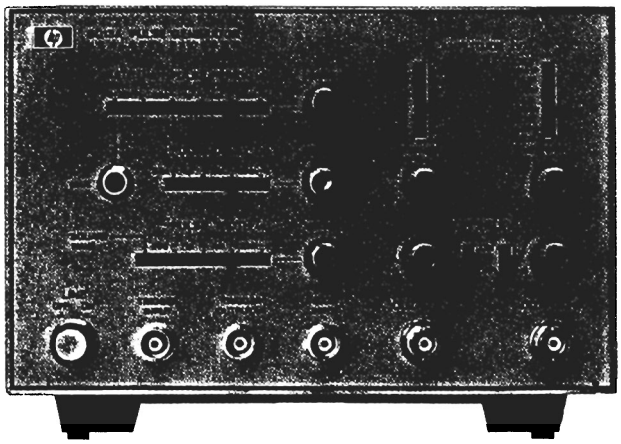
OPERATING MANUAL

Hall A

PULSE GENERATOR 8013A



HEWLETT hp PACKARD

HP 8013A

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OPERATING MANUAL

MODEL 8013A
PULSE GENERATOR

703 BÖBLINGEN, HERRENBERGER STR. 110, WEST GERMANY

08013–90001

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CONTENTS

Table 1–1 Specifications

PULSE CHARACTERISTICS

(50Ω source and load impedance)

Transition Times: < 3.5 nS fixed

Overshoot and Ringing: < ± 5 % of pulse amplitude

Preshoot: < ± 5 % of pulse amplitude

Pulse Width: < 10 nS to 1 S in four ranges. Vernier provides continuous adjustment within ranges.

Width Jitter: < 0.1 % + 50 pS on any width setting.

Maximum Duty Cycle: > 75 % from 1 Hz to 10 MHz, decreasing to ⩾ 40 % at 50 MHz.

Maximum Output: 5 V across 50 Ω (10 V across open circuit). Output circuit protected, cannot be damaged by shorting (10V across 50Ω, when internal 50Ω load is disconnected).

Attenuator: Four-step attenuator reduces output voltage to 0.5 V. Vernier provides continuous adjustment between steps and reduces output to 0.2V.

Polarity: Dual channel, positive and negative output simultaneously.

Source Impedance: 50 Ω ± 3 % shunted by (typically) 20 pF.

DC Offset: Positive channel: variable from–5 V to + 1 V across 50 Ω load. Negative channel: variable from + 5 V to–1 V across 50 Ω load.
Offset voltage independent of attenuator and amplitude vernier setting, can be switched off. If internal 50 Ω load is disconnected, DC-Offset switches off.

Pulse Delay: < 35 nS to 1 S (with respect to trigger output) in four ranges; vernier provides continuous adjustment within ranges.

Delay Jitter: < 0.1 % + 50 pS on any delay setting.

REPETITION RATE AND TRIGGER

Repetition: 1 Hz to 50 MHz in four ranges. Vernier provides continuous adjustment within ranges.

Period Jitter: < 0.1 % + 50 pS on any repetition rate setting.

Square Wave: 0.5 Hz to 25 MHz in four ranges. Duty cycle 50% ± 5% up to 1 MHz, tolerance increases to ± 15% at 25 MHz.

Trigger Output: Amplitude: > + 1 V across 50 Ω. Width: 16 nS ± 10 nS. Suitable for triggering another 8013A.

EXTERNAL OPERATION

External Triggering

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

Trigger Input: Sinewaves > 1.5 Vpp (about zero) or pulses >0.8V, (positive or negative) at least 7 nS wide.

Delay: 25 nS ± 8 nS between leading edge of trigger input and trigger output signals.

Maximum Input Amplitude: ± 7V

Input Impedance: 50 Ω ± 10 %

Coupling: DC-Coupled

Manual: Front panel push button for single pulse.

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 gate pulse ends during generation of output pulse.

Gate Input: DC-coupled; voltage at open circuit gate connector approximately + 1.8 V. Shorting current ⩽ 12 mA. Input impedance approximately 160Ω

Gate Input Signal: Voltage > + 1.5V or resistor > 300Ω from gate input to ground enables the repetition rate generator.
Voltage < + 0.8 V or resistor < 160 Ω disables the repetition rate generator. Gate input is TTL compatible.

Maximum Input Signal: ± 5V

External Width and RZ Modes

External Width: Output pulse width determined by the width of drive input signal. Amplitude 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 drive input switched to delay generator. Pulse period determined by pulse period of drive

Table 1–1 Specifications (cont.)

input signal. Delay, width and amplitude are selectable.

Input Signal: Input Impedance 50Ω, DC-coupled. Signal > +1V, at least 7 nS wide, provides output signal.

Maximum Input Signal: ± 5V

Repetition rate generator running provides trigger output but these trigger pulses are not related to the pulses at the output connector.

GENERAL

Operating Temperature Range: 0°C to + 55°C

Power Requirements: 115 or 230 V + 10%, −15%, 48 to 440 Hz, 70 VA maximum.

Weight: Net 9 lbs. (4 kg), shipping 14.6 lbs. (6.5 kg)

Dimensions: 7.9 in. wide, 5.6 in. high, 13 in. deep. (200 x 142 x 330 mm)

SECTION I
GENERAL INFORMATION

1–1 INTRODUCTION

1–2 The Hewlett-Packard Model 8013A Pulse Generator is a dual channel, multi-purpose pulse source with variable repetition rate (PULSE PERIOD controls), pulse delay and pulse width. The dual outputs, OUTPUT (+) and OUTPUT (-), are usually developed across a 50 ohm external impedance and have independent amplitude controls. In addition, symmetrical pulse outputs, either as single pulses or pulse trains (in which the positive and negative limits of the respective pulse amplitude are an equal amount above an below ground potential), or a compliment of each pulse, can be obtained by introducing a suitable dc bias (OFFSET controls).

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

a) Normal Mode: In this mode the 8013A repetition rate generator determines the pulse period. The generator may be triggered internally, externally, or manually; it may also be gated. Trigger pulses are available for synchronising external circuits; the delay time between the trigger and the output pulses may be varied as required.

b) RZ Mode: In this mode the external pulses determine only the repetition rate of the output pulses. All other output pulse parameters are determined by the settings of the pulse generator's front panel controls. Pulses produced by the repetition rate generator bear no time relationship to the output pulse train but can be used as an independent trigger for other equipment, if desired. It is not possible to gate the output pulses or to obtain square waves.

c) External Width Mode: Pulses applied to an input socket on the rear panel determine the width and repetition rate of the output pulses. Pulses produced by the repetition rate generator bear no time relationship to them, but can be used as an independent trigger for other equipment, if desired. Note that it is not possible to gate the output pulses and that square wave pulse forms are not available in this mode.

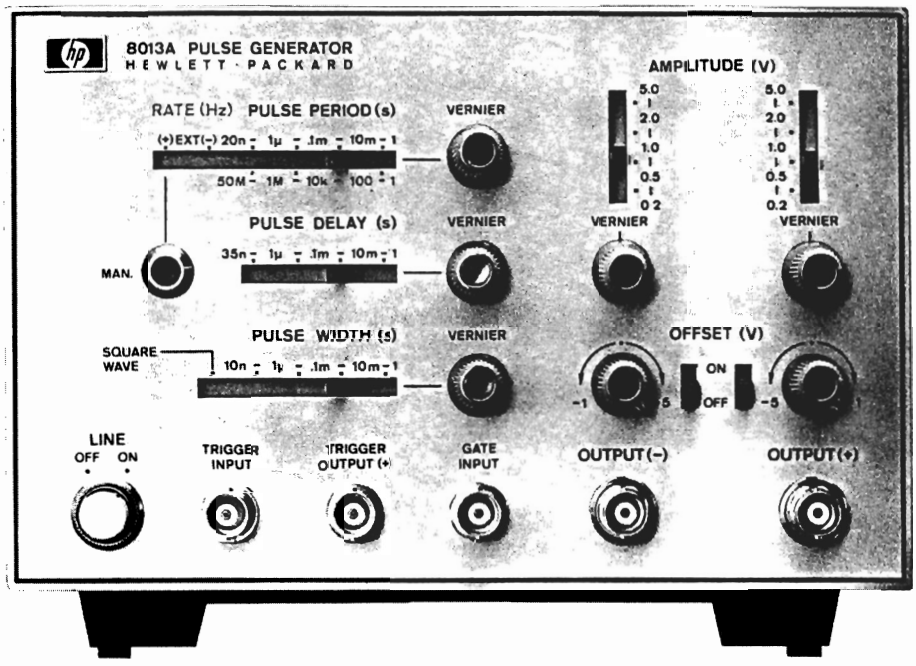


Figure 1–1 HP Model 8013A Pulse Generator

1–4 ACCESSORIES AVAILABLE

1–5 Electronic test equipment, cables, connectors, adaptors, 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 statement for all HP instruments are on the inside cover of this manual.

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

	HP Stock Numbers
Power Cord	8120–1492
Fuse, 0. 5 A for 230 V operation	2110–0202
Fuse, 1 A for 115 V operation	2110–0007

2–4 PREPARATION FOR USE

2–5 Power Source Requirements

2–6 The Model 8013A may be operated from an ac source of 115 or 230 volts + 10%, - 15%, at 48 to 440 Hz. Power dissipation is approximately 60 VA. 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 V or 230 V).

e) Push the lever back into position and place the appropriate fuse in the fuse holder.

f) Slide the safety window to the right and insert the power cable.

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 8013A 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 8013A 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 The operating instructions commence with a procedure to display a simple pulse train on an oscilloscope. This is followed by detailed instructions for the use of each control in the three different modes of operation and stylized waveforms are presented to make their effects clear. For ease of operation the following instructions will refer to Figure 5–1 which shows the controls identified by a reference number that also appears in the text in **bold** type. The control functions are indicated on the block diagram (Figure 5–2).

3–3 BASIC OPERATING GUIDE

3–4 The initial settings (Table 3–1) are given to obtain a 'normal' pulse waveform (Figure 3–1) for someone unfamiliar with the operation of the Model 8013A. One, or both, of the pulse output connectors – OUTPUT (+) **21** or OUTPUT (–) **20** – should be connected to a high-frequency oscilloscope via a 50 ohm coaxial cable. The oscilloscope should be terminated by a 50 ohm load and set with sweep time at 2 us/cm and with sensitivity at 1V/cm.

LINE **16**	ON
PULSE PERIOD **1**	1u – .1m
VERNIER **2**	Mid-range
PULSE DELAY **6**	35n – 1u
VERNIER **7**	CCW
PULSE WIDTH **10**	1u – .1m
VERNIER **11**	CCW
Mode Selector **22**	NORM
AMPLITUDE **3**	5.0 – 2.0
AMPLITUDE **4**	5.0 – 2.0
VERNIER **8**	CW
VERNIER **9**	CW
OFFSET **13**	OFF
OFFSET **14**	OFF

Table 3–1. 8013A Initial Settings

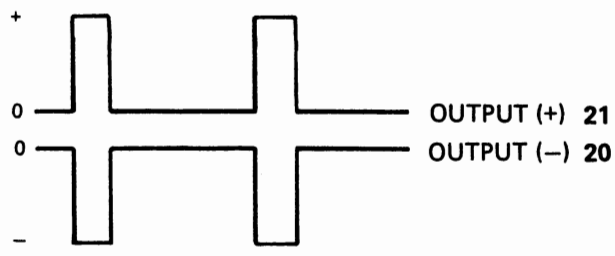


Figure 3–1. The 'normal' pulse

3–5 NORMAL MODE

3–6 There are five ways of operating the pulse generator in the normal mode:

a) Where the pulse period is determined internally.

b) As above, but with the repetition rate generator triggered externally.

c) Manual trigger

d) In each of the above, square wave output may be selected instead of the variable pulse width.
Note that the square wave output is available only in the normal mode of operation.

e) The repetition rate generator may also be gated (except in square wave mode).

All output pulses are preceded by a trigger pulse at the TRIGGER OUTPUT socket **18**. The delay is fixed at approximately 35 nS for square waves but may otherwise be varied by the PULSE DELAY switch **6** and the VERNIER **7**.

3–7 Internal Trigger

3–8 Use the following procedure to obtain pulse outputs similar to those shown in Figure 3–2.

a) Set the Mode Selector **22** to NORM.

b) Set the PULSE PERIOD switch **1** to the required range and adjust VERNIER **2** to obtain the exact pulse period.

c) Set the PULSE DELAY switch **6** to the required range and adjust VERNIER **7** until the required delay between the trigger and the output pulse is obtained. Note that the pulse delay and pulse width time must always be less than 75 % of the pulse period.

d) Set the PULSE WIDTH switch **10** to the required range and adjust VERNIER **11** to obtain the exact pulse width.

e) Set the AMPLITUDE switches **3** and **4** to the required ranges and adjust VERNIER **8** and **9** to obtain the exact amplitude.

f) If required, switch the OFFSET switches **13** and **14** to ON and adjust VERNIER **12** and **15** to the desired dc offset level.

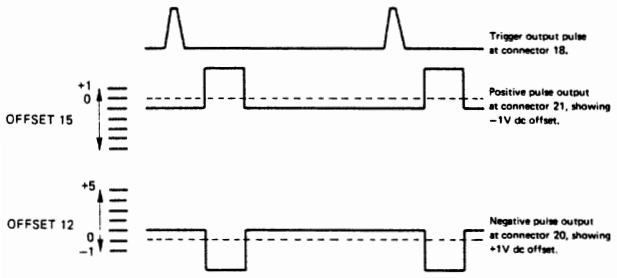


Figure 3–2. Examples of internally triggered waveforms.

3–9 External Trigger

3–10 Use the following procedure to obtain an output similar to that shown in Figure 3–3

a) Set the Mode Selector **22** to NORM

b) Apply suitable trigger pulses to the TRIGGER INPUT socket **17**.

c) Set the PULSE PERIOD switch **1** to EXT + for positive, or to EXT − for negative, input pulses.

d) Set the delay between the Trigger and output pulses as required (refer to paragraph 3–8).

e) Set the pulse width, amplitude and offset as required (refer to paragraph 3–8).

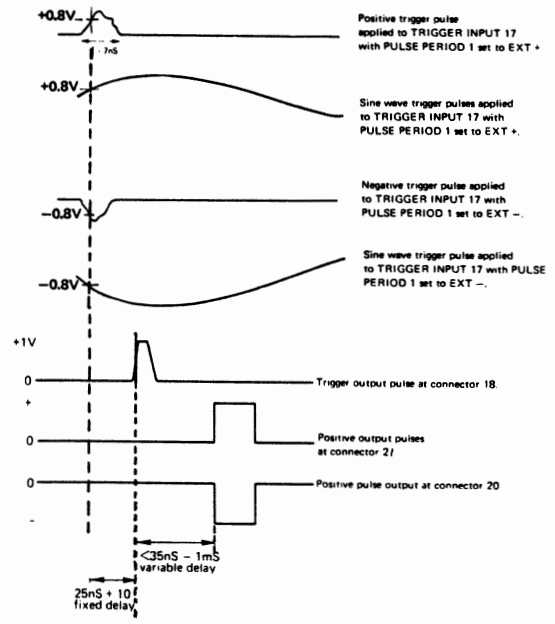


Figure 3–3. Examples of externally triggered waveforms.

3–11 Manual

3–12 Use the following procedure to obtain an output similar to that shown in Figure 3–4.

a) Set the Mode Selector **22** to NORM.

b) Set the PULSE PERIOD switch **1** to either EXT + or EXT −.

c) Set the delay between the trigger and the output pulse as described in paragraph 3- 8.

d) Set the pulse width, amplitude and offset as required (refer to paragraph 3–8).

e) Press the MAN button **5** once for each output pulse required.

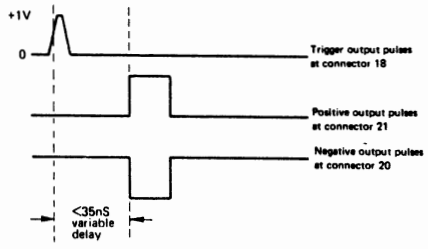


Figure 3–4. Output waveforms for manual operation.

3–13 Square Wave

3–14 Use the following procedure to obtain an output similar to that shown in Figure 3–5.

a) Set the Mode Selector **22** to NORM.

b) Set the PULSE PERIOD switch **1** to an internal range as described in paragraph 3–8 or set EXT as described in paragraph 3–9 and apply external trigger pulses in order to set the repetition rate of the output pulses.

c) Set the PULSE WIDTH switch **10** to SQUARE WAVE.

d) Set the amplitude and offset as required (refer to paragraph 3–8).

Note that, the square wave output cannot be gated.

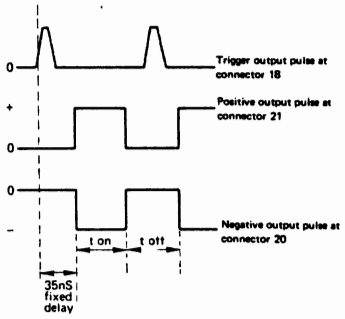


Figure 3–5. Examples of square wave output pulses.

3–15 Gating

3–16 The trigger and output pulses obtained in the normal mode may be gated (except in square wave mode) by applying a suitable gate pulse to the GATE INPUT socket **19**. In the gated operation only the repetition rate generator is affected and, therefore, all output pulse parameters are controlled in the same manner as for internal trigger as described in paragraph 3–8. Figure 3–6 illustrates samples of output obtainable when the pulse generator is gated by an external signal.

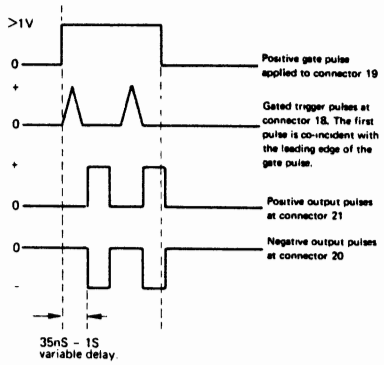


Figure 3–6. Examples of gated output waveforms.

3–17 RZ MODE

3–18 External pulses applied to the INPUT socket **23** (rear panel) trigger the delay generator directly and thus the shape of the output pulses is determined by the delay generator and the pulse-forming circuits that follow. The pulse output in this mode cannot be gated. Note that, although the repetition rate generator is on, it does not drive the pulse generator in this mode; thus, an internally generated trigger (independent of the OUTPUT at connectors **20** and **21**) is available at the TRIGGER OUTPUT connector **18**. To avoid interference between the internal repetition rate and the external signals when the TRIGGER OUTPUT **18** is not required, it is advisable to set the PULSE PERIOD switch **1** to EXT +. Square wave output is not available in the mode.
Use the following procedure to obtain an output similar to that shown in Figure 3–7.

a) Set the Mode Selector **22** to RZ.

b) Set the PULSE DELAY switch **6** to the desired range and adjust VERNIER **7**. The output pulses will be delayed with respect to the external signal.

c) Set the PULSE WIDTH switch **10** to the required range and adjust VERNIER **11** for exact pulse width.

d) Set the amplitude and offset as required (refer to paragraph 3–7).

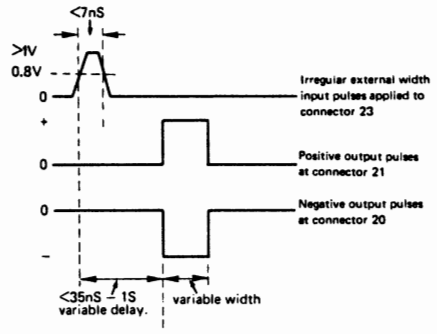


Figure 3–7. Examples of RZ Mode waveforms.

3–19 EXTERNAL WIDTH MODE

3–20 In this mode the output pulse width and pulse period is determined by the width of the input signal and the output pulses cannot be gated. Note that, although the repetition rate generator is on, it does not drive the pulse generator in this mode; thus, an internally generated trigger (independent of the OUTPUTS at connectors **20** and **21** is available at the TRIGGER OUTPUT connector **18**. To avoid interference between the internal repetition rate and the external signals when the TRIGGER OUTPUT **18** is not required, it is advisable to set the PULSE PERIOD switch **1** to EXT +. Square wave output is not available in this mode.

Use the following procedure to obtain an output similar to that shown in Figure 3–8.

a) Set the Mode Selector **22** to EXT WIDTH.

b) Set the amplitude and offset as required (refer to paragraph 3–7).

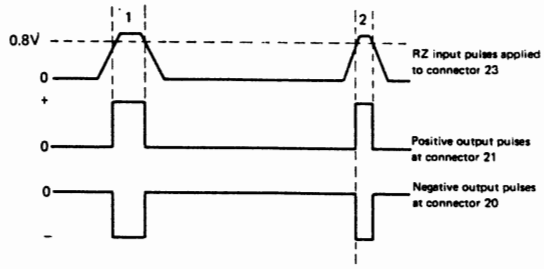


Figure 3–8. Comparison of input and output pulse widths.

SECTION IV
MAINTENANCE

4–1 INTRODUCTION

4–2 The following information is presented in this section:

a) Testing, troubleshooting and adjustment

b) Removal and replacement of cover and assemblies.

4–3 TESTING, TROUBLESHOOTING AND ADJUSTMENT

4–4 The tests have been arranged into three groups (preliminary checks, performances tests, and internal checks and adjustments) so that:

a) The instrument covers need not be removed unless repair or adjustment is required.

b. An indication of the general serviceability of the pulse generator is obtained at an early stage by the preliminary checks. In this way the bulk of troubleshooting and repair may be done before the performance tests are commenced.

A possible way in which testing and troubleshooting may be organised will now be described; a flow-charted procedure is used which will locate faults to an assembly and sometimes to a circuit within an assembly. Troubleshooting down to component level (once the faulty assembly or circuit is identified) will depend on standard techniques using the appropriate circuit diagram.

4–5 Organisation (Figure 4–1)

4–6 The instrument is prepared for use and the switching procedure completed. The preliminary checks (Tables 4–2 to 4–8) are then performed and, if these are satisfactory, the performance tests (Tables 4–9 to 4–23) are carried out. Satisfactory completion of the performance tests will establish that the instrument reaches the specification. Execute a table in the order in which it is written. Note that, only the tests for OUTPUT **21** are described; when it is necessary to check the OUTPUT **20** (as indicated by a broken-line connection), repeat the table–substituting the appropriate controls where different from those used for OUTPUT **20**.

4–7 If the preliminary checks are not satisfactory, the troubleshooting charts in Figures 5–4 to 5–9 should be performed. At this point it is recommended that the internal checks and adjustments (Tables 4–24 to 4–27) be performed before attempting to repair the fault as diagnosed by means of the flowcharts – in this way, the possibilities of failure due to the power supply, the timing or output circuits are eliminated.

4–8 When the internal checks and adjustments, and any repairs deemed necessary while the troubleshooting procedure was carried out, have been satisfactorily completed, procede with the performance test.

4–9 Test Equipment

4–10 A list of the test equipment and accessories required appears in Table 4–1.

4–11 Troubleshooting Charts.

4–12 The waveforms shown on the troubleshooting charts are those which should be obtained with the given control settings and these should be compared with those actually obtained. All the waveforms are shown on the Normal Mode flowchart but only the waveforms which differ from the normal are shown on the subsequent flowcharts.

4–13 REMOVAL AND REPLACEMENT OF COVERS AND ASSEMBLIES

4–14 Access to Test Points and Assemblies

4–15 To gain access to all test points and assemblies remove the top and bottom covers after first removing their fastening screws.

4–16 Removal of Assemblies (Figure 5–3)

4–17 Assembly 1 is removed as follows:

a. Disconnect coaxial cable and wire (0–4).
b. Remove three securing screws.
c. Unplug from connector XA1 on A3.

Assembly 2 is removed as follows:

a. Disconnect wire (0–4).

b. Remove three securing screws
c. Unplug from connector XA2 on A3.

Assembly 3 is removed as follows:
a. Remove assemblies 1 and 2.
b. Remove all cables and wires.
c. Push on A3 until front panel moves out of frame.
d. Remove six securing screws.

Assembly 4 is removed as follows:
a. Remove four securing screws (at rear panel).
b. Disconnect all wires.

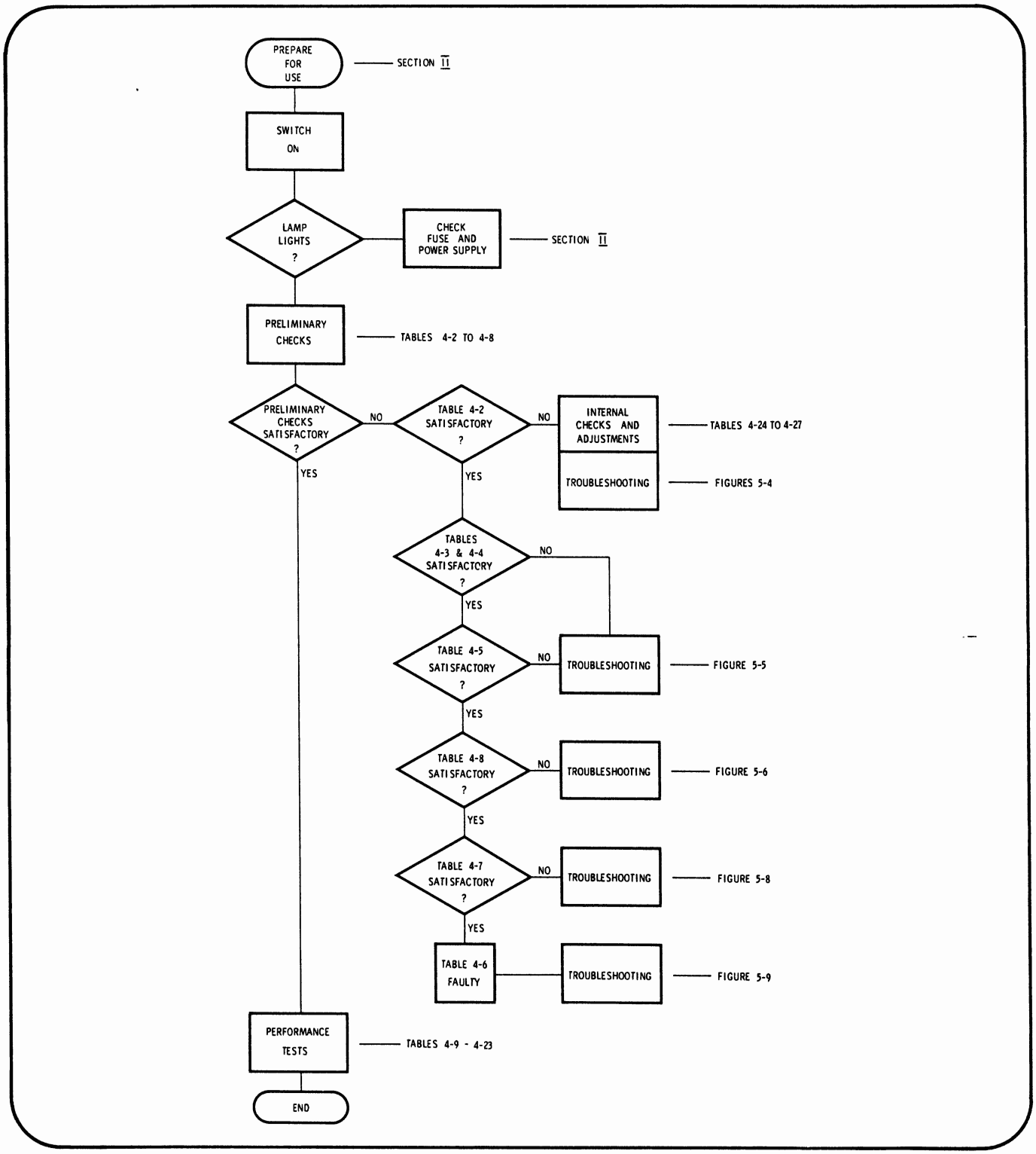


Figure 4–1 Organization of Tests and Troubleshooting

Table 4–1. Test Equipment and Accessories

INSTRUMENT	BRIEF SPECIFICATION	RECOMMENDED MODEL
Counter	Frequency range 0 – 50 MHz	HP 5245L
Oscilloscope	Dual-channel, 50 MHz bandwidth	HP 180A with plug-ins 1801A, 1821A
Digital Voltmeter	10V dc range to 4 significant figures. Accuracy ± 0.05 % ± 1 digit.	HP 3440A with plug-in 3444A.
Sampling Oscilloscope	Dual-channel, 1 GHz bandwidth	HP 140A with plug-ins 1410A, 1424A
AC Voltmeter	Sensitivity 100uV to 300V rms.	HP 403B
Voltmeter Ammeter Ohmmeter	1mV to 1000V FSD. ± 1 % of FSD. 1uA to 1A FSD. ± 2 % of FSD. 1ohm to 100 Mohm ± 5 % at center scale	HP 412A
Test Oscillator	Frequency range 10 Hz – 10 MHz	HP 651A
Test Oscillator	Frequency range 10 to 500 MHz	HP3200B
Pulse Generator	Frequency range 100 MHz with variable rise and falltime capability.	HP 8007A

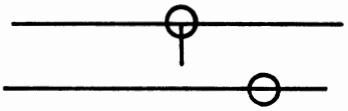
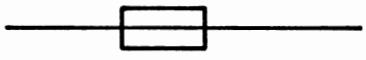
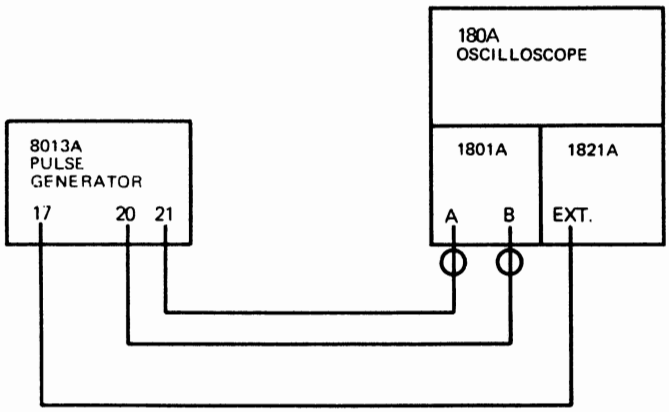
ACCESSORIES	SYMBOLS USED IN THIS SECTION	RECOMMENDED MODEL
50 cable assembly with male BNC connectors (6 required).		HP 10120A
50 Termination, type GR (2 required)		GR 874 – W50B
10:1 Divider Probe		HP 10214A
50 Tee Connector (2 required) 10:1 Voltage Divider Probe 50 Feed-through termination		HP 10221A HP 10004B HP 11048B UG–274/u 74868
Cable Assembly (2 required) Pulse Adder 20 dB Attenuator, 50 (2 required)		HP 1100A HP 15104A HP 8491A

Table 4–2. Preliminary Check: Internal Operation.

TEST SET-UP



STEP	INSTRUCTIONS	RESULTS
1	Set the 8013A controls as follows:	
	PULSE PERIOD **1** — 1u – .1m	
	VERNIER **2** — CW	
	PULSE DELAY **6** — 1u – .1m	
	VERNIER **7** — CCW	
	PULSE WIDTH **10** — 1u – .1m	
	VERNIER **11** — Mid-range	
	AMPLITUDE **3** — 5.0 – 2.0	
	VERNIER **8** — CW	
	AMPLITUDE **4** — 5.0 – 2.0	
	VERNIER **9** — CW	
	OFFSET **13** — ON	
	VERNIER **12** — Mid-range	
	OFFSET **14** — ON	
	VERNIER **15** — Mid-range	
	Mode selector **22** — NORM	
2	With reference to the diagram below, check the function of the pulse generator and compare the output from both channels.	

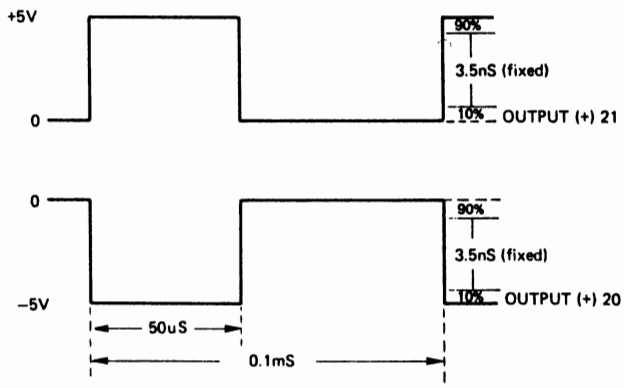
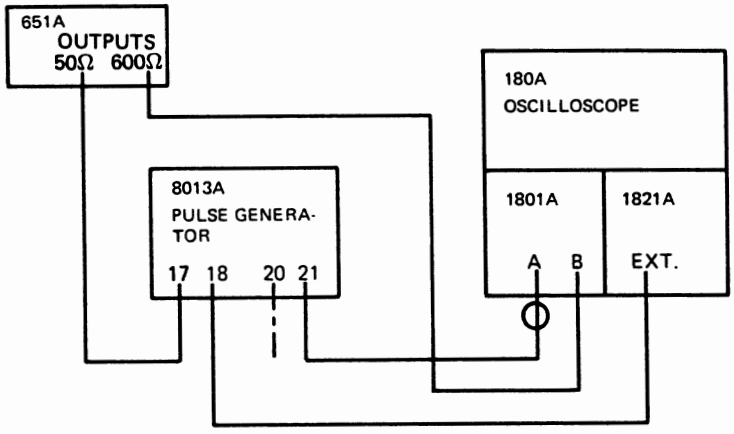


Table 4–3. Preliminary Check: External Trigger Operation

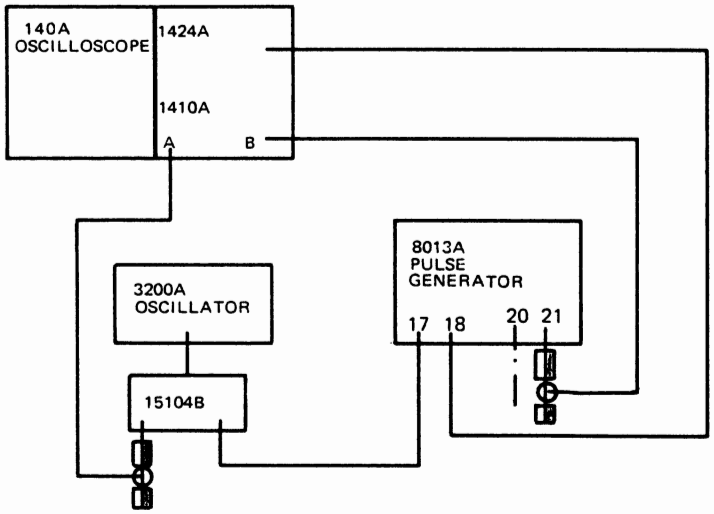
TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	Set the 8013A controls as follows:		
	PULSE PERIOD **1**	EXT (+)	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Set the 651A controls as follows:		
	Range	X10	
	Vernier	2.5	
	Attenuator	+10 dB (1. 0V)	
3	Center with vertical channels on the oscilloscope and observe the waveforms. The leading edge of the output pulse shall occur during positive slope of the sinewave.		
4	Set PULSE PERIOD **1** EXT (–): the leading edge of the output pulse shall occur during the negative slope of the sinewave.		

Table 4–4. Preliminary Check: High Frequency Trigger Operation

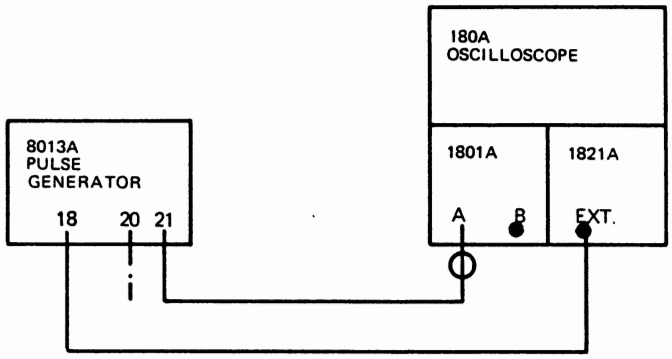
TEST SET-UP



STEP	INSTRUCTIONS		RESULTS
1	Set the 8013A controls as follows:		
	PULSE PERIOD **1**	EXT (+)	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
2	Mode selector **22**	NORM	
	Apply a sinewave with a repetition rate of 50 MHz and amplitude of 1.5V pp. Check repetition rate of output is equal repetition rate of input i.e. 50 MHz.		
3	Set PULSE PERIOD **1** to EXT (–).		
4	Repeat step 2.		

Table 4–5. Preliminary Check: Manual Operation.

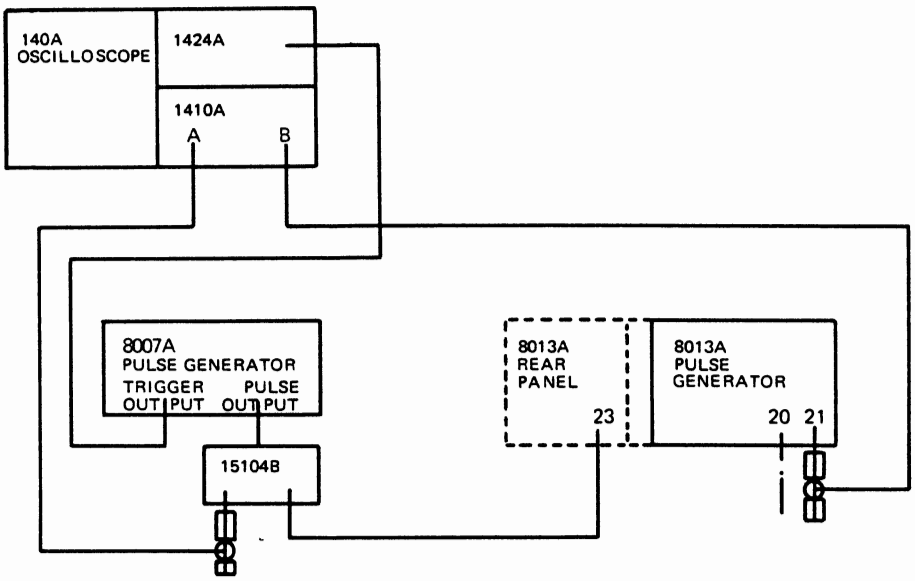
TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	PULSE PERIOD **1**	EXT (+)	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	1u – .1m	
	VERNIER **11**	CW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Press MAN button 5.		
	Only one output pulse must occur when the button is pressed, no pulse must occur when the button is released.		

Table 4–6. Preliminary Check: External Width Operation.

TEST SET–UP



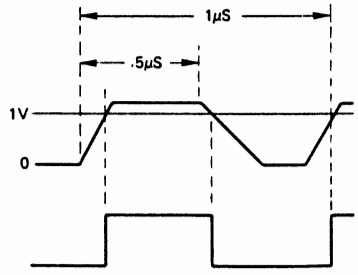
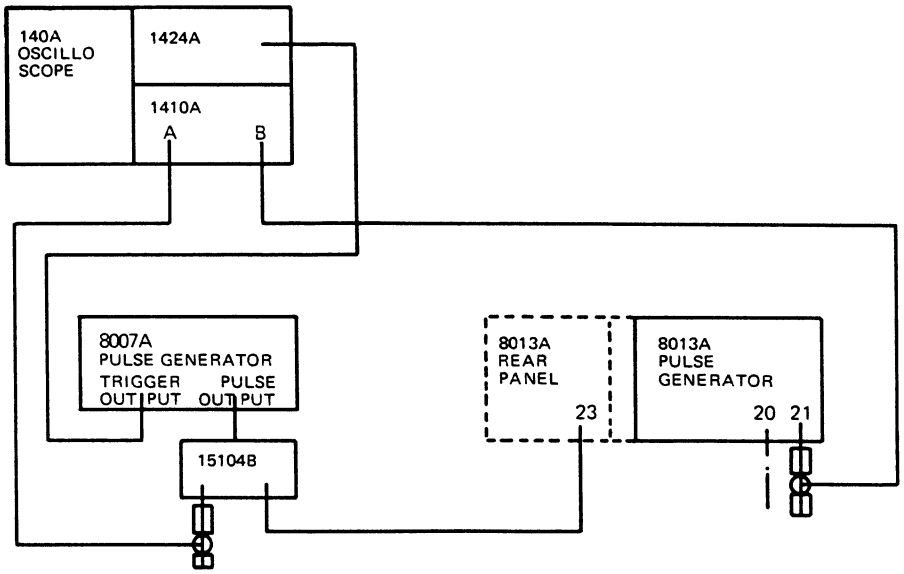
STEP	INSTRUCTIONS	RESULT
1	Set the 8013A controls as follows:	
	PULSE PERIOD **1**	EXT +
	AMPLITUDE **3**	5.0 – 2.0
	VERNIER **8**	CCW
	AMPLITUDE **4**	5.0 – 2.0
	VERNIER **9**	CCW
	OFFSET **13**	OFF
	OFFSET **14**	OFF
	Mode selector **22**	EXT. WIDTH
2	Apply external signals to INPUT **23**	
3	Note that, the leading and trailing edge of the output pulse is coincident with the leading and trailing edges of the input pulse. The output pulse width will be that of the input pulse at the switching level of 1V.	

Table 4–7. Preliminary Check: RZ Operation

TEST SET–UP



STEP	INSTRUCTIONS	RESULT
1	Set the 8013A controls as follows:	
	PULSE PERIOD **1** — EXT+	
	PULSE DELAY **6** — 35n – 1u	
	VERNIER **7** — CCW	
	PULSE WIDTH **10** — 10n – 1u	
	VERNIER **11** — CCW	
	AMPLITUDE **3** — 5.0 – 2.0	
	VERNIER **8** — CCW	
	AMPLITUDE **4** — 5.0 – 2.0	
	VERNIER **9** — CCW	
	OFFSET **13** — OFF	
	OFFSET **14** — OFF	
	Mode selector **22** — RZ	
2	With reference to the diagram, apply an external signal to the INTPUT connector **23** and observe the pulse output.	

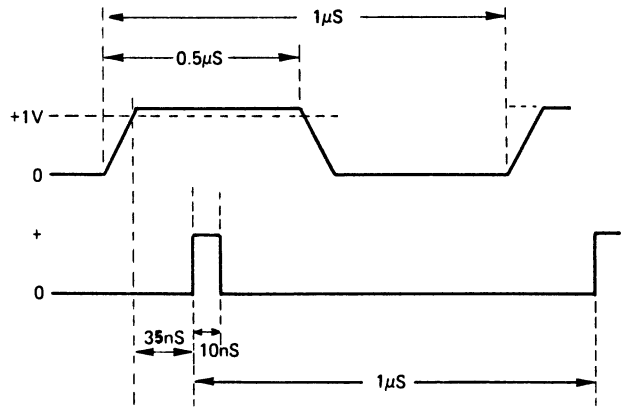
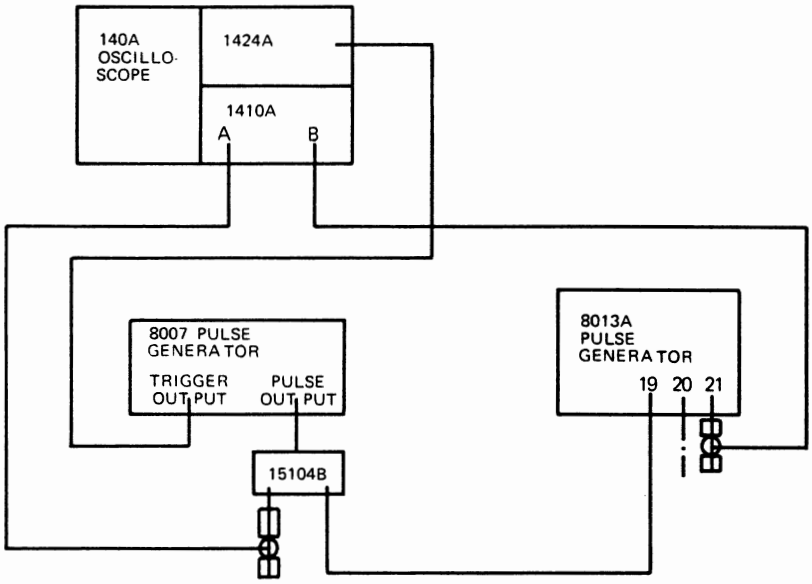


Table 4–8. Preliminary Check: Gate Operation.

TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	PULSE PERIOD **1**	20n – 1u	
	VERNIER **2**	CCW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CCW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CCW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Apply gate pulse to GATE INPUT 19.		
3	Check that output pulses only occur during on time of gate pulse: Turn pulse period VERNIER **2** slowly CW and check gate operation for all pulse periods.		
4	Check that leading edge of first trigger output pulse (TRIGGER OUTPUT **18**) coincides with leading edge of gate pulse and that trigger pulses occur only during on time of gate pulse.		
5	Check that last pulse width is correct even though gate pulse trailing edge appears during last pulse:		

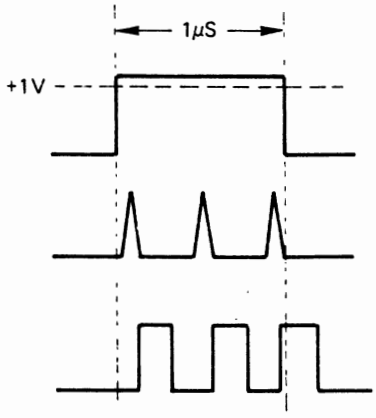
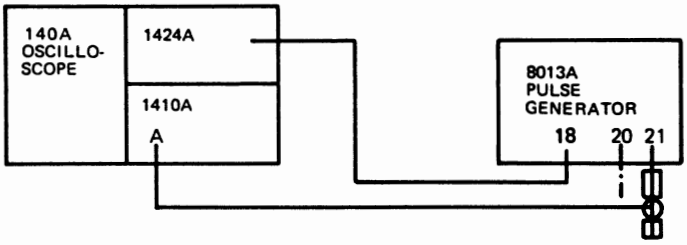


Table 4–9. Performance Test: Preshoot, Overshoot and Ringing

TEST SET–UP



STEP	INSTRUCTIONS	RESULTS
1	Set the 8013A controls as follows:	
	PULSE PERIOD **1** — 20n – 1u	
	VERNIER **2** — CCW	
	PULSE DELAY **6** — 35n – 1u	
	VERNIER **7** — CCW	
	PULSE WIDTH **10** — SQUARE WAVE	
	VERNIER **11** — CW	
	AMPLITUDE **3** — 5.0 – 2.0	
	VERNIER **8** — CW	
	AMPLITUDE **4** — 5.0 – 2.0	
	VERNIER **9** — CW	
	OFFSET **13** — OFF	
	OFFSET **14** — OFF	
	Mode selector **22** — NORM	
2	With reference to the diagram below, measure preshoot, overshoot and ringing in turn to ensure that these are $< \pm$ 5% of the pulse amplitude.	

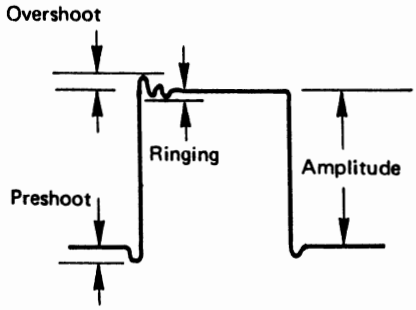
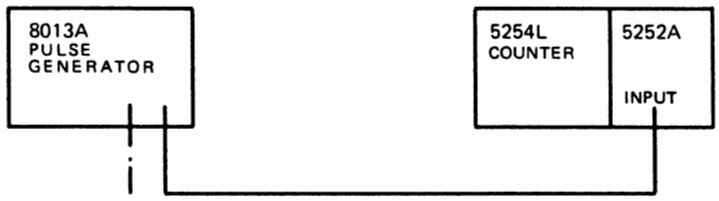


Table 4–10. Performance Test: Pulse Period

TEST SET–UP

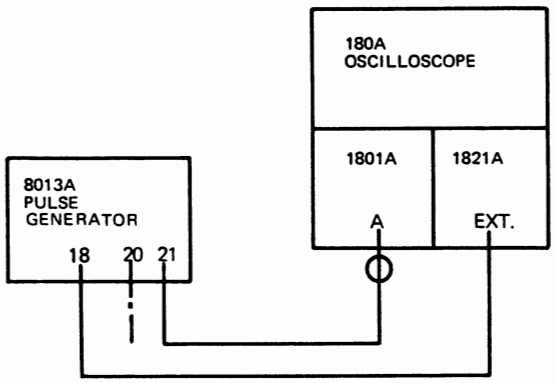


STEP	INSTRUCTIONS		RESULTS
1	Set the 8013A controls as follows:		
	PULSE PERIOD **1**	20n – 1u	
	VERNIER **2**	CCW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Check repetition rate for each set of control settings given in table:		

PULSE PERIOD (1)	VERNIER (2)	PULSE PERIOD	FREQUENCY
20n – 1u	CCW	<20nS	> 50 MHz
20n – 1u	CW	> 1uS	< 1 MHz
1u – .1m	CW	>.1mS	< 10 kHz
1u – .1m	CCW	< 1uS	> 1 MHz
.1m – 10m	CW	>10mS	< 100 Hz
.1m – 10m	CCW	<.1mS	> 10 kHz
10m – 1	CW	> 1S	< 1 Hz
10m – 1	CCW	<10mS	> 100 Hz

Table 4—11. Performance Test: Pulse Period Jitter.

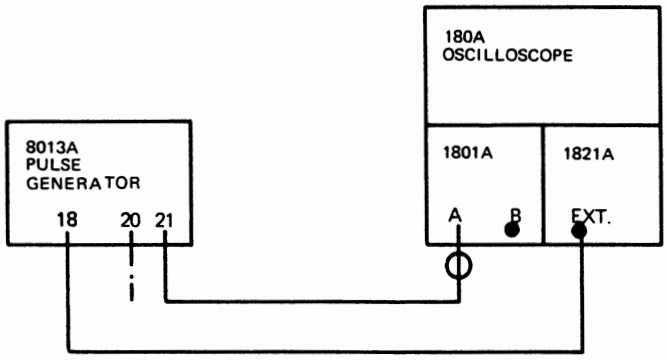
TEST SET—UP



STEP	INSTRUCTIONS		RESULTS
1	Set the 8012A controls as follows:		
	PULSE PERIOD **1**	1u — .1m	
	PULSE DELAY **6**	35n — 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	1u — .1m	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 — 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 — 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
3	Set the 1821A controls as follows:		
	Main Sweep	0.1mS/div	
	Delayed Sweep	0.1uS/div	
	Sweep Mode	Norm.	
	Delayed Trigger	Auto.	
	CM Delay	2.0	
4	Adjust pulse period VERNIER **2** to obtain 0.1mS pulse period on display.		
5	Adjust 1821A Delay (Div) vernier until intensified spot coincides with leading edge of second pulse on display.		
6	Switch Mode switch on 1821A to MIXED.		
7	Measure pulse period jitter:		$<$.1%

Table 4–12. Performance Test: Pulse Delay

TEST SET–UP



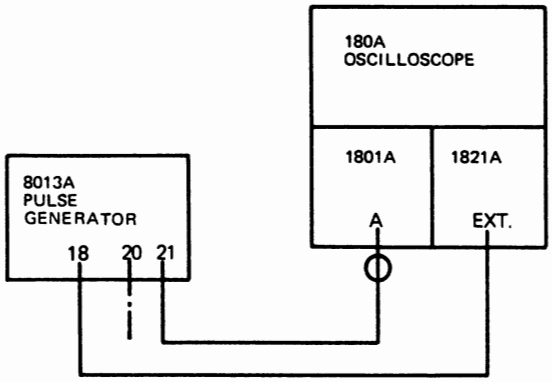
STEP	INSTRUCTIONS		RESULTS
1	Set 8013A controls as follows:		
	PULSE PERIOD **1**	1u – .1m	
	VERNIER **2**	CW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	

2 Check the pulse delay for both VERNIER **7** extremities of each range setting of the PULSE DELAY selector **6** as follows:

PULSE DELAY **6**	VERNIER **7**	PULSE PERIOD **1**	PULSE WIDTH **10**	
35n – 1u	CW	1u – .1m	10n – 1u	> 1uS
1u – .1m	CW	,1m – 10m	1u – .1m	> 100uS
1u – .1m	CCW	10n – .1m	1u – .1m	< 1uS
.1m – 10m	CW	10m – 1	.1m – 10m	> 10us
.1m – 10m	CCW	.1m – 10m	.1u – .1m	< 100uS
10m – 1m	CW	EXT+(press MAN)	10m – 1	> 1S
10m – 1m	CCW	10m – 1m	.1m – 10m	< 10mS

Table 4–13. Performance Test: Pulse Delay Jitter.

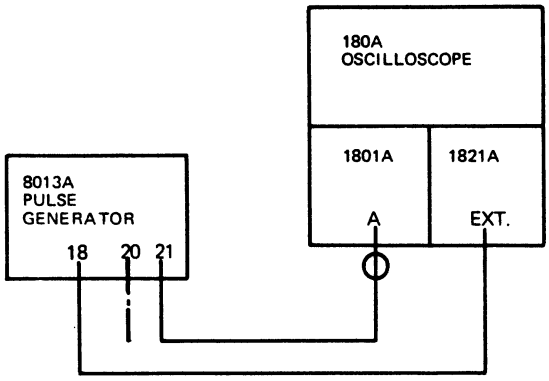
TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	Set the 8013A controls as follows:		
	PULSE PERIOD **1**	.1m – 10m	
	VERNIER **2**	CW	
	PULSE DELAY **6**	1u – .1m	
	VERNIER **7**	CW	
	PULSE WIDTH **10**	1u – .1m	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Adjust pulse period VERNIER **2** to obtain 0.4mS pulse period on display.		
3	Adjust pulse delay VERNIER **7** to obtain 0.1mS pulse delay.		
4	Adjust 1821A Delay (Div) vernier until intensified spot coincides with leading edge of first pulse.		
5	Switch Mode switch on 1821A to MIXED.		
6	Measure the pulse delay jitter		$<.1\%$

Table 4—14 Performance Test: Pulse Width (greater than 1uS).

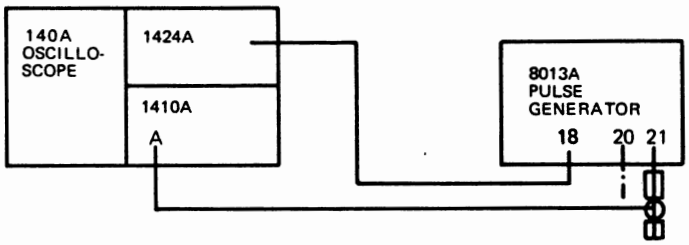
TEST SET—UP



STEP	INSTRUCTIONS		RESULTS
1	Set 8012A controls as follows:		
	PULSE PERIOD **1**	1u – .1m	
	VERNIER **2**	CW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Check the pulse width for both VERNIER **11** extremities of each range setting of the PULSE WIDTH selector **10** as follows:		
	PULSE WIDTH **10**	VERNIER **11**	PULSE PERIOD **1**	
	10n – 1u	CW	1u – .1m	> 1uS
	1u – .1m	CW	.1m – 10m	> .1mS
	1u – .1m	CCW	1u – .1m	< 1uS
	.1m – 10m	CW	10m – 1	> 10mS
	.1m – 10m	CCW	.1m – 10m	< .1mS
	10m – 1	CW	EXT+ (Press MAN)	> 1S
	10m – 1	CCW	10m – 1	> 10mS

Table 4–15. Performance Test: Pulse Width (less than 10nS).

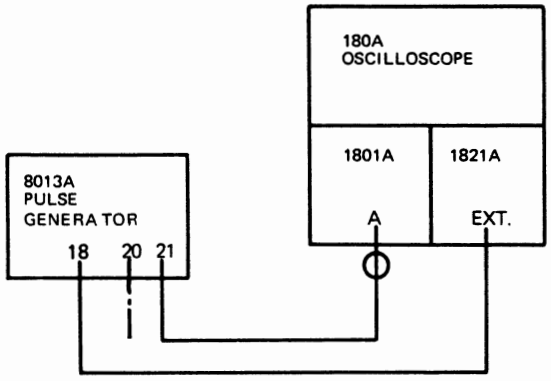
TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	Set the 8012A controls as follows:		
	PULSE PERIOD **1**	20n – 1u	
	VERNIER **2**	CCW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Measure the pulse width:		< 10nS

Table 4–16. Performance Test: Pulse Width Jitter.

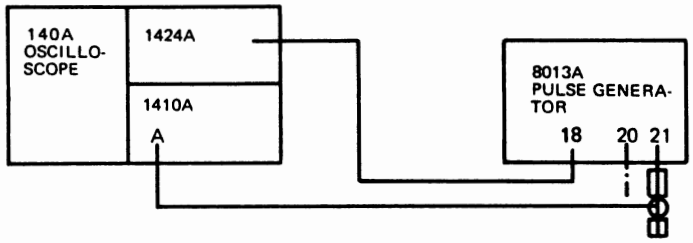
TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	Set the 8013A controls as follows:		
	PULSE PERIOD **1**	.1m – 10m	
	VERNIER **2**	CW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	1u – .1m	
	VERNIER **11**	CW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
4	Adjust pulse period VERNIER **2** to obtain 0.4mS pulse period on display.		
5	Adjust pulse width VERNIER **11** to obtain 0.1mS pulse width.		
6	Adjust 1821A Delay (Div) vernier until intensified spot coincides with trailing edge of first pulse.		
7	Switch Mode switch on 1821A to MIXED.		
8	Measure pulse width jitter:		$<.1\ \%$

Table 4–17. Performance Test: Square Wave

TEST SET–UP



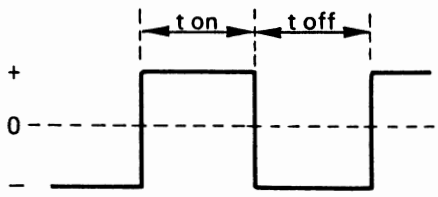
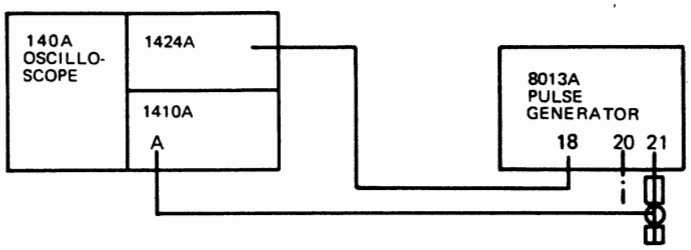
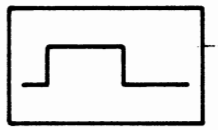
STEP	INSTRUCTIONS	RESULTS
1	Set the 8013A controls as follows:	
	PULSE PERIOD **1** — 20n – 1u VERNIER **2** — CW PULSE DELAY **6** — 35n – 1u VERNIER **7** — CW PULSE WIDTH **10** — SQUARE WAVE VERNIER **11** — CW AMPLITUDE **3** — 5.0 – 2.0 VERNIER **8** — CW AMPLITUDE **4** — 5.0 – 2.0 VERNIER **9** — CW OFFSET **13** — OFF OFFSET **14** — OFF Mode selector **22** — NORM	
2	For each setting of the PULSE PERIOD control **1**, given in the table below, turn the VERNIER **2** slowly from fully CCW to fully CW and check that the PULSE DELAY **6** and VERNIER **7** controls have no effect on the position of the displayed pulse. PULSE PERIOD **1** 20n – 1u 1u – .1m .1m – 10m 10m – 1	
3	For all settings of the pulse period control, check that the pulse width (t on) equals the pulse off time (t off)	
4	Check that the square wave output pulse is symmetrically above and below zero volts.	

Table 4–18. Performance Test: Duty Cycle.

TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	PULSE PERIOD **1**	1u – .1m	
	VERNIER **2**	CW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	1u – .1m	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	For each set of control settings given in table below, display the output pulse so that it occupies half of the display (see diagram):		

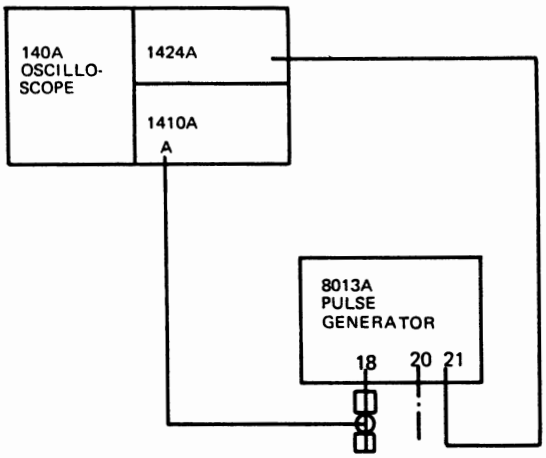
Starting with the pulse period VERNIER **2** fully CW turn VERNIER **2** slowly CCW until the trailing edge of the pulse begins to move or the pulse divides. When this happens measure the pulse period (Tp) and use in the formula:

$$\text{Duty Cycle}_{\text{Max}} = \frac{\text{Pulse Width (Tw)}}{\text{Pulse Period (Tp)}} \cdot 100\%$$

PULSE PERIOD (1)	PULSE WIDTH (10)	VERNIER (11)	
1u – .1m	1u – .1m	Adjust for 1uS	>75 %
.1m – 10m	.1m – 10m	Adjust for 0.1mS	>75 %
10m – 1	10m – 1	Adjust for 10mS	>75 %

Table 4–19. Performance Test: Trigger Output.

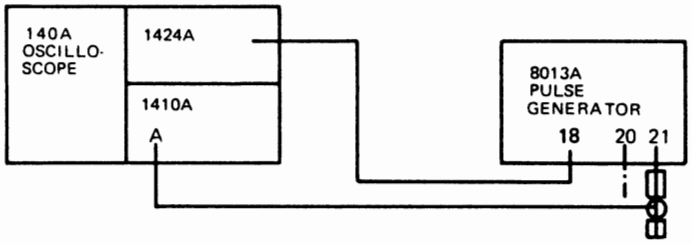
TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	Set the 8013A controls as follows:		
	PULSE PERIOD **1**	20n – 1u	
	VERNIER **2**	CCW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	2.5 – 1.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	2.5 – 1.0	
	VERNIER **9**	CW	
	OFFSETT **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Measure amplitude of trigger output pulse (TRIGGER OUTPUT **18**).		> 1.0 V
3	Measure width of trigger output pulse:		> 5nS < 20nS
4	Turn VERNIER **2** slowly from CCW to CW, the amplitude and width limits given must be true for the whole range.		
5	Switch PULSE PERIOD **1** to range 1u – .1m and repeat steps 2 to 4.		
6	Switch PULSE WIDTH **10** to SQUARE WAVE and repeat steps 2 to 5.		

Table 4–20. Performance Test: Amplitude.

TEST SET–UP

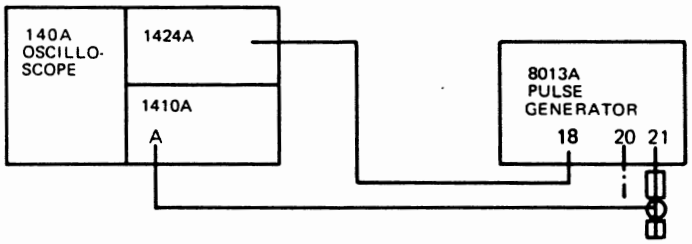


STEP	INSTRUCTIONS		RESULTS
1	Set the 8013A controls as follows:		
	PULSE PERIOD **1**	20n – 1u	
	VERNIER **2**	CW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	Mid-range	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Check the amplitude for both VERNIER **8** and **9** extremities of each setting of the AMPLITUDE selector **3** and **4** as follows:		

AMPLITUDE **3 (4)**	VERNIER **8 (9)**	
5.0 – 2.0	CW	>5.0
5.0 – 2.0	CCW	<2.0
2.5 – 1.0	CW	>2.5
2.5 – 1.0	CCW	<1.0
1.0 – 0.4	CW	>1.0
1.0 – 0.4	CCW	<0.4
0.5 – 0.2	CW	>0.5
0.5 – 0.2	CCW	<0.2

Table 4–21. Performance Test: DC Offset.

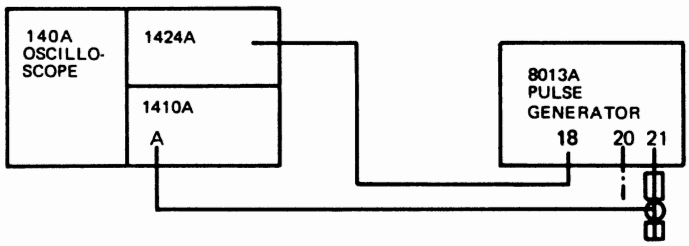
TEST SET–UP



STEP	INSTRUCTIONS		RESULTS
1	Set the 8012A controls as follows:		
	PULSE PERIOD **1**	20n – 1u	
	VERNIER **2**	CCW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	CCW	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSET **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM	
2	Set the output pulse baseline to the center of the oscilloscope display.		
3	Set OFFSET **14** to ON.		
4	Turn VERNIER **15** fully CCW		
5	Measure negative offset:		>–5V
6	Turn VERNIER **15** fully CW.		
7	Measure positive offset:		> +1V
8	Turn OFFSET **14** to OFF.		
9	Output pulse baseline should be at center of oscilloscope display.		
10	Repeat steps 2 to 9 for OFFSET **13** and VERNIER **12** but with the following limits:		
	VERNIER **12** fully CCW		>–1V
	VERNIER **12** fully CW		>+5V

Table 4–22. Performance Test: Baseline Position.

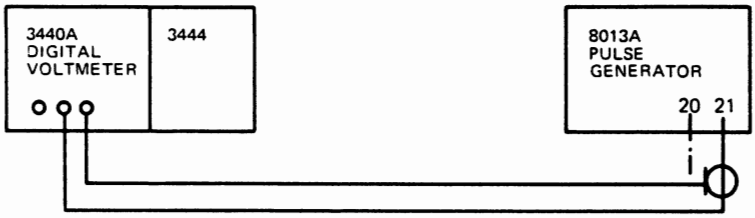
TEST SET–UP



STEP	INSTRUCTIONS	RESULTS
1	Set the 8012A controls as follows:	
	PULSE PERIOD **1** — 20n – 1u	
	VERNIER **2** — CW	
	PULSE DELAY **6** — 35n – 1u	
	VERNIER **7** — CW	
	PULSE WIDTH **10** — 10n – 1u	
	VERNIER **11** — Adjust for a duty cycle of 50%.	
	AMPLITUDE **3** — 5.0 – 2.0	
	VERNIER **8** — CW	
	AMPLITUDE **4** — 5.0 – 2.0	
	VERNIER **9** — CW	
	OFFSET **13** — OFF	
	OFFSET **14** — OFF	
	Mode selector **22** — NORM.	
2		
3	Disconnect 8012A from oscilloscope	
4	Center the oscilloscope display trace.	
5	Reconnect 8013A to oscilloscope.	
6	Check that output pulse baseline is in center of display.	

Table 4–23. Performance Test: Output Impedance.

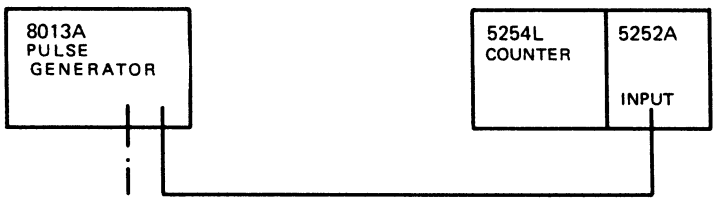
TEST SET–UP



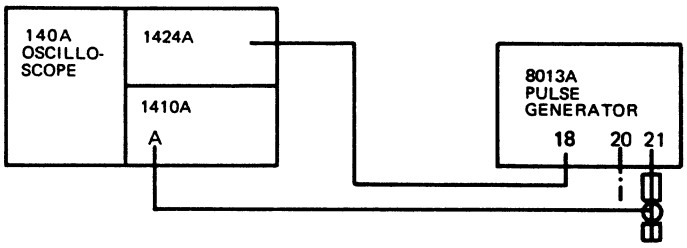
STEP	INSTRUCTIONS		RESULTS
1	Set the 8013A controls as follows:		
	LINE **15**	OFF	
	PULSE PERIOD **1**	20n – 1u	
	VERNIER **2**	CW	
	PULSE DELAY **6**	35n – 1u	
	VERNIER **7**	CCW	
	PULSE WIDTH **10**	10n – 1u	
	VERNIER **11**	SQUARE WAVE	
	AMPLITUDE **3**	5.0 – 2.0	
	VERNIER **8**	CW	
	AMPLITUDE **4**	5.0 – 2.0	
	VERNIER **9**	CW	
	OFFSETT **13**	OFF	
	OFFSET **14**	OFF	
	Mode selector **22**	NORM.	
2	Turn amplitude VERNIER 9 from fully CW to fully CCW and check resistance:		50 Ω ± 4 Ω

Table 4–24. Initial Settings of 8013A for Internal Checks and Adjustments: Assembly 1.

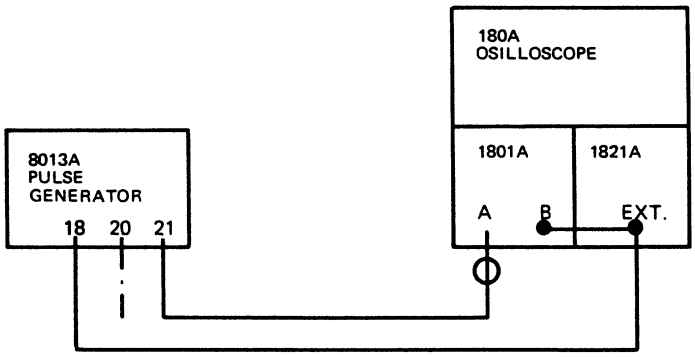
TEST SET–UP 1



TEST SET–UP 2



TEST SET–UP 3



Set the 8013A controls as follows:

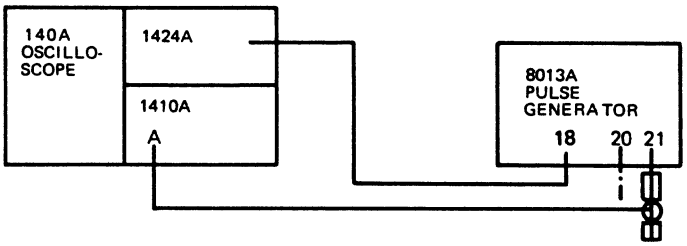
PULSE PERIOD **1**	20n – 1u
VERNIER **2**	CW
PULSE DELAY **6**	35n – 1u
VERNIER **7**	CCW
PULSE WIDTH **10**	10n – 1u
VERNIER **11**	CW
AMPLITUDE **3**	5.0 – 2.0
VERNIER **8**	CW
AMPLITUDE **4**	5.0 – 2.0
VERNIER **9**	CW
OFFSET **13**	OFF
OFFSET **14**	OFF
Mode selector **22**	NORM

Table 4–25. Internal Checks and Adjustments: Assembly 1
Refer to Table 4–24 for the test set–up and initial settings.

Step	INSTRUCTIONS	ADJUST	RESULT
	Pulse Period		
1	Connect equipment as shown in TEST SET–UP 1		
2	Turn VERNIER 2 fully CCW		
3	Measure the pulse period:	A1C24	51 MHz.
	Pulse Width		
4	Connect equipment as shown in TEST SET–UP 2.		
5	Turn VERNIER 11 fully CCW		
6	Measure the pulse width:	A1C45	9nS
	Pulse Delay		
7	Connect equipment as shown in TEST SET–UP 3 and reset the controls as follows: PULSE PERIOD 1 — 1u – 0.1m VERNIER 2 — CW VERNIER 7 — CW VERNIER 11 — CW		
8	Measure the delay between the trigger pulse and the output pulse:	A1C35	< 35nS

Table 4–26. Internal Checks and Adjustments: Assembly 2

TEST SET–UP



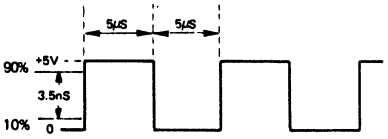
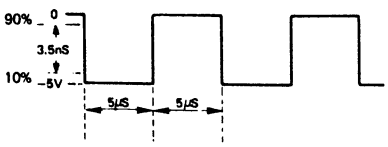
STEP	INSTRUCTIONS		ADJUST	RESULT
1	Set the 8013 controls as follows:			
	PULSE PERIOD **1**	10n – 1u		
	VERNIER **2**	CCW		
	PULSE DELAY **6**	35n – 1u		
	VERNIER **7**	CCW		
	PULSE WIDTH **10**	SQUARE WAVE		
	VERNIER **11**			
	AMPLITUDE **3**	5.0 – 2.0		
	VERNIER **8**	CW		
	AMPLITUDE **4**	5.0 – 2.0		
	VERNIER **9**	CW		
	OFFSET **13**	OFF		
	OFFSET **14**	OFF		
	Mode selector **22**	NORM.		
	Pulse shape: OUTPUT (+)			
2	Observe the pulse for correct shape while turning VERNIER **9** from fully CW to fully CCW		A2C5 A2R19	
	Pulse shape: OUTPUT (–)			
3	Observe the pulse for correct shape while turning VERNIER **8** from fully CW to fully CCW		A2C16 A2R50	

Table 4–27. Internal Checks and Adjustments: Assembly 3

STEP	INSTRUCTIONS		ADJUST	RESULT
1	Set the 8013A controls as follows:			
	PULSE PERIOD **1**	EXT+		
	VERNIER **2**	CW		
	PULSE DELAY **6**	1u – 0.1m		
	VERNIER **7**	CCW		
	PULSE WIDTH **10**	1u – 0.1m		
	VERNIER **11**	CCW		
	AMPLITUDE **3**	5.0 – 2.0		
	VERNIER **8**	CW		
	AMPLITUDE **4**	5.0 – 2.0		
	VERNIER **9**	CW		
	OFFSET **13**	ON		
	VERNIER **12**	Mid–range		
	OFFSET **14**	ON		
	VERNIER **15**	Mid-range		
	Mode selector **22**	NORM.		
	Voltages are measured with respect to chassis.			
2	Connect the digital voltmeter to TP1 on board A3.		A3R15	+17V ± 100mV
3	Connect the ac voltmeter to TP1 on board A3 and observe the ripple.			2mV rms
4	Connect the digital voltmeter to TP 2 on board A3.		A3R16	–17V ± 100mV
5	Connect the ac voltmeter to TP2 on board A3 and observe the ripple.			2mV rms