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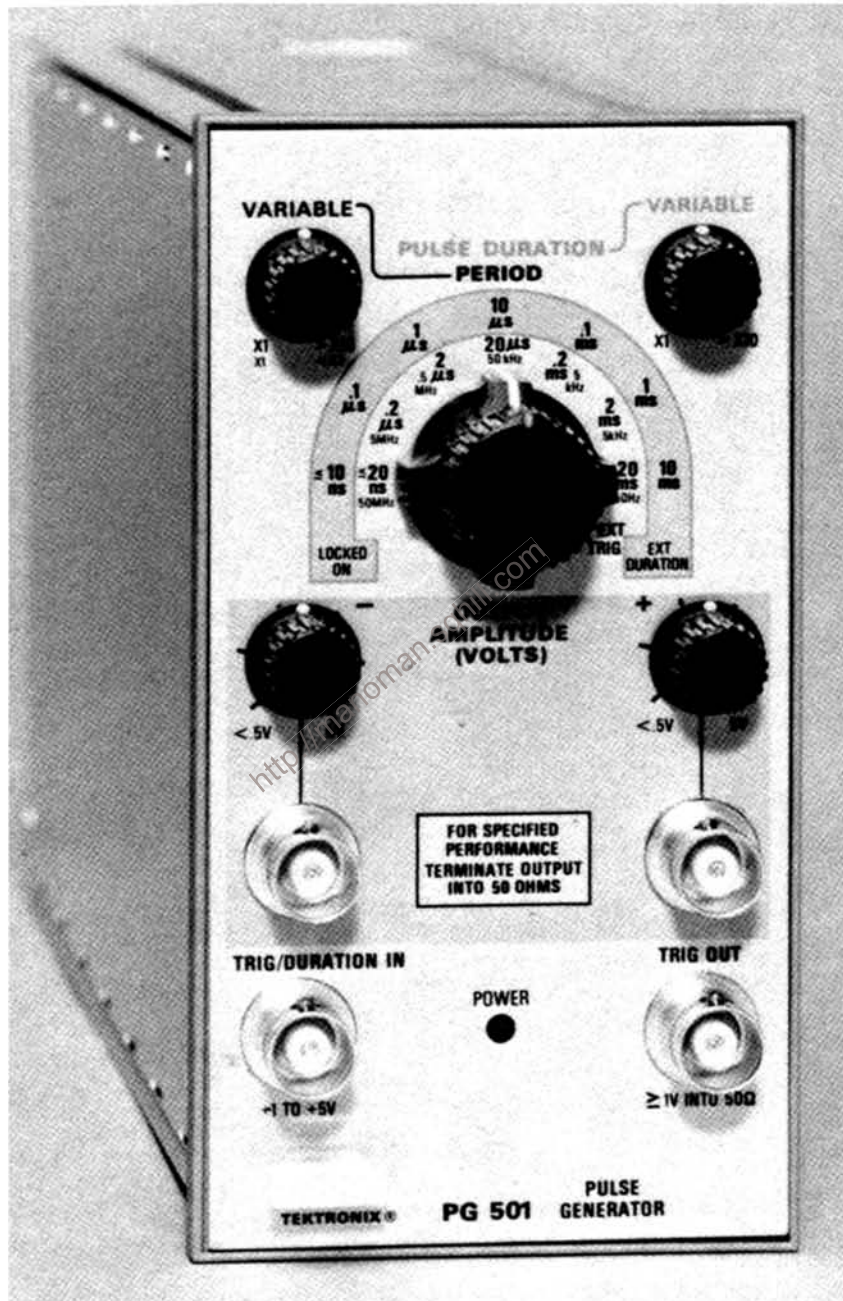
PULSE GENERATOR

PG 501

INSTRUCTION MANUAL

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SECTION 1 OPERATING INSTRUCTIONS

INSTRUMENT DESCRIPTION

The PG 501 Pulse Generator is designed to operate in a TM 500 Series Power Module. The generator provides simultaneous positive and negative 50 MHz output pulses with 5 ns rise and fall times and independently variable amplitudes from 0.5 V to 5 V. Front panel controls provide calibrated decade selection of pulse period from 20 ns to 20 ms and duration from 10 ns to 10 ms. Uncalibrated pulse period from 20 ns to 0.2 s and duration from 10 ns to 0.1 s can be obtained with the variable controls.

In addition to the normal pulse output mode, a locked-on mode is provided which holds the outputs at a selected DC level. Also included is an output gated mode which ties an external trigger input at the front panel to the outputs. A trigger output that occurs approximately 10 ns prior to the normal pulse output is available at the front panel.

PREPARATION FOR USE

Introduction

The PG 501 is calibrated and ready for use when received. It is designed to operate in any compartment of a TM 500 Series Power Module only. Refer to the Power Module Instruction Manual for line voltage requirements and Power Module operation.

Installation and Removal

1. Install by aligning the upper and lower rails on the PG 501 with the Power Module tracks and inserting until the plug-in panel is flush with the Power Module panel.

2. Remove by pulling the release latch at the bottom of the PG 501 front panel and sliding the plug-in straight out of the Power Module.

Turn-On Procedure

1. Check that the PG 501 is fully inserted into the Power Module.
2. Pull the PWR switch on the Power Module to apply power to the PG 501. Check that the POWER indicator on the PG 501 front panel comes on.

CAUTION

Turn the Power Module off before inserting the plug-in; otherwise, damage may occur to the plug-in circuitry.

3. Refer to the Front-Panel Controls, Connectors, and Indicators description on the Controls and Adjustments foldout page in Section 3.

OPERATING CONSIDERATIONS

Output Connections

The output of the PG 501 operates as a voltage source behind 50 Ω and works into a 50 Ω load. An unterminated or improperly terminated output will cause excessive aberrations on the output pulse (see Impedance Matching). Loads less than 50 Ω will reduce the pulse amplitude.

Pulse characteristics can be preserved by observing the following precautions:

1. Use high quality 50 Ω coaxial cables and connectors.
2. Make all connections tight and as short as possible.

3. Use high quality attenuators, if necessary, to reduce the pulse amplitude to sensitive circuits.
4. Use terminators or impedance matching devices to avoid reflections.
5. Insure that attenuators, terminations, etc., have adequate power handling capabilities for the output pulse (approximately 0.5 watt into a 50 Ω load). Power output is determined by the duty factor of output pulse current.

Risetime and Faltime

If the output pulse from the PG 501 is used for measuring the rise or falltime of a device, the risetime characteristics of associated equipment may have to be considered. If the risetime of the device under test is at least 10 times longer than the combined risetimes of the PG 501 plus the monitoring oscilloscope and associated cables, the error introduced will not exceed 1% and generally can be ignored. If the rise or falltime of the test device, however, is less than 10 times as long as the combined risetimes of the testing system, the actual risetime of the device will have to be determined from the risetime of each component making up the system. This equals the square root of the sum of the squares of the individual risetimes. Conversely, the risetime of the device under test can be found from the same relationship if the actual risetimes in the system are known except that of the device under test.

The physical and electrical characteristics of the pulse transmitting cable determine the characteristic impedance, velocity of propagation, and amount of signal loss. Signal loss, due to energy dissipation in the cable dielectric, is proportional to the frequency; therefore, a few feet of cable can attenuate high frequency information in a fast-rise pulse. It is important, therefore, to keep these cables as short as possible.

When signal comparison measurements or time difference determinations are made, the two signals from the test device should travel through coaxial cables with identical loss and time delay characteristics.

If there is a DC voltage across the output load, the output pulse amplitude will be compressed, or in some cases, if the voltage exceeds ±10 V, it may short the output. To prevent this from occurring, the output must be coupled through a DC blocking capacitor to the load. The time constant of the coupling capacitor and load must be long enough to maintain pulse flatness.

Impedance Matching

A mismatch, or different impedance in a transmission line, generates a reflection back along the line to the source. The amplitude and polarity of the reflections are determined by the load impedance in relation to the characteristic impedance of the cable. If the load impedance is higher than the characteristic impedance of the line, the reflection will be of the same polarity as the applied signal, if it is lower, the reflection will be of opposite polarity.

If the reflected signal returns before the pulse is ended it adds to or subtracts from the amplitude of the pulse. This distorts the pulse shape and amplitude. The following describes methods for matching impedance networks into relatively low impedances. If the PG 501 is driving a high impedance, such as the 1 MΩ input impedance of the vertical input for an oscilloscope, the transmission line should be terminated into a X10 50 Ω attenuator and 50 Ω termination at the oscilloscope input. The attenuator isolates the input capacity of the oscilloscope. Distortion can be caused by this input capacity.

A simple resistive impedance-matching network, that provides minimum attenuation, is illustrated in Fig. 1-1. To match impedances with the illustrated network, the following conditions must exist:

$$\frac{(R_1 + Z_2)R_2}{R_1 + Z_2 + R_2} \text{ must equal } Z_1$$

and

$$R_1 + \frac{Z_1 R_2}{Z_1 + R_2} \text{ must equal } Z_2$$

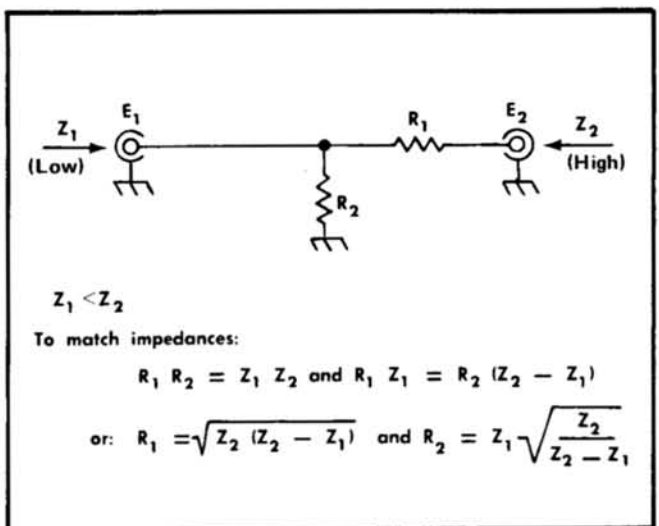


Fig. 1-1. Impedance matching network that provides minimum attenuation.

Therefore:

$$R_1 R_2 = Z_1 Z_2; \text{ and } R_1 Z_1 = R_2 (Z_2 - Z_1)$$

$$\text{or } R_1 = \sqrt{Z_2(Z_2 - Z_1)}$$

$$\text{and } R_2 = Z_1 \sqrt{\frac{Z_2}{Z_2 - Z_1}}$$

For example; to match a 50 Ω system to a 125 Ω system, Z₁ equals 50 Ω and Z₂ equals 125 Ω.

Therefore:

$$R_1 = \sqrt{125(125 - 50)} = 96.8 \text{ ohms}$$

$$\text{and } R_2 = 50 \sqrt{\frac{125}{125 - 50}} = 64.6 \text{ ohms}$$

When constructing such a device, the environment surrounding the components should also be designed to provide a transition between the impedances. Keep in mind that the characteristic impedance of a coaxial device is determined by the ratio between the outside diameter of the inner conductor to the inside diameter of the outer conductor

$$Z_0 = \frac{138}{\sqrt{e}} \log_{10} D/d$$

where e is the relative dielectric constant, D is the inside diameter of the outer conductor and d is the diameter of the inner conductor (e_{air} = 1).

Though the network in Fig. 1-1 provides minimum attenuation for a purely resistive impedance-matching device, the attenuation as seen from one end does not equal that seen from the other end. A signal (E₁) applied from the lower impedance source encounters a voltage attenuation (A₁) which is greater than 1 and less than 2, as follows:

$$A_1 = \frac{E_1}{E_2} = \frac{R_1}{Z_2} + 1$$

A signal (E₂) applied from the higher impedance source (Z₂) encounters a greater voltage attenuation (A₂) which is greater than 1 and less than 2 (Z₂/Z₁):

$$A_2 = \frac{E_2}{E_1} = \frac{R_1}{R_2} + \frac{R_1}{Z_1} + 1$$

In the example of matching 50 Ω to 125 Ω,

$$A_1 = \frac{96.8}{125} + 1 = 1.77$$

and

$$A_2 = \frac{96.8}{64.6} + \frac{96.8}{50} + 1 = 4.43$$

The illustrated network can be modified to provide different attenuation ratios by adding another resistor (less than R₁) between Z₁ and the junction of R₁ and R₂.

OPERATING MODES

Normal

In the normal mode, the period generator free runs at the rate set by the PERIOD selector and VARIABLE control. The duration of the output pulse (see Definitions of Pulse Characteristics) is set by the DURATION selector and its associated VARIABLE control. Amplitude is set by the + and - OUTPUT AMPLITUDE controls. The PERIOD and DURATION selectors are mechanically coupled so the duty factor cannot exceed 50% with the VARIABLE controls in the X1 position.

Output Locked On

When the DURATION selector is in the LOCKED ON position, the + and - output remain locked at a DC level selected by the OUTPUT AMPLITUDE controls (<0.5 V to 5 V).

External Trigger

The period generator is disabled when the PERIOD selector is in the EXT TRIG position. An external positive-going trigger signal at least 1 V in amplitude applied to the TRIG/DURATION IN connector will trigger the duration generator. The duration of the output pulse is variable with the front-panel DURATION selector while period is dependent on the triggering signal frequency (see Fig. 1-2). The triggering signal must remain below +100 mV for 10 ns to reset the generator for the next trigger.

If the input trigger contains a DC component which prevents it from moving within the +1 V turn on and +100 mV reset levels, the trigger should be capacitively coupled. The time constant of the coupling network should be sufficient to obtain the full frequency capabilities of the instrument.

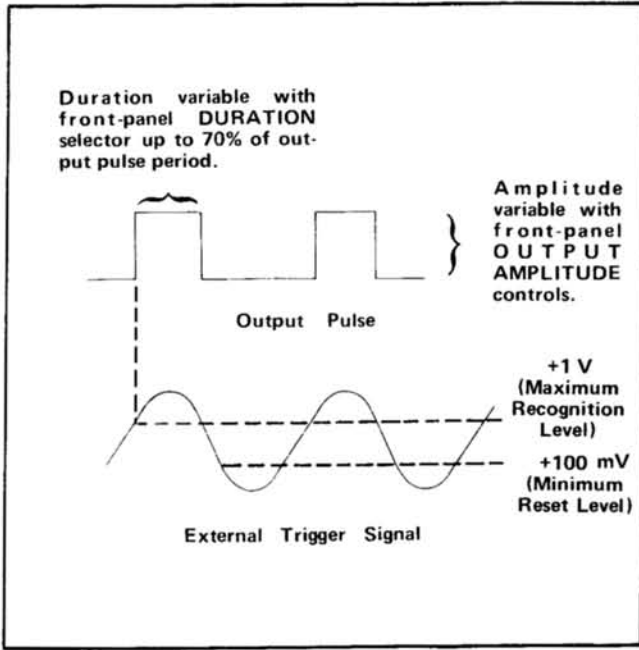


Fig. 1-2. External trigger signal vs output pulse in EXT TRIG mode.

External Duration

When the DURATION selector is in the EXT DURATION position, the period generator is disabled. The outputs can then be turned on by applying a positive-going signal to the TRIG/DURATION IN connector. The outputs will turn on when the external signal amplitude reaches +1 V and turn off when the signal amplitude drops to the +100 mV lower threshold. The period and duration of the output pulses is dependent on the period and duration of the external signal (see Fig. 1-3).

If the external signal contains a DC component which prevents it from moving within the +1 V turn on level and

+100 mV lower threshold, the external signal should be capacitively coupled. The time constant of the coupling network should be long enough so the external remains above the turn-on level ($\approx +1$ V) for its entire duration.

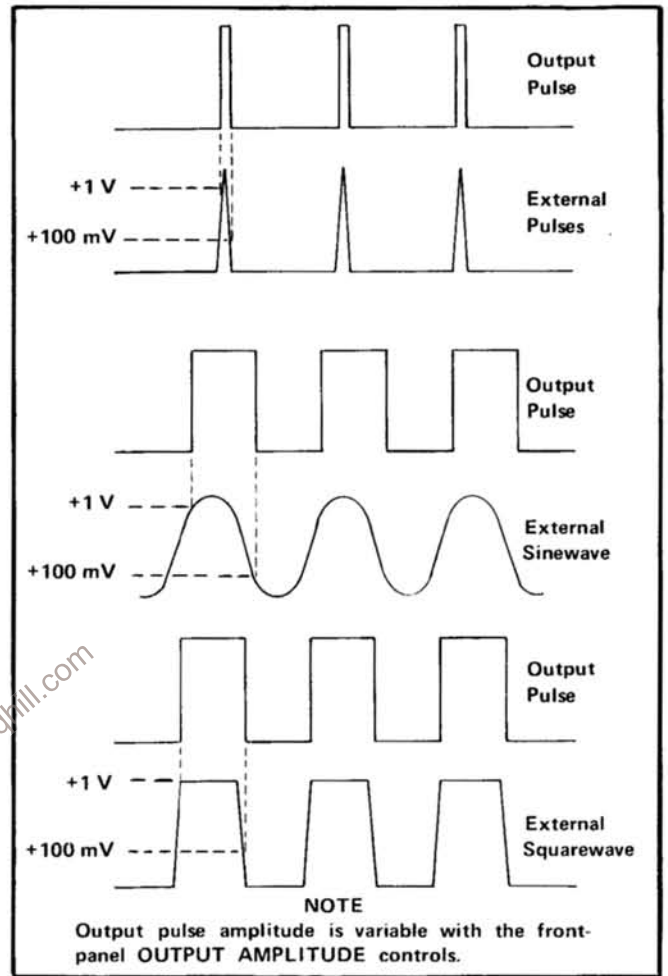


Fig. 1-3. External gating signals vs output pulses in EXT DURATION mode.

FUNCTIONS AVAILABLE AT REAR CONNECTOR

Pretrigger Output

Rear connector pins 27B and 28A (with grounds on pins 27A and 28B) provide a buffered pretrigger signal that occurs approximately 10 ns before the normal output pulse. The pretrigger signal is approximately 1 V from 27 Ω with period determined by the PERIOD selector setting.

Averaged Amplitude Output

Rear connector pin 25A (with ground on pin 26A) provides an averaged amplitude output which is internally

selected by the Amplitude Monitor Switch, S150, (+, OFF, and -).

External Trigger Input

An external trigger signal can be applied through the rear connector by connecting an appropriate length of coaxial cable to pins 24B (center conductor) and 25B (ground). Connect the opposite end of the cable to the point on the circuit board where the cable from the front-panel TRIG/DURATION IN is connected. The external trigger input to the rear connector is then in parallel with the front-panel TRIG/DURATION IN.

Other Functions Available

Unassigned pins are available at the rear connector for routing signals to and from the PG 501 for specialized appli-

cations (see Rear Connector Pin Assignments in Section 3). One or more compartments of a multi-plug-in Power Module can be wired with barriers installed to provide specific functions between compartments. See Power Module instruction manual for additional information.

DEFINITIONS OF PULSE CHARACTERISTICS

The following is a glossary of common pulse characteristics used in this manual. They are also illustrated in Fig. 1-4.

Amplitude—The maximum absolute peak value of a pulse, regardless of sign excluding unwanted aberrations or overshoot, from the zero axis. Measured between a point that is 50% of the pulse duration (pulse top) to a baseline reference that is 50% of the off time (pulse period minus pulse duration).

Aberration—Unwanted deviations or excursions in the pulse shape from an ideal square corner and flat top, i.e., overshoot, undershoot or rounding, ringing, and tilt or slope.

Baseline—The quiescent DC voltage reference level of the pulse waveform.

Duty Factor—Sometimes referred to as duty cycle. The ratio of pulse duration to period or the product of pulse duration and pulse repetition rate. $\text{Duty Factor \%} = \text{Duration/Period} \times 100$.

Falltime—The time interval, at the pulse trailing edge, for the pulse amplitude to fall from the 90% amplitude level to the 10% amplitude level.

Flatness—The absence of long term variations to the pulse top; excluding overshoot, ringing or pulse rounding. Sometimes referred to as tilt or slope.

Overshoot—The short term pulse excursion (or transient) above the pulse top or below the baseline; which is simultaneous to the leading and trailing edge of the pulse.

Period—The time interval for a full pulse cycle. Inverse of frequency or repetition rate. Interval between corresponding pulse amplitudes of two consecutive undelayed or delayed pulses. Generally measured between the 50% amplitude levels of two consecutive pulses.

Preshoot—A transient excursion which precedes the step function. It may be of the same or opposite polarity as the pulse.

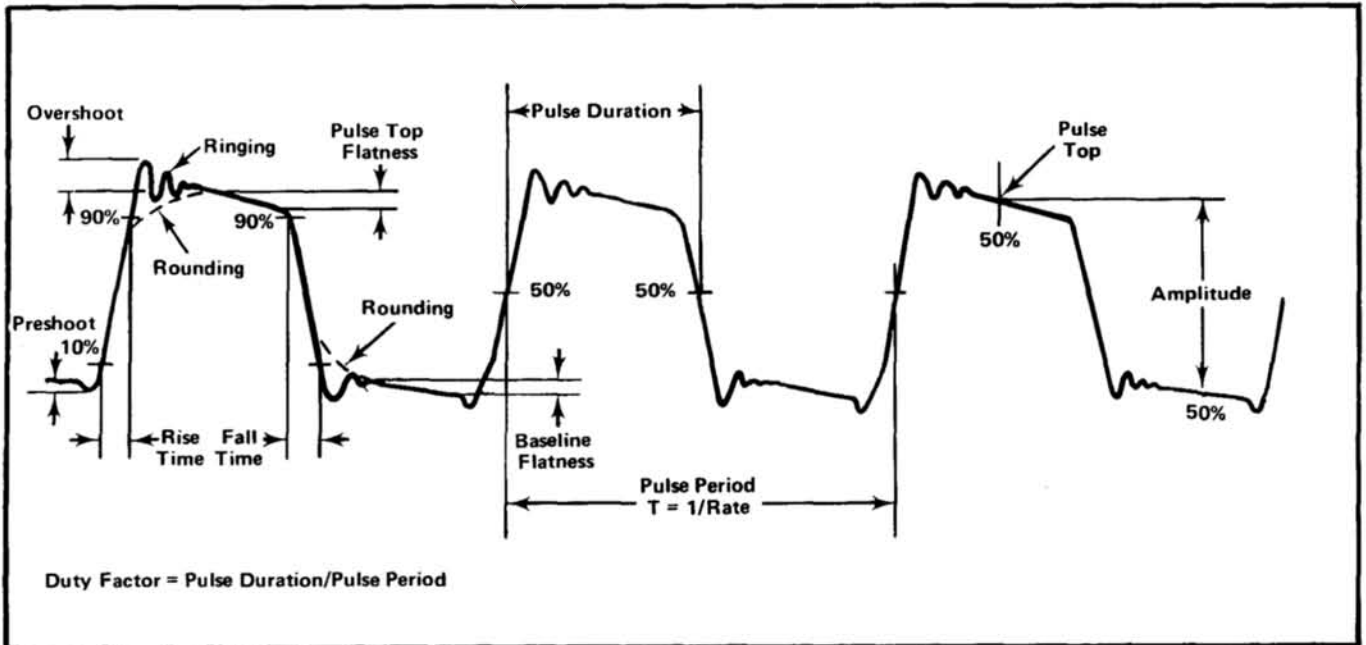


Fig. 1-4. Pulse characteristics.

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Pulse Duration—The time interval between the leading and trailing edge of a pulse at which the instantaneous amplitude reaches 50% of the peak pulse amplitude.

Polarity—The direction from the baseline of the pulse excursion. Either positive-going (+) or negative-going (—).

Ringings—Periodic aberrations that dampen in time, following the overshoot.

Risetime—The time interval, at the step function leading edge, for the pulse to rise from the 10% to 90% amplitude levels.

Rounding or Undershoot—The rounding of the pulse corners at the edges of a step function.

Tilt or Slope—A distortion of an otherwise flat-topped pulse, characterized by either a decline or a rise of the pulse top. (See Flatness).

ELECTRICAL CHARACTERISTICS

Performance Conditions

The electrical characteristics are valid only if the PG 501: (1) has been calibrated at an ambient temperature between +20°C and +30°C, (2) is operating at an ambient temperature between 0°C and +50°C unless otherwise noted and (3) outputs are terminated into a 50 Ω load.

NOTE

Definitions of some of the more common pulse characteristics specified here are described and illustrated under Definitions of Pulse Characteristics.

PULSE PERIOD: 20 ns or less to 20 ms (within 5% from 0.2 μs to 2 ms and within 15% at 20 ms) in decade steps with the VARIABLE control fully ccw (X1). VARIABLE extends period to at least 0.2 s in full cw position (>X10).

PULSE DURATION: 10 ns or less to 10 ms (within 5% from 0.1 μs to 10 ms) in decade steps with the VARIABLE control fully ccw (X1). VARIABLE extends duration to at least 0.1 s in fully cw position (>X10).

DUTY FACTOR: At least 70% for periods of 0.2 μs or more. Duty factor decreases to 50% at 20 ns period. Minimum off time is 10 ns.

PULSE RISETIME AND FALLTIME: 3.5 ns or less from 2 V to at least 5 V into a 50 Ω load.

ABERRATIONS (see Fig. 1-4): Within 3.5% at 5 V pulse amplitude.

PULSE AMPLITUDE: 0.5 V or less to at least 5 V into 50 Ω load.

PULSE COINCIDENCE (+ and — Outputs): Leading edge of pulse outputs within 1 ns of each other (measured at 50% amplitude points).

TRIGGER OUTPUT: At least 1 V into 50 Ω load occurring approximately 8 ns prior to pulse output.

EXTERNAL TRIGGER DURATION INPUT: At least 1 V not to exceed +5 V (DC + peak AC). Trigger/Duration Recognition Level +1 V or less. Trigger/Duration Reset Level +100 mV or less. Minimum On and Off Time 10 ns (measured at 50% amplitude points).

SECTION 2

THEORY OF OPERATION

Introduction

The following is a brief discussion of the basic operation of the major circuits in the PG 501. The simplified block diagram in Fig. 2-1 and detailed schematic diagrams on foldout pages at the back of this manual are provided to aid in understanding this discussion.

Period Generator

Period generator U30B operates as an astable multivibrator in the normal pulse output mode. Multivibrator frequency is determined by the feedback resistance and capacitance switched (by the PERIOD cam switch S30A) between the gate input, pin 10, and the inverting, non-inverting outputs at pins 6 and 7 respectively. When pin 7 is high, pin 6 is low (below the level at pin 10). Therefore, current is pulled from pin 10 through the feedback resistance (selected by the PERIOD cam switch S30A) between pins 6 and 10. The feedback capacitor (selected by PERIOD cam switch S30A) then discharges through the feedback resistance until the threshold level of gate U30B is reached. At this point, pin 7 starts to go low. Due to positive feedback through the timing capacitor, pin 10 is forced below its switching level. Pin 6 abruptly switches high. Voltage at pin 6 is now above that at pin 10 which causes current to reverse through the feedback resistors and forces current into the timing capacitor. Voltage at the gate input, pin 10, rises until the gate again reaches the threshold level from the negative direction. As pin 7 starts its transition to the high state, positive feedback causes pin 10 to be drawn high. Pin 6 goes low and U30B has thus completed a switching cycle. The period of oscillation is dependent on the RC time constant of the feedback network selected by the front-panel PERIOD selector S30A and PERIOD VARIABLE control R38. Period Cal potentiometer R23 calibrates the output pulse period. Resistors R26 and R37 are external pull-down resistors for the integrated circuit gate outputs.

Trigger and Trigger Output Amplifiers

The outputs from pins 6 and 7 of U30B are fed to transistors Q40 and Q42 which comprise the trigger amplifier. The collector of Q42 is tied through trigger-shaping capacitor C42, then through resistor network

R44/R45/R65 which establishes the threshold level for the trigger signal applied to pin 12 of integrated circuit U30C in the duration generator. Also, a trigger signal from the collector of Q40 is applied to the base of Q52 in the trigger output amplifier. Transistors Q50 and Q52 comprise the trigger output amplifier circuit which operates as a current mode switch with the base of Q50 biased at a DC level established by resistor network R48/R50/R52. Resistor R48 also drops the voltage to the collectors of Q40 and Q42.

The collector of Q52 produces the trigger signal available at the front-panel TRIG OUT connector. Transistor Q50 produces the internal trigger signal which is available at pins 27B and 28A at the PG 501 rear connector.

Duration Generator

The trigger signal from the collector of Q42 in the trigger amplifier is fed to pin 12 of U30C which causes the non-inverting output at pin 15 to go high and pin 14 to go low. Pin 13 is also pulled high through R67 and C67. Integrated circuit U30C is then latched.

Diode CR69 is biased off when pin 14 went low, and, since the base of Q80 went high with pin 15, current through R77 passes through Q80 and pulls 5 V zener VR79 low. Subsequently, the base of Q82 goes low and turns Q82 off, thus allowing the timing capacitor (selected by DURATION cam switch S30B) to discharge through the timing resistor. The resultant ramp appears at the base of Q70. When the ramp voltage drops low enough, Q70 turns on and pulls down on pin 13 of U30C and causes U30C to reset. Pin 15 now goes low and pin 14 goes high. Diode CR69 is biased on turning off Q80 which allows zener VR79 to step high, turning on Q82. The timing capacitor now begins to charge through current limiting resistor R84. Thus, the duration generator is reset for the next input trigger.

Timing current is established by front-panel DURATION VARIABLE control R95 and is calibrated by Duration Cal potentiometer R90. Resistors R91, R96, and R98 are shunts that control duration range when switched in by DURATION cam switch S30B.

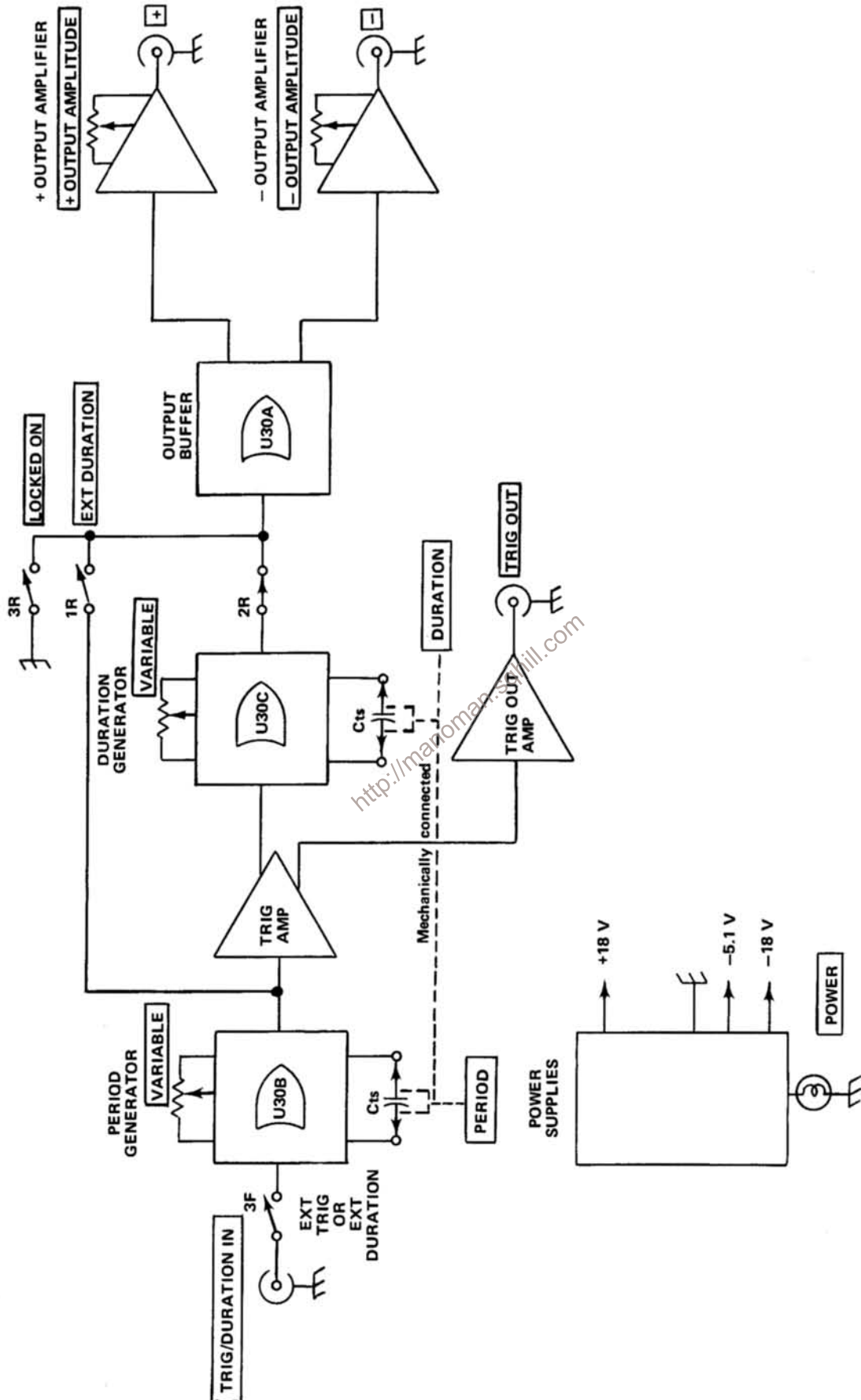


Fig. 2-1. PG 501 Simplified Block Diagram.

Output Buffer

Output buffer U30A is the third section of integrated circuit U30. As the name implies, U30A buffers and shapes the output of duration generator U30C for the output amplifiers. The output of U30A is a push-pull pulse which is applied to the base of transistors Q110 and Q115 in the + amplifier and to the base of Q150 and Q155 in the – amplifier.

Output Amplifiers

The two output amplifiers operate identically except for output polarity. The + output amplifier uses PNP transistors where the – amplifier uses NPN transistors. To complete the voltage inversion, the diodes in the + amplifier are electrically opposite of those in the – amplifier. Due to the similarity of the output amplifiers, the remainder of this discussion concerns the + output amplifier with differences mentioned where pertinent.

Transistors Q110 and Q115 comprise a current mode switch driven by output buffer U30A. This circuit also shifts the input voltage from U30C to a positive level and provides a push-pull potential at R110 and R115 to drive the bases of buffer emitter followers Q120 and Q124. Emitter followers Q120 and Q124 allow lower source impedance drive for the bases of the output driving current switch composed of Q130 and Q136. The current through Q130 and Q136 is variable with the front-panel + OUTPUT AMPLITUDE control R134. Maximum current through Q130 and Q136, thus, the maximum output amplitude at the + output connector is adjusted by + Amplitude Cal potentiometer R114. Potentiometer R114 adjusts the emitter voltage at Q130 and Q136 which changes the voltage drop across R132 and R134. At maximum output amplitude R134 is at minimum voltage drop so the current is actually set by R132, the end resistance of potentiometer R114, and the voltage difference between the +18 V supply and the emitter voltages.

Inductor L132 provides isolation from the effects of R132 on the emitters of Q130 and Q136. The collector of Q130 is tied to R130 and zener VR130 to reduce the power dissipated in Q130. The collector of Q136 drives the base of output transistor Q140. Peaking inductor L136 and load resistors R136/R137 apply a peaked signal to the base of Q140 providing flat response into 50 Ω . Output transistor Q140 is an emitter follower driving the + output connector through the 47 Ω series-parallel resistance network R143/R144/R146/R147. Capacitor C143 (+ Output Comp Set) allows the first section of the 47 Ω network to compensate for the output reactance of Q140.

The 47 Ω series-parallel network along with the emitter of Q140 looks like a source impedance of approximately 50 Ω during the pulse on condition. (During the pulse off condition, the source impedance is higher.) Resistor R141 pulls the output of Q140 low during the pulse off condition. Diode CR141 protects the Q140 output from inductive loads. Resistor R138 pulls an offset voltage through R136 and R137 which biases Q140 nearly on to improve pulse response when the signal from Q136 steps high.

Network R148/C148/C149 picks off a small amount of the output pulse, filters it, and applies it through Amplitude Monitor switch S150 to rear connector pin 25A.

External Trigger/Duration Mode

Period generator U30B is utilized in a Schmitt bistable multivibrator configuration in the EXT TRIG and EXT DURATION modes. Contact 15 on PERIOD selector cam switch S30A connects feedback resistor R29 between pins 7 and 9 of U30B and, thus, enables U30B to operate as a bistable switch.

Diodes CR17 and CR20 with their associated RC networks shift and clamp the ground-referenced input signal from the TRIG/DURATION IN connector down to the proper operating level for U30B, i.e., between –2 V and –0.8 V.

Normally, the output from pins 6 and 7 of U30B is applied to trigger amplifier transistors Q40 and Q42. However, in the EXT DURATION mode, contact 1 is closed and 2 is opened by DURATION cam switch S30B which bypasses the period generator output signal around the duration generator and applies it directly to pin 4 of output buffer U30A. Output buffer U30A and the output amplifiers function as described for normal pulse output operation.

Output Locked On Mode

In the LOCKED ON mode, contact 13 of DURATION cam switch S30B closes while contacts 1 and 2 are open. The voltage at diode CR65 is then applied to pin 4 of output buffer U30A. Thus, pin 4 of U30A is high and pin 5 is low, locking U30A on. Transistor Q115 in the + output amplifier and Q150 in the – output amplifier turn on. Since both output amplifiers essentially follow the state of the output buffer, the resulting output at the + and – output connectors is a DC level which is variable with front-panel + and – OUTPUT AMPLITUDE controls R134/R174.

Power Supplies

The +18 V and -18 V supplies are similar in operation. The +18 V supply utilizes PNP transistors where the -18 V supply uses NPN transistors. Due to the similarity of these two supplies, the +18 V supply will be discussed here with the exceptions mentioned where pertinent.

An unregulated filtered +33.5 V from the Power Module is applied to rear connector pins 12A and 12B through current limiting resistor R214 to the emitter of the series-pass transistor located in the Power Module. The collector of the series-pass transistor is the +18 V regulated output which is monitored by divider network R216/R218 at the base of Q220. The emitter of Q220 is tied to 6.2 V zener VR220 which is temperature compensated by the base-emitter junction of Q220.

If the +18 V output attempts to go more positive, the collector of Q220 pulls down on the base of Q210 through R211 which tends to turn off the base of Q216. Resistor R211 provides current limiting during plug-in insertion or removal. Thus, the current through Q216 is reduced which, in turn, reduces the base current in the series-pass transistor (in the Power Module) and, also the voltage across current limiting resistor R214. Resistor R215 provides current limiting during plug-in insertion or removal. Consequently, the current supplied to the +18 V line is reduced to the proper level. Resistor R212 and 3 V zener VR210 establish the operating voltage range for Q210.

If the +18 V output is shorted (i.e., output goes low), Q220 starts to turn off which pulls the base of Q210 high through R210. Consequently, transistor Q210 saturates

against the voltage established by 3 V zener VR210 and R212. Thus, the voltage at the collector of Q210 is nearly 3 V below the unregulated line. The 3 V is reduced by the voltage drops at the base-emitter of Q216 and the base-emitter of the series-pass transistor in the Power Module to a maximum of approximately 1.6 V across R214. The 1.6 V across R214 establishes the maximum current that can be drawn from the +18 V supply. Clamp diode CR224 protects the +18 V supply in case of a short to the -18 V supply.

The -18 V supply differs from the +18 V supply in the way it obtains its reference voltage. The -5.1 V and -18 V supplies are referenced to the +18 V supply. Divider network R221/R251/CR221/CR222 establishes the reference voltage for the -18 V supply with the voltage at the junction of CR222/R251 nearly one diode drop below ground. This divider voltage is applied to the base of Q250.

If the -18 V supply output goes more positive, Q250 starts to turn off which allows R240 to pull down on the base of Q240. Thus, the collector of Q240 goes high as does the base of the series-pass transistor in the Power Module. The voltage drop across R244 increases which supplies more current to the -18 V output, thus bringing it back to the correct voltage.

The front-panel POWER indicator DS250 is powered through dropping resistor R253 from the -18 V supply.

The -5.1 V supply is also powered from the -18 V supply. Zener VR260 establishes the -5.1 V level with current supplied by R260.

SECTION 3

SERVICING

INFORMATION

Contents

This section of the manual contains information necessary to service the PG 501. Adjustment procedures are provided on the Controls and Adjustments foldout page with supporting illustrations that show internal adjustment locations and describe front-panel control functions. Also included is the electrical parts list with an illustration on the Component Location foldout page that shows the physical location of components. A schematic diagram is located opposite both the electrical parts list and the circuit board illustration to further facilitate the location of components. Rear connector pin assignments are listed at the middle of this section.

Mechanical parts are listed at the rear of this section with an exploded view of the instrument.

Maintenance

General system maintenance procedures are provided in the Power Module instruction manual, i.e., preventive maintenance, troubleshooting aids, part removal and replacement procedures, parts ordering information, etc.

Service Available

Tektronix, Inc. provides complete instrument repair and calibration at local Field Service centers and at the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

Repackaging for Shipment

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted, complete instrument serial number and a description of the service required.

Save and re-use the package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing three inches of dunnage or urethane foam between carton and instrument, on all sides. Seal carton with shipping tape or industrial stapler.

The carton test strength for your instrument is 200 pounds.

ADJUSTMENT PROCEDURE

Introduction

The adjustment procedure is located on the Controls and Adjustments foldout page. Adjustment is generally required after a repair has been made, or after long time intervals in which normal aging of components may affect instrument accuracy.

Test Equipment Required

The following test equipment or the equivalent, is required for complete adjustment of the PG 501. Specifications given for the test equipment are the minimum necessary for accurate adjustment. Therefore, some of the specifications listed may be less rigorous than the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within its listed specifications.

If other test equipment is substituted, control settings or set-up may need altering to meet the requirements of the equipment used. Detailed 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 needed.

1. Real-Time Oscilloscope. TEKTRONIX 5440 Oscilloscope with a 5B40 Time Base and 5A45 Amplifier plug-in recommended.

2. Sampling Oscilloscope. (Necessary only if the + or - Output Compensation adjustments are performed. See Preliminary Considerations.) TEKTRONIX 5440 Oscilloscope with 5S14N Sampling plug-in recommended.

Servicing Information—PG 501

3. Plug-In Extension. Tektronix 067-0645-02 Calibration Fixture. (Not mandatory for this procedure.)

NOTE

Do not use the Plug-In Extension to plug the PG 501 into any instrument other than the TM 500 Series Power Module.

4. 10X Attenuator. Tektronix Part No. 011-0059-02 recommended.

5. 50 Ω Coaxial Cable. Tektronix Part No. 012-0057-01 recommended.

Preliminary Considerations

Read the Operating Considerations in Section 1 before adjusting the PG 501.

This instrument should be adjusted at an ambient temperature between +20°C and +30°C (+68°F and +86°F) for optimum performance.

Do not preset internal controls unless they are known to be significantly out of adjustment, or unless repairs have been made in the circuit. In these instances, the internal adjustments can be set to midrange.

Normally, the + and – Output Compensation capacitors (C143 and C183) will not require adjustment. However, if output amplifier transistors Q140 or Q180 are replaced, or if it is suspected that aberrations are excessive, C143 and C183 should be adjusted as described in the adjustment procedure.

Preparation

1. Remove the cover from the left side of the PG 501 and, if necessary, from the right side. Blow off accumulated dust with low-pressure compressed air.

2. Insert the PG 501 into the left or right compartment (depending on which adjustments are to be made) if a multi-plug-in Power Module is used. (Note: It may be convenient to use the plug-in extension, Part No. 067-0645-02, to make internal adjustments without inserting the PG 501 into the Power Module. However, it is not mandatory for this procedure.

3. If the plug-in extension is not used, remove the Power Module cabinet cover to gain access to the PG 501 internal adjustments.

4. Apply power to the PG 501 by pulling out on the Power Module PWR button.

5. Refer to the Controls and Adjustments foldout page in this section for internal adjustment procedures.

NOTE

If a malfunction is detected during adjustment, refer to system maintenance in the Power Module instruction manual for troubleshooting techniques, parts removal and replacement procedures, parts ordering information, etc.

REPLACEABLE ELECTRICAL PARTS

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 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.

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number
00X Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71450	CTS CORP.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
79727	C-W INDUSTRIES	550 DAVISVILLE RD., P O BOX 96	WARMINSTER, PA 18974
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET P O BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

<http://manoman.sghill.com>

Kct No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-2104-00	B010100	B082517	CKT BOARD ASSY:MAIN	80009	670-2104-00
A1	670-2104-01	B082518	B082527	CKT BOARD ASSY:MAIN	80009	670-2104-01
A1	670-2104-02	B082528	B084889	CKT BOARD ASSY:MAIN	80009	670-2104-02
A1	670-2104-03	B084890		CKT BOARD ASSY:MAIN	80009	670-2104-03
C15	281-0579-00			CAP., FXD, CER DI:21PF, 5%, 500V	72982	301-050C0G0210J
C20	283-0081-00			CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C28	281-0579-00			CAP., FXD, CER DI:21PF, 5%, 500V	72982	301-050C0G0210J
C29	283-0642-00			CAP., FXD, MICA D:33PF, +/-0.5PF, 300V	00853	D10-3E330G0
C30	283-0594-00			CAP., FXD, MICA D:0.001UF, 1%, 100V	00853	D151F102F0
C31	285-1049-00	B010100	B039999	CAP., FXD, PLSTC:0.01UF, 1%, 200V	14752	230B1C103F
C31	285-0596-00	B040000		CAP., FXD, PLSTC:0.01UF, 1%, 100V	14752	410B1B103F
C32	285-1050-00			CAP., FXD, PLSTC:0.1UF, 1%, 200V	14752	230B1C104F
C33	285-1051-00			CAP., FXD, PLSTC:1UF, 1%, 200V	14752	230B1C105F
C34	285-1052-00			CAP., FXD, PLSTC:10UF, 1%, 100V	14752	230B1B106F
C35	290-0531-00			CAP., FXD, ELCTLT:100UF, 20%, 10V	90201	TDC107M010WLC
C36	290-0531-00			CAP., FXD, ELCTLT:100UF, 20%, 10V	90201	TDC107M010WLC
C37	290-0531-00			CAP., FXD, ELCTLT:100UF, 20%, 10V	90201	TDC107M010WLC
C38	290-0531-00			CAP., FXD, ELCTLT:100UF, 20%, 10V	90201	TDC107M010WLC
C39	283-0647-00	B010100	B059999	CAP., FXD, MICA D:70PF, 1%, 100V	00853	D151E700F0
C39	283-0634-00	B060000	B079999	CAP., FXD, MICA D:65PF, 1%, 100V	00853	D151E650F0
C39	283-0647-00	B080000		CAP., FXD, MICA D:70PF, 1%, 100V	00853	D151E700F0
C42	283-0663-00			CAP., FXD, MICA D:16.8PF, +/-0.5PF, 500V	00853	D155C16.8D0
C48	283-0081-00			CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C52	283-0002-00			CAP., FXD, CER DI:0.01UF, +80-20%, 500V	72982	811-546E103Z
C64	283-0081-00			CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C67	281-0579-00			CAP., FXD, CER DI:21PF, 5%, 500V	72982	301-050C0G0210J
C81	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C82	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C87	281-0593-00	XB050000		CAP., FXD, CER DI:3.9PF, 10%, 500V	72982	301-000C0J0399C
C98	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C110	283-0081-00			CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C120	283-0002-00			CAP., FXD, CER DI:0.01UF, +80-20%, 500V	72982	811-546E103Z
C130	283-0081-00			CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C132	283-0081-00	B010100	B010135X	CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C142	290-0536-00	XB082518		CAP., FXD, ELCTLT:10UF, 20%, 25V	90201	TDC106M025FL
C143	281-0167-00			CAP., VAR, CER DI:9-45PF, 200V	72982	538-011-D 9-45
C148	283-0002-00			CAP., FXD, CER DI:0.01UF, +80-20%, 500V	72982	811-546E103Z
C149	283-0002-00			CAP., FXD, CER DI:0.01UF, +80-20%, 500V	72982	811-546E103Z
C150	283-0081-00			CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C160	283-0002-00			CAP., FXD, CER DI:0.01UF, +80-20%, 500V	72982	811-546E103Z
C170	283-0081-00			CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C172	283-0081-00	B010100	B010135X	CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C174	281-0627-00	XB084890		CAP., FXD, CER DI:1PF, +/-0.25PF, 500V	72982	301-000C0K0109C
C182	290-0536-00	XB082518		CAP., FXD, ELCTLT:10UF, 20%, 25V	90201	TDC106M025FL
C183	281-0167-00			CAP., VAR, CER DI:9-45PF, 200V	72982	538-011-D 9-45
C184	281-0509-00	XB084890		CAP., FXD, CER DI:15PF, +/-1.5PF, 500V	72982	301-000C0G0150K
C188	283-0002-00			CAP., FXD, CER DI:0.01UF, +80-20%, 500V	72982	811-546E103Z
C189	283-0002-00			CAP., FXD, CER DI:0.01UF, +80-20%, 500V	72982	811-546E103Z
C216	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P
C224	290-0527-00			CAP., FXD, ELCTLT:15UF, 20%, 20V	90201	TDC156M020FL
C226	290-0519-00			CAP., FXD, ELCTLT:100UF, 20%, 20V	90201	TDC107M020WLD
C228	283-0081-00			CAP., FXD, CER DI:0.1UF, +80-20%, 25V	56289	36C600
C240	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P

Replaceable Electrical Parts—PG 501

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C254	290-0527-00			CAP., FXD, ELCTLT: 15UF, 20%, 20V	90201	TDC156M020FL
C256	290-0519-00			CAP., FXD, ELCTLT: 100UF, 20%, 20V	90201	TDC107M020WLD
C258	283-0081-00			CAP., FXD, CER DI: 0.1UF, +80-20%, 25V	56289	36C600
C260	283-0002-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 500V	72982	811-546E103Z
C261	290-0531-00			CAP., FXD, ELCTLT: 100UF, 20%, 10V	90201	TDC107M010WLC
CR15	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR17	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR20	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR65	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR69	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR79	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR80	152-0153-00			SEMICON D DEVICE: SILICON, 15V, 50MA	80009	152-0153-00
CR141	152-0333-00			SEMICON D DEVICE: SILICON, 55V, 200MA	80009	152-0333-00
CR181	152-0333-00			SEMICON D DEVICE: SILICON, 55V, 200MA	80009	152-0333-00
CR212	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR221	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR222	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR224	152-0066-00			SEMICON D DEVICE: SILICON, 400V, 750MA	80009	152-0066-00
CR240	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR250	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	80009	152-0141-02
CR254	152-0066-00			SEMICON D DEVICE: SILICON, 400V, 750MA	80009	152-0066-00
DS250	150-0048-00			LAMP, INCAND: 5V, 60MA	08806	683
J10	131-0955-00			CONNECTOR, RCPT, : BNC, FEMALE, W/HARDWARE	13511	31-279
J50	131-0955-00			CONNECTOR, RCPT, : BNC, FEMALE, W/HARDWARE	13511	31-279
J140	131-0955-00			CONNECTOR, RCPT, : BNC, FEMALE, W/HARDWARE	13511	31-279
J180	131-0955-00			CONNECTOR, RCPT, : BNC, FEMALE, W/HARDWARE	13511	31-279
L132	108-0409-00			COIL, RF: 17.5UH	80009	108-0409-00
L136	108-0436-00			COIL, RF: FIXED, 240NH	80009	108-0436-00
L172	108-0409-00			COIL, RF: 17.5UH	80009	108-0409-00
L176	108-0436-00			COIL, RF: FIXED, 240NH	80009	108-0436-00
Q40	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q42	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q50	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q52	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q70	151-0220-00	B010100	B059999	TRANSISTOR: SILICON, PNP	80009	151-0220-00
Q70	151-0410-00	B060000		TRANSISTOR: SILICON, PNP	80009	151-0410-00
Q80	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q82	151-0190-01			TRANSISTOR: SILICON, NPN	80009	151-0190-01
Q110	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q115	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q120	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q124	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q130	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q136	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q140	151-0411-00	B010100	B082527	TRANSISTOR: SILICON, NPN	80009	151-0411-00
Q140	151-0451-00	B082528		TRANSISTOR: SILICON, NPN	80009	151-0451-00
Q150	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q155	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q160	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q164	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q170	151-0424-00	B010100	B084889	TRANSISTOR: SILICON, NPN	80009	151-0424-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q170	153-0624-00	B084890		SEMICON DVC SE:SILICON,NPN,MATCHED PAIR	80009	153-0624-00
Q170	-----			* FURNISHED AS A MATCHED PAIR WITH Q176		
Q176	151-0424-00	B010100	B084889	TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q176	153-0624-00	B084890		SEMICON DVC SE:SILICON,NPN,MATCHED PAIR	80009	153-0624-00
Q176	-----			* FURNISHED AS A MATCHED PAIR WITH Q170		
Q180	151-0285-00	B010100	B069999	TRANSISTOR:SILICON,PNP	80009	151-0285-00
Q180	151-0450-00	B070000		TRANSISTOR:SILICON,PNP,SEL FROM 2N5583	80009	151-0450-00
Q210	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q216	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q220	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q240	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q246	151-0103-00			TRANSISTOR:SILICON,NPN	80009	151-0103-00
Q250	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
R12	301-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.50W	01121	EB5105
R14	321-0276-00			RES.,FXD,FILM:7.32K OHM,1%,0.125W	91637	MFF1816G73200F
R15	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R17	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R20	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R22	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R23	311-1124-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5531
R25	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R26	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R28	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R29	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R30	315-0330-00	B010100	B049999	RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R30	315-0390-00	B050000		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R31	315-0620-00			RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R32	307-0115-00	B010100	B010135X	RES.,FXD,CMPSN:7.5 OHM,5%,0.25W	01121	CB75G5
R32	307-0115-00	XB040000		RES.,FXD,CMPSN:7.5 OHM,5%,0.25W	01121	CB75G5
R37	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R38	311-0963-00			RES.,VAR,WW:5K OHM,10%	11237	300SF-3P1686
R40	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R41	301-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.50W	01121	EB8215
R42	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R44	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R45	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R48	301-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.50W	01121	EB5615
R50	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R52	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R54	316-0560-00			RES.,FXD,CMPSN:56 OHM,10%,0.25W	01121	CB5601
R55	316-0270-00	B010100	B084379	RES.,FXD,CMPSN:27 OHM,10%,0.25W	01121	CB2701
R55	315-0270-00	B084380		RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R58	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R59	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R60	301-0910-00			RES.,FXD,CMPSN:91 OHM,5%,0.50W	01121	EB9105
R62	301-0910-00			RES.,FXD,CMPSN:91 OHM,5%,0.50W	01121	EB9105
R64	301-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.50W	01121	EB8205
R65	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R67	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R69	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R71	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R73	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R75	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715

Replaceable Electrical Parts—PG 501

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R77	315-0162-00			RES., FXD, CMPSN: 1.6K OHM, 5%, 0.25W	01121	CB1625
R79	301-0122-00			RES., FXD, CMPSN: 1.2K OHM, 5%, 0.50W	01121	EB1225
R80	315-0392-00			RES., FXD, CMPSN: 3.9K OHM, 5%, 0.25W	01121	CB3925
R81	315-0101-00			RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R84	315-0220-00			RES., FXD, CMPSN: 22 OHM, 5%, 0.25W	01121	CB2205
R87	315-0101-00			RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R89	315-0182-00			RES., FXD, CMPSN: 1.8K OHM, 5%, 0.25W	01121	CB1825
R90	311-1370-00			RES., VAR, NONWIR: 2K OHM, 30%, 0.25W	71450	201-YA5556
R91	315-0221-00			RES., FXD, CMPSN: 220 OHM, 5%, 0.25W	01121	CB2215
R95	311-1099-00			RES., VAR, NONWIR: 100K OHM, 0.5W	01121	WA1G040S104AZ
R96	315-0433-00			RES., FXD, CMPSN: 43K OHM, 5%, 0.25W	01121	CB4335
R98	316-0103-00			RES., FXD, CMPSN: 10K OHM, 10%, 0.25W	01121	CB1031
R100	316-0391-00			RES., FXD, CMPSN: 390 OHM, 10%, 0.25W	01121	CB3911
R102	316-0270-00			RES., FXD, CMPSN: 27 OHM, 10%, 0.25W	01121	CB2701
R104	316-0391-00			RES., FXD, CMPSN: 390 OHM, 10%, 0.25W	01121	CB3911
R105	316-0270-00			RES., FXD, CMPSN: 27 OHM, 10%, 0.25W	01121	CB2701
R110	321-0085-00			RES., FXD, FILM: 75 OHM, 1%, 0.125W	91637	MFF1816G75R00F
R111	301-0821-00			RES., FXD, CMPSN: 820 OHM, 5%, 0.50W	01121	EB8215
R112	315-0161-00			RES., FXD, CMPSN: 160 OHM, 5%, 0.25W	01121	CB1615
R114	311-1124-00			RES., VAR, NONWIR: 250 OHM, 30%, 0.25W	71450	201-YA5533
R115	321-0085-00			RES., FXD, FILM: 75 OHM, 1%, 0.125W	91637	MFF1816G75R00F
R120	316-0471-00			RES., FXD, CMPSN: 470 OHM, 10%, 0.25W	01121	CB4711
R122	316-0471-00			RES., FXD, CMPSN: 470 OHM, 10%, 0.25W	01121	CB4711
R124	316-0471-00			RES., FXD, CMPSN: 470 OHM, 10%, 0.25W	01121	CB4711
R126	316-0471-00			RES., FXD, CMPSN: 470 OHM, 10%, 0.25W	01121	CB4711
R130	301-0121-00			RES., FXD, CMPSN: 120 OHM, 5%, 0.50W	01121	EB1215
R132	301-0910-00			RES., FXD, CMPSN: 91 OHM, 5%, 0.50W	01121	EB9105
R134	311-1427-00			RES., VAR, NONWIR: 2K OHM, 20%, 0.50W	01121	16M147
R136	301-0131-00	B010100	B082517	RES., FXD, CMPSN: 130 OHM, 5%, 0.50W	01121	EB1315
R136	323-0108-00	B082518		RES., FXD, FILM: 130 OHM, 1%, 0.50W	75042	CECTO-1300F
R137	301-0131-00	B010100	B082517	RES., FXD, CMPSN: 130 OHM, 5%, 0.50W	01121	EB1315
R137	323-0108-00	B082518		RES., FXD, FILM: 130 OHM, 1%, 0.50W	75042	CECTO-1300F
R138	315-0682-00			RES., FXD, CMPSN: 6.8K OHM, 5%, 0.25W	01121	CB6825
R140	306-0270-00	B010100	B082517	RES., FXD, CMPSN: 27 OHM, 10%, 2W	01121	HB2701
R140	303-0150-00	B082518		RES., FXD, CMPSN: 15 OHM, 5%, 1W	01121	GB1505
R141	316-0103-00			RES., FXD, CMPSN: 10K OHM, 10%, 0.25W	01121	CB1031
R142	303-0150-00	XB082518		RES., FXD, CMPSN: 15 OHM, 5%, 1W	01121	GB1505
R143	303-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 1W	01121	GB4705
R144	303-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 1W	01121	GB4705
R146	303-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 1W	01121	GB4705
R147	303-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 1W	01121	GB4705
R148	316-0273-00			RES., FXD, CMPSN: 27K OHM, 10%, 0.25W	01121	CB2731
R150	321-0085-00			RES., FXD, FILM: 75 OHM, 1%, 0.125W	91637	MFF1816G75R00F
R151	301-0911-00			RES., FXD, CMPSN: 910 OHM, 5%, 0.50W	01121	EB9115
R152	315-0151-00			RES., FXD, CMPSN: 150 OHM, 5%, 0.25W	01121	CB1515
R154	311-1124-00			RES., VAR, NONWIR: 250 OHM, 30%, 0.25W	71450	201-YA5533
R155	321-0085-00			RES., FXD, FILM: 75 OHM, 1%, 0.125W	91637	MFF1816G75R00F
R160	316-0471-00			RES., FXD, CMPSN: 470 OHM, 10%, 0.25W	01121	CB4711
R162	316-0471-00			RES., FXD, CMPSN: 470 OHM, 10%, 0.25W	01121	CB4711
R164	316-0471-00			RES., FXD, CMPSN: 470 OHM, 10%, 0.25W	01121	CB4711
R166	316-0471-00			RES., FXD, CMPSN: 470 OHM, 10%, 0.25W	01121	CB4711
R170	301-0121-00			RES., FXD, CMPSN: 120 OHM, 5%, 0.50W	01121	EB1215
R172	301-0910-00			RES., FXD, CMPSN: 91 OHM, 5%, 0.50W	01121	EB9105

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R174	311-1427-00			RES., VAR, NONWIR: 2K OHM, 20%, 0.50W	01121	16M147
R175	315-0101-00	XB084890		RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R176	301-0131-00	B010100	B082517	RES., FXD, CMPSN: 130 OHM, 5%, 0.50W	01121	EB1315
R176	323-0108-00	B082518		RES., FXD, FILM: 130 OHM, 1%, 0.50W	75042	CECT0-1300F
R177	301-0131-00	B010100	B082517	RES., FXD, CMPSN: 130 OHM, 5%, 0.50W	01121	EB1315
R177	323-0108-00	B082518		RES., FXD, FILM: 130 OHM, 1%, 0.50W	75042	CECT0-1300F
R178	315-0682-00			RES., FXD, CMPSN: 6.8K OHM, 5%, 0.25W	01121	CB6825
R180	306-0270-00	B010100	B082517	RES., FXD, CMPSN: 27 OHM, 10%, 2W	01121	HB2701
R180	303-0150-00	B082518		RES., FXD, CMPSN: 15 OHM, 5%, 1W	01121	GB1505
R181	316-0103-00			RES., FXD, CMPSN: 10K OHM, 10%, 0.25W	01121	CB1031
R182	303-0150-00	XB082518		RES., FXD, CMPSN: 15 OHM, 5%, 1W	01121	GB1505
R183	303-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 1W	01121	GB4705
R184	303-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 1W	01121	GB4705
R185	317-0100-00	XB082518		RES., FXD, CMPSN: 10 OHM, 5%, 0.125W	01121	BB1005
R186	303-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 1W	01121	GB4705
R187	303-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 1W	01121	GB4705
R188	316-0273-00	B010100	B084379	RES., FXD, CMPSN: 27K OHM, 10%, 0.25W	01121	CB2731
R188	315-0273-00	B084380		RES., FXD, CMPSN: 27K OHM, 5%, 0.25W	01121	CB2735
R210	316-0472-00			RES., FXD, CMPSN: 4.7K OHM, 10%, 0.25W	01121	CB4721
R211	316-0472-00			RES., FXD, CMPSN: 4.7K OHM, 10%, 0.25W	01121	CB4721
R212	302-0682-00			RES., FXD, CMPSN: 6.8 OHM, 10%, 0.50W	01121	EB6821
R214	308-0459-00			RES., FXD, WW: 1.1 OHM, 5%, 3W	91637	RS2B-D1R100J
R215	302-0560-00			RES., FXD, CMPSN: 56 OHM, 10%, 0.50W	01121	EB5601
R216	321-0256-00			RES., FXD, FILM: 4.53K OHM, 1%, 0.125W	91637	MFF1816G45300F
R218	321-0235-00			RES., FXD, FILM: 2.74K OHM, 1%, 0.125W	91637	MFF1816G27400F
R220	316-0822-00			RES., FXD, CMPSN: 8.2K OHM, 10%, 0.25W	01121	CB8221
R221	321-0289-00			RES., FXD, FILM: 10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R240	316-0472-00			RES., FXD, CMPSN: 4.7K OHM, 10%, 0.25W	01121	CB4721
R241	316-0472-00			RES., FXD, CMPSN: 4.7K OHM, 10%, 0.25W	01121	CB4721
R242	302-0682-00			RES., FXD, CMPSN: 6.8 OHM, 10%, 0.50W	01121	EB6821
R244	308-0459-00			RES., FXD, WW: 1.1 OHM, 5%, 3W	91637	RS2B-D1R100J
R246	302-0560-00			RES., FXD, CMPSN: 56 OHM, 10%, 0.50W	01121	EB5601
R251	321-0289-00			RES., FXD, FILM: 10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R253	305-0271-00			RES., FXD, CMPSN: 270 OHM, 5%, 2W	01121	HB2715
R260	308-0075-00			RES., FXD, WW: 100 OHM, 5%, 3W	91637	RS2B-B100ROJ
S30A)						
S30B)	105-0374-00			ACTR ASSY, CAM S: RANGE	80009	105-0374-00
S150	260-0984-00			SWITCH, SLIDE: DP 3 POSN, 0.5A, 125VAC-DC	79727	G-128-S-0012
U30	156-0182-00			MICROCIRCUIT, DI: TRIPLE 2-3-2 INPUT GATE	80009	156-0182-00
VR79	152-0279-00			SEMICONV DEVICE: ZENER, 0.4W, 5.1V, 5%	80009	152-0279-00
VR81	152-0149-00			SEMICONV DEVICE: ZENER, 0.4W, 10V, 5%	80009	152-0149-00
VR90	152-0149-00			SEMICONV DEVICE: ZENER, 0.4W, 10V, 5%	80009	152-0149-00
VR110	152-0149-00			SEMICONV DEVICE: ZENER, 0.4W, 10V, 5%	80009	152-0149-00
VR115	152-0149-00			SEMICONV DEVICE: ZENER, 0.4W, 10V, 5%	80009	152-0149-00
VR130	152-0280-00			SEMICONV DEVICE: ZENER, 0.4W, 6.2V, 5%	80009	152-0280-00
VR150	152-0217-00			SEMICONV DEVICE: ZENER, 0.4W, 8.2V, 5%	80009	152-0217-00
VR155	152-0217-00			SEMICONV DEVICE: ZENER, 0.4W, 8.2V, 5%	80009	152-0217-00
VR170	152-0280-00			SEMICONV DEVICE: ZENER, 0.4W, 6.2V, 5%	80009	152-0280-00
VR210	152-0278-00			SEMICONV DEVICE: ZENER, 0.4W, 3V, 5%	07910	1N4372A
VR220	152-0280-00			SEMICONV DEVICE: ZENER, 0.4W, 6.2V, 5%	80009	152-0280-00
VR240	152-0278-00			SEMICONV DEVICE: ZENER, 0.4W, 3V, 5%	07910	1N4372A
VR260	152-0279-00			SEMICONV DEVICE: ZENER, 0.4W, 5.1V, 5%	80009	152-0279-00

DIAGRAMS AND CIRCUIT BOARD 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).

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

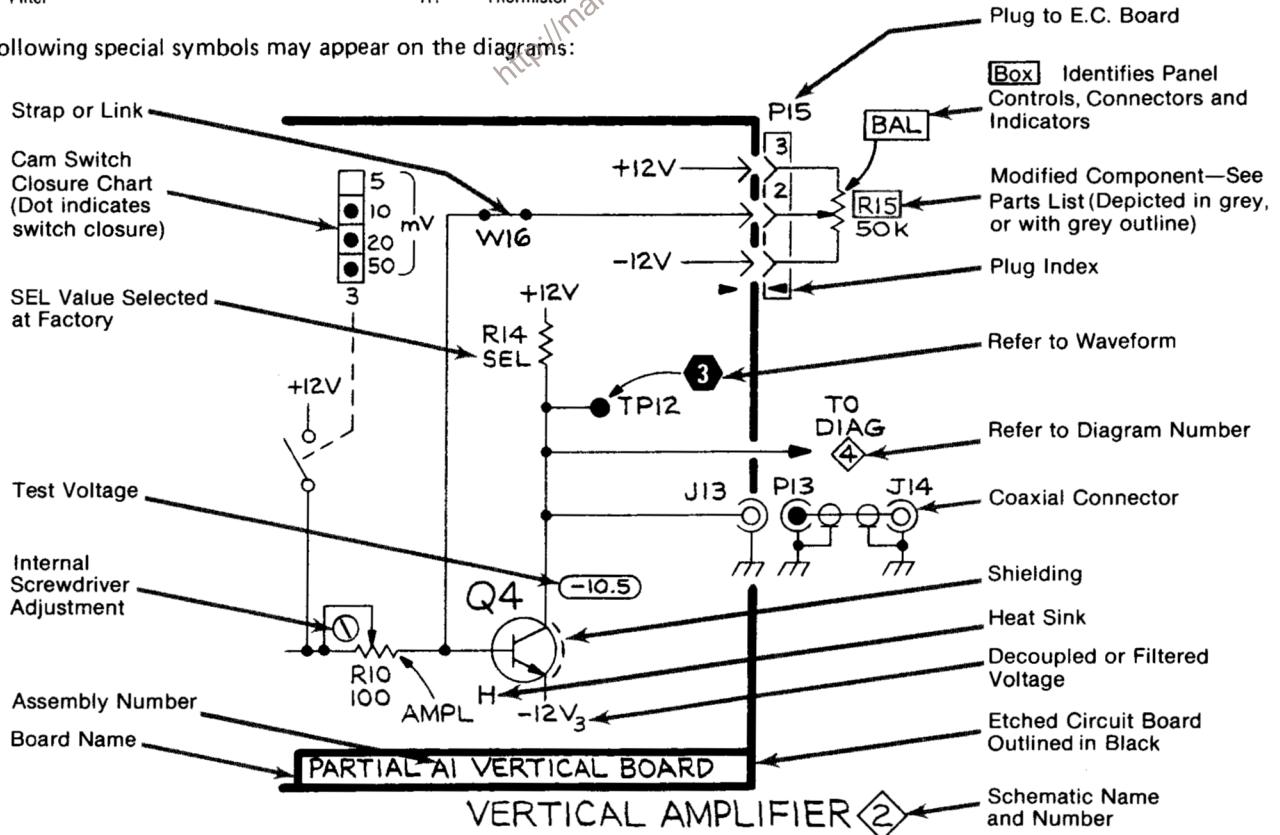
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

- Y14.15, 1966 Drafting Practices.
- Y14.2, 1973 Line Conventions and Lettering.
- Y10.5, 1968 Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

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)	H	Heat dissipating device (heat sink, heat radiator, etc)	S	Switch or contactor
AT	Attenuator, fixed or variable	HR	Heater	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BT	Battery	J	Connector, stationary portion	TP	Test point
C	Capacitor, fixed or variable	K	Relay	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CB	Circuit breaker	L	Inductor, fixed or variable	V	Electron tube
CR	Diode, signal or rectifier	M	Meter	VR	Voltage regulator (zener diode, etc.)
DL	Delay line	P	Connector, movable portion	W	Wirestrap or cable
DS	Indicating device (lamp)	Q	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead	R	Resistor, fixed or variable	Z	Phase shifter
F	Fuse	RT	Thermistor		
FL	Filter				

The following special symbols may appear on the diagrams:



REAR CONNECTOR PIN ASSIGNMENTS

Pin No.	Left (A)	Right (B)
28	Internal Frequency Monitor	Internal Frequency Monitor Ground
27	Internal Frequency Monitor Ground	Internal Frequency Monitor
26	Amplitude Monitor Ground	Not Used
25	Amplitude Monitor	External Trigger Signal Ground
24	Not Used	External Trigger Signal
13 through 23	See Power Module Manual for Assignments	
12	+33.5 V Filtered DC	+33.5 V Filtered DC
11	Base of PNP Series Pass	Collector of PNP Series Pass
10	Emitter of PNP Series Pass	Not Used
9	+33.5 V Common	+33.5 V Common
8	-33.5 V Filtered DC	-33.5 V Filtered DC
7	Emitter of NPN Series Pass	Collector of NPN Series Pass
6	Base of NPN Series Pass	Not Used
1 through 5	See Power Module Manual for Assignments	

The left (A) and right (B) sides of the rear connector are as viewed from the front of the plug-in. Pins are as viewed from the front of the plug-in. Pins are numbered from the bottom of the connector.

ADJUSTMENT PROCEDURE

NOTE

Read information under Adjustment Procedure on page 3-1 before proceeding.

1

Set PULSE DURATION selector to .1 ms, PERIOD selector to .2 ms, and +OUTPUT AMPLITUDE control fully cw. (Check that the VARIABLE controls are at X1.)

2

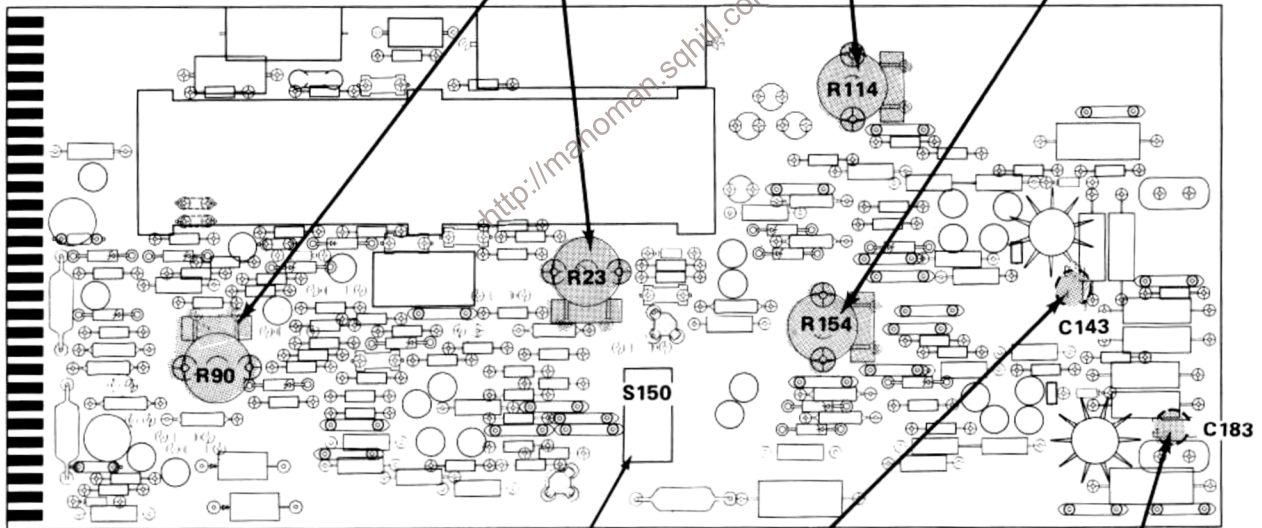
Monitor the + pulse output with the Real-Time Oscilloscope. Adjust R23 (Period Set) for a + pulse period of 0.2 ms and R90 (Duration Set) for a + pulse duration of 0.1 ms.

3

Adjust R114 (+ Amplitude Set) for a + pulse amplitude of 5.2 V.

4

Monitor the - output pulse with the Real-Time Oscilloscope. Adjust R154 (- Amplitude Set) for a - pulse amplitude of 5.2 V.



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NOTE

Perform steps 5 & 6 only if output amplifier transistors Q140 and Q180 have been replaced or if it is suspected that output pulse aberrations are excessive.

Internal Amplitude Monitor Switch (see text)

5

Monitor the + output pulse through the 10X Attenuator with the Sampling Oscilloscope. Adjust the + OUTPUT AMPLITUDE control for a 5 V output pulse amplitude. Adjust C143 (+ Output Comp Set) for minimum aberrations on the displayed pulse at a sweep rate of 10 ns/div.

6

Monitor the - output pulse through the 10X Attenuator with the Sampling Oscilloscope. Adjust the - OUTPUT AMPLITUDE control for a 5 V output pulse amplitude. Adjust C183 (- Output Comp Set) for minimum aberrations on the displayed pulse at a sweep rate of 10 ns/div.

PERIOD Selector

Selects pulse periods from less than 20 ns (uncalibrated) to 20 ms in 7 decade steps. Mechanically coupled to DURATION selector so the period is always greater than the duration when both VARIABLE controls are in the X1 position. Also selects external trigger mode.

DURATION Selector

Selects pulse duration from less than 10 ns (uncalibrated) to 10 ms in 7 decade steps. Mechanically coupled to PERIOD selector so the duration is always less than the period when both VARIABLE controls are in the $> X1$ position. Also selects output locked on and external duration modes.

VARIABLE (Period) Control

Provides continuously variable selection of pulse period between calibrated steps. Extends period to at least 0.25 10X PERIOD selector switch setting in the fully cw ($> X10$) position.

VARIABLE (Duration) Control

Provides continuously variable selection of pulse duration between calibrated steps. Extends duration to at least 0.1 s in the fully cw ($> X10$) position.

OUTPUT AMPLITUDE Controls

Provide independent amplitude adjustment of negative and positive output pulses from less than 0.5 V to 5 V. Also control the DC level at the output connectors and at the internal amplitude monitor line (pin 25A on rear connector) when the DURATION selector is in the OUTPUT LOCKED ON position.

Output Connectors

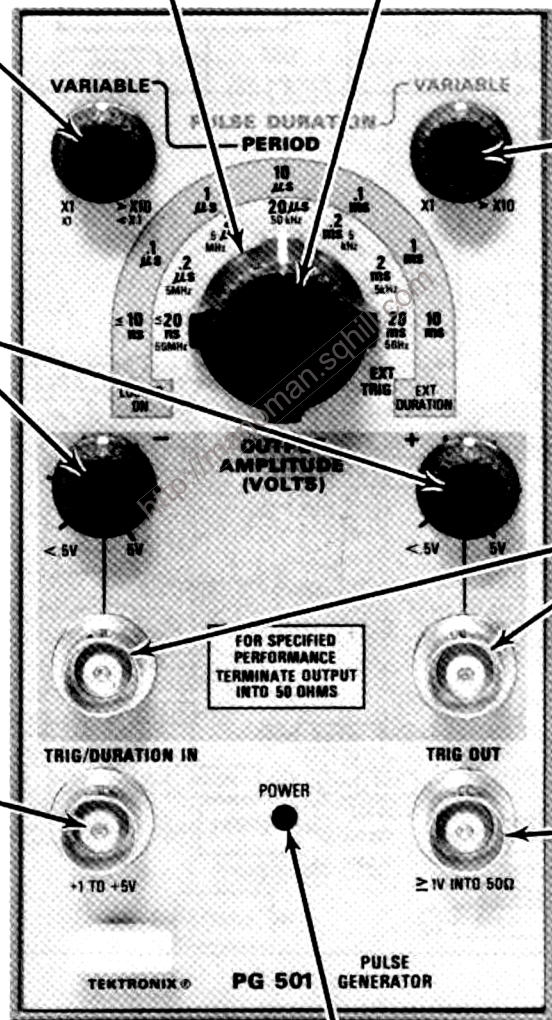
Provide simultaneous negative and positive pulse outputs. Outputs are protected against no load, shorting, or inductive load conditions.

TRIG/DURATION IN Connector

Permits external triggering of the period generator when the PERIOD selector is in the EXT TRIG position. A positive signal of at least 1 V will trigger one pulse cycle from the period generator. Gated pulse output is provided when the DURATION selector is in the EXT DURATION position. An external DC-coupled gating signal applied to the TRIG/DURATION IN connector will enable the period generator for the duration of the input gating signal. Output starts before the input gate amplitude reaches +1 V and continues until gate amplitude drops below the reset level (never less than +100 mV).

TRIG OUT Connector

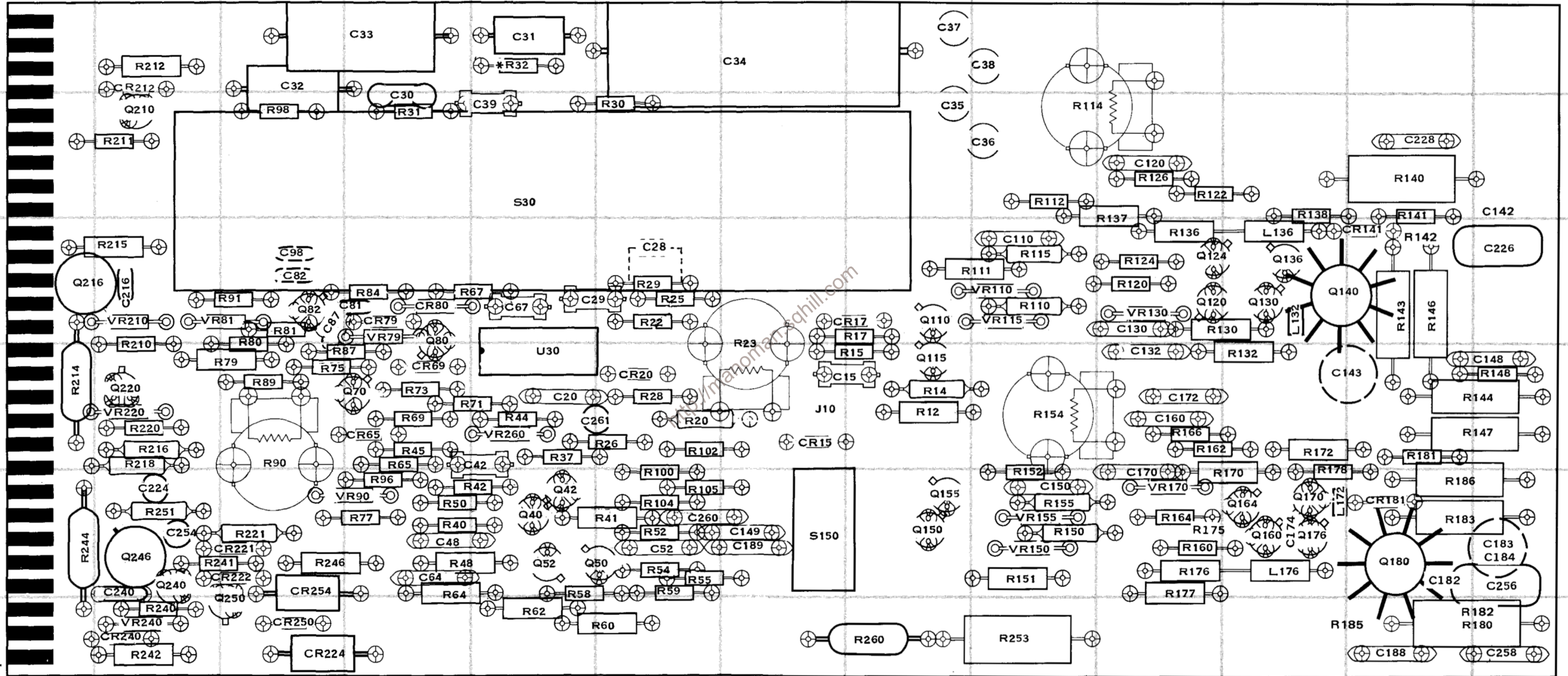
Provides a positive output pulse of at least 1 V into 50 Ω . Pulse occurs at least 10 ns prior to the pulse output at the + and - output connectors.



POWER Indicator

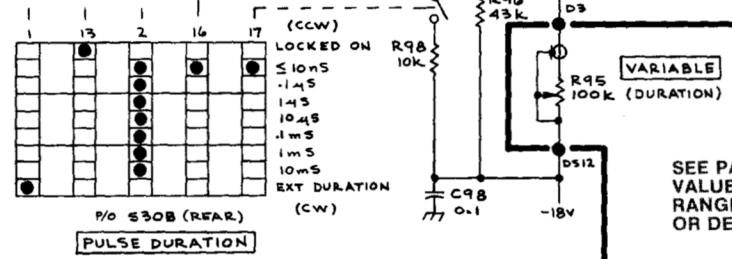
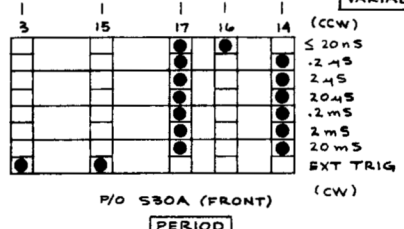
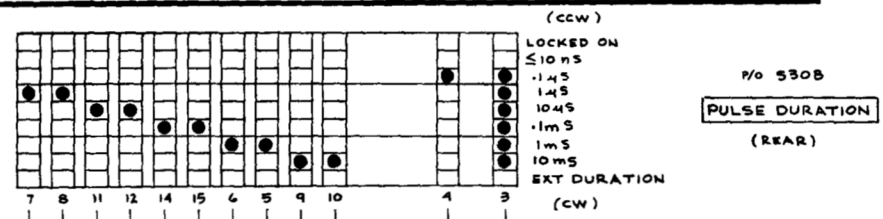
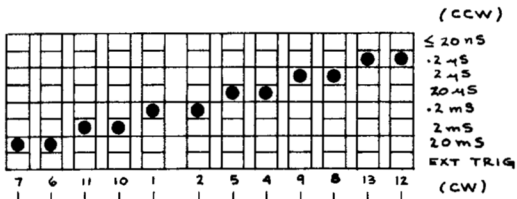
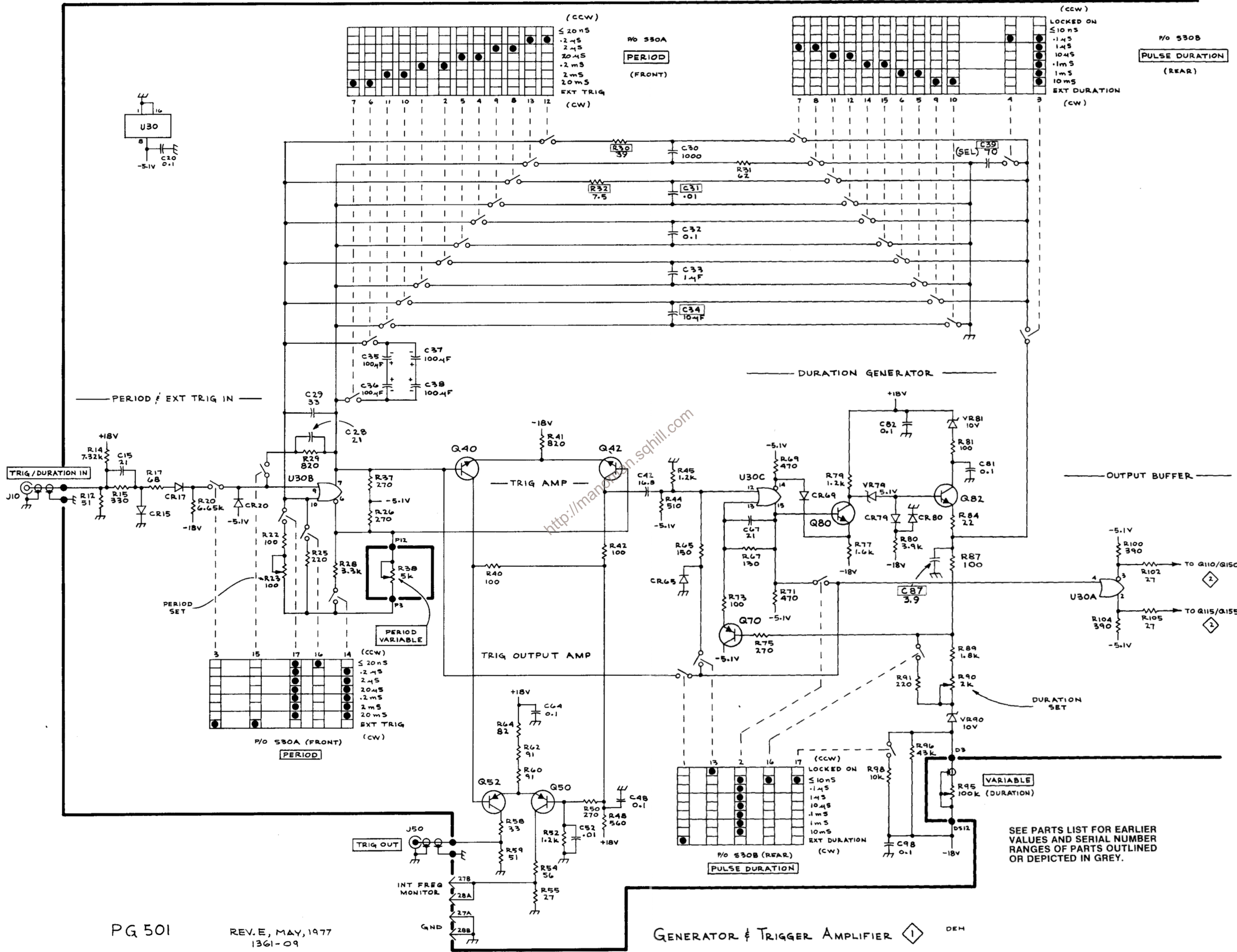
Lights when power is applied to the PG 501.

1361-07

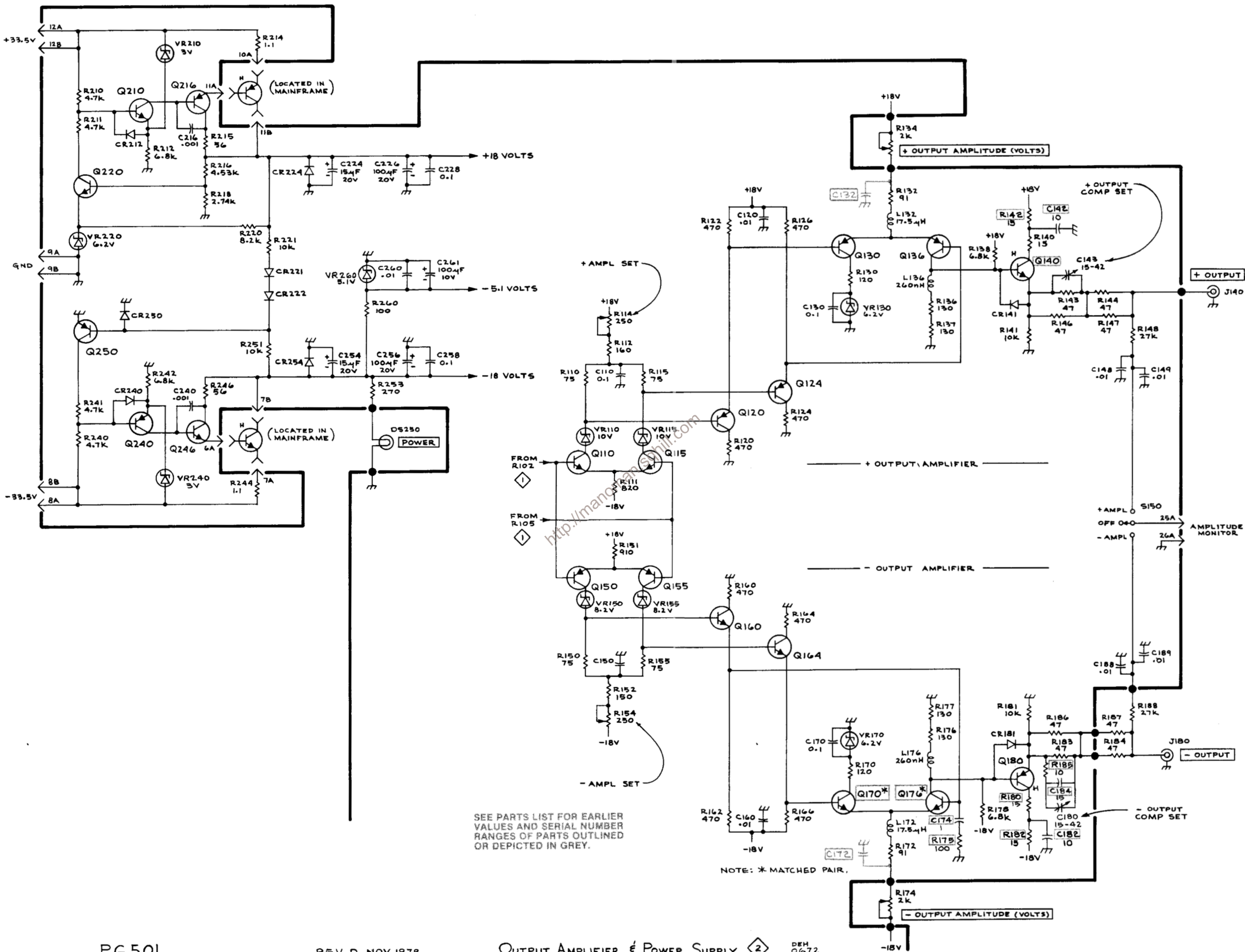


NOTE: COMPONENTS SHOWN WITH DASHED LINES ARE LOCATED ON BACK SIDE OF BOARD,

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C15	G4	CR221	C5	R44	E4	R162	J4
C20	E4	CR222	C5	R45	D4	R164	J5
C28*	F3	CR224	C6	R48	D5	R166	J4
C29	E3	CR240	B6	R50	D5	R170	J5
C30	D1	CR250	C6	R52	F5	R172	K4
C31	E1	CR254	C5	R54	F5	R175*†	J5
C32	C1			R55	F5	R176	J5
C33	D1	J10*	G4	R58	E5	R177	J5
C34	G1			R59	F5	R178	K4
C35	H2	L132	K3	R60	F6	R180	L6
C36	I2	L136	K3	R62	E6	R181	L4
C37	H1	L172	K5	R64	D6	R182*	L6
C38	I1	L176	K5	R65	D4	R183	L5
C39*	E2			R67	D3	R185*	K6
C42	D4	Q40	E5	R69	D4	R186	L5
C48	D5	Q42	E5	R71	D4	R210	B3
C52	F5	Q50	E5	R73	D4	R211	B2
C64	D5	Q52	E5	R75	C4	R212	B1
C67	E3	Q70	D4	R77	D5	R214	A4
C81	C3	Q80	D3	R79	B4	R215	B3
C82	C3	Q82	C3	R80	C3	R216	B4
C87*	C3	Q110	H3	R81	C3	R218	B4
C98	C3	Q115	H4	R84	D3	R220	B4
C110	I3	Q120	J3	R87	C4	R221	C5
C120	J2	Q124	J3	R89	C4	R240	B6
C130	J3	Q130	K3	R90	C4	R241	B5
C132*	J4	Q136	K3	R91	C3	R242	B6
C142	M2	Q140	K3	R96	D5	R244	A5
C143	K4	Q150	H5	R98	C2	R246	C5
C148	M4	Q155	H5	R100	F4	R251	B5
C149	G5	Q160	K5	R102	F4	R253	I6
C150	I5	Q164	K5	R104	F5	R260	H6
C160	J5	Q170	K5	R105	F5		
C170	J5	Q176	K5	R110	I3	S30	E2
C172*	J4	Q180	L5	R111	H3	S150	G5
C174*†	K5	Q210	B2	R112	I2		
C182*	L5	Q216	A3	R114	I2	U30	E4
C183	M5	Q220	B4	R115	I3		
C184*	M5	Q240	B5	R120	J3	VR79	D3
C188	L6	Q246	B5	R122	J2	VR81	B3
C189	G5	Q250	C6	R124	J3	VR90	C5
C216	B3			R126	J2	VR110	I3
C224	B5	R12	H4	R130	J3	VR115	I3
C226	M3	R14	H4	R132	K4	VR130	J3
C228	L2	R15	G4	R136	J3	VR150	I5
C240	B5	R17	G3	R137	J2	VR155	I5
C254	B5	R20	F4	R138	K2	VR170	J5
C256	M5	R22	F3	R140	L2	VR210	B3
C258	M6	R23	G3	R141	L2	VR220	B4
C260	F5	R25	F3	R142*	L3	VR240	B6
C261	E4	R26	E4	R143	L3	VR260	E4
		R28	F4	R144	L4		
CR15	G4	R29	F3	R146	L3		
CR17	G3	R30	F2	R147	L4		
CR20	F4	R31	D2	R148	M4		
CR65	D4	R32*	E1	R150	I5		
CR69	D4	R37	E4	R151	I5		
CR79	D3	R40	D5	R152	I4		
CR80	D3	R41	F5	R154	I4		
CR141	L3	R42	D5	R155	I5		
CR181	L5			R160	J5		
CR212	B1						



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

NOTE: * MATCHED PAIR.

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
45722	USM CORP., PARKER-KALON FASTENER DIV.		CAMPBELLSVILLE, KY 42718
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79727	C-W INDUSTRIES	550 DAVISVILLE RD., P O BOX 96	WARMINISTER, PA 18974
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111

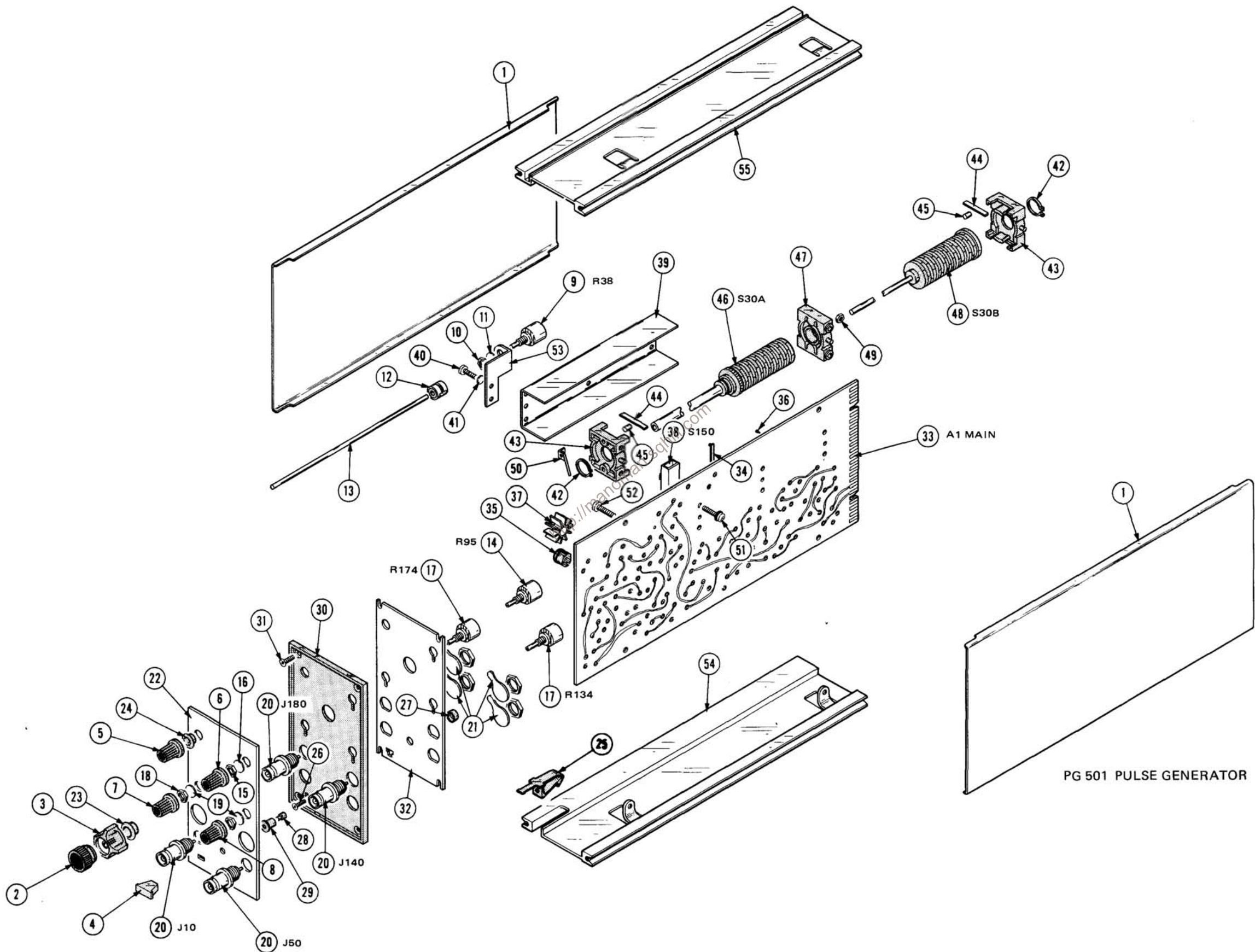
<http://manoman.sqhill.com>

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-1	337-1399-00		2						SHLD,ELECTRICAL:SIDE	80009	337-1399-00
-2	366-1201-00		1						KNOB:GRAY	80009	366-1201-00
	213-0153-00		2						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-3	366-1202-00		1						KNOB:GRAY	80009	366-1202-00
	213-0153-00		2						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-4	366-1422-00	B010100 B019999	1						KNOB:LATCH	80009	366-1422-00
	366-1422-01	B020000 B084159	1						KNOB:LATCH	80009	366-1422-01
	366-1690-00	B084160	1						KNOB,LATCH:	80009	366-1690-00
	214-1840-00	XB020000 B084159X	1						PIN,KNOB SECRG:0.094 OD X 0.120 INCH LONG	80009	214-1840-00
-5	366-0494-00		1						KNOBGRAY,W/SETSCREW	80009	366-0494-00
	213-0153-00		1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-6	366-0494-00		1						KNOBGRAY,W/SETSCREW	80009	366-0494-00
	213-0153-00		1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-7	366-0494-00		1						KNOBGRAY,W/SETSCREW	80009	366-0494-00
	213-0153-00		1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-8	366-0494-00		1						KNOBGRAY,W/SETSCREW	80009	366-0494-00
	213-0153-00		1						SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-9	-----		1						RESISTOR,VAR:(SEE R38 EPL) (ATTACHING PARTS)		
-10	210-0583-00		1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-11	210-0046-00		1						WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL - - - * - - -	78189	1214-05-00-0541C
-12	376-0051-00	B010100 B082517	1						CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	354-0251-00		2						. RING,COUPLING:0.251 ID X 0.375 INCH OD,AL	80009	354-0251-00
	213-0022-00		4						. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
	376-0151-01	B082518	1						CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0151-01
	376-0149-00		2						CPLG,SHAFT,FLEX:PLASTIC	80009	376-0149-00
	213-0078-00		2						. SCR,TPG,THD CTG:4-24 X 0.375 FLH,100 DEG	83385	OBD
-13	384-0180-00		1						EXTENSION SHAFT:0.125 OD X 5.75 INCH LONG	80009	384-0180-00
-14	-----		1						RESISTOR,VAR:(SEE R95 EPL) (ATTACHING PARTS)		
-15	210-0583-00		1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-16	210-0940-00		1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL - - - * - - -	79807	OBD
-17	-----		2						RESISTOR,VAR:(SEE R134 AND R174 EPL) (ATTACHING PARTS FOR EACH)		
-18	210-0583-00		1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-19	210-0940-00		1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL - - - * - - -	79807	OBD
-20	131-0955-00		4						CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE (ATTACHING PARTS FOR EACH)	13511	31-279
-21	210-0255-00		1						TERMINAL,LUG:0.391" ID INT TOOTH - - - * - - -	80009	210-0255-00
-22	333-1602-00		1						PANEL,FRONT:	80009	333-1602-00
-23	358-0216-00		1						BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-24	358-0378-00	B010100 B095199	1						BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00
	358-0599-00	B095200	1						BUSHING,SLEEVE:0.125 ID X 0.234 THK,PLSTC	28520	B-187-125
-25	214-1513-00	B010100 B019999	1						LCH,PL-IN RTNG:PLASTIC	80009	214-1513-00
	214-1513-01	B020000 B084159	1						LCH,PLUG-IN RET:	80009	214-1513-01
	105-0719-00	B084160	1						LATCH,RETAINING:PLUG-IN (ATTACHING PARTS)	80009	105-0719-00
-26	213-0254-00		1						SCR,TPG,THD CTG:2-32 X 0.250,100 DEG,FLH - - - * - - -	45722	OBD
	105-0718-00	XB084160 B085279	1						BAR,LATCH RLSE:	80009	105-0718-00
	105-0718-01	B085280	1						BAR,LATCH RLSE:	80009	105-0718-01
-27	200-0935-00		1						BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-28	378-0602-00		1						LENS,LIGHT:GREEN	80009	378-0602-00
-29	352-0157-00		1						LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-30	386-2286-00		1						SUBPANEL,FRONT: (ATTACHING PARTS)	80009	386-2286-00
-31	213-0229-00		4						SCR,TPG,THD FOR:6-20 X 0.375"100 DEG,FLH STLL - - - * - - -	93907	OBD

Replaceable Mechanical Parts—PG 501

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-32	337-1669-00		1						SHIELD,ELEC:SUBPANEL	80009	337-1669-00
-33	-----		1						CKT BOARD ASSY:MAIN(SEE AI EPL)		
-34	131-0604-00		34						. CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-35	136-0183-00		2						. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-36	136-0252-04		16						. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-37	214-1291-00		2						. HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H	05820	207-AB
-38	260-0984-00		1						. SWITCH,SLIDE:DP 3 POSN,0.5A,125VAC-DC	79727	G-128-S-0012
	105-0374-00		1						. ACTR ASSY,CAM S:	80009	105-0374-00
-39	200-1429-00		1						. . COVER,CAM SW: (ATTACHING PARTS)	80009	200-1429-00
-40	211-0008-00		6						. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-41	210-0004-00		6						. . WASHER,LOCK:#4 INTL,0.015THK,STL CD PL - - - * - - -	78189	1204-00-00-0541C
-42	354-0391-00		1						. . RING,RETAINING:0.395"FREE ID X 0.025" STL	97464	3100-43-CD
-43	401-0081-02		2						. . BEARING,CAM SW:FRONT	80009	401-0081-02
-44	214-1139-00 ¹		1						. . SPRING,FLAT:0.885 X 0.156CU BE GLD CLR	80009	214-1139-00
	214-1139-00 ¹		1						. . SPRING,FLAT:0.885 X 0.156CU BE GLD CLR	80009	214-1139-00
	214-1139-02 ¹		1						. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-45	214-1127-00		4						. . ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-46	105-0368-00		1						. . ACTUATOR,CAM SW:PULSE PERIOD,LONG SHAFT	80009	105-0368-00
-47	401-0115-00		1						. . BEARING,CAM SW:CENTER	80009	401-0115-00
-48	105-0367-00		1						. . ACTUATOR,CAM SW:PULSE DURATION	80009	105-0367-00
-49	210-0406-00		10						. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-50	131-0963-00		2						. . CONTACT,ELEC:GROUNDING (ATTACHING PARTS FOR ACTR ASSY)	80009	131-0963-00
-51	211-0116-00		6						. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS - - - * - - -	83385	OBD
-52	213-0146-00		4						(ATTACHING PARTS FOR CKT BD ASSY) SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL - - - * - - -	83385	OBD
-53	407-1204-00		1						BRACKET,ANGLE:	80009	407-1204-00
	386-3657-00	XB084160	2						SUPPORT,PLUG-IN:	80009	386-3657-00
	210-1270-00	XB084160	2						WASHER,FLAT:0.141 ID X 0.04 THK,AL	80009	210-1270-00
-54	426-0724-00		1						FR SECT,PLUG-IN:BOTTOM	80009	426-0724-00
-55	426-0725-00		1						FR SECT,PLUG-IN:TOP	80009	426-0725-00
	214-1061-00		1						SPRING,GROUND:FLAT	80009	214-1061-00

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



PG 501 PULSE GENERATOR

ACCESSORIES

Index No.	Tektronix Part No.	Serial/Model No.		Qty						Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont		1	2	3	4	5			
	070-1361-00			1						MANUAL, TECH: INSTRUCTION	80009	070-1361-00

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CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107 108	PG 501 - Risetime less than 3.5 ns into 50 Ω. PG 501 - 5 V output pulse; 3.5 ns Risetime	107 - Risetime less than 3.0 ns into 50 Ω. 108 - 10 V output pulse 1 ns Risetime
PG 502 replaces 107 108 111	PG 502 - 5 V output PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay	108 - 10 V output 111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay
PG 508 replaces 114 115 2101	Performance of replacement equipment is the same or better than equipment being replaced.	
PG 506 replaces 106 067-0502-01	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V. PG 506 - Does not have chopped feature.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V. 0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B 191 067-0532-01	SG 503 - Amplitude range 5 mV to 5.5 V p-p. SG 503 - Frequency range 250 kHz to 250 MHz.	190B - Amplitude range 40 mV to 10 V p-p. 0532-01 - Frequency range 65 MHz to 500 MHz.
SG 504 replaces 067-0532-01 067-0650-00	SG 504 - Frequency range 245 MHz to 1050 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A 181 184 2901	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time. TG 501 - Trigger output-slaved to market output from 5 sec through 100 ns. One time-mark can be generated at a time. TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously. 181 - Multiple time-marks 184 - Separate trigger pulses of 1 and 0.1 sec; 10, 1, and 0.1 ms; 10 and 1 μs. 2901 - Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.