

INSTRUCTION MANUAL

Serial Number B01049

26G3
PULSE
GENERATOR



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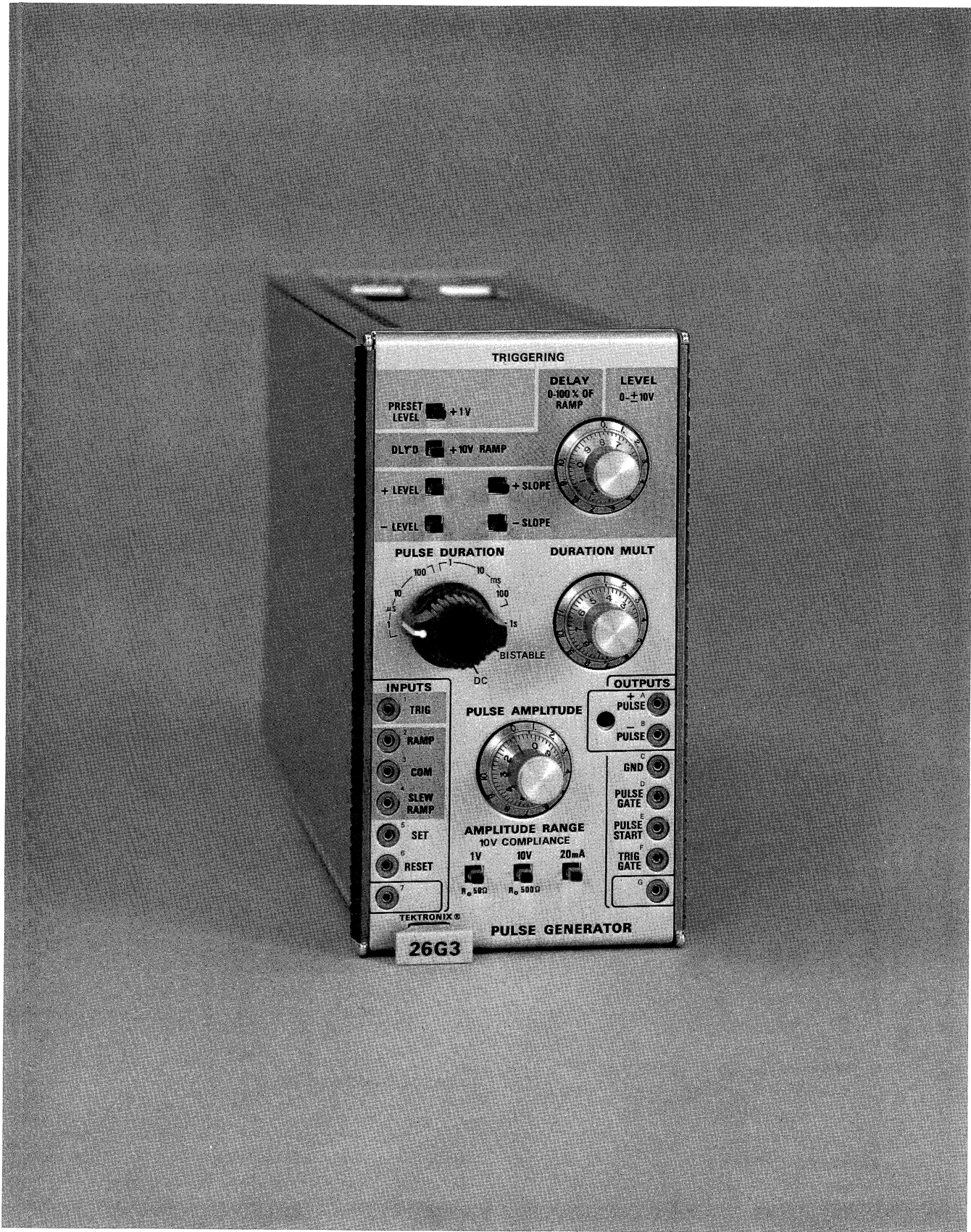


Fig. 1-1. 26G3 Pulse Generator.

SECTION 1

26G3 SPECIFICATION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

The 26G3 is a pulse generator plug-in unit designed for use with 2600-Series Power Supply and Interconnection systems.

The output is a precise rectangular pulse. The pulse duration is set by two calibrated front-panel controls (PULSE DURATION and DURATION MULTIPLIER). The pulse amplitude is selected by calibrated front-panel controls (AMPLITUDE RANGE and PULSE AMPLITUDE). The

Generator has precisely controlled voltage level selection of the trigger point, and when a ramp is used as a trigger source, the 26G3 can pick off a voltage proportional to time, thus providing calibrated time delay.

The 26G3 will perform to the specifications listed in this section within an ambient temperature range between 0°C and +50°C. No warmup time is required. The performance check instructions, Section 5, provide a convenient means of checking performance of the 26G3.

OUTPUTS

Characteristic	Performance Requirement	Supplemental Information
Pulse Duration Accuracy Pulse Duration Setting 1 μ s to 100 ms 1 s	Within 3% of indicated Within 5% of indicated	
Minimum Pulse Separation Pulse Duration Setting 1 μ s 10 μ s 100 μ s 1 ms 10 ms 100 ms 1 s	1 μ s, within 30%	1 μ s, within 30% 10 μ s, within 30% 100 μ s, within 30% 1 ms, within 30% 10 ms, within 30% 100 ms, within 30%
+Pulse (A) and -Pulse (B) Amplitude Accuracy	Within 1% of full scale for pulse amplitudes of 10% to 100% of full scale	

OUTPUTS (cont.)

Characteristic	Performance Requirement	Supplemental Information
Risetime, Falltime Range Voltage Compliance Baseline DC Level Source Impedance 1 V Range 10 V Range Delay after Trigger + and – Pulse Coincidence	200 ns or less for pulse amplitudes of 10% to 100% of full scale	0 V to + and –1 V 0 V to + and –10 V 0 mA to + and –20 mA At least + and –10 V 1 mV or less into 500 Ω or less 50 Ω, within 1.0% 500 Ω, within 1.0% 250 ns or less Within 50 ns or less
Pulse Gate (D) Amplitude Off State Source Impedance Coincidence with +Pulse Risetime, Falltime	+3 V, within 20%	0 V, within 100 mV 150 Ω, within 5% 100 ns or less 100 ns or less
Pulse Start (E) Amplitude Risetime Off State Source Impedance Delay after Trigger Crossing	+3 V, within 20%	100 ns or less 0 V, within 100 mV 150 Ω, within 5% 100 ns or less
Trigger Gate (F) Amplitude Off State Source Impedance Risetime, Falltime Delay after Trigger Crossing	+3 V, within 20%	0 V, within 100 mV 150 Ω, within 5% 100 ns or less 100 ns or less

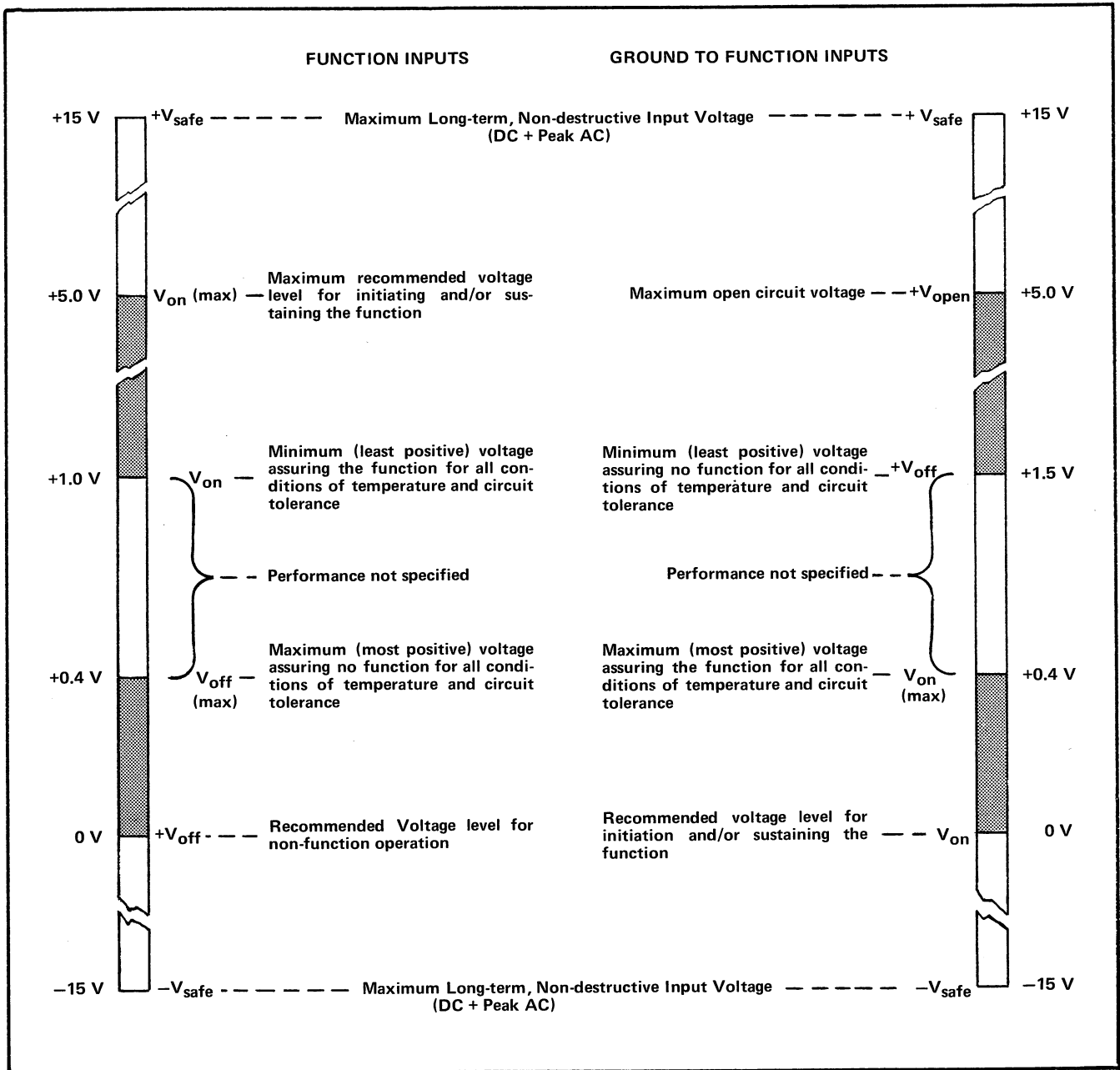


Fig. 1-2. Input Function Levels.

INPUTS

Characteristic	Performance Requirement	Supplemental Information
Triggering (1)		
Preset Level		
Triggering Amplitude V_{on}^1	At least +1 V	
Non-Function Level V_{off}^1		+0.4 V or less
Maximum Safe Input		30 V (DC + Peak AC)

¹See Fig. 1-2 for Input Ranges.

INPUTS (cont.)

Characteristic	Performance Requirement	Supplemental Information
Minimum On Time Input Resistance		100 ns 20 k Ω , within 10% for input signals 10 V or less
+Level Accuracy Range Hysteresis Maximum Safe Input Minimum On Time Maximum Input Current	Within 100 mV for +Slope (1% of full scale) Within 150 mV for –Slope (1.5% of full scale)	0 V to +10 V 70 mV or less (50 mV typical) 30 V (DC + Peak AC) 100 ns 1 mA at +10 V input
–Level Accuracy Range Hysteresis Maximum Safe Input Minimum On Time Maximum Input Current	Within 150 mV for +Slope (1.5% of full scale) Within 200 mV for –Slope (2% of full scale)	0 to –10 V 70 mV or less (50 mV typical) 30 V (DC + Peak AC) 100 ns 1 mA at –10 V Input
Ramp (2) or Slew Ramp (4) Delayed Mode Range Accuracy Hysteresis Maximum Safe Input Maximum Input Current		0 to 100% Within 1% of total amplitude for 10.00 volt ramp input 70 mV or less (50 mV typical) 30 V (DC + Peak AC) 1 mA at +10 V Input
Set (5) Function Amplitude V_{On}^1 Non-Function Level V_{Off}^1 Input Resistance Maximum Safe Input	+1 V, minimum	+0.4 V or less 5 k Ω ; –10%, +110% 15 V (DC + Peak AC)

INPUTS (cont.)

Characteristic	Performance Requirement	Supplemental Information
Reset (6) Function Amplitude V_{on}^1 Non-Function Level V_{off}^1 Input Resistance Maximum Safe Input	+1 V, minimum	+0.4 V or less 5 k Ω ; -10%, +110% 15 V (DC + Peak AC)

Accessories

An illustrated list of Standard and Optional accessories for the 26G3 will be found at the end of the Mechanical Parts List pullout pages.

NOTE

The pins, jacks and cables supplied to interconnect 2600-System modules are based upon a standard 40-mil (0.040 inch or ≈ 1 mm) pin diameter. These items are manufactured by Cambion (Cambridge Thermionic Corp.) and others. Allied Radio Shack catalogs the basic elements of this 40-mil system.

SECTION 2

OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

The 26G3 Pulse Generator unit is one of a series of plug-in modules and mainframes in the 2600 system. The 26G3 and other units in the series may also be plugged into 7000-Series Oscilloscopes, using an adapter.

To use the 26G3 effectively, the operation and capabilities should be understood. This section describes the functions and features of the controls and connectors.

The 26G3 is designed to be operated in any one of the plug-in compartments in the 2600-Series mainframes. To install the 26G3 into the mainframe, align the bottom groove of the 26G3 with the plastic guide bar in the mainframe. Push the 26G3 into the opening until the front panel is flush with the mainframe. To remove the 26G3, pull the release latch to disengage the unit from the mainframe connector. Continue to pull the release latch to remove the unit from the mainframe.

CONTROLS

A description of the function and operation of controls and connectors follows.

The switches used for selecting the various functions are miniature illuminated pushbuttons. The buttons in each column are mechanically interlocked so that only one button at a time may be depressed. Each button is illuminated from behind when the button is pushed in.

Triggering Mode Selection (Pushbutton switch)

PRESET LEVEL, +1 V—Selects preset triggering level and polarity. A positive-going trigger signal of at least +1 volt initiates a pulse generation cycle.

DLY'D, +10 V RAMP—Selects delayed trigger mode. Triggering occurs and a pulse generation cycle is initiated when a positive-going +10-volt ramp passes the percent of ramp amplitude set by the DELAY control.

DELAY, 0-100% of RAMP—Provides continuously calibrated selection of triggering level (or time) from a +10-volt ramp.

+LEVEL—Selects variable level triggering. Triggering occurs and a pulse generation cycle is initiated as a positive-level trigger passes the level selected by the LEVEL control.

–LEVEL—Selects variable level triggering. Triggering occurs and a pulse generation cycle is initiated as a negative-level trigger passes the level selected by the LEVEL control.

+SLOPE—Permits triggering on the positive-going slope of either a positive- or negative-level trigger.

–SLOPE—Permits triggering on the negative-going slope of either a positive- or negative-level trigger.

LEVEL—Provides continuously calibrated trigger level selection (trigger polarity selected by the +LEVEL and –LEVEL buttons).

PULSE DURATION—Selects (1) Calibrated pulse duration, (2) Bistable Mode, or (3) DC Mode. The calibrated position provide pulse durations from 1 μ s to 1 s in decade steps. BISTABLE provides a mode in which each succeeding trigger reverses the output state (output switches to high state on one trigger and switches to the low state on the following trigger). The DC mode provides a calibrated DC output level determined by the PULSE AMPLITUDE and AMPLITUDE RANGE settings.

DURATION MULTIPLIER—Provides continuously calibrated pulse durations from 1.00 to 11.00 times the PULSE DURATION switch setting.

AMPLITUDE RANGE—Selects the maximum range of pulse amplitude: 1 V, 10 V, or 20 mA. If a maximum voltage other than 1 V or 10 V is desired, a resistance from +PULSE or –PULSE to ground will set the output when using the 20 mA setting. The output voltage is, however, limited to 10 volts. The auxiliary resistance may be added internally, if desired, on the component side of the Amplitude Range switch (+Pulse on the edge nearest the multi-pin connector and –Pulse on the opposite edge).

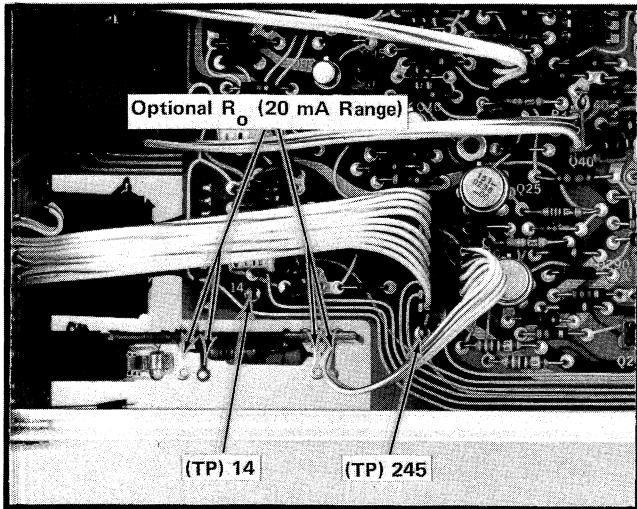


Fig. 2-1. Location of TP14 and TP245.

PULSE AMPLITUDE—Provides continuously calibrated output pulses within the amplitude range selected. The control is calibrated from 0.00 to 10.00.

PULSE OUTPUT INDICATOR LAMP—Lamp ON indicates that a pulse is in progress, or has just occurred.

OUTPUTS

+PULSE (A)—Provides positive output pulses or DC level as selected by DURATION and AMPLITUDE controls.

−PULSE (B)—Provides negative output pulses or DC level as selected by DURATION and AMPLITUDE controls.

GND (C)—Provides a reference ground for the output signals.

PULSE GATE (D)—Provides a +3-volt Gate Out, coincident with the pulse at +PULSE and −PULSE OUTPUT.

PULSE START (E)—Provides a +3-volt trigger coincident with the leading edge of +PULSE and −PULSE OUTPUT.

TRIG GATE (F)—Provides an output level which is at its low state before triggering level is reached, and at its high state after triggering level is passed.

Spare (G)—Spare connector is bused through to the rear connector (A8) and appears also at a test point, TP245 (see Fig. 2-1).

INPUTS

TRIGGER (1)—Triggering input for PRESET LEVEL, +LEVEL, or −LEVEL.

RAMP (2)—Ramp input for DLY'D triggering mode. Ramp level is compared to a continuously calibrated voltage to initiate trigger.

COM (3)—Reference ground for RAMP and SLEW RAMP INPUTS.

SLEW RAMP (4)—Ramp input for DLY'D triggering mode. Ramp level algebraically sums with level at RAMP (2).

SET (5)—A signal of +1 volt or greater sets OUTPUT Pulse to its high state regardless of the state(s) of other inputs, except RESET INPUT.

RESET (6)—A signal of +1 volt or greater resets the OUTPUT Pulse to its low state regardless of the state(s) of other inputs. RESET INPUT overrides the SET INPUT.

Spare (7)—Spare connector is bused through to the rear connector (A2) and appears at a test point, TP14 (see Fig. 2-1).

SECTION 3 CIRCUIT DESCRIPTION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This section of the manual contains an electrical description of the circuits in the 26G3.

Each circuit is described in detail using block diagrams where applicable to show interconnections between major circuits, and to show the relationships of front panel controls to the major circuits.

It is suggested that the schematic diagrams provided at the rear of this manual be referred to while studying this circuit description.

The Pulse Generator consists of voltage comparator and reference, switching, and timing circuits. These circuits provide the logic necessary for starting and stopping the timing, trigger polarity selection, input level comparison to a precise reference voltage level, and pulse output amplifier (See Fig. 3-1).

Input Comparator

The Input comparator, consisting of Q25 and U40, is a switching circuit using positive feedback to provide rapid switching within a narrow hysteresis range. Fig. 3-2 shows the basic feedback switching configuration.

Assuming that the input level is slightly below ground level and the output of the comparator (point A) at +3 volts, the level at point B will be at approximately 0 V, established by the divider, R6-R7-R27. With 0 V at point B and the input slightly negative, the output will be held at +3 volts out. Now, if the level at the input rises to a point more positive than point B, the output level starts to fall, causing point B to fall. Since the voltage at point B becomes even more negative with respect to the input level, a rapid switch follows. The output drops to zero volts, point B drops to -25 mV and a stable state is reached.

If the input voltage drops to a level slightly more negative than point B, the output will start to rise, pulling point

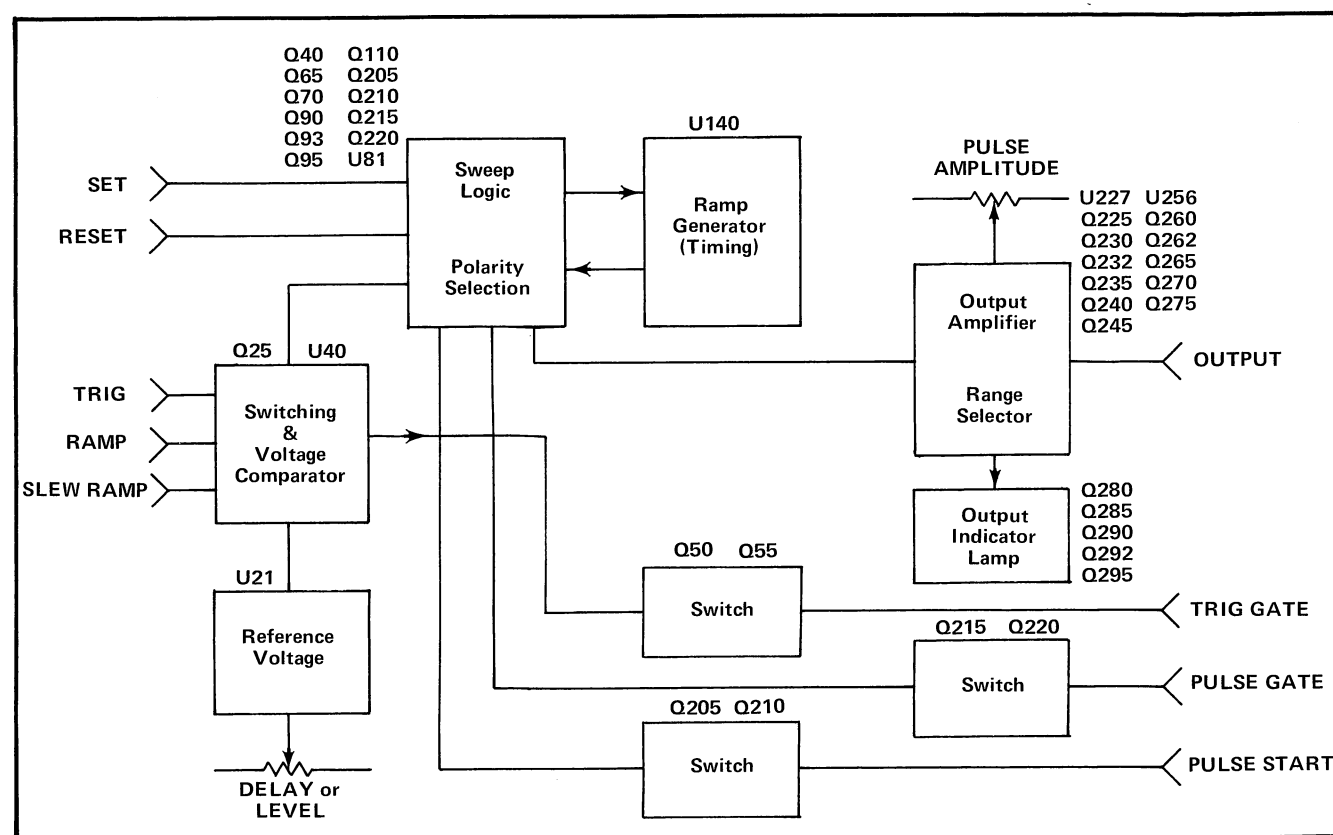


Fig. 3-1. Block diagram of the 26G3.

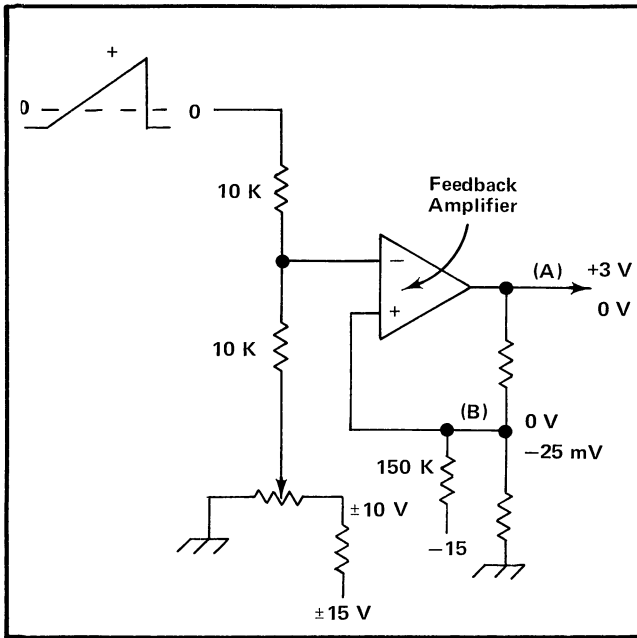


Fig. 3-2. Basic switching configuration.

B up, reinforcing the switching action and the second stable state is reached.

The difference in input level necessary to cause the switching action is approximately 25 mV at comparator input except in the preset condition of Trigger Selector Switch S1. In preset the hysteresis range is approximately 100 mV.

To provide a calibrated time delay, a linear ramp of known time duration may be fed into the Ramp Input. This linear ramp is compared to a calibrated DC potential of either polarity (depending on the position of +LEVEL, -LEVEL pushbuttons).

Assume that the +LEVEL button is pushed in and the DELAY OR LEVEL control is at 5.00 (midrange). With the +LEVEL button pushed, -15 volts is applied to the DELAY OR LEVEL voltage setting resistors. The arm of R13, being set at 5.00, will apply -5 volts to the +Input of U21. Since U21 is a voltage follower type of feedback amplifier, the output of U21 will also be -5 volts.

Fig. 3-3 shows the basic circuitry and conditions for setting the delay.

With the ramp level at zero volts, the level at point A is -2.5 volts, the output is up (+3 volts), and the level at point B is 0 volt.

As the input rises the level at point A comes closer to the level at point B.

When the input ramp reaches +5 volts, the level at point A reaches zero.

As the input rise continues, point A becomes more positive than point B and the circuit switches to the other stable state. The output, point C, falls to zero, causing point B to fall to -25 mV.

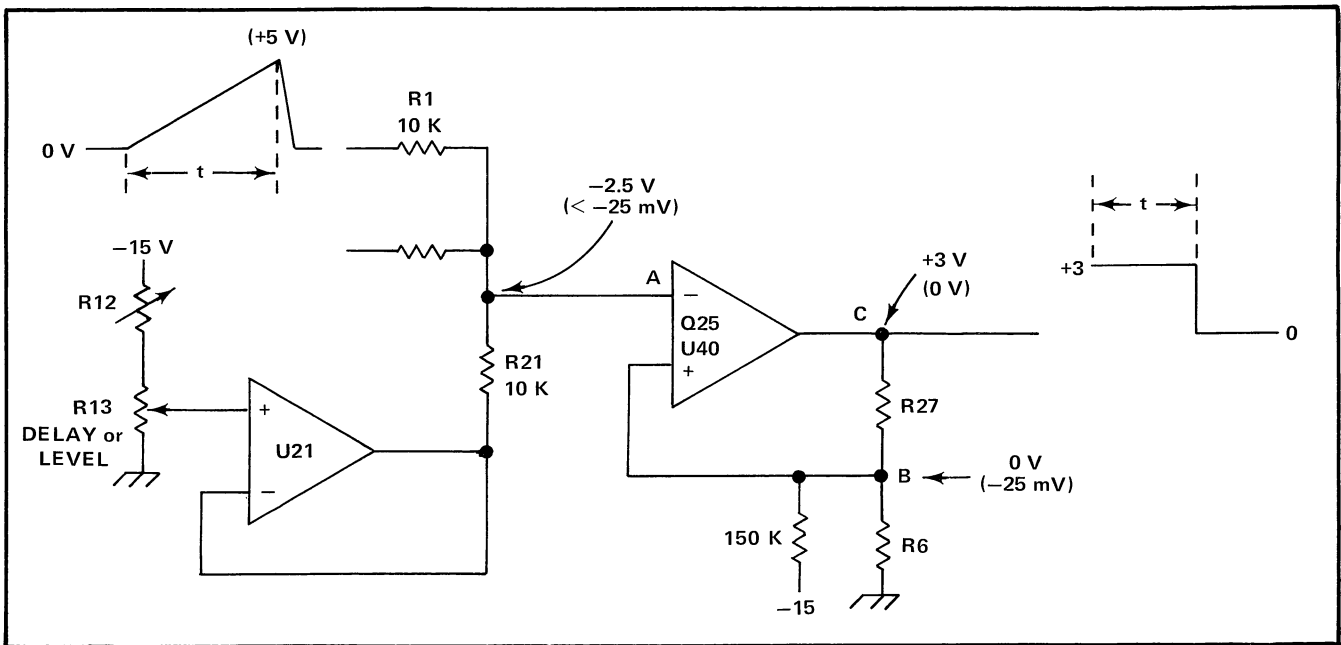


Fig. 3-3. Basic circuit for setting delay.

The voltage at the top of R13, DELAY OR LEVEL, (see schematic diagram) is set by R12 (Delay or Level Cal) to cause the switching to occur at the voltage setting of R13.

When the input voltage goes negative it must reach a level which makes point A more negative than point B (which is now -25 mV) to cause the circuit to switch to its former stable state. The hysteresis at point A is, therefore, 25 mV.

Due to the divider, R1-R21, the hysteresis at the input is twice that at point A, or 50 mV.

In PRESET (Trigger Selector Switch), the hysteresis is widened to about 200 mV at TRIGGER INPUT by substituting R10-R11 for R6. In addition, the bottom of R21 is set at zero volts by switching the top of R12 to ground. The circuit will now give a trigger pulse to U81 when the input rises above approximately 0.8 volt, and will switch back when the level drops below approximately 0.6 volt.

U21, an integrated operational amplifier circuit, used as a voltage follower, provides isolation between the variable voltage source and the comparator input.

The DELAY OR LEVEL control provides calibrated voltage to the comparator, giving precise time increments when setting delay; or, it serves as a level control to set the point on the incoming signal at which a trigger will be produced.

Diodes CR19, CR20, CR34, and CR35 provide overdrive protection for Q25 and U40. L25 prevents oscillation in Q25 and VR30-VR35 provide operating voltages for U40.

Q40 serves as isolation between trigger input to U81 and the feedback amplifier. Q40 also serves as a pickoff point for the comparator output circuit.

Trigger and Gating Logic

Integrated circuit U81, with its associated discrete circuitry, supplies the necessary logic for starting and stopping the timing, externally setting and resetting, trigger inhibiting, trigger slope selection, and operating mode selection (times, DC or bistable).

Table 3-1 lists each terminal of U81 and discusses its function. All terminals are digital unless otherwise noted, and positive logic is employed.

TABLE 3-1
U81 Input-Output

Terminal	Function
1, End Swp	Current (logic 1) for at least 20 ns ends timing regardless of time remaining in a timing cycle.
2, Set (free run)	Logic 1 on pin 2 causes the circuit to free run (generate pulses at the output with appropriate holdoff between pulses).
3, 8	Chassis ground.
4, Trigger Input	Analog Input, low impedance. Accepts current trigger signal. Trigger threshold, ± 100 μ A.
5, Slope Select	Logic 1 permits trigger to be initiated on the positive slope of a trigger signal. Logic 0 permits trigger to be initiated on the negative slope of a trigger signal.
6, Not used	Held at logic 1.
7, Not used	Held at logic 0.
8, 3	Chassis ground.
9, Not used	Held at logic 0.
10, Not used	Held at logic 0.
11, Holdoff Timing	Connects timing components which set trigger lockout period after end of each pulse out. Holdoff capacitor discharges when output pulse starts and holdoff timing starts when output pulse ends (holdoff capacitor charges).
12, Trig Out	Provides a negative going signal to Q110 for each trigger in at pin 4 (regardless of the slope of the incoming trigger) but dependent on the level on pin 13 (trigger inhibit).
13, Trig In	Trigger inhibit provides the necessary logic to prevent a trigger out signal at pin 12 when level at pin 15 is high (pin 14 low).

TABLE 3-1 (cont.)

Terminal	Function
14, +Gate Out	Provides the signal (logic 1) to start the timing action of U140. Also provides signal to the Output Amplifier.
15, -Gate Out	Provides signal to pin 13, Trig Inh to prevent signal output on pin 12, Trig Out, when pin 14, +Gate is low.
16, Power Supply	+5 volts, DC.

Timed Operation (1 μ s to 1 s)

In timed operation, the Pulse Duration is a function of the timing components switched in between pins 8 and 9 of U140. Table 3-2 lists each terminal of U140 and describes its function.

TABLE 3-2
U140 Miller Integrator

Terminal	Function
1, Swp Gate	Positive signal (logic 1) on pin 1 initiates a linear ramp output between pins 8 and 9.
2, Comp	Connects discrete components to prevent oscillation of the feedback amplifier.
3, Gnd	Reference Ground.
4, Dly Trig	Provides logic 1 to pin 1 of U81 to end the pulse and start the holdoff cycle.
5, Dly Trig Enable	Allows passage of delayed trig from internal comparator to pin 4.
6, Dly Control	Connects external voltage divider to a reference comparator inside U140 establishing the level at which the ramp at pin 8 is terminated.
7, +V _{CC}	+15 volt supply connection.
8, Ramp Out	Produces positive going linear ramp when current is gated into pin 1. Integrator Output.

TABLE 3-2 (cont.)

Terminal	Function
9, -In	Connects timing components which determine ramp rate. Integrator negative input.
10, I _{CC}	- \cong 13 mA from R117.

When pin 14, U81 steps positive, the current into pin 1, U140 opens a switch between pins 8 and 9. Pin 8 is the output of a feedback amplifier in which the timing capacitor is the feedback element. The result is a linear ramp having a rate of rise which is a function of C_t and R_t.

When the voltage at pin 8 reaches the level set on pin 6 (Dly Control), a comparator in U140 provides a positive-going signal at pin 4 (Dly Trig), through R114 to pin 1, to reset U81. The +Gate terminal steps negative (ending the output pulse), gates the ramp off, and starts the holdoff timing.

When the output pulse ends, the holdoff capacitor C_h starts to charge. While the holdoff capacitor is charging, any incoming trigger will be locked out.

The DURATION MULTiplier control is a continuously variable voltage source used to fine-adjust the DC level to the voltage comparator (pin 6) in U140. This variable voltage provides continuously variable timing from 1.00 to 11.00 times the time set on the PULSE DURATION switch. Cal X1 and Cal X11 calibrate the DURATION MULTiplier.

The 1 μ s Cal compensates for propagation delays in U81 and U140 at 1 μ s by setting the voltage at the bottom of the DURATION MULTiplier a bit more negative in the 1 μ s position only. The switch, 1 μ s Only, is closed only in the 1 μ s position of the PULSE DURATION switch. See cam number 6 (1 μ s Width Compensation), Diagram 4.

DC Operation

When the PULSE DURATION switch is in the DC position, a logic 1 is placed on pin 2, U81, thus setting U81. At the same time, cam 12 on the PULSE DURATION switch closes and shunts the timing components associated with U140, so that the integrator output never rises to the point at which it will provide a reset trigger to U81. Q95 is turned on to inhibit external reset signals.

The output in the DC mode is simply a DC level which is made variable by the level control (PULSE AMPLITUDE) in the Output Amplifier.

Bistable Operation

The operation of U81 and associated discrete components has two stable states when the PULSE DURATION switch is in the BISTABLE position.

A negative going signal is seen at pin 12, U81 for each incoming trigger, regardless of the slope of the trigger being detected, provided pin 13 is low.

Assuming that the output pulse level is in the low state, +Gate, pin 14 low, the -Gate, pin 15 will be high. This high state on -Gate, coupled to Trig Inh (pin 13) will prevent any trigger signal from appearing on pin 12.

When a trigger arrives at pin 4, the level at pin 14 (+Gate), steps positive, causing the output to rise to the high state. Immediately following, pin 15 (-Gate) steps negative, thereby enabling pin 12 output for the next trigger. As the next trigger arrives at pin 4, a negative step is seen at pin 12. This negative step discharges C105, cutting off Q110, causing a positive step on pin 1 (End Sweep), terminating the output pulse.

As the output pulse terminates (pin 14 low) U81 is again reset, ready to accept another trigger.

The result is that one trigger causes the output to step up, and the following trigger causes the output to step back down (two stable states).

SET and RESET Inputs

If a positive pulse is applied to the SET input, U81 output (pin 14) goes to its high state. If the SET Input is held positive, U81 free runs.

If a positive pulse is applied to the RESET Input, U81 Output (pin 14) goes to its low state. If pin 14 is high and a positive pulse is applied to the RESET Input while a timing ramp is running, the timing ramp terminates and U81 falls to the low state.

PULSE START Output

The positive going pulse from the timing circuit is coupled across C200, turning off Q205. Q205 turn-off turns on Q210, causing 20 mA to flow in R210, and producing a voltage step of +3 volts.

When the input step ends, Q205 base falls exponentially to the point at which Q210 turns off. Q210 current has

decreased exponentially, giving an output trigger signal which steps to +3 volts, then decays exponentially to zero volts.

PULSE GATE Output

The positive going pulse from the timing circuit is applied to Q215 base, cutting off Q215, turning on Q220, causing 20 mA to flow in R220, producing a +3 volt step out. When the level at Q215 base steps back to 0 volt, Q215 turns on, turning Q220 off, and interrupting the current in R220. The output voltage drops to zero.

TRIG GATE Output

The operation of the TRIG GATE circuit is identical to that of PULSE GATE. Only the time relations are different, due to the difference in pickoff point.

OUTPUT AMPLIFIER

The Output Amplifier provides simultaneous + and - pulse outputs and an output lamp to indicate that a pulse is being generated, as well as precise control of output amplitude.

OUTPUT Lamp

The Output Indicator lamp circuit provides switching logic to indicate that a pulse is in progress, or has just occurred.

The lamp circuit is a monostable multi having a minimum on time of 100 ms. It indicates for the shortest pulse duration. If the pulse duration is greater than 100 ms, the lamp indicates during, and 100 ms beyond, the end of the pulse.

A positive pulse from U81, pin 14, turns on Q280 and Q285, which holds the collector of Q285 negative, quickly discharging C285 (within 1 μ s). Q290 turns off, turning off Q292. Q295 turns on, providing operating current for lamp DS295.

When the pulse ends, Q280 turns off, turning Q285 off. C285 starts to charge toward +15 volts through R286, allowing Q290 Gate to rise. Q290 turns on, turning on Q292, turning Q295 off, extinguishing the lamp.

Pulse Amplitude

Pulse output amplitude is precisely set by setting the voltage across R260, thereby setting the current in the output stage.

Circuit Description—26G3

To isolate Q232 and Q260 from R227, the voltage setting control, two voltage follower feedback amplifiers, U227 and U256 are used.

The voltage between U227 and U256 can be adjusted to give 0 to +15 volts across R260. The current through R260 has a range of 0 to 20 mA, depending on the position of the PULSE AMPLITUDE control, R227.

The current set in R260 will pass through either Q230 or Q235, and either Q262 or Q265, depending on the condition of the signal from the timing circuit.

The base voltage on Q235 is fixed at +10 volts and on Q265 at -10 volts. When the base of Q230 goes negative and Q262 base goes positive, Q230 and Q262 turn off and whatever current is set in R260 will pass through Q235 and Q265 and be duplicated in the output.

The output amplifier configuration, Q240-Q245 and Q275-Q270, is a pair of current sources providing current out equal to current in. Each has a control (R243-R278) to compensate for base currents and minor differences in characteristics of the transistors.

The voltage out (+PULSE and -PULSE) is set by switching in the appropriate value of resistance between the collectors of Q245 and Q270. The 1 Volt Output gives a zero to 1 volt output range (0 to 20 mA in 50 ohms) and the 10 Volt Output gives a zero to 10 volt range (0 to 20 mA in 500 ohms).

In the 20 mA switch position (20 mA button pushed) the voltage out will depend on the value of resistance connected between +PULSE and -PULSE (output limited to 10 volts).

LOW VOLTAGE POWER SUPPLY

General

The regulated DC is supplied in two stages, (1) pre-regulation of the power transformer primary in the main-frame and (2) regulation in the 26G3 of the three individual voltages supplied by the mainframe power supply (transformer secondary).

Each of the three mainframe supplies (-17 V, +7 V, and +17 V) is rectified and filtered in the mainframe and supplied to the 26G3 unit via the rear connector.

Regulation

The heart of each regulator is a μ A723C Integrated precision voltage regulator, containing a feedback amplifier, reference voltage, current limiter, and output emitter follower. Fig. 3-4 shows the equivalent circuit of the μ A723C.

R340 and R341 (with the temperature compensated Zener in the μ A723C) provide the reference voltage for the -15-volts supply. The -15-volt supply is the reference for the +5- and +15-volt supplies.

VR346 provides a negative operating voltage for the +5- and +15-volt supplies.

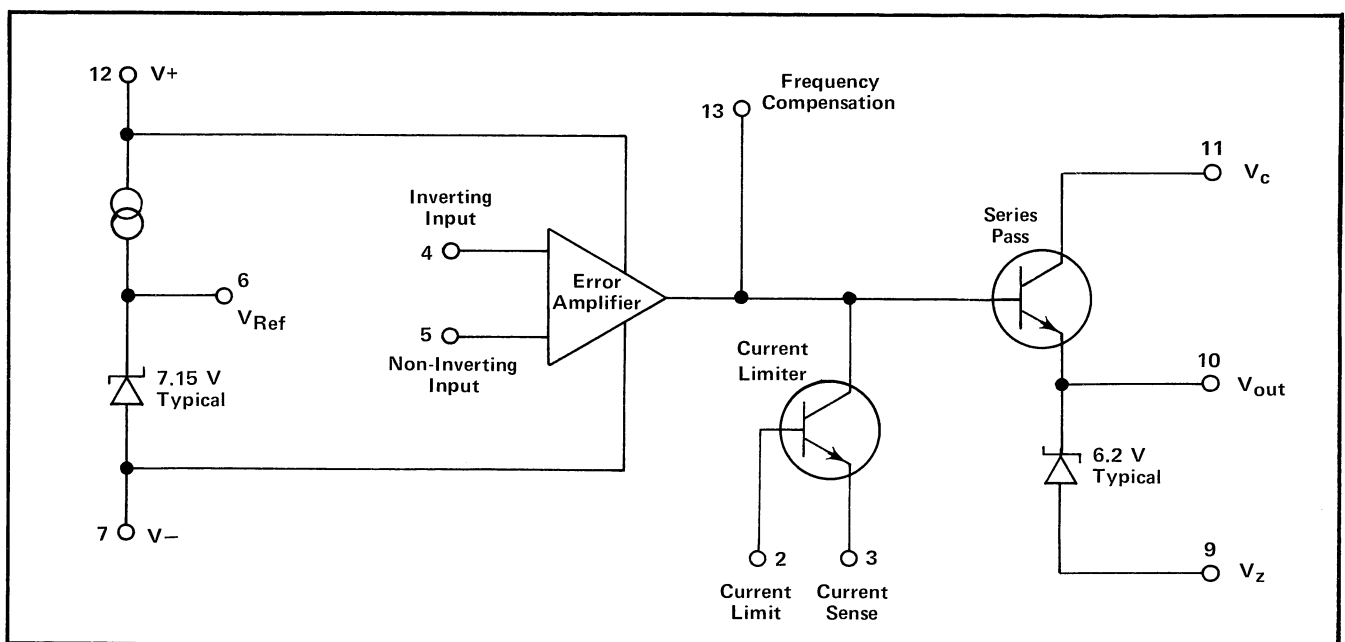


Fig. 3-4. Equivalent circuit of the μ A723C.

Q328, Q334, and Q346 are series pass transistors for the +15-, +5- and -15-volt supplies, respectively, and R324, R334, and R349 establish drive current levels for the μ A723C output transistors.

R326, R333, and R348 resolve series pass base current as a voltage which will limit current through the series pass transistors during turn-on charging of C328, C336, and C346.

Error voltage is fed back to the -Input from the dividers, R328-R329, R336-R338, and R344-R345-R346 (R345 being the -15-volt adjust).

C321, C331, and C343 prevent oscillations in the feedback loops.

Disable Lines

If the instrument is used in a 7000-Series oscilloscope, which provides the necessary regulated voltages, the -15 V, +5 V, and +15 V regulators are disabled. Plugging the 26G3 into the 7000-Series oscilloscope applies regulated voltage to both input and output of each regulator as well as +15 volts to each disable line. The voltage provided on the disable lines disables the regulators.

SECTION 4

MAINTENANCE

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

This section of the manual contains maintenance information for use in preventive or corrective maintenance and troubleshooting of the 26G3.

Cleaning

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone or similar solvents.

Semiconductor Checks

Periodic checks of the semiconductors in the 26G3 are not recommended. The best check of semiconductor performance is actual operation in the instrument.

Recalibration

A calibration check is recommended after each 1000 hours of operation, or every year if used infrequently. Replacement of components may necessitate recalibration of the affected circuits. Complete calibration instructions are given in the Performance Check/Adjustment section.

TROUBLESHOOTING

Troubleshooting Aids

Diagrams. Circuit diagrams are given on foldout pages in Section 7. The circuit number and electrical value of each component are given on the diagrams. Important voltages are also shown.

Circuit Boards. The circuit boards used in the 26G3 are outlined with a tint band on the Schematic Diagram, and a photograph of each board is shown to the left of the diagram. Each board-mounted electrical component is identified on the photograph by its circuit number.

Voltages and Waveforms. Often the defective components can be located by checking for the correct voltage or waveform in the circuit. Typical voltages are given on the Schematic diagrams. These voltages are not absolute, and

may vary slightly from instrument to instrument. To obtain operation conditions similar to those used to take the reading, see the instructions in the Schematic Diagrams section.

Power Supply Voltage and Ripple. Table 4-1 lists the voltage and ripple tolerance of the power supplies in the 26G3. If a power supply voltage and ripple are within the listed tolerance, the supply can be assumed to be working properly. If outside the tolerance, the supply may be misadjusted or operating incorrectly.

TABLE 4-1

Supply	Ripple	Voltage
-15	3 mV, p-p	-15 V, ± 40 mV
+5	2 mV, p-p	+5 V, ± 50 mV
+15	3 mV, p-p	+15 V, ± 150 mV

Troubleshooting Equipment

The following equipment is useful for troubleshooting the 26G3.

1. Semiconductor Tester. Some means of testing the transistors and diodes used in the instrument is helpful. Since most of the semiconductor devices are used in a digital function, probably the most convenient check is that of measuring the junction resistance. For more complete tests, the Tektronix Type 576 is recommended. The most convenient method of integrated circuit check is substitution.

2. DC Voltmeter and Ohmmeter. For most applications a 20,000 ohms/volt VOM can be used to check voltages and resistance, if allowance is made for the circuit loading when making voltage measurements at high impedance points.

3. Test Oscilloscope. A test oscilloscope is required to check circuit waveforms. An oscilloscope having a DC to 10 MHz frequency response and 1 mV/Div to 10 V/Div vertical deflection factor is suggested. A 10X probe should be used where circuit loading is critical.

REPLACEMENT PARTS

Standard Parts

All electrical and mechanical parts replacements for the 26G3 can be obtained through your local Tektronix Field Office or Representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before buying or ordering replacement parts, check the parts lists for value, tolerance, rating and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of the component may affect its performance in the instrument. All replacement parts should be direct replacements, unless it is known that a different component will not adversely affect the instrument performance.

CAUTION

Multi-layer circuit boards require extra care when replacing soldered components. Excess heat can cause the board laminations to separate and conductors to release. Many components have clinched leads which should be straightened before removal so as not to damage the plated through holes. Such damage may result in irreparable loss of connection to an inner layer conductor.

Special Parts

Some parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured for Tektronix, Inc. to our specifications. These special parts are indicated in the parts list by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., refer to the Parts Ordering Information and Special Notes and Symbols on the page immediately preceding the Electrical Parts List section. Include the following information:

1. Instrument Type (26G3)
2. Instrument Serial Number
3. A description of the part (if electrical, include the circuit number).
4. Tektronix Part Number

COMPONENT REPLACEMENT

General

The exploded view drawings associated with the Mechanical Parts Lists (Fig. 1, pullout page) may be helpful when disassembling or reassembling individual components or subassemblies.

Circuit Board Replacement

Most of the circuit boards in this instrument are easily removed for maintenance. However, some of the circuit boards are permanent parts of switch assemblies and are not intended for removal. For these boards, see the instructions given under Pushbutton Switch Assembly Replacement.

The following general instructions apply to the removable main board.

1. Disconnect all of the multiple-pin connectors.
2. Remove the four screws (at the rear of the instrument) that secure the plastic guide to the side rails.
3. Pull the circuit board straight out to the rear. The four plastic clips that position the board will slide out with the board.

To replace the board, proceed as follows:

1. Place two plastic clips as shown in Fig. 4-1.
2. Position the circuit board between the two clips.
3. Slide the circuit board toward the front of the instrument until the notch about half-way back on the board edge is about 1/2 inch from the rear of the cutout side panel. Place the clip on the board edge, slide the board and clip forward, guiding the clip into the channel.
4. Slide the circuit board forward until the board notch at the opposite side is in position to mount the plastic clip. Position the clip over the board notch and again push the assembly forward until the rear plastic guide seats against the ends of the side panels.
5. Replace the screws.
6. Reconnect the multiple-pin connectors.

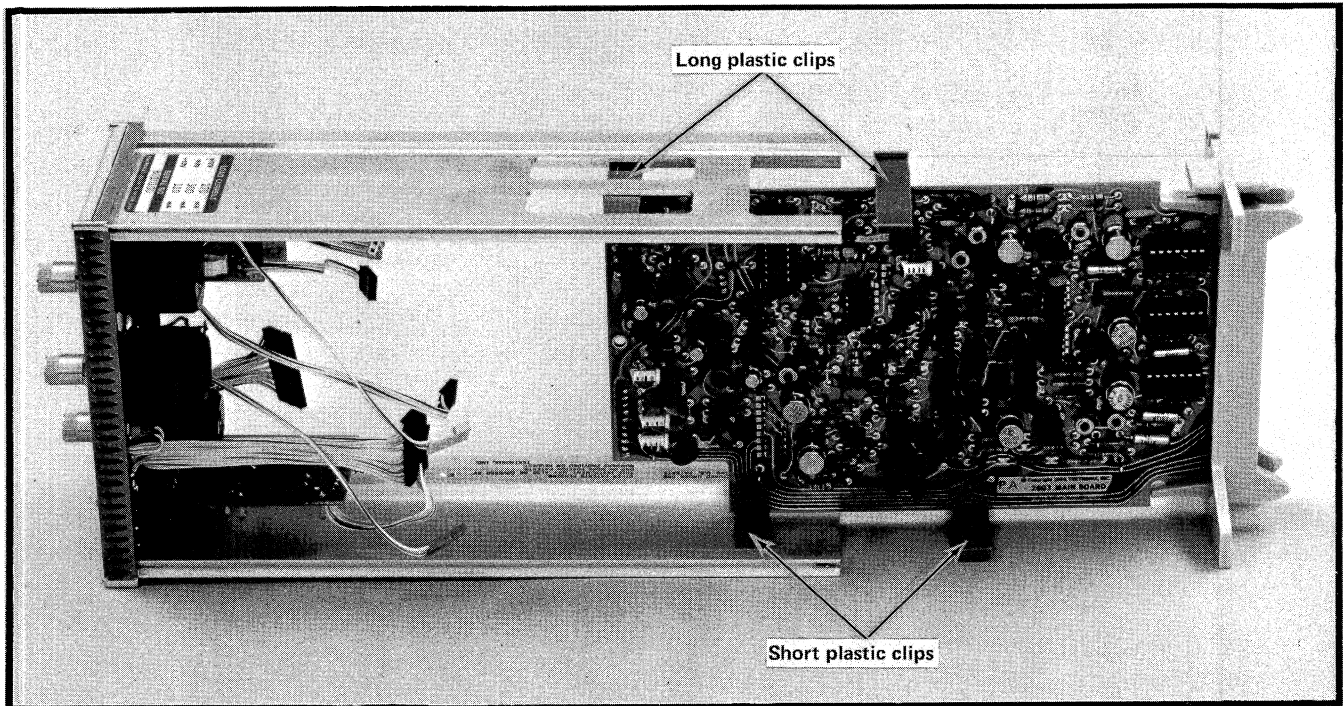


Fig. 4-1. Replacing the circuit board.

Semiconductor Replacement

Replacement semiconductors should be of the original type or a direct replacement. Fig. 4-2 shows the lead configuration of the semiconductors used in this instrument. Some plastic case transistors have lead configurations which do not agree with those shown here. If a replacement transistor is made by a manufacturer other than the original, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for the standard basing as used for metal-cased transistors.

An extracting tool should be used to remove the 14-pin integrated circuits to prevent damage to the pins. A removing tool is available from Tektronix, Inc., as Part Number 003-0619-00. If an extracting tool is not available for removal of integrated circuits, pull evenly on both ends of the device. Avoid having one end of the package disengage from the socket ahead of the other.

Lead-end Pin Connectors

The pin connectors are grouped together and mounted in a plastic holder to serve as a multi-pin connector. To provide correct orientation of this multi-pin connector, an arrow is stamped on the circuit board and a matching arrow is molded into the plastic connector body. Replace the connector with the arrows aligned. If individual lead-end pin connectors are removed from the plastic body, note the individual wire color.

Pushbuttons

The pushbutton switches are not repairable and should be replaced as a unit. The pushbutton-illuminating lamp is the only replaceable component on some of the pushbutton assembly circuit boards (see the information under Lamp replacement).

To remove the pushbutton switches, use the following procedure:

1. Remove the PULSE DURATION switch knob (front panel).
2. Insert a screwdriver blade between the bottom of the front-panel casting and the indentation at the bottom center of the front-panel overlay. Carefully twist the screwdriver to move the overlay away from the sub-panel. Remove the overlay.
3. Remove the two flat-head, No. 0, POZ-I-DRIV ^(R) screws and remove the switch from the rear.

To replace the switch, reverse the above procedure.

Lamp Replacement (Series 70 Switches)

The following procedure describes lamp replacement in the pushbutton assembly.

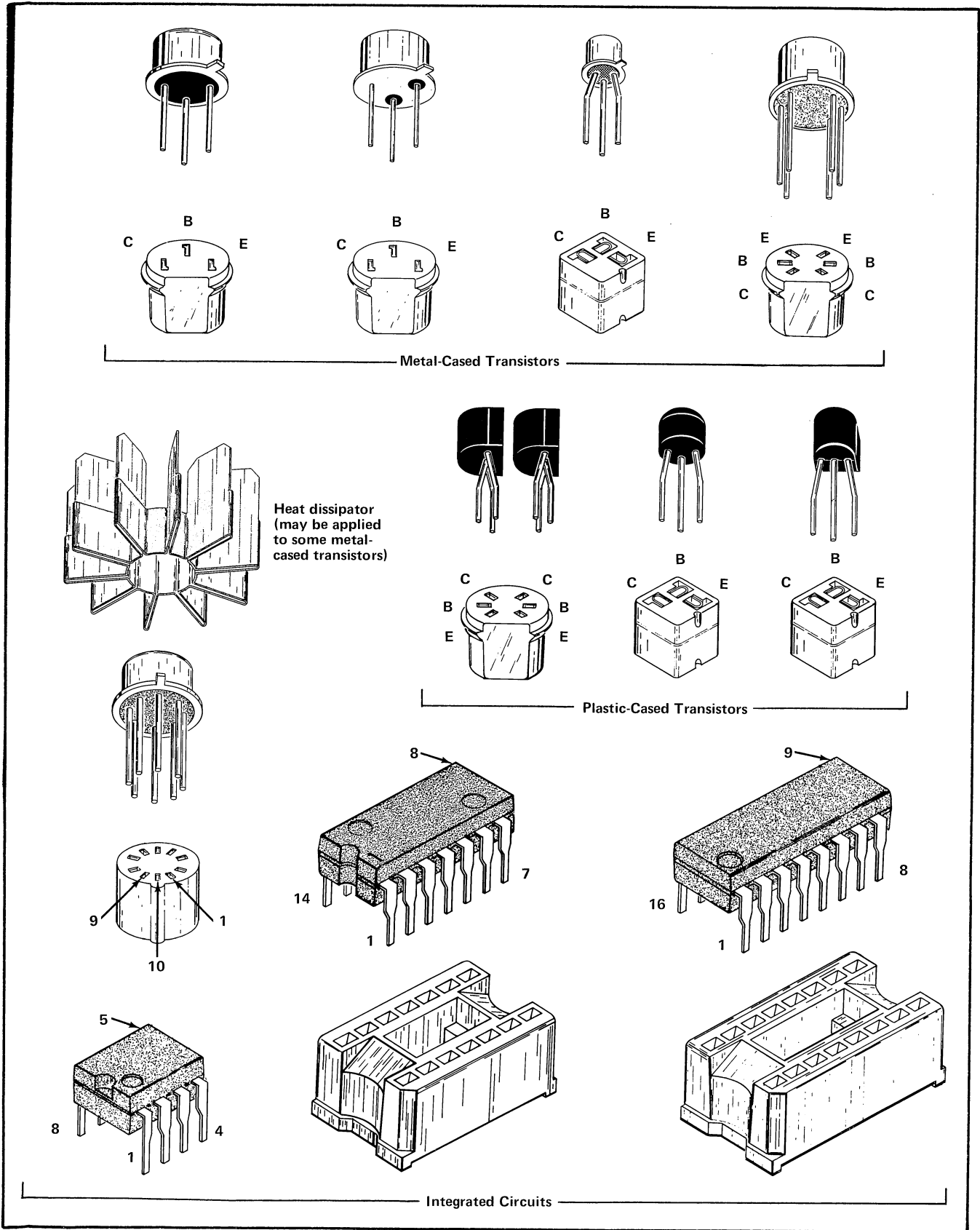


Fig. 4-2. Semiconductor Lead Configuration.

1. Remove the pushbutton switch as described previously.

2. Note the position of the lamp on the circuit board. Unsolder the lamp leads from the circuit board.

3. Remove the lamp out through the light manifold.

4. Install the new lamp in the same position as the original and solder the leads to the circuit board. Use a heat sink to protect the lamp during soldering.

Lamp Replacement (Output Indicator)

This lamp is mounted in a plastic cap that snaps into a holder mounted behind the front panel.

Cam-Type Switch Repairs

CAUTION

Repair of cam-type switches should be undertaken only by experienced maintenance personnel. Switch alignment and spring tension of the contacts must be carefully maintained for proper operation of the switch. For assistance in maintenance of the cam-type switch, contact your local Tektronix Field Office or Representative.

The cam-type switch consists of a rotating cam which is turned by a front-panel knob, and a set of contacts mounted on a circuit board. The switch contacts are actuated by lobes on the cam. The PULSE DURATION switch can be disassembled for inspection, cleaning, repair, or replacement as follows:

1. To remove the cam-switch assembly:

a. Remove the 10-pin connector from the main circuit board.

b. Remove the PULSE DURATION knob (1/16-inch hex-socket screws).

c. Remove the 7/16-inch hex nut securing the PULSE DURATION switch to the subpanel.

d. Slide the cam-switch circuit-board assembly toward the rear of the instrument.

e. Remove the circuit-board assembly from the instrument.

2. To remove the cam:

a. Remove the cover screws and lift off the cover.

b. Remove the four machine screws from the back side of the board.

c. Lift the cam assembly away from the circuit board as a unit.

3. To replace Defective Switch Contacts:

NOTE

A cam-type switch repair kit including necessary tools, instructions, and replacement contacts is available from Tektronix, Inc. Order Part Number 040-0541-00.

a. Unsolder the damaged contact and clean the excess solder from the hole in the circuit board.

b. Position the new contact in the hole so that it is properly aligned in relation to the other switch contacts and the mating area on the circuit board (alignment tool provided in switch-repair kit).

c. Solder the new contact into place (be sure that the spring end of the contact has adequate clearance from the circuit board).

4. To remove the cam from the front support block, remove the retaining ring from the shaft at the front of the switch and slide the cam out of the support block. Be careful not to lose the small detent roller.

5. To re-install the switch assembly, reverse the above procedure.

SECTION 5 PERFORMANCE CHECK/ADJUSTMENT

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

A calibration check is recommended every 1000 hours of operation, or every year if used infrequently. Before complete calibration, the instrument should be cleaned and inspected as outlined in the Maintenance section.

As an aid to checking the performance of the 26G3, a Short-Form Procedure is given prior to the complete procedure. To facilitate instrument checkout, the Short-Form Procedure lists the check and applicable tolerances. This Procedure also includes the step and number and title as listed in the complete Performance Check, and the page number on which each step begins. The Short-Form Procedure also provides spaces to record performance data or to check off steps as they are completed.

The Performance Check can be used to check instrument performance without making any internal adjustments.

Following the Performance Check is a complete ADJUSTMENT Procedure. Completion of the Adjustment Procedure insures that the instrument meets the electrical specifications given in Section 1.

NOTE

Limits, tolerances and waveforms in the ADJUSTMENT procedure are given as calibration guides and should not be interpreted as instrument specifications except as specified in Section 1. All waveforms shown in this procedure were taken with a Tektronix Oscilloscope Camera system.

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or equivalent are required for complete check or adjustment of the 26G3. Specifications given are the minimum necessary for accurate check or adjustment. Some of the recommended equipment may have specifications that exceed those given. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

Special Tektronix calibration fixtures are used in this procedure only where they facilitate calibration. These special fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

Test Equipment

1. Test Oscilloscope, consisting of indicator, Dual Trace Amplifier, Differential Comparator, and Time Base.

Dual Trace Amplifier—Deflection Factor, 100 mV to 5 V; Bandwidth, 10 MHz, Single, Alternate and chopped display modes; Trigger Source selection.

Differential Comparator—Comparison Voltage range from zero volts to +15.00 volts; Deflection Factor from 2 V/Div to 1 mV/Div.

Time Base—Time/Div from 1 μ s to 1 s with 10X magnification.

The Oscilloscope recommended is the Tektronix 7504 with the following plug-ins:

7A12 Dual Trace Amplifier

7A13 Differential Comparator

7B50 Time Base

2. Time Mark Generator. Marker Range, .1 μ s to 1 s; Trigger Range, 1 μ s to 1 s. Type 184 or 2901 Time Mark Generator is recommended.

3. Pulse Generator. Output Pulse and Duration Variable; Output level 0-1 V, within 1% of indicated; DC Output level, 0-1 V, within 1% of indicated. The 26G3 is recommended.

4. 2600-Series Mainframe. To provide operating power for two 26G3 Pulse generators.

Performance Check/Adjustment—26G3

5. Plug-in extender. To provide access to the adjustments and test points in the 26G3. Tektronix Part Number 067-0630-00.

6. Coaxial Cable Assembly (2 required). 50 Ω with BNC connectors. Tektronix Part Number 012-0057-01.

7. BNC to 40-Mil Pin adapter cable. Tektronix Part Number 175-1178-00 (2 required).

8. BNC 'T' Connector. Tektronix Part Number 103-0030-00.

9. 1X Probe with BNC connectors (2 required). Tektronix Type P6011 is recommended. Tektronix Part Number 010-0192-00.

6. Check Ramp or Slew Ramp Page 5-4

Ok if steps 2 through 5 are ok.

7. Check Reset Input Level Page 5-4

+1 volt or less

8. Check Set Input Level Page 5-5

At least +1 volt

9. Check Pulse Duration Accuracy Page 5-5

1 μ s through 100 ms settings, 3%

1 s setting, 5%

10. Check Pulse Amplitude Accuracy Page 5-6

10 volts, within 100 mV

11. Check Pulse Gate Amplitude Page 5-6

3 volts, $\pm 20\%$

12. Check +Pulse Risetime and Falltime Page 5-6

Risetime, 200 ns or less

Falltime, 200 ns or less

13. Check Pulse Start Amplitude Page 5-7

3 volts, $\pm 20\%$

14. Check Trigger Gate Amplitude Page 5-7

3 volts, $\pm 20\%$

SHORT-FORM PERFORMANCE CHECK AND INDEX

26G3 Serial No.

Date.

By.

1. Check Preset Triggering Level Page 5-3

+1 volt or less

2. Check Triggering Level Accuracy (+Level, +Slope) Page 5-3

+1 volt, ± 100 mV

3. Check Triggering Level Accuracy (+Level, -Slope) Page 5-3

+1 volt, ± 150 mV

4. Check Triggering Level Accuracy (-Level, +Slope) Page 5-4

-1 volt, ± 150 mV

5. Check Triggering Level Accuracy (-Level, -Slope) Page 5-4

-1 volt, ± 200 mV

PERFORMANCE CHECK PROCEDURE

General

The following procedure is arranged to check the 26G3 with the least reconnection of equipment. The control settings throughout this procedure continue from the preceding step(s) unless otherwise noted. The control settings can be checked at the points listed as Preliminary Control Settings.

NOTE

Control titles which are printed on the front panel of the 26G3 are capitalized in this procedure (e.g., PULSE DURATION). Associated equipment controls are initial capitalized only (e.g., Marker Output).

The following procedure uses the equipment listed under Test Equipment Required. If other equipment is substituted, control settings or checking setup may need to be altered to meet the requirements of the equipment used. Operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is required.

NOTE

The performance of this instrument may be checked at any temperature from 0°C to +50°C, provided that the instrument was adjusted within an ambient range of +20°C to +30°C.

Preliminary Control Settings:

Test 26G3

Pulse Duration	1 ms
Duration Mult	1.00
Triggering	Preset Level
Pulse Amplitude	0.00
Amplitude Range	1 volt

26G3 (UUT) Unit Under Test

PULSE DURATION	1 ms
DURATION MULT	1.00
AMPLITUDE RANGE	10 V
PULSE AMPLITUDE	10.00
TRIGGERING	PRESET LEVEL

Time Mark Generator

Trigger Selector	1 ms
------------------	------

1. Check Preset Triggering Level

a. Connect Time Mark Generator Trigger Output to Test 26G3 Trig Input.

b. Connect Test 26G3 +Pulse Output to 26G3 (UUT) TRIG INPUT.

c. Turn Test 26G3 Pulse Amplitude control slowly clockwise until 26G3 (UUT) OUTPUT Indicator lamp lights.

d. CHECK—That the Test 26G3 Pulse Amplitude setting is +1 volt or less.

Reset the following controls:

Test 26G3

Pulse Duration	DC
Pulse Amplitude	0.00
Amplitude Range	10 V

26G3 (UUT)

TRIGGERING	+LEVEL, +SLOPE
LEVEL	1.00

2. Check Triggering Level Accuracy (+Level, +Slope)

a. Connect Test 26G3 +Pulse Output to 26G3 (UUT) TRIG INPUT and to Differential Comparator +Input.

b. Turn Test 26G3 Pulse Amplitude control very slowly clockwise until the 26G3 (UUT) OUTPUT lamp flashes.

c. CHECK—That the voltage (read on Differential Comparator) is 1 volt, ± 100 mV.

Reset the following control:

26G3 (UUT)

LEVEL	2.00
-------	------

d. Slowly increase Test 26G3 Pulse Amplitude until 26G3 (UUT) OUTPUT Indicator lamp flashes.

e. CHECK—That the voltage (read on Differential Comparator) is 2 volts, ± 100 mV.

Reset the following controls:

26G3 (UUT)

TRIGGERING	+LEVEL, -SLOPE
LEVEL	1.00

3. Check Triggering Accuracy (+Level, -Slope)

a. Slowly decrease 26G3 Pulse Amplitude until 26G3 (UUT) OUTPUT Indicator lamp flashes.

Performance Check/Adjustment—26G3

b. CHECK—That the voltage (read on Differential Comparator) is 1 volt, ± 150 mV.

Reset the following controls:

Test 26G3

Pulse Amplitude 2.00

26G3 (UUT)

LEVEL —LEVEL, +SLOPE

4. Check Triggering Level Accuracy (—Level, +Slope)

a. Connect Test 26G3 —Pulse Output to 26G3 (UUT) TRIG INPUT and to Differential Comparator +Input.

b. Slowly decrease Test 26G3 Pulse Amplitude until 26G3 (UUT) OUTPUT Indicator lamp flashes.

c. CHECK—That the voltage (read on Differential Comparator) is 1 volt, ± 150 mV.

Reset the following controls:

Test 26G3

Pulse Amplitude 0.00

26G3 (UUT)

TRIGGERING —LEVEL, —SLOPE
LEVEL 1.00

5. Check Triggering Level Accuracy (—Level, —Slope)

a. Slowly increase Test 26G3 Pulse Amplitude until 26G3 (UUT) OUTPUT Indicator lamp flashes.

b. CHECK—That the voltage (read on Differential Comparator) is 1 volt, ± 200 mV.

6. Check Ramp or Slew Ramp

Since RAMP, SLEW RAMP, and TRIG use common circuitry except for the Input resistors, R1, R2, R3 (all 0.1%) the circuits should meet requirements if the preceding steps 2 through 5 meet requirements.

Set the following controls:

Test 26G3

Triggering	Preset Level
Pulse Duration	DC
Duration Mult	1.00
Pulse Duration	10.00
Amplitude Range	10 V

26G3 (UUT)

TRIGGERING	PRESET LEVEL
PULSE DURATION	1 ms
DURATION MULT	1.00
PULSE AMPLITUDE	10.00
AMPLITUDE RANGE	10 V

Time Mark Generator

Trigger Selector	.1 ms
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Time Base

Time/Div	2 ms
Triggering Mode	Auto
Coupling	AC
Source	Int

Differential Comparator

Volts/Div	50 mV
+Input	Gnd
—Input	Gnd
Comparison Voltage	0.500 V

Dual Trace Amplifier

Volts/Div CH 1	2 V
Input	DC
Display Mode	CH 1
Trigger Source	CH 1

7. Check Reset Input Level

a. Connect Time Mark Generator Trigger Output to Test 26G3 Trig Input and to 26G3 (UUT) TRIG INPUT.

b. Connect Test 26G3 +Pulse Output to 26G3 (UUT) RESET INPUT.

c. Increase the Test 26G3 Pulse Amplitude until the 26G3 (UUT) OUTPUT lamp extinguishes.

d. CHECK—That the level at which the lamp extinguishes (circuit resets) is +1 volt or less on the Test 26G3 Pulse Amplitude control.

Reset the following controls:

Test 26G3

AMPLITUDE RANGE 1 V
 PULSE AMPLITUDE 0.00

26G3 (UUT)

TRIGGERING PRESET LEVEL

8. Check Set Input Level

- a. Remove Triggering signal from 26G3 (UUT) TRIG INPUT.
- b. Connect Test 26G3 +Pulse Output to 26G3 (UUT) SET INPUT.
- c. Monitor 26G3 (UUT) +PULSE OUTPUT.
- d. Increase Test 26G3 Output until pulses are seen on test scope.
- e. CHECK—That the Pulses start by the time the Set voltage reaches +1 volt.

Set the following controls:

26G3 (UUT)

PULSE DURATION 100 μ s
 DURATION MULT 10.00
 TRIGGERING PRESET LEVEL
 AMPLITUDE RANGE 10 V
 PULSE AMPLITUDE 10.00

Dual Trace Amplifier

CH 1
 Input DC
 Volts/Div 5 V
 CH 2
 Input DC
 Volts/Div .5 V
 Display Mode Add
 Trigger Source CH 1

Time Base

Time/Div .1 ms
 Magnifier X1
 Triggering
 Mode Auto
 Coupling AC
 Source Ext

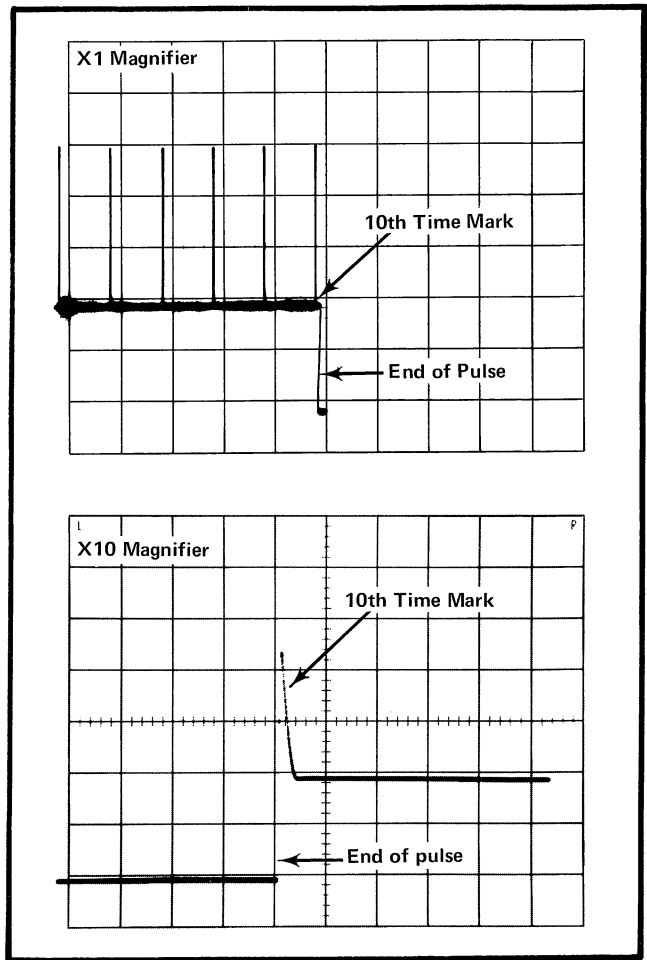


Fig. 5-1. Typical display of Output Pulse and Time Marks for checking Pulse Duration Accuracy.

Time Mark Generator

Marker Selector .1 ms
 Trigger Selector 10 ms

9. Check Pulse Duration Accuracy

- a. Connect Time Mark Generator Marker Output to Dual Trace Amplifier CH 2 Input.
- b. Connect Time Mark Generator Trigger Output to 26G3 TRIG INPUT and to Time Base Ext Trig In.
- c. Connect 26G3 +PULSE OUTPUT to Dual Trace Amplifier CH 1 Input.
- d. Display Output Pulse and Time Marks as shown in Fig. 5-1.

Performance Check/Adjustment—26G3

e. Switch Time Base Magnifier to X10.

f. CHECK—That an Output Pulse terminates on the 10th time mark, within 3 divisions (3%).

g. CHECK—The remaining ranges, 1 μ s through 100 ms for 3% accuracy.

h. CHECK—The 1 s range 5% accuracy.

Set the following controls:

26G3 (UUT)

PULSE DURATION	1 ms
DURATION MULT	1.00
PULSE AMPLITUDE	1.00
AMPLITUDE RANGE	10 V
TRIGGERING	PRESET LEVEL

Differential Comparator

+Input	Gnd
−Input	Gnd
Volts/Div	50 mV
Variable	Pushed in
Comparison Voltage	+1.000

Time Base

Time/Div	1 ms
Magnifier	X1
Triggering	
Mode	Auto
Coupling	AC
Source	Ext
Display Mode	Time Base

10. Check Pulse Amplitude Accuracy

a. Connect Time Mark Generator Trigger Output to 26G3 TRIG INPUT and to Time Base Ext Trig In.

b. Connect the 26G3 +PULSE OUTPUT to Differential Comparator +Input.

c. Vertically position the trace to graticule center.

d. Switch +Input to DC.

e. Switch −Input to V_c .

f. CHECK—That the Pulse Amplitude is 1 volt, within 100 mV.

g. Set Differential Comparator Comparison Voltage to 10 V (pull Variable knob).

h. Turn 26G3 PULSE AMPLITUDE to 10.00.

i. CHECK—That the Pulse Amplitude is 10 volts, within 100 mV.

Reset the following controls:

Dual Trace Amplifier

CH 1	
Input	DC
Volts/Div	1 V
Display Mode	CH 1
Trigger Source	CH 1

11. Check Pulse Gate Amplitude

a. Connect the 26G3 PULSE GATE OUTPUT to Dual Trace Amplifier CH 1 Input.

b. CHECK—That the pulse amplitude is 3 volts, within 0.6 division (20%).

Reset the following controls:

Dual Trace Amplifier

Volts/Div CH 1	2 V
----------------	-----

Time Base

Time/Div	1 μ s
Magnifier	X10

12. Check +Pulse Risetime and Falltime

a. Connect the 26G3 +PULSE OUTPUT to the Dual Trace Amplifier CH 1 Input.

b. Display the Output Pulse as shown in Fig. 5-2.

c. CHECK—That the Risetime is 2 divisions or less (200 ns).

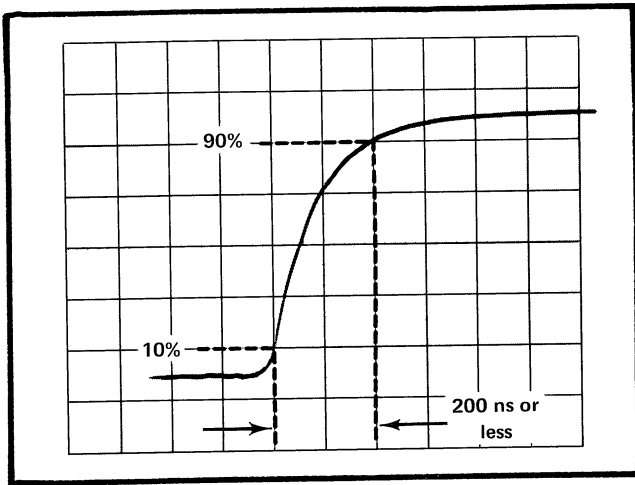


Fig. 5-2. Typical display of Output Pulse for checking Risetime.

d. Reset the Test Scope controls to view the fall of the pulse (trigger on the negative slope).

e. CHECK—That the Faltime is 200 ns or less.

f. Set 26G3 PULSE AMPLITUDE to 1.00.

g. Set Dual Trace Amplifier CH 1 Volts/Div to .2 V.

h. View the leading edge of the pulse.

i. CHECK—That the risetime is 200 ns or less.

j. Reset the test scope controls to view the fall of the pulse.

k. CHECK—That the falltime is 200 ns or less.

Reset the following controls:

Dual Trace Amplifier	
Volts/Div, CH 1	1 V

Time Base	
Time/Div	1 ms
Magnifier	X1

13. Check Pulse Start Amplitude

a. Connect 26G3 PULSE START OUTPUT to Dual Trace Amplifier CH 1 Input.

b. Display the pulse on the test scope.

c. CHECK—That the pulse amplitude is 3 divisions (3 volts), within 0.6 division (20%).

Reset the following controls:

Time Base	
Time/Div	1 ms
Magnifier	X1

Dual Trace Amplifier	
Volts/Div, CH 1	1 V

14. Check Trigger Gate Amplitude

a. Connect the 26G3 TRIG GATE OUTPUT to Dual Trace Amplifier CH 1 Input.

b. CHECK—That the Trigger Gate Amplitude is 3 volts, within 20%.

SHORT FORM ADJUSTMENT PROCEDURE AND INDEX

1. Adjust -15-volt Supply Page 5-8
ADJUST R345 for exactly -15 volts
2. Adjust Pulse Duration, X1 Page 5-9
ADJUST R129 to set exact coincidence of end of pulse (50% amplitude) with 1st time mark
3. Adjust Pulse Duration, X10 Page 5-9
ADJUST R136 to set exact coincidence of end of pulse (50% amplitude) with 10th time mark
4. Adjust +Pulse Cal Page 5-10
ADJUST R243 to set +Pulse Amplitude to exactly 1 volt
5. Adjust -Pulse Cal Page 5-10
ADJUST R278 to set -Pulse Amplitude to exactly 1 volt

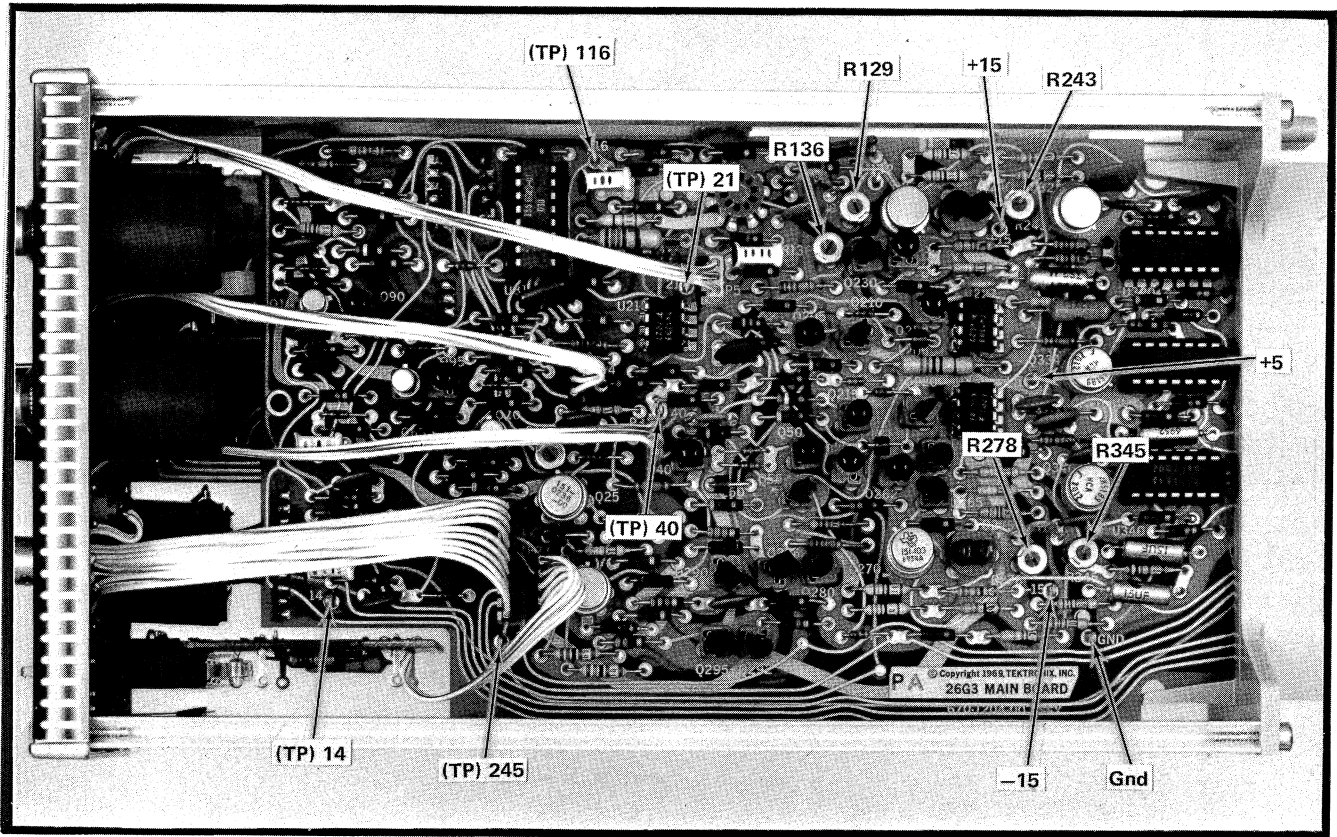


Fig. 5-3. Location of Test Points.

6. Adjust Delay or Level Cal Page 5-11

ADJUST R12 to set voltage at TP21 to exactly -10.000 volts

7. Adjust 100 μ s Pulse Duration Page 5-11

ADJUST C158 to set Pulse Duration to exactly 100 μ s (50% amplitude points)

8. Adjust 1 μ s Pulse Duration Page 5-12

ADJUST R120 to set Pulse Duration to exactly 1 μ s (50% amplitude points)

ADJUSTMENT PROCEDURE

Preliminary Control Settings:

Differential Comparator

+Input	Gnd
-Input	Gnd
Comparison Voltage	-15
Volts/Div	10 mV

Time Base

Time/Div	1 ms
Triggering Mode	Auto
Coupling	AC
Source	Int
Display Mode	Time Base

1. Adjust -15 Volt Supply (R345) ❶

a. Connect a 1X probe from Differential Comparator +Input to 26G3 -15 volt Test Point (location shown in Fig. 5-3). Ground probe at Gnd Test Point in 26G3 (UUT).

b. Vertically position the trace to graticule center (Differential Comparator Position control).

c. Switch +Input to DC.

d. Switch -Input to V_C .

e. ADJUST-R345 to position the trace to graticule center.

f. Check the +5 and +15 volt supplies in the manner detailed above.

Set the following controls:

26G3

PULSE DURATION	1 ms
DURATION MULT	1.00
PULSE AMPLITUDE	10.00
AMPLITUDE RANGE	10 V
TRIGGERING	PRESET LEVEL

Dual Trace Amplifier

Display Mode	Add
Trigger Source	CH 2
Volts/Div	
CH 1	2 V
CH 2	.5 V
Inputs, CH 1 and CH 2	DC

Time Base

Time/Div	.1 ms
Magnifier	X1
Triggering	
Mode	Auto
Coupling	AC
Source	Ext
Display Mode	Time Base

Time Mark Generator

Marker Selector	.1 ms
Trigger Selector	10 ms

2. Adjust Pulse Duration X1 (R129)

a. Connect Time Mark Generator Marker Output to Dual Trace Amplifier, CH 2.

b. Connect Time Mark Generator Trigger Output to 26G3 TRIG INPUT and COM and to Time Base, Ext Trig In.

c. Connect 26G3 +PULSE OUTPUT and GND to Dual Trace Amplifier CH 1.

d. Adjust Time Base trigger and position for display shown in Fig. 5-4.

e. Switch Time Base Magnifier to X10.

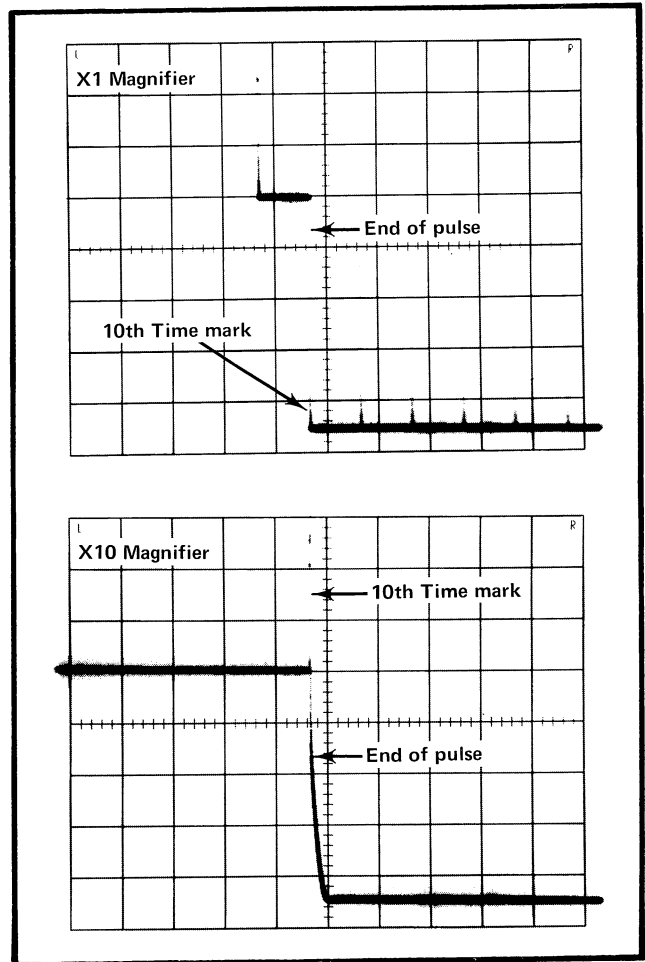


Fig. 5-4. Typical display of Pulse and Time Marks for setting X1 Pulse Duration.

f. ADJUST—R129 (see Fig. 5-3 for location) for exact coincidence of end of pulse with 10th time mark (see Fig. 5-4).

Reset the following controls:

26G3

DURATION MULT	10.00
---------------	-------

Time Base

Time/Div	1 ms
Magnifier	X1

3. Adjust Pulse Duration X10 (R136)

a. Display the pulse and time marks as shown in Fig. 5-5.

b. Switch Magnifier to X10.

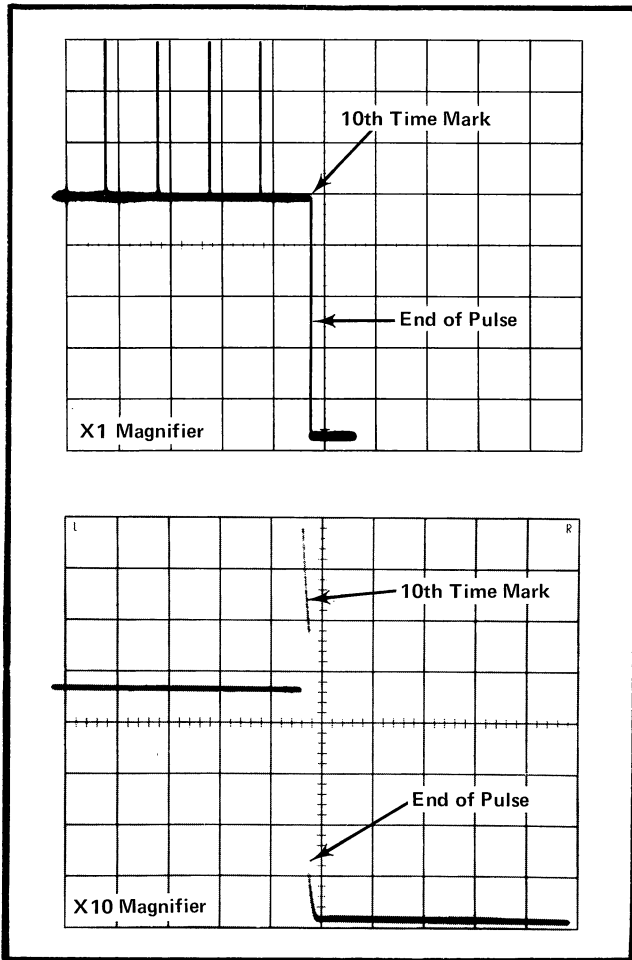


Fig. 5-5. Typical display of Output Pulse and Time Marks for adjusting Pulse Duration X10.

c. ADJUST—R136 (see Fig. 5-3 for location) to position the end of pulse exactly to the tenth time mark.

Set the following controls:

Time-Mark Generator

Trigger Selector 1 ms

26G3

TRIGGERING PRESET +1 V
 PULSE DURATION 1 ms
 DURATION MULT 1.00
 PULSE AMPLITUDE 10.00
 AMPLITUDE RANGE 1 V

Differential Comparator

+Input Gnd
 -Input Gnd
 Comparison Voltage 1.000
 Volts/Div 50 mV
 Variable Pushed in

Time Base

Time/Div 1 ms
 Magnifier 1X
 Triggering Mode Auto
 Coupling AC
 Source Int
 Display Mode Time Base

4. Adjust +Pulse Cal (R243)

a. Connect the Time Mark Generator Trigger Output to the 26G3 TRIG INPUT and COM.

b. Connect Differential Comparator +Input to 26G3 +PULSE OUTPUT and GND.

c. Vertically center the trace on the test scope.

d. Switch +Input to DC.

e. Switch -Input to V_C .

f. ADJUST—R243 (see Fig. 5-3 for location) to place the top of the pulse exactly to graticule center.

Reset the following controls:

Differential Comparator

Comparison Voltage Polarity -
 +Input Gnd
 -Input Gnd

5. Adjust -Pulse Cal (R278)

a. Connect Differential Comparator +Input to 26G3 -PULSE OUTPUT and GND.

b. Vertically position the trace to graticule center.

c. Switch +Input to DC.

d. Switch -Input to V_C .

e. ADJUST—R278 to place the top of the pulse exactly to graticule center.

Reset the following controls:

26G3

TRIGGERING DLY'D
 DELAY 10.00

Differential Comparator

Volts/Div 10 mV
 Variable Pulled
 Comparison Voltage -10.00 V

6. Adjust Delay or Level Cal (R12)

- Connect RAMP INPUT and COM INPUT to GND.
- Connect a 1X probe (Differential Comparator +Input) to TP21 (26G3). See Fig. 5-3 for location.
- Vertically center the trace.
- Switch +Input to DC.
- Switch -Input to V_c .
- ADJUST-R12 to set the trace exactly to graticule center.

Set the following controls:

26G3

TRIGGERING PRESET LEVEL
 PULSE DURATION 10 μ s
 DURATION MULT 10.00
 AMPLITUDE RANGE 10 V
 PULSE AMPLITUDE 10.00

Dual Trace Amplifier

CH 1
 Input DC
 Volts/Div 2 V
 CH 2
 Input DC
 Volts/Div .5 V
 Display Mode Alt
 Trigger Source CH 2

Time Mark Generator

Marker Selector 10 μ s
 Trigger Selector 1 ms

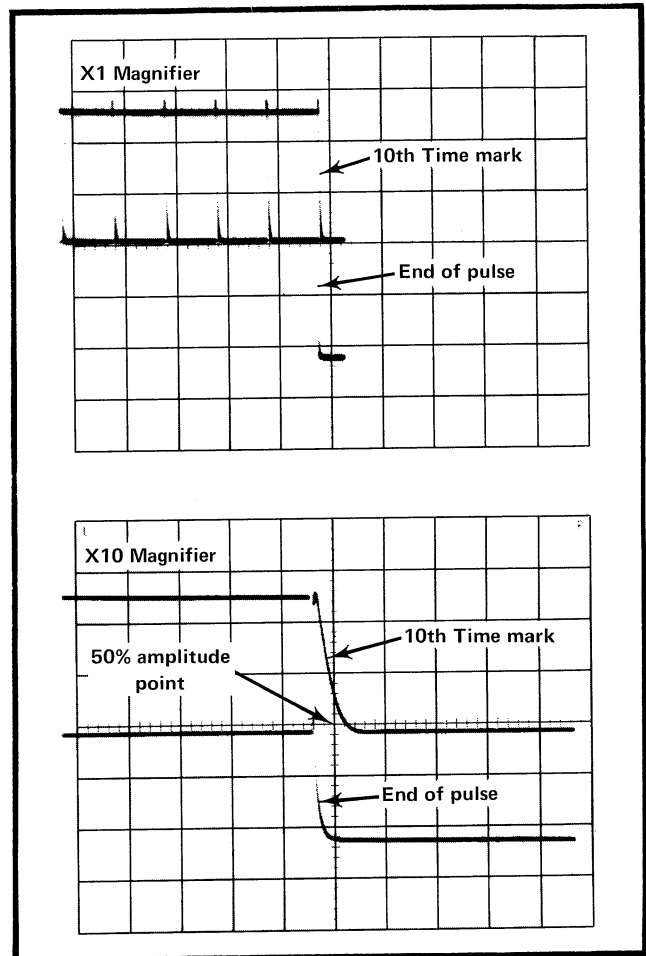


Fig. 5-6. Typical displays of Output Pulse and Time Marks for adjusting 100 μ s Pulse Duration.

Time Base

Time/Div 10 μ s
 Magnifier X1
 Triggering
 Mode Auto
 Coupling AC
 Source Ext
 Display Mode Time Base

7. Adjust 100 μ s Pulse Duration (C158)

- Connect Time Mark Generator Marker Output to Dual Trace Amplifier CH 2 Input.
- Connect Time Mark Generator Trigger Output to 26G3 TRIG INPUT and to Time Base Ext Trig In.
- Connect 26G3 +PULSE OUTPUT to Dual Trace Amplifier CH 1 Input.
- Display the Output Pulse and Time Marks as shown in Fig. 5-6.

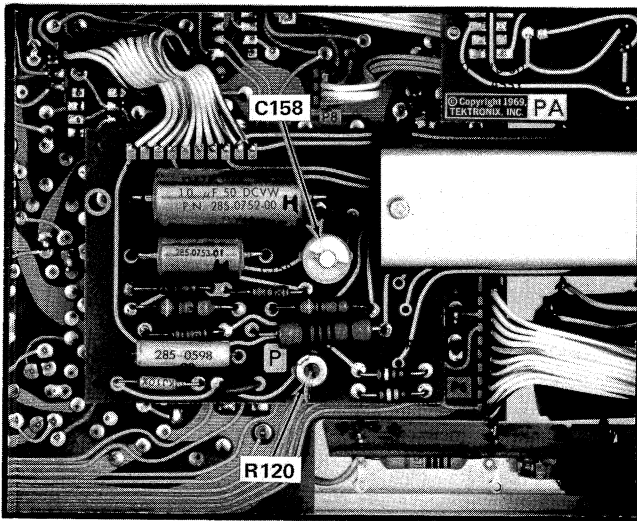


Fig. 5-7. Location of C158 and R120.

e. Switch Time Base Magnifier to X10.

f. ADJUST—C158 (Fig. 5-7 for location) to align end of pulse with time mark. Measure Pulse duration at 50% amplitude points.

Reset the following controls:

26G3

PULSE DURATION $1 \mu\text{s}$
 DURATION MULT 1.00

Time Mark Generator

Marker Selector $1 \mu\text{s}$
 Trigger Selector $10 \mu\text{s}$

Time Base

Time/Div $1 \mu\text{s}$
 Magnifier X1

8. Adjust $1 \mu\text{s}$ Pulse Duration (R120)

a. Display the $1 \mu\text{s}$ Pulse with the Time Marks as shown in Fig. 5-8.

b. Switch Magnifier to X10.

c. ADJUST—R120 (Fig. 5-7 for location) to align the end of the Pulse to the time mark. Measure Pulse duration at 50% amplitude points.

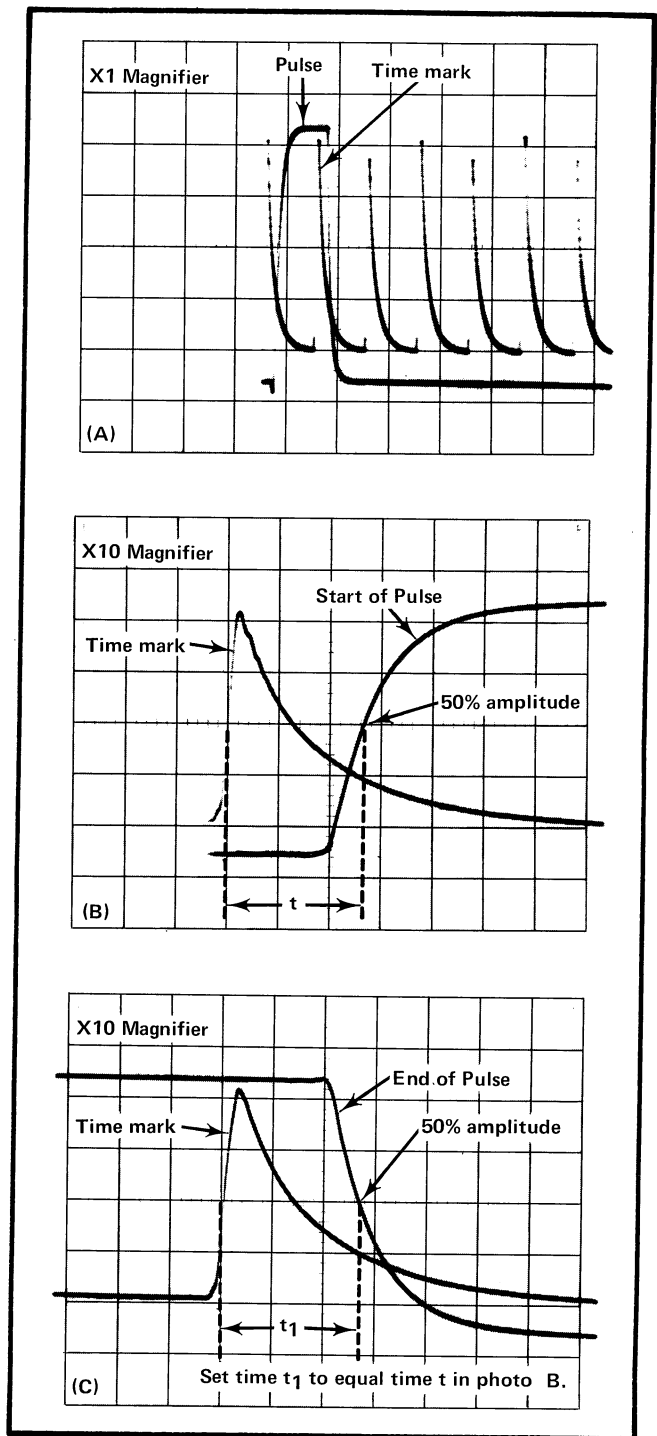


Fig. 5-8. Typical displays of Output Pulse and Time Marks for adjusting $1 \mu\text{s}$ Pulse Duration.

PARTS LIST ABBREVIATIONS

BHB	binding head brass	int	internal
BHS	binding head steel	lg	length or long
cap.	capacitor	met.	metal
cer	ceramic	mtg hdw	mounting hardware
comp	composition	OD	outside diameter
conn	connector	OHB	oval head brass
CRT	cathode-ray tube	OHS	oval head steel
csk	countersunk	P/O	part of
DE	double end	PHB	pan head brass
dia	diameter	PHS	pan head steel
div	division	plstc	plastic
elect.	electrolytic	PMC	paper, metal cased
EMC	electrolytic, metal cased	poly	polystyrene
EMT	electrolytic, metal tubular	prec	precision
ext	external	PT	paper, tubular
F & I	focus and intensity	PTM	paper or plastic, tubular, molded
FHB	flat head brass	RHB	round head brass
FHS	flat head steel	RHS	round head steel
Fil HB	fillister head brass	SE	single end
Fil HS	fillister head steel	SN or S/N	serial number
h	height or high	S or SW	switch
hex.	hexagonal	TC	temperature compensated
HHB	hex head brass	THB	truss head brass
HHS	hex head steel	thk	thick
HSB	hex socket brass	THS	truss head steel
HSS	hex socket steel	tub.	tubular
ID	inside diameter	var	variable
inc	incandescent	w	wide or width
		WW	wire-wound

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

SPECIAL NOTES AND SYMBOLS

- | | |
|-----------------|---|
| ×000 | Part first added at this serial number |
| 00× | Part removed after this serial number |
| *000-0000-00 | Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components. |
| Use 000-0000-00 | Part number indicated is direct replacement. |

INDEX OF ELECTRICAL PARTS LIST

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SECTION 6

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
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CHASSIS

Bulb

DS295	*150-0048-01			Incandescent, #683, selected
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Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R13	311-1058-00			10 k Ω , Var
R132	311-1058-00			10 k Ω , Var
R227	311-1058-00			10 k Ω , Var

A1 MAIN Circuit Board Assembly

*670-1204-00

Complete Board

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C1	281-0562-00		39 pF	Cer	500 V	
C2	281-0562-00		39 pF	Cer	500 V	
C3	281-0562-00		39 pF	Cer	500 V	
C25	283-0060-00		100 pF	Cer	200 V	5%
C60	283-0060-00		100 pF	Cer	200 V	5%
C61	283-0060-00		100 pF	Cer	200 V	5%
C81	283-0164-00		2.2 μ F	Cer	25 V	
C85	283-0060-00		100 pF	Cer	200 V	5%
C86	283-0060-00		100 pF	Cer	200 V	5%
C105	283-0060-00		100 pF	Cer	200 V	5%
C110	283-0115-00		47 pF	Cer	200 V	5%
C114	281-0628-00		15 pF	Cer	600 V	5%
C132	283-0000-00		0.001 μ F	Cer	500 V	
C140	283-0059-00		1 μ F	Cer	25 V	+80% -20%
C142	281-0511-00		22 pF	Cer	500 V	10%

A1 MAIN Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
Capacitors (cont)						
C145	283-0060-00		100 pF	Cer	200 V	5%
C200	283-0054-00		150 pF	Cer	200 V	5%
C227	283-0000-00		0.001 μ F	Cer	500 V	
C235	283-0000-00		0.001 μ F	Cer	500 V	
C265	283-0000-00		0.001 μ F	Cer	500 V	
C285	283-0110-00		0.005 μ F	Cer	150 V	
C321	283-0060-00		100 pF	Cer	200 V	5%
C328	290-0135-00		15 μ F	Elect.	20 V	
C331	283-0060-00		100 pF	Cer	200 V	5%
C336	290-0135-00		15 μ F	Elect.	20 V	
C341	290-0135-00		15 μ F	Elect.	20 V	
C343	283-0060-00		100 pF	Cer	200 V	5%
C346	290-0135-00		15 μ F	Elect.	20 V	
C350	283-0003-00		0.01 μ F	Cer	150 V	
C352	283-0003-00		0.01 μ F	Cer	150 V	
C354	283-0003-00		0.01 μ F	Cer	150 V	

Semiconductor Device, Diodes

CR19	*152-0185-00		Silicon	Replaceable by 1N4152		
CR20	*152-0185-00		Silicon	Replaceable by 1N4152		
CR34	*152-0185-00		Silicon	Replaceable by 1N4152		
CR35	*152-0185-00		Silicon	Replaceable by 1N4152		
CR40	*152-0185-00		Silicon	Replaceable by 1N4152		
CR46	*152-0185-00		Silicon	Replaceable by 1N4152		
CR55	*152-0185-00		Silicon	Replaceable by 1N4152		
CR65	*152-0185-00		Silicon	Replaceable by 1N4152		
CR70	*152-0185-00		Silicon	Replaceable by 1N4152		
CR90	*152-0185-00		Silicon	Replaceable by 1N4152		
CR95	*152-0185-00		Silicon	Replaceable by 1N4152		
CR98	*152-0185-00		Silicon	Replaceable by 1N4152		
CR105	*152-0185-00		Silicon	Replaceable by 1N4152		
CR110	*152-0185-00		Silicon	Replaceable by 1N4152		
CR210	*152-0185-00		Silicon	Replaceable by 1N4152		
CR220	*152-0185-00		Silicon	Replaceable by 1N4152		
CR225	*152-0185-00		Silicon	Replaceable by 1N4152		
CR285	152-0246-00		Silicon	Low Leakage 250 mW, 40 V		
CR324	*152-0185-00		Silicon	Replaceable by 1N4152		
VR30	152-0168-00		Zener	1N963B 400 mW, 12 V, 5%		
VR35	152-0280-00		Zener	1N753A 400 mW, 6.2 V, 5%		
VR346	152-0217-00		Zener	1N756A 400 mW, 8.2 V, 5%		

A1 MAIN Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
Inductors				
L25	276-0507-00			Core, ferramic suppressor
L50	276-0507-00			Core, ferramic suppressor
L205	276-0507-00			Core, ferramic suppressor
L215	276-0507-00			Core, ferramic suppressor
Transistors				
Q25	*151-0236-00		Silicon	NPN TO-77 Dual, Tek Spec
Q40	151-0190-00		Silicon	NPN TO-92 2N3904
Q50	*151-0219-00		Silicon	PNP TO-18 Replaceable by 2N4250
Q55	151-0188-00		Silicon	PNP TO-92 2N3906
Q65	151-0190-00		Silicon	NPN TO-92 2N3904
Q70	*151-0230-00		Silicon	NPN TO-105 Selected from RCA 40235
Q90	151-0190-00		Silicon	NPN TO-92 2N3904
Q93	*151-0230-00		Silicon	NPN TO-105 Selected from RCA 40235
Q95	151-0190-00		Silicon	NPN TO-92 2N3904
Q110	*151-0230-00		Silicon	NPN TO-105 Selected from RCA 40235
Q205	*151-0219-00		Silicon	PNP TO-18 Replaceable by 2N4250
Q210	151-0188-00		Silicon	PNP TO-92 2N3906
Q215	*151-0219-00		Silicon	PNP TO-18 Replaceable by 2N4250
Q220	151-0188-00		Silicon	PNP TO-92 2N3906
Q225	151-0190-00		Silicon	NPN TO-92 2N3904
Q230	*151-0195-00		Silicon	NPN TO-92 Replaceable by MPS 6515
Q232	151-0190-00		Silicon	NPN TO-92 2N3904
Q235	151-0190-00		Silicon	NPN TO-92 2N3904
Q240	*153-0586-00		Silicon	PNP TO-92 2N3906 (matched pair)
Q245	*151-0134-00		Silicon	PNP TO-5 Replaceable by 2N2905
Q260	151-0188-00		Silicon	PNP TO-92 2N3906
Q262	*151-0219-00		Silicon	PNP TO-18 Replaceable by 2N4250
Q265	151-0188-00		Silicon	PNP TO-92 2N3906
Q270	*151-0103-00		Silicon	NPN TO-5 Replaceable by 2N2219
Q275	*153-0587-00		Silicon	NPN TO-92 2N3904 (matched pair)
Q280	151-0188-00		Silicon	PNP TO-92 2N3906
Q285	*151-0195-00		Silicon	NPN TO-92 Replaceable by MPS 6515
Q290	151-1025-00		Silicon	FET N channel, junction type, X55
Q292	151-0188-00		Silicon	PNP TO-92 2N3906
Q295	151-0164-00		Silicon	PNP TO-5 2N5447
Q328	*151-0134-00		Silicon	PNP TO-5 Replaceable by 2N2905
Q334	151-0260-00		Silicon	NPN TO-39 2N5189
Q346	151-0260-00		Silicon	NPN TO-39 2N5189

A1 MAIN Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
Resistors						
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.						
R1	321-0289-07		10 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R2	321-0289-07		10 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R3	321-0289-07		10 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R6	321-0130-00		221 Ω	$\frac{1}{8}$ W	Prec	1%
R7	321-0402-00		150 k Ω	$\frac{1}{8}$ W	Prec	1%
R10	316-0473-00		47 k Ω	$\frac{1}{4}$ W		
R11	316-0102-00		1 k Ω	$\frac{1}{4}$ W		
R12	311-0635-00		1 k Ω , Var			
R14	316-0100-00		10 Ω	$\frac{1}{4}$ W		
R15	316-0682-00		6.8 k Ω	$\frac{1}{4}$ W		
R18	321-0256-07		4.53 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R19	321-0256-07		4.53 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R20	321-0130-00		221 Ω	$\frac{1}{8}$ W	Prec	1%
R21	321-0289-07		10 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R25	321-0260-00		4.99 k Ω	$\frac{1}{8}$ W	Prec	1%
R27	321-0338-00		32.4 k Ω	$\frac{1}{8}$ W	Prec	1%
R30	316-0271-00		270 Ω	$\frac{1}{4}$ W		
R31	321-0260-00		4.99 k Ω	$\frac{1}{8}$ W	Prec	1%
R34	321-0306-00		15 k Ω	$\frac{1}{8}$ W	Prec	1%
R35	321-0306-00		15 k Ω	$\frac{1}{8}$ W	Prec	1%
R37	316-0821-00		820 Ω	$\frac{1}{4}$ W		
R40	315-0242-00		2.4 k Ω	$\frac{1}{4}$ W		5%
R41	315-0512-00		5.1 k Ω	$\frac{1}{4}$ W		5%
R43	315-0152-00		1.5 k Ω	$\frac{1}{4}$ W		5%
R45	315-0302-00		3 k Ω	$\frac{1}{4}$ W		5%
R50	315-0471-00		470 Ω	$\frac{1}{4}$ W		5%
R55	315-0151-00		150 Ω	$\frac{1}{4}$ W		5%
R60	316-0103-00		10 k Ω	$\frac{1}{4}$ W		
R61	316-0103-00		10 k Ω	$\frac{1}{4}$ W		
R62	316-0683-00		68 k Ω	$\frac{1}{4}$ W		
R65	316-0103-00		10 k Ω	$\frac{1}{4}$ W		
R70	316-0102-00		1 k Ω	$\frac{1}{4}$ W		
R71	316-0682-00		6.8 k Ω	$\frac{1}{4}$ W		
R74	316-0682-00		6.8 k Ω	$\frac{1}{4}$ W		
R76	316-0271-00		270 Ω	$\frac{1}{4}$ W		
R78	316-0682-00		6.8 k Ω	$\frac{1}{4}$ W		
R85	316-0103-00		10 k Ω	$\frac{1}{4}$ W		
R86	316-0103-00		10 k Ω	$\frac{1}{4}$ W		
R87	316-0683-00		68 k Ω	$\frac{1}{4}$ W		
R90	316-0103-00		10 k Ω	$\frac{1}{4}$ W		

A1 MAIN Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description	
Resistors (cont)				
R93	316-0102-00	1 k Ω	1/4 W	
R95	316-0682-00	6.8 k Ω	1/4 W	
R97	316-0222-00	2.2 k Ω	1/4 W	
R98	316-0682-00	6.8 k Ω	1/4 W	
R105	316-0392-00	3.9 k Ω	1/4 W	
R107	316-0122-00	1.2 k Ω	1/4 W	
R110	316-0102-00	1 k Ω	1/4 W	
R112	316-0222-00	2.2 k Ω	1/4 W	
R114	316-0562-00	5.6 k Ω	1/4 W	
R116	315-0682-00	6.8 k Ω	1/4 W	5%
R117	315-0621-00	620 Ω	1/4 W	5%
R118	316-0682-00	6.8 k Ω	1/4 W	
R125	316-0103-00	10 k Ω	1/4 W	
R127	322-0205-00	1.33 k Ω	1/4 W	Prec 1%
R129	311-0635-00	1 k Ω , Var		
R130	321-0093-00	90.9 Ω	1/8 W	Prec 1%
R134	321-0261-00	5.11 k Ω	1/8 W	Prec 1%
R136	311-0633-00	5 k Ω , Var		
R140	316-0100-00	10 Ω	1/4 W	
R142	316-0153-00	15 k Ω	1/4 W	
R145	316-0101-00	100 Ω	1/4 W	
R146	316-0474-00	470 k Ω (nominal value)	Selected	
R200	315-0392-00	3.9 k Ω	1/4 W	5%
R202	315-0752-00	7.5 k Ω	1/4 W	5%
R203	315-0243-00	24 k Ω	1/4 W	5%
R205	315-0471-00	470 Ω	1/4 W	5%
R210	315-0151-00	150 Ω	1/4 W	5%
R215	315-0471-00	470 Ω	1/4 W	5%
R220	315-0151-00	150 Ω	1/4 W	5%
R221	315-0102-00	1 k Ω	1/4 W	5%
R225	321-0222-00	2 k Ω	1/8 W	Prec 1%
R226	321-0260-00	4.99 k Ω	1/8 W	Prec 1%
R228	321-0259-00	4.87 k Ω	1/8 W	Prec 1%
R229	321-0222-00	2 k Ω	1/8 W	Prec 1%
R235	321-0230-00	2.43 k Ω	1/8 W	Prec 1%
R237	316-0101-00	100 Ω	1/4 W	
R238	321-0260-00	4.99 k Ω	1/8 W	Prec 1%
R240	321-0117-00	162 Ω	1/8 W	Prec 1%
R242	321-0176-00	665 Ω	1/8 W	Prec 1%
R243	311-0635-00	1 k Ω , Var		

A1 MAIN Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
Resistors (cont)						
R244	321-0176-00		665 Ω	1/8 W	Prec	1%
R245	321-0117-00		162 Ω	1/8 W	Prec	1%
R253	315-0332-00		3.3 kΩ	1/4 W		5%
R256	321-0260-00		4.99 kΩ	1/8 W	Prec	1%
R260	323-0181-00		750 Ω	1/2 W	Prec	1%
R265	316-0101-00		100 Ω	1/4 W		
R267	321-0260-00		4.99 kΩ	1/8 W	Prec	1%
R268	321-0230-00		2.43 kΩ	1/8 W	Prec	1%
R270	321-0117-00		162 Ω	1/8 W	Prec	1%
R275	321-0117-00		162 Ω	1/8 W	Prec	1%
R276	321-0176-00		665 Ω	1/8 W	Prec	1%
R278	311-0635-00		1 kΩ, Var			
R279	321-0176-00		665 Ω	1/8 W	Prec	1%
R280	316-0152-00		1.5 kΩ	1/4 W		
R285	316-0333-00		33 kΩ	1/4 W		
R286	316-0336-00		33 MΩ	1/4 W		
R290	316-0103-00		10 kΩ	1/4 W		
R292	316-0332-00		3.3 kΩ	1/4 W		
R320	316-0103-00		10 kΩ	1/4 W		
R324	316-0681-00		680 Ω	1/4 W		
R326	316-0470-00		47 Ω	1/4 W		
R328	321-0603-07		15 kΩ	1/8 W	Prec	1/10%
R329	321-0603-07		15 kΩ	1/8 W	Prec	1/10%
R330	316-0103-00		10 kΩ	1/4 W		
R333	316-0330-00		33 Ω	1/4 W		
R334	316-0681-00		680 Ω	1/4 W		
R335	308-0269-00		22 Ω	3 W	WW	5%
R336	321-0816-07		5 kΩ	1/8 W	Prec	1/10%
R338	321-0603-07		15 kΩ	1/8 W	Prec	1/10%
R340	321-0239-00		3.01 kΩ	1/8 W	Prec	1%
R341	321-0239-00		3.01 kΩ	1/8 W	Prec	1%
R343	316-0103-00		10 kΩ	1/4 W		
R344	321-0274-00		6.98 kΩ	1/8 W	Prec	1%
R345	311-0634-00		500 Ω, Var			
R346	321-0223-00		2.05 kΩ	1/8 W	Prec	1%
R348	316-0470-00		47 Ω	1/4 W		
R349	316-0681-00		680 Ω	1/4 W		
Integrated Circuits						
U21	156-0067-00		Op amp. Replaceable by Fairchild μA741C			
U40	156-0013-00		Diff comparator. Replaceable by Fairchild μA710C			
U81	*155-0029-01		Sweep control			
U140	*155-0028-00		Miller integrator			
U227	156-0067-00		Op amp. Replaceable by Fairchild μA741C			

A1 MAIN Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
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Integrated Circuits (cont)

U256	156-0067-00			Op amp. Replaceable by Fairchild μ 741C
U320	156-0071-00			Volt reg. Replaceable by Fairchild μ A723C
U330	156-0071-00			Volt reg. Replaceable by Fairchild μ A723C
U340	156-0071-00			Volt reg. Replaceable by Fairchild μ A723C

A2 PULSE DURATION Circuit Board Assembly

*670-0336-00

Complete Board

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C80	290-0183-00	1 μ F	Elect.	35 V	10%
C82	285-0598-00	0.01 μ F	PTM	100 V	5%
C84	283-0060-00	100 pF	Cer	200 V	5%
C150A } C150B }	*295-0138-00	1 μ F 0.01 μ F	Matched set		
C156	283-0677-00	82 pF	Mica	500 V	1%
C158	281-0093-00	5.5-18 pF, Var	Cer		

Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R80	315-0394-00	390 k Ω	1/4 W		5%
R82	315-0393-00	39 k Ω	1/4 W		5%
R120	311-0607-00	10 k Ω , Var			
R150	321-0410-07	182 k Ω	1/8 W	Prec	1/10%
R152	322-0678-07	910 k Ω	1/4 W	Prec	1/10%
R154	322-0678-07	910 k Ω	1/4 W	Prec	1/10%
R156	325-0072-00	10 M Ω	1 W	Prec	1%
R157	321-0272-07	6.65 k Ω	1/8 W	Prec	1/10%
R158	321-0281-07	8.25 k Ω	1/8 W	Prec	1/10%

Switch

Wired or Unwired

S100 ¹	*670-0336-00	Cam	PULSE DURATION
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¹See Mechanical Parts List for replacement parts.

A3 TRIGGER SELECTOR Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
	*670-1210-00			Complete Board
				Bulb
DS18	*150-0048-01			Incandescent, #683, selected
				Switch
	Wired or Unwired			
S1 ²	*670-1210-00			Pushbutton TRIGGER SELECTOR

A4 SLOPE Circuit Board Assembly

	*670-1211-00			Complete Board
				Bulb
DS15	*150-0048-01			Incandescent, #683, selected
				Switch
	Wired or Unwired			
S15 ²	*670-1211-00			Pushbutton SLOPE

A5 RANGE Circuit Board Assembly

	*670-1212-00			Complete Board
				Bulb
DS272	*150-0048-01			Incandescent, #683, selected

²See Mechanical Parts List for replacement parts.

A5 RANGE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description			
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Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R247	323-0626-07	50 Ω	$\frac{1}{2}$ W	Prec	1/10%
R248	322-0685-07	500 Ω	$\frac{1}{4}$ W	Prec	1/10%
R271	323-0626-07	50 Ω	$\frac{1}{2}$ W	Prec	1/10%
R272	322-0685-07	500 Ω	$\frac{1}{4}$ W	Prec	1/10%

Switch

	Wired or Unwired	Pushbutton	OUTPUT RANGE SELECTOR
S245 ³	*670-1212-00		

³See Mechanical Parts List for replacement parts.



SECTION 7

DIAGRAMS, CIRCUIT BOARDS, MECHANICAL AND REPACKAGING PARTS ILLUSTRATIONS

Symbols and Reference Designators

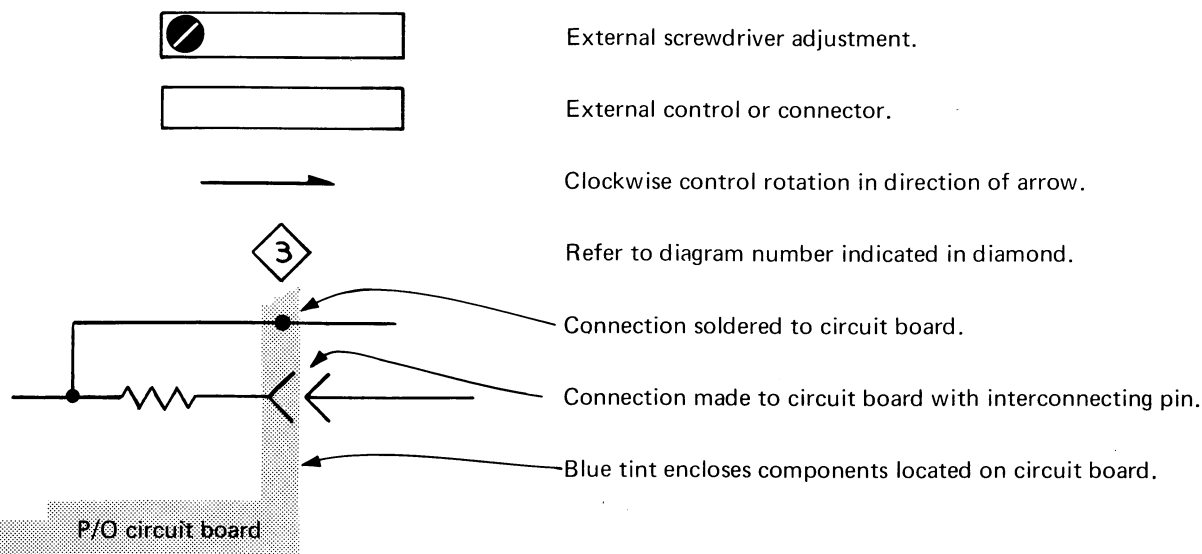
Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors =	Values one or greater are in picofarads (pF). Values less than one are in microfarads (μ F).
Resistors =	Ohms (Ω)

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

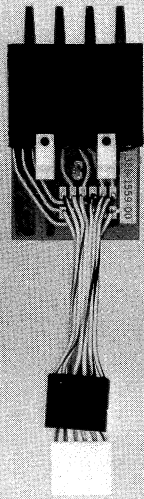
Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)	LR	Inductor/resistor combination
AT	Attenuator, fixed or variable	M	Meter
B	Motor	Q	Transistor or silicon-controlled rectifier
BT	Battery	P	Connector, movable portion
C	Capacitor, fixed or variable	R	Resistor, fixed or variable
CR	Diode, signal or rectifier	RT	Thermistor
DL	Delay line	S	Switch
DS	Indicating device (lamp)	T	Transformer
F	Fuse	TP	Test point
FL	Filter	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
H	Heat dissipating device (heat sink, heat radiator, etc.)	V	Electron tube
HR	Heater	VR	Voltage regulator (zener diode, etc.)
J	Connector, stationary portion	Y	Crystal
K	Relay		
L	Inductor, fixed or variable		



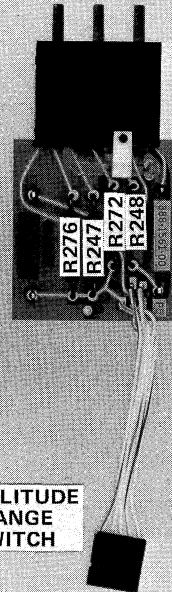
TRIGGERING
SWITCH

A3



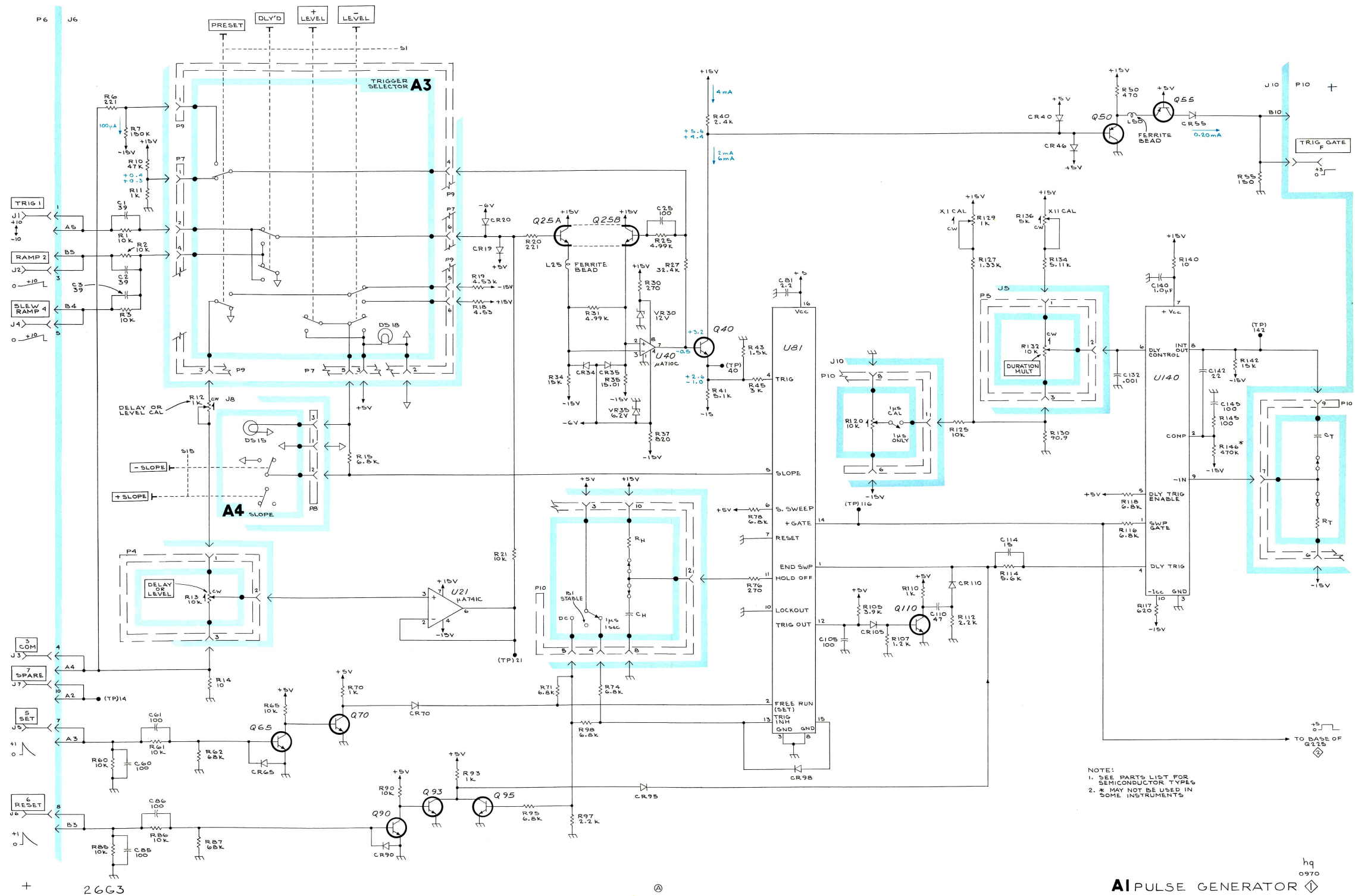
SLOPE
SWITCH

A4



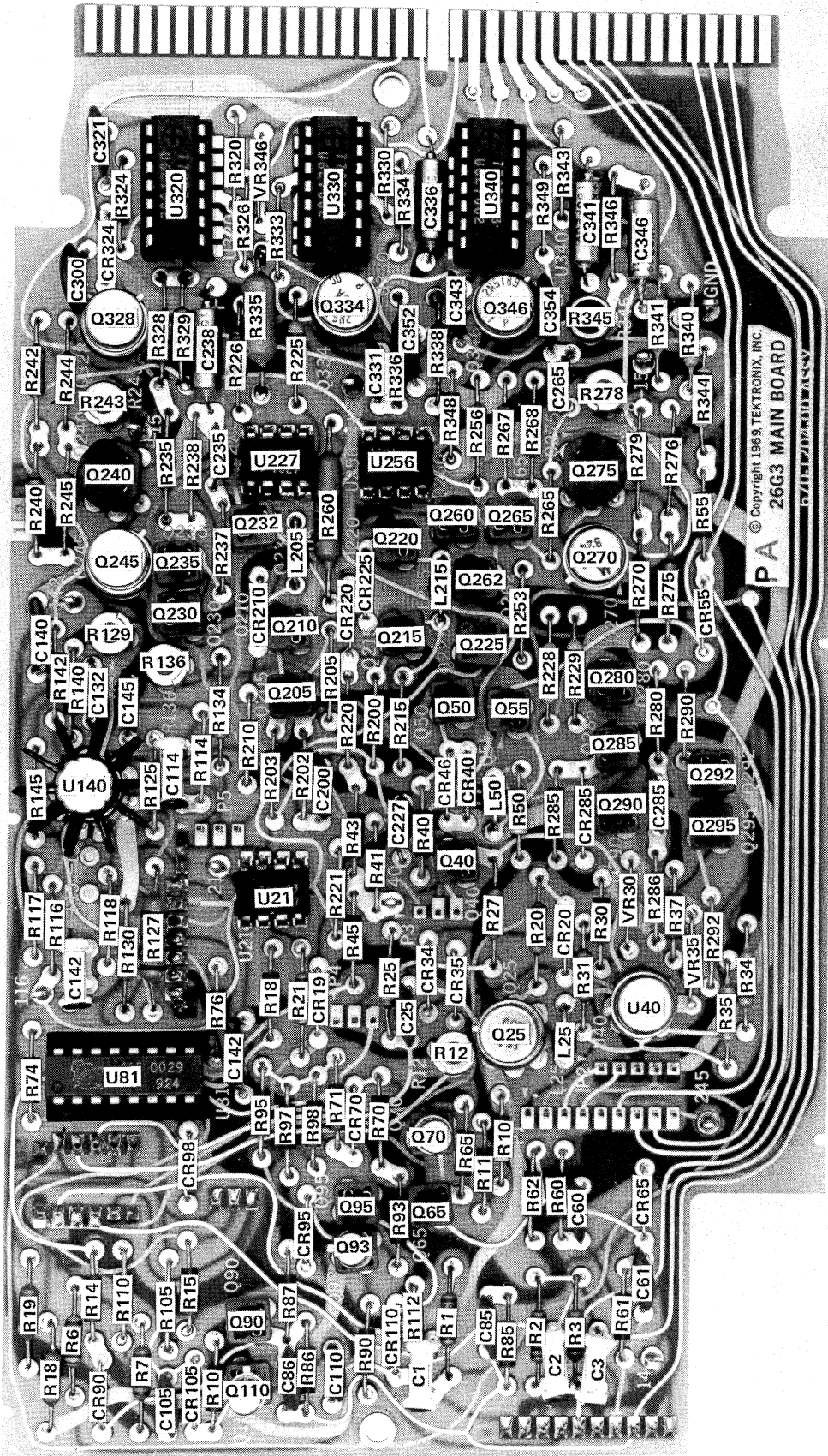
AMPLITUDE
RANGE
SWITCH

A5

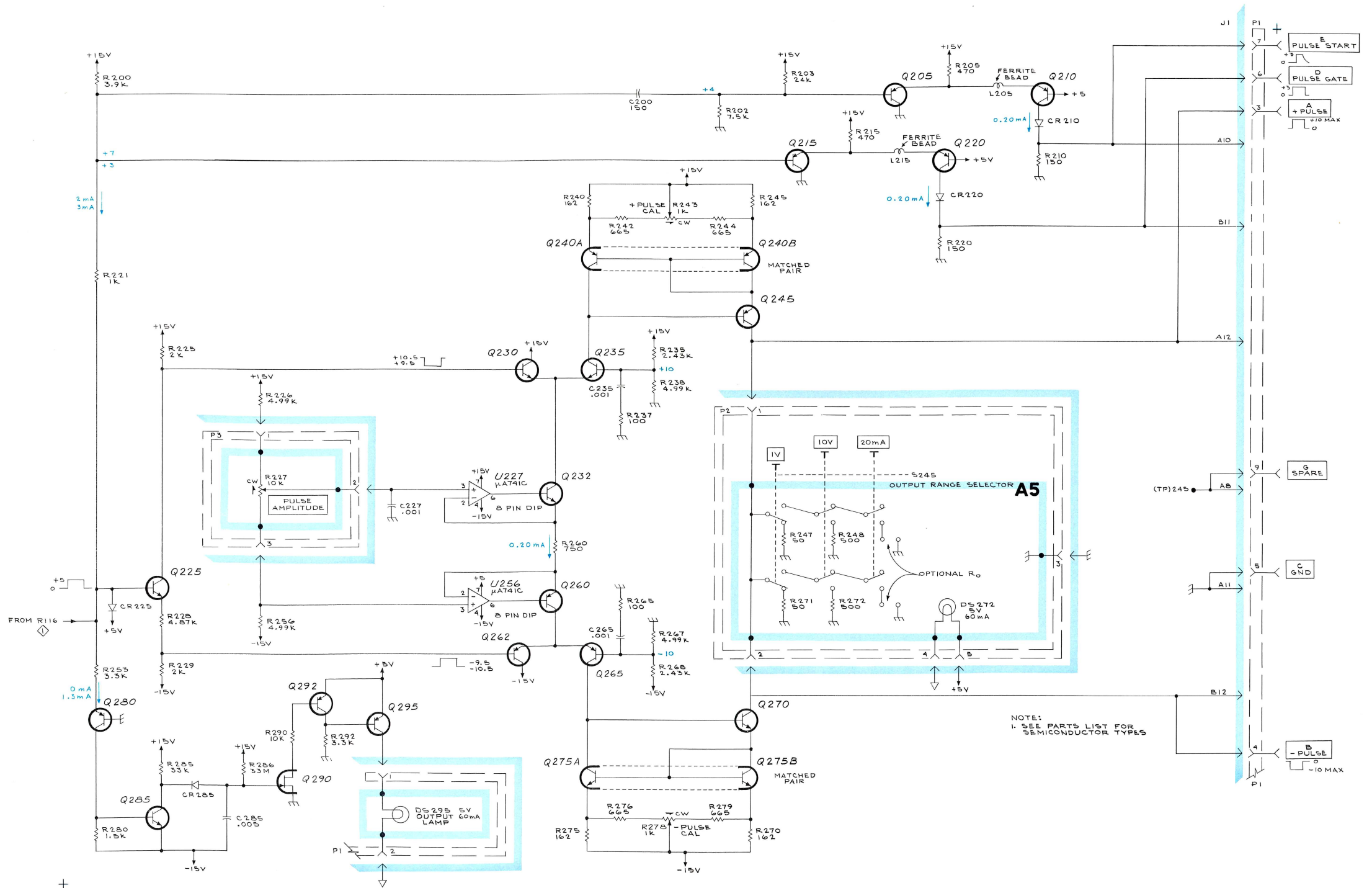


NOTE:
 1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
 2. * MAY NOT BE USED IN SOME INSTRUMENTS

26G3

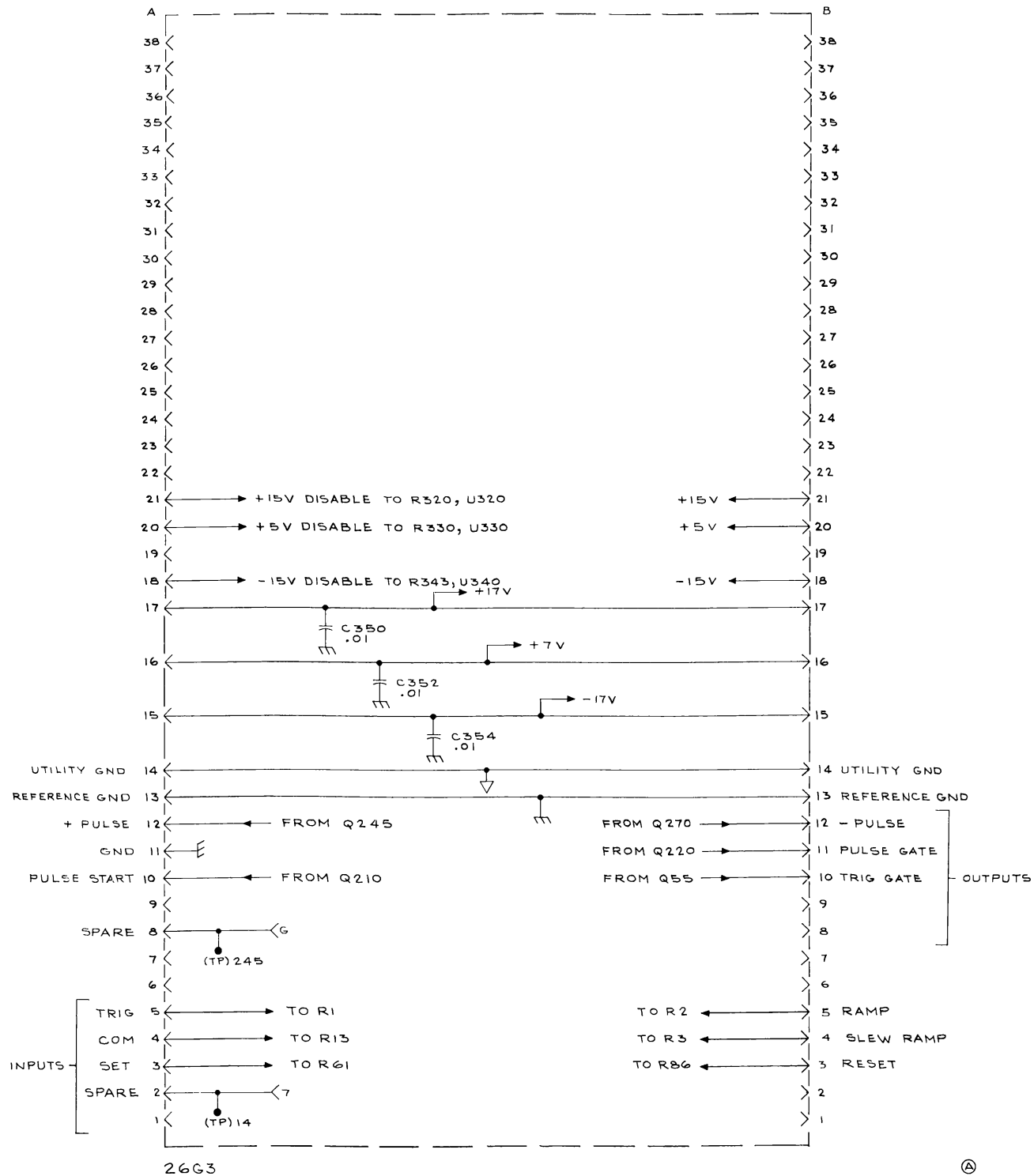


© Copyright 1969, TEKTRONIX, INC.
26G3 MAIN BOARD

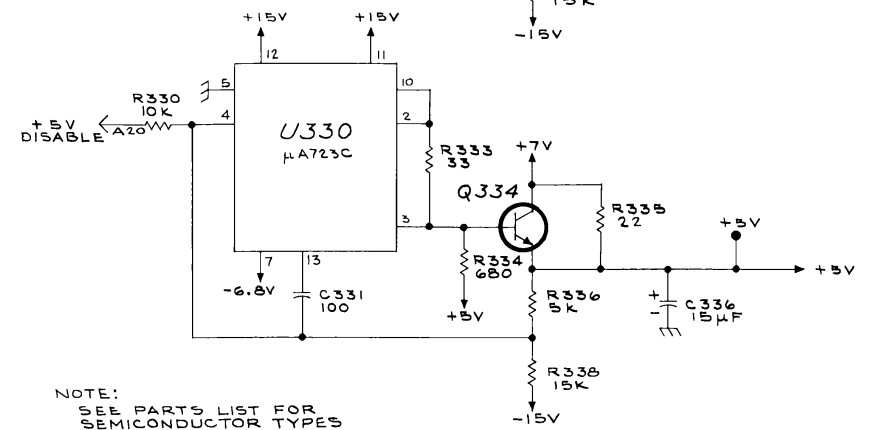
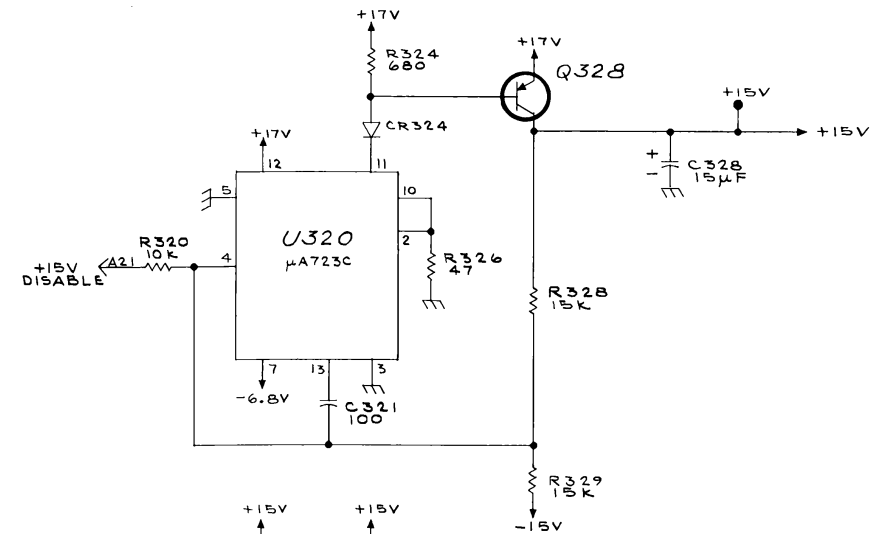


NOTE:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES

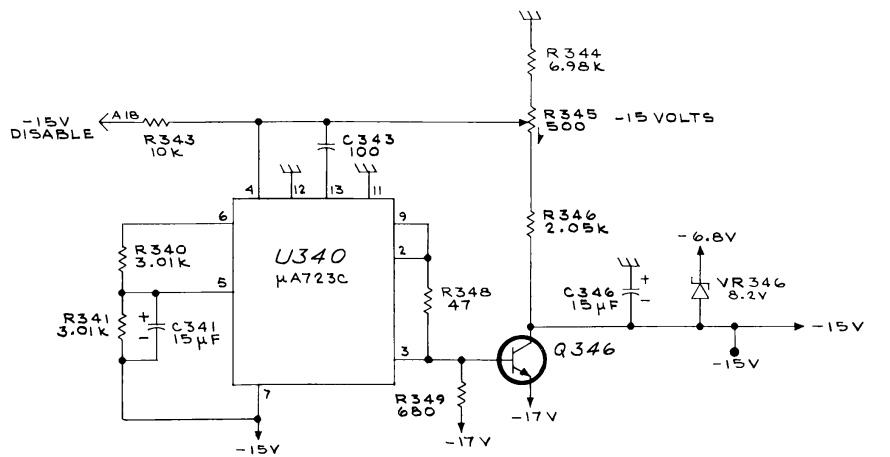
OUTPUT AMPLIFIER 2



26G3



NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES



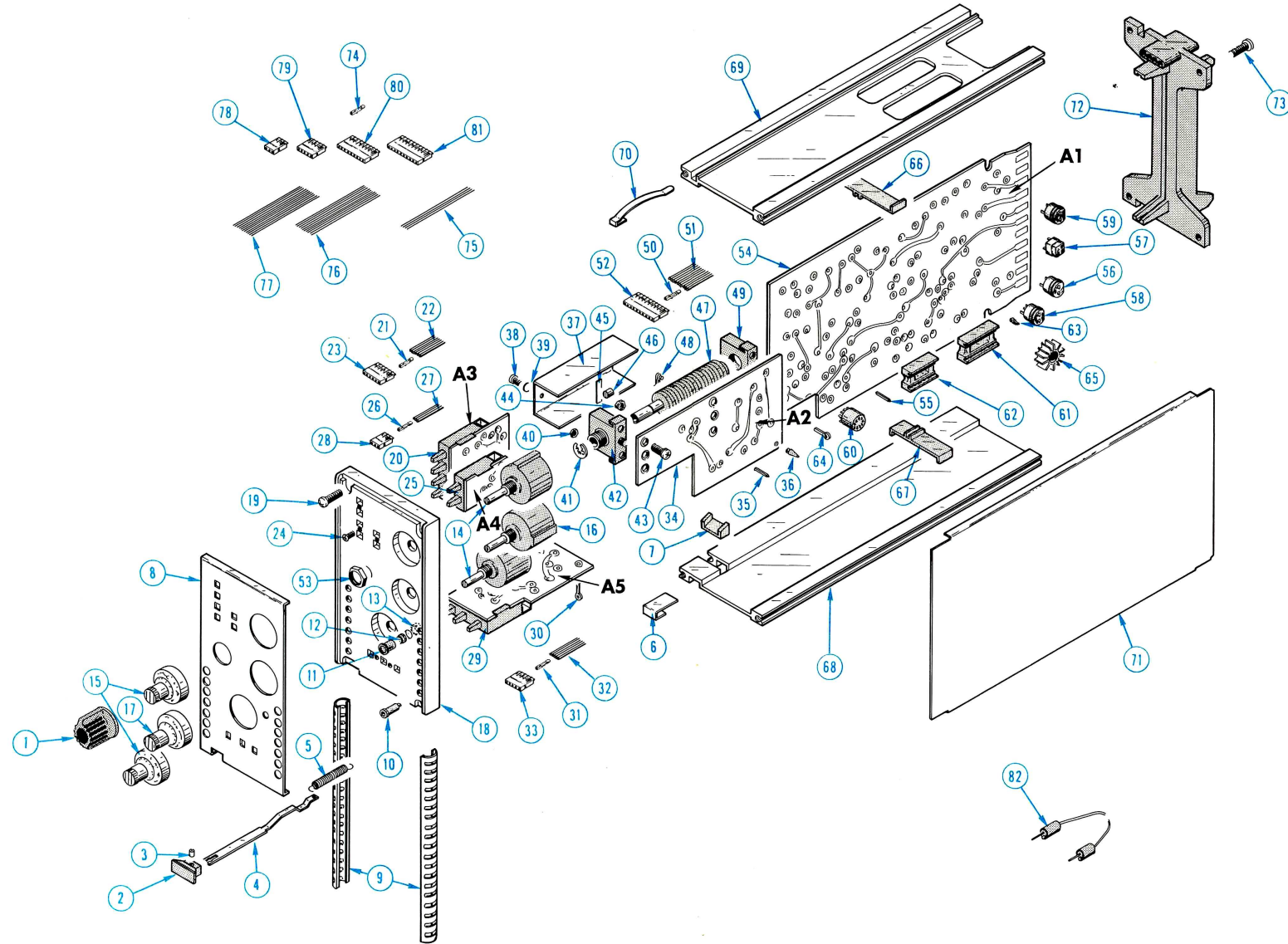
Ⓐ

AI PLUG-IN CONNECTOR & REGULATORS ③ hq 0970

PLUG-IN CONNECTOR & REGULATORS ③

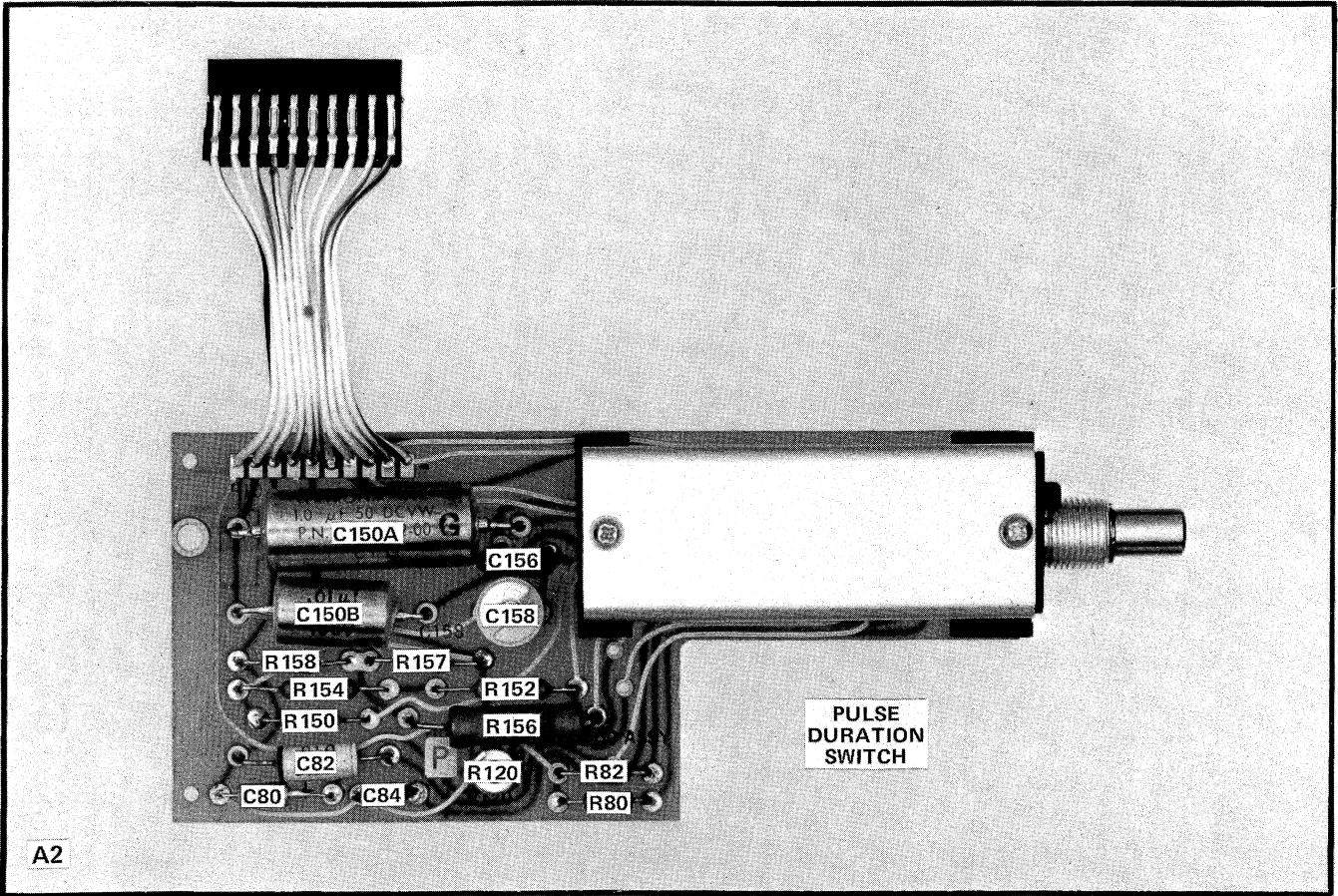
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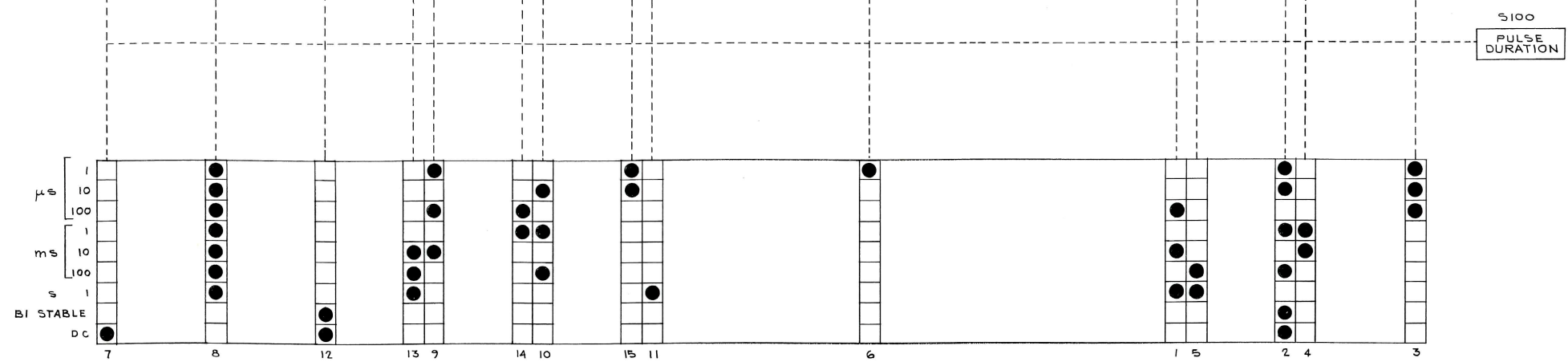
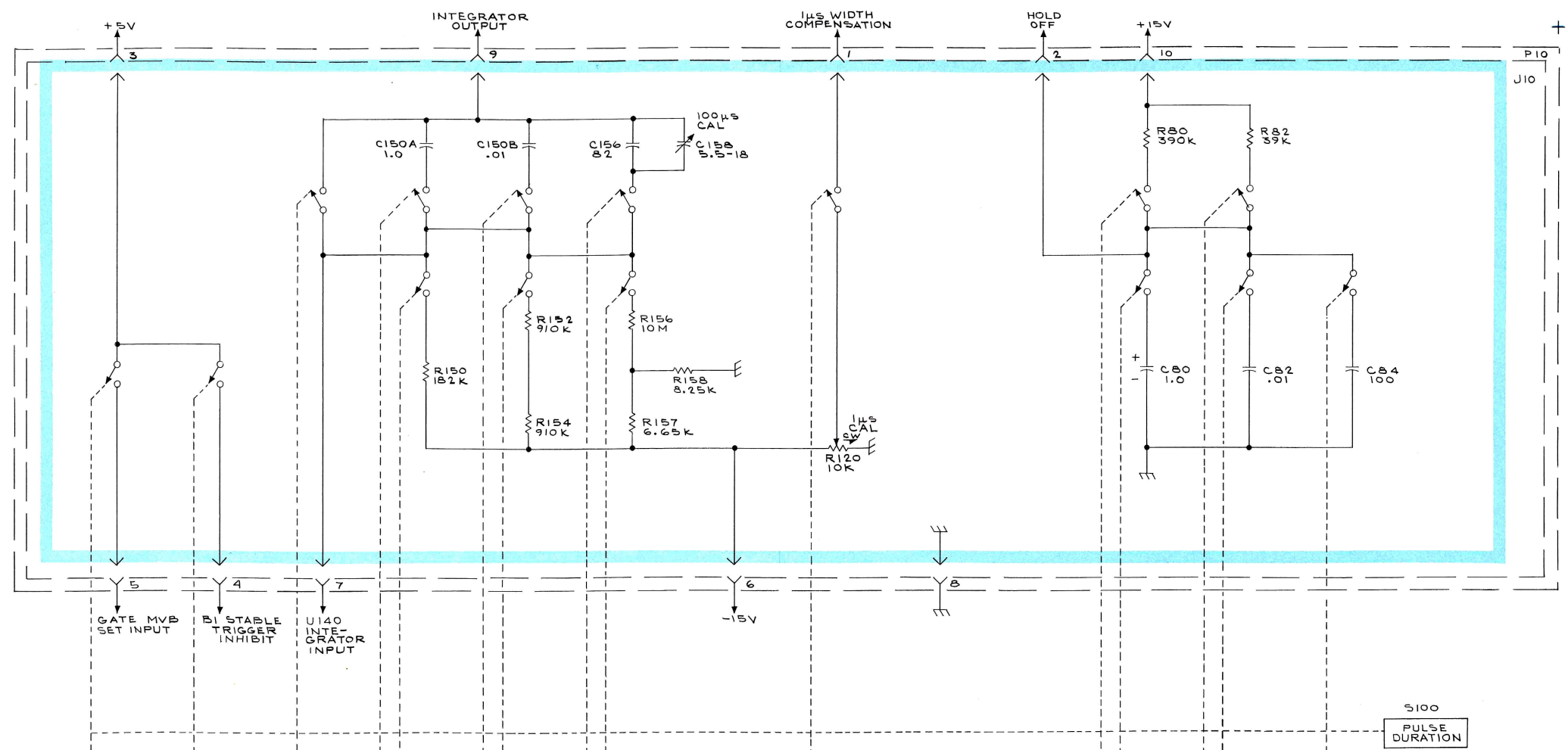
FIG. 1 EXPLODED &
STANDARD ACCESSORIES



26G3 PULSE GENERATOR

+





26G3

(A)

A2 PULSE DURATION SWITCH 4

+

CARTON ASSEMBLY
(Part No. 065-0138-00)

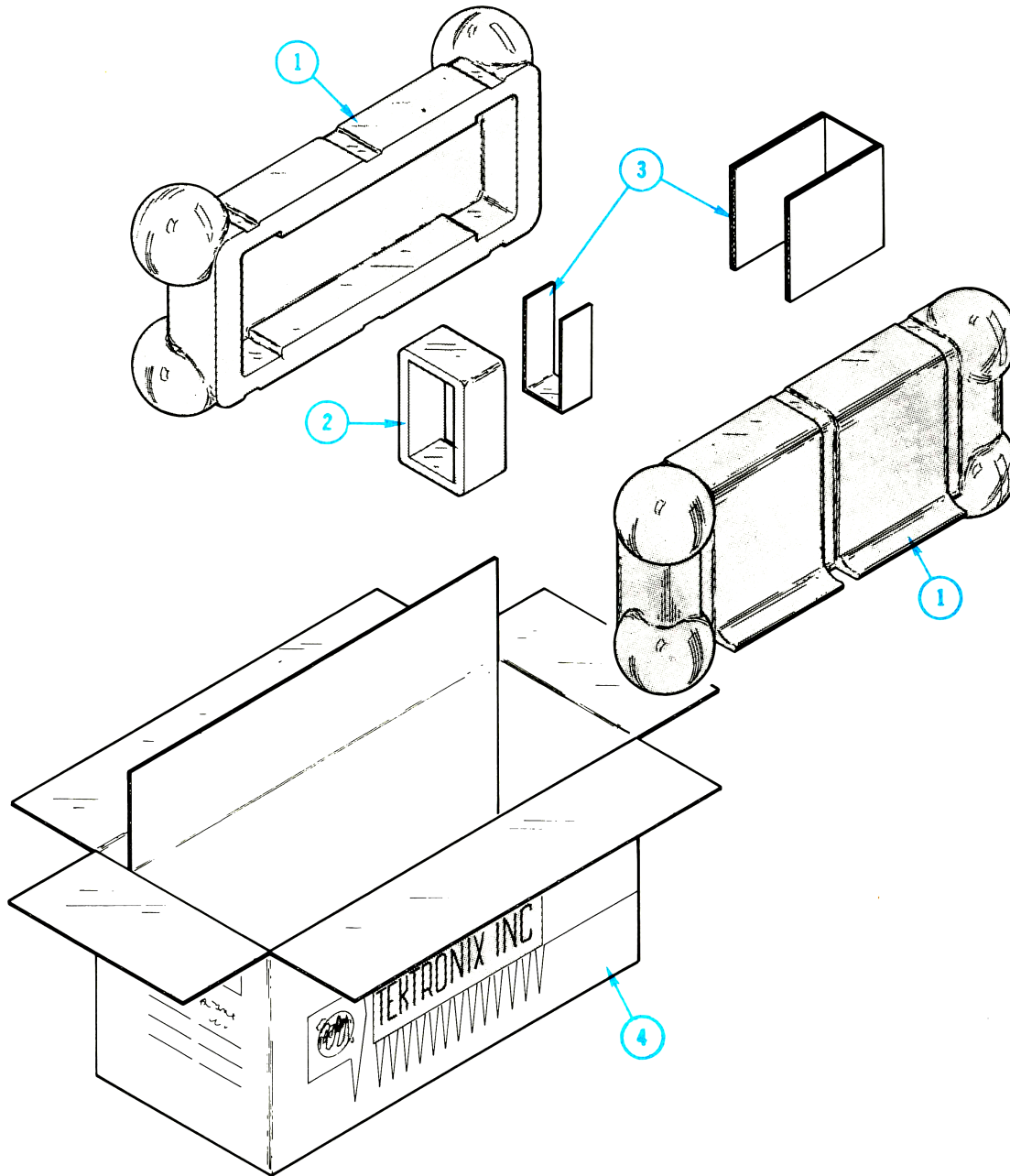


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q t y	Description					Ⓐ
					1	2	3	4	5	
2-	065-0138-00			1	CARTON ASSEMBLY					
	- - - - -			-	carton assembly includes:					
-1	004-0241-00			2	CASE HALF					
-2	004-0243-00			1	END CAP, front					
-3	004-1079-00			1	PAD SET, 2 piece					
-4	004-0748-00			1	CARTON					

26G3 PULSE GENERATOR

Ⓐ +

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear either on the back of the diagrams or on pullout pages immediately following the diagrams of the instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicated item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL AND REPACKAGING PARTS ILLUSTRATIONS

Title	Location (reverse side of)
Figure 1 Exploded & Stand. Access.	Plug-in Connector & Regulators Diagram
Figure 2 Repackaging	Pulse Duration Switch Diagram

SECTION 8

MECHANICAL PARTS LIST

FIGURE 1 EXPLODED & STANDARD ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q					Description	
				t	y	1	2	3		4
1-1	366-1028-00			1						1 KNOB, gray—PULSE DURATION
	- - - - -			-						knob includes:
	213-0153-00			2						2 SETSCREW, 5-40 x 0.125 inch, HSS
-2	366-1058-18			1						1 KNOB, latch
	- - - - -			-						mounting hardware: <i>(not included w/knob)</i>
-3	214-1095-00			1						1 PIN, spring, split
-4	105-0075-00			1						1 RELEASE BAR, latch
-5	214-1280-00			1						1 SPRING, helical compression
-6	214-1054-00			1						1 SPRING, flat, latch detent
-7	105-0076-00			1						1 BOLT, latch, plastic
-8	333-1297-00			1						1 PANEL, front
-9	348-0235-00			2						2 SHIELDING GASKET, electrical
-10	136-0387-00			14						14 SOCKET, 1 pin
-11	352-0157-00			1						1 HOLDER, lamp
-12	378-0602-00			1						1 LENS, indicator light
-13	200-0935-00			1						1 CAP, lamp holder
-14	- - - - -			2						2 RESISTOR, variable
	- - - - -			-						mounting hardware for each: <i>(not included w/resistor)</i>
-15	331-0247-00			1						1 DIAL, control, 10 turn, 0.00 to 10.00
-16	- - - - -			1						1 RESISTOR, variable
	- - - - -			-						mounting hardware: <i>(not included w/resistor)</i>
-17	331-0268-00			1						1 DIAL, control, 10 turn, 1.00 to 11.00
-18	386-1447-37			1						1 SUBPANEL, front
	- - - - -			-						mounting hardware: <i>(not included w/subpanel)</i>
-19	213-0192-00			4						4 SCREW, thread forming, 6-32 x 0.50 inch, Fil HS

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q					Description	
				t	y	1	2	3		4
-20	670-1210-00			1						CIRCUIT BOARD ASSEMBLY—TRIGGER SELECTOR A3
				-						circuit board assembly includes:
-21	131-0707-00			12						CONNECTOR, terminal
-22	175-0829-00			ft						WIRE, electrical, 6 wire ribbon, 0.458 foot long
-23	352-0164-07			1						HOLDER, terminal connector 6 wire (violet)
	352-0164-09			1						HOLDER, terminal connector, 6 wire (white)
	380-0155-00			1						HOUSING, light, 4 button
				-						mounting hardware: (not included w/housing)
	213-0181-00			1						SCREW, thread forming, #2 x 0.375 inch, PHS
				-						mounting hardware: (not included w/circuit board assembly)
-24	211-0156-00			2						SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-25	670-1211-00			1						CIRCUIT BOARD ASSEMBLY—SLOPE A4
				-						circuit board assembly includes:
-26	131-0707-00			3						CONNECTOR, terminal
-27	175-0826-00			ft						WIRE, electrical, 3 wire ribbon, 0.229 foot long
-28	352-0161-08			1						HOLDER, terminal connector, 3 wire (gray)
	380-0152-00			1						HOUSING, light, 2 button
				-						mounting hardware: (not included w/housing)
	213-0181-00			1						SCREW, thread forming, #2 x 0.375 inch, PHS
				-						mounting hardware: (not included w/circuit board assembly)
	211-0156-00			1						SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-29	670-1212-00			1						CIRCUIT BOARD ASSEMBLY—AMPLITUDE RANGE A5
				-						circuit board assembly includes:
-30	214-0579-00			4						PIN, test point
-31	131-0707-00			5						CONNECTOR, terminal
-32	175-0828-00			ft						WIRE, electrical, 5 wire ribbon, 0.271 foot long
-33	352-0163-02			1						HOLDER, terminal connector, 6 wire (red)
	380-0154-00			1						HOUSING, light, 3 button
				-						mounting hardware: (not included w/housing)
	213-0181-00			1						SCREW, thread forming, #2 x 0.375 inch, PHS
				-						mounting hardware: (not included w/circuit board assembly)
	211-0156-00			2						SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-34	670-0336-00			1						CIRCUIT BOARD ASSEMBLY—PULSE DURATION A2
				-						circuit board assembly includes:
	388-1645-00			1						CIRCUIT BOARD
-35	131-0608-00			10						TERMINAL, pin, 0.365 inch long
-36	386-1556-00			2						SUPPORT, circuit board
-37	200-1111-00			1						COVER, cam switch
				-						mounting hardware: (not included w/cover)
-38	211-0079-00			2						SCREW, 2-56 x 0.188 inch, PHS
-39	210-0001-00			2						WASHER, lock, internal, #2
-40	210-0405-00			2						NUT, hex., 2-56 x 0.188 inch

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q					Description	
				t	y	1	2	3		4
-41	354-0219-00			1						RING, retaining
-42	401-0053-00			1						BEARING, cam switch, front, w/bushing
	- - - - -			-						mounting hardware: (not included w/bearing)
-43	211-0116-00			2						SCREW, sems, 4-40 x 0.312 inch, PHB
-44	210-0591-00			2						NUT, hex., 4-40 x 0.188 inch
-45	214-1126-00 ¹			-						SPRING, flat, gold
	214-1126-01 ¹			-						SPRING, flat, green
	214-1126-02 ¹			-						SPRING, flat, red
-46	214-1127-00			1						ROLLER, detent
-47	105-0208-00			1						DRUM, cam switch—PULSE DURATION
-48	131-0604-00			15						CONTACT, electrical
-49	401-0061-00			1						BEARING, cam switch, rear
	- - - - -			-						mounting hardware: (not included w/bearing)
	211-0116-00			2						SCREW, sems, 4-40 x 0.312 inch, PHB
	210-0591-00			2						NUT, hex., 4-40 x 0.188 inch
-50	131-0707-00			10						CONNECTOR, terminal
-51	175-0833-00			ft						WIRE, electrical, 10 wire ribbon, 0.208 foot long
-52	352-0168-00			1						HOLDER, terminal connector, 10 wire (black)
	- - - - -			-						mounting hardware: (not included w/circuit board assembly)
-53	210-0590-00			1						NUT, hex., 0.375-32 x 0.438 inch
-54	670-1204-00			1						CIRCUIT BOARD ASSEMBLY—MAIN A1
	- - - - -			-						circuit board assembly includes:
	388-1553-00			1						CIRCUIT BOARD
-55	131-0608-00			58						TERMINAL, pin
-56	136-0183-00			5						SOCKET, transistor, 3 pin
-57	136-0220-00			25						SOCKET, transistor, 3 pin, square
-58	136-0235-00			2						SOCKET, transistor, 6 pin
-59	136-0237-00			1						SOCKET, transistor, 8 pin
-60	136-0241-00			1						SOCKET, integrated circuit, 10 pin
-61	136-0260-01			1						SOCKET, integrated circuit, 16 pin
-62	136-0269-00			3						SOCKET, integrated circuit, 14 pin
-63	136-0399-00			24						SOCKET, terminal
-64	214-0579-00			10						PIN, test point
-65	214-1291-00			1						HEAT SINK, transistor
	- - - - -			-						mounting hardware: (not included w/circuit board assembly)
-66	344-0210-00			2						CLIP, spring tension, plastic, top
-67	344-0211-00			2						CLIP, spring tension, plastic, bottom
-68	426-0628-00			1						FRAME SECTION, bottom
-69	426-0629-00			1						FRAME SECTION, top
-70	210-1061-00			1						SPRING, flat, sliding ground
-71	337-1316-00			2						SHIELD, electrical

¹Replace only with part bearing the same color as the original part in your instrument

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Disc	Q t y	Description				
				1	2	3	4	5
-72	386-1402-00		1	PANEL, rear				
	- - - - -		-	mounting hardware: <i>(not included w/panel)</i>				
-73	213-0192-00		4	SCREW, thread forming, 6-32 x 0.50 inch, Fil HS				
-74	131-0707-00		44	CONNECTOR, terminal				
-75	175-0826-00		ft	WIRE, electrical, 3 wire ribbon, 1.646 feet long				
-76	175-0832-00		ft	WIRE, electrical, 9 wire ribbon, 0.458 foot long				
-77	175-0833-00		ft	WIRE, electrical, 10 wire ribbon, 0.334 foot long				
-78	352-0161-03		1	HOLDER, terminal connector, 3 wire <i>(orange)</i>				
	352-0161-04		1	HOLDER, terminal connector, 3 wire <i>(yellow)</i>				
	352-0161-05		1	HOLDER, terminal connector, 3 wire <i>(green)</i>				
-79	352-0163-02		1	HOLDER, terminal connector, 5 wire <i>(red)</i>				
-80	352-0167-01		1	HOLDER, terminal connector, 9 wire <i>(brown)</i>				
-81	352-0168-06		1	HOLDER, terminal connector, 10 wire <i>(blue)</i>				

STANDARD ACCESSORIES

-82	012-0200-00		2	PATCH CORD, pinjack to pinjack <i>(red)</i>				
	012-0201-00		2	PATCH CORD, pinjack to pinjack <i>(blue)</i>				
	012-0202-00		1	PATCH CORD, pinjack to pinjack <i>(black)</i>				
	070-1067-00		1	MANUAL, instruction <i>(not shown)</i>				

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.