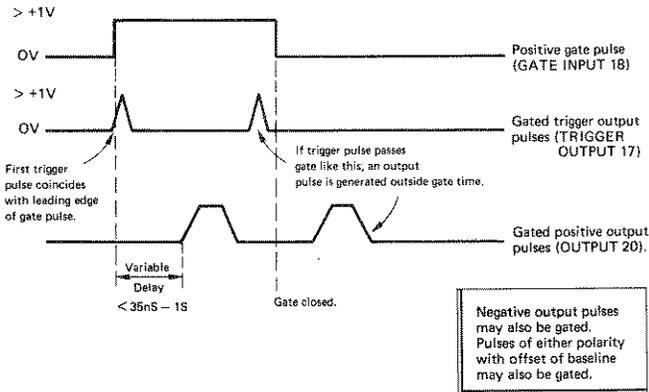


Figure 3-9 Output Waveforms: Normal Mode - Gating.

### 3-15 RZ MODE

3-16 External pulses (applied to the INPUT socket 22 on the rear panel) trigger the delay generator directly (figure 3-10) and the shape of the output pulses is determined by the pulse forming circuits following the delay generator.

The output pulses cannot be gated and, as explained in paragraph 3-19, are independent of the pulses at the TRIGGER OUTPUT socket 17.

The following procedure should be used to obtain outputs similar to those indicated in figure 3-11.

- Set the Mode Selector 21 to RZ.
- Set the delay between the external applied pulses and the resulting output pulses by selecting the range required on the PULSE DELAY switch 6 and adjusting the VERNIER 7.

- Set the PULSE WIDTH switch 10 to the required range, then adjust the VERNIER 11 for the exact pulse width.
- Set the amplitude, risetime, falltime, polarity and offset of the output pulses as described in paragraph 3-6.

See Fig.3-14 for rate Generator

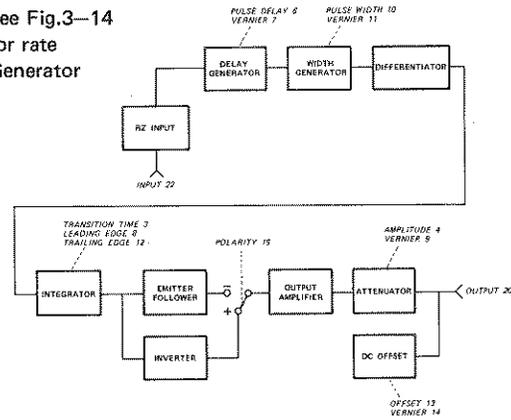


Figure 3-10 Operation Block Diagram: RZ Mode.

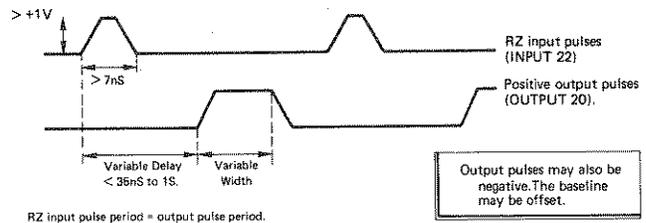


Figure 3-11 Output Waveform: RZ Mode.

### 3-17 EXTERNAL WIDTH MODE

3-18 External pulses (applied to the INPUT connector 22 on the rear panel) trigger the transition time circuit (figure 3-12). The output thus obtained cannot be gated and, as explained in paragraph 3-19, is independent of the TRIGGER OUTPUT 17. The following procedure should be used to obtain outputs similar to those shown in figure 3-11.

- Set the Mode Selector 21 to EXT. WIDTH.

- b. Set the amplitude, risetime, falltime, polarity and offset of the output pulses as described in paragraph 3-16.

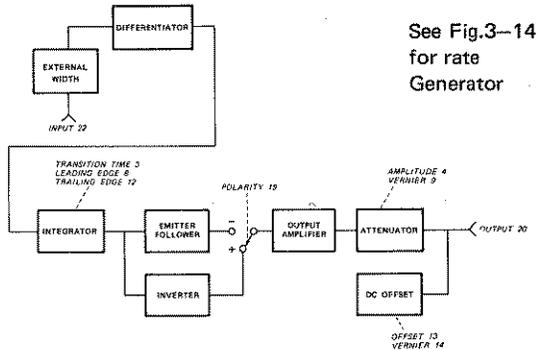


Figure 3-12 Operation Block Diagram: External Width Mode

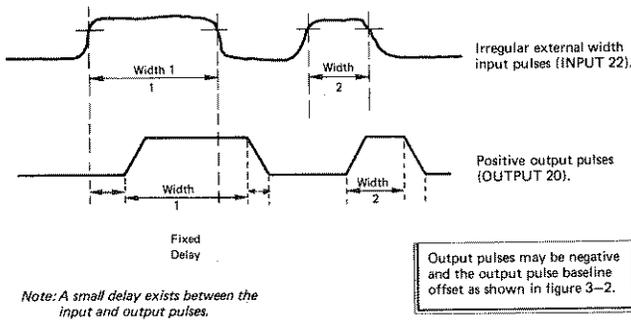


Figure 3-13 Output Waveforms: External Width Mode

### 3-19 ADDITIONAL FACILITIES IN THE RZ OR EXT. WIDTH MODES.

3-20 When operating in the RZ or EXT.WIDTH modes, the internal oscillator is available for use as an independent clock generator (figure 3-14) which provides an output at the TRIGGER OUTPUT connector 17. This output may be triggered internally, externally, or manually, and in addition gated, as described for the normal operating mode (paragraph 3-3). If this facility is not required, it may be switched off by setting the PULSE PERIOD control 1 to EXT and disconnecting the TRIGGER INPUT 16.

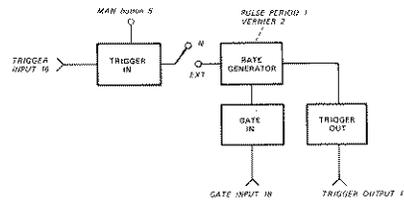


Figure 3-14 Operation Block Diagram: Additional Facilities - RZ/EXT.WIDTH Mode.