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PG 505 PULSE GENERATOR

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077
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Product Group 75


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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

Terms In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

Terms As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

Symbols In This Manual



This symbol indicates where applicable cautionary or other information is to be found.

Symbols As Marked on Equipment



DANGER — High voltage.



Protective ground (earth) terminal.



ATTENTION — refer to manual.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor

and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Operate Without Covers

To avoid personal injury, do not operate this product without covers or panels installed. Do not apply power to the plug-in via a plug-in extender.

SERVICE SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

Use Care When Servicing With Power On

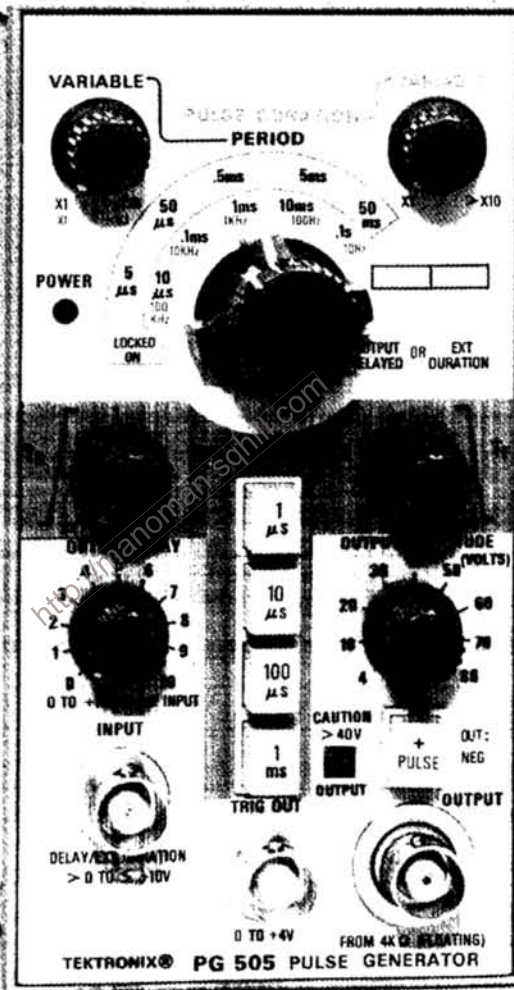
Dangerous voltages may exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

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1583-1

PG 505 Pulse Generator

SPECIFICATION

INTRODUCTION

Description

The PG 505 is a compact 100 kHz, 80 V general purpose pulse generator that is designed to operate in a TM 500 Series Power Module. Controls are provided for selection of a specific pulse period, duration, risetime, falltime, amplitude and output polarity. Additional features are listed in the Operators Section.

All inputs and outputs available at the interface connector, located at the back of the PG 505 and the TM 500 Series Power Module, are shown in the Maintenance Section.

The performance limits in this specification are valid with the following conditions:

Each instrument must be calibrated at an ambient temperature between +20° C and +30° C. Each instrument must be in an environment as described in Table 1-2.

Supplemental Information

The Supplemental Information listed here represents limits for optimum instrument operation. These limits are not instrument specifications, but they are intended to be used as maintenance or operational aids.

Table 1-1

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
Pulse Output		
Amplitude	± 4 V or less to at least ± 80 V from a 4 k Ω source.	
Aberrations	$\leq 5\%$ peak-to-peak at full amplitude into a 4 k Ω , 20 pF load.	
Residual DC Offset	$\leq 0.5\%$ at full amplitude.	
Isolation		± 200 V dc from chassis ground.
		Shipped from factory with bnc OUTPUT connector shell grounded by removable ground strap. Shell is grounded through 100 k Ω resistor R545 when ground strap is removed. The resistor may also be removed, but causes some degradation of performance.
Caution Indicator	On at ≤ 40 V; off at ≥ 20 V.	
Risetime and Falltime		
1 μ s	Within +0%, -10%, (10% and 90% points).	

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
10 μ s, 100 μ s, and 1 ms	Within $\pm 5\%$ of indicated time when T_R and T_F controls are set to X1 position. (Between 0% and 100% points.)	
Pulse Duration (Width)	5 μ s or less to 50 ms (5 μ s to 5 ms within 5%, 50 ms within 20%) in decade steps with the VARIABLE control fully ccw (X1). VARIABLE extends duration to at least 0.5 s in fully cw position (X10).	Stated limits apply over a temperature range of +15° C to +35° C. An additional 3% tolerance must be added to the stated limits over the temperature range of 0° C to +50° C.
Duty Factor	Maximum duty factor — 99%, minimum duty factor — minimum specified pulse duration can be attained for any specified period setting.	Duty Factor is defined as Pulse Duration/Pulse Period X100.
Pulse Period (Repetition Range)	10 μ s (100 kHz) or less to 100 ms (100 Hz), within 5% in decade steps with the VARIABLE control fully ccw (X1). VARIABLE extends period to at least 1 s (1 Hz) in fully cw position X10).	
Pulse Risetime and Fall time	1 μ s or less to 1 ms in decade steps with the T_R or T_F controls fully ccw (X1). T_R or T_F controls extends time to at least 20 ms in fully cw position (X20).	
Trigger Output	0 to $>+4$ V into 10 k Ω 0 to $>+3$ V into 600 Ω	Trigger pulse duration follows output pulse duration.
Delay Mode		
Delay Range (With Respect to Delay Signal)	0 to 10 V within 5%.	
Delay Jitter		$\leq 0.02\%$ of a ramp period with a 0 V to +10 V range input signal. Measured between 5 and 95% points on a 10 V input ramp.
External Duration		
Input Amplitude	≥ 0.5 V (TTL) into >10 k Ω	EXT DURATION mode always overrides OUTPUT DELAYED mode.
Custom Pulse Duration Range		5 μ s and slower, depending upon capacitor and setting of PULSE DURATION VARIABLE.
Custom Pulse Period Range		10 μ s and slower, depending upon capacitor and setting of PERIOD VARIABLE.

Table 1-2
ENVIRONMENTAL CHARACTERISTICS

Characteristics	Description
Temperature	
Operating	0°C to +50°C
Storage	-40°C to +75°C
Altitude	
Operating	To 15,000 feet
Storage	To 50,000 feet
Vibration	
Operating and Non-Operating	With the instrument complete and operating, vibration frequency swept from 10 to 50 to 10 Hz and 1 minute per sweep. Vibrate 15 minutes in each of the three major axes at 0.015 inch total displacement. Hold 3 minutes at any major resonance, or if none, at 50 Hz. Total time, 54 minutes.
Shock	
Operating and Non-Operating	30 g's, 1/2 sine, 11 ms duration, 2 shocks in each direction along 3 major axes, for a total of 12 shocks.
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.

Table 1-3
PHYSICAL CHARACTERISTICS

Characteristics	Description
Finish	Anodized aluminum panel and chassis.
Net Weight	1.6 lbs (724.8 grams).

OPERATING INSTRUCTIONS

Initial Operation

CAUTION

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

The PG 505 is calibrated and ready for use when received. It is designed to operate in any compartment of the TM 500 series power module.

Refer to the power module instruction manual for line voltage requirements and power module operation. See Fig. 2-1 for installation and removal procedure.

Be sure that the PG 505 is fully inserted in the power module. Pull the PWR switch on the power module. Check

that the POWER light on the PG 505 is on. The Controls and Connectors Fig. 2-2 gives a complete description of the front panel controls and connectors.

Functions Available At Rear Connector

Refer to the rear connector assignment illustration in the Maintenance Section of this manual for pin assignments.

A slot between pins 23 and 24 on the rear connector identifies the PG 505 as a member of the signal source family. A barrier may be inserted in the corresponding position of the power module jack to prevent other than signal source plug-ins from being used in that compartment. This protects the plug-in if specialized connections are made to that compartment. Consult the *Building A System* section of the power module manual for further information.

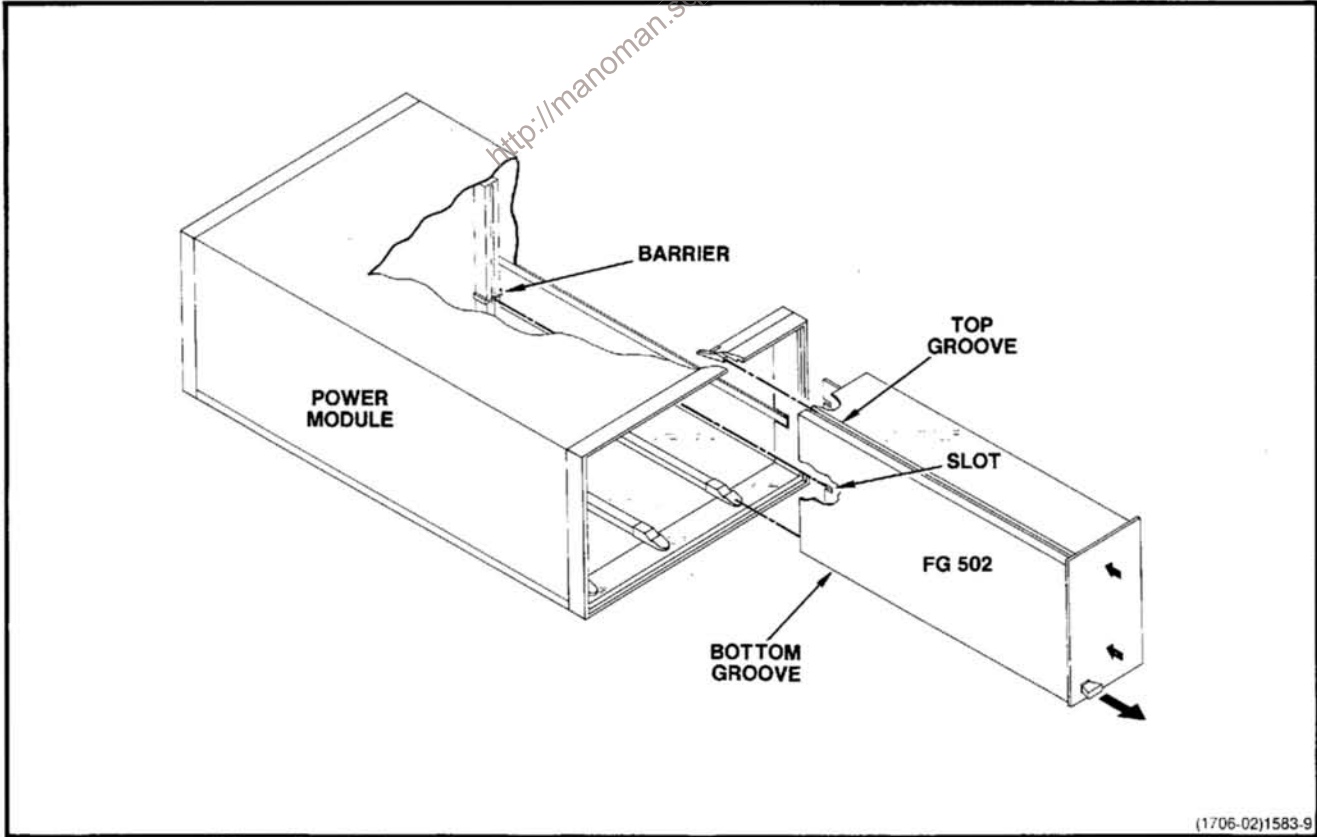


Fig. 2-1. PG 505 Installation and removal.

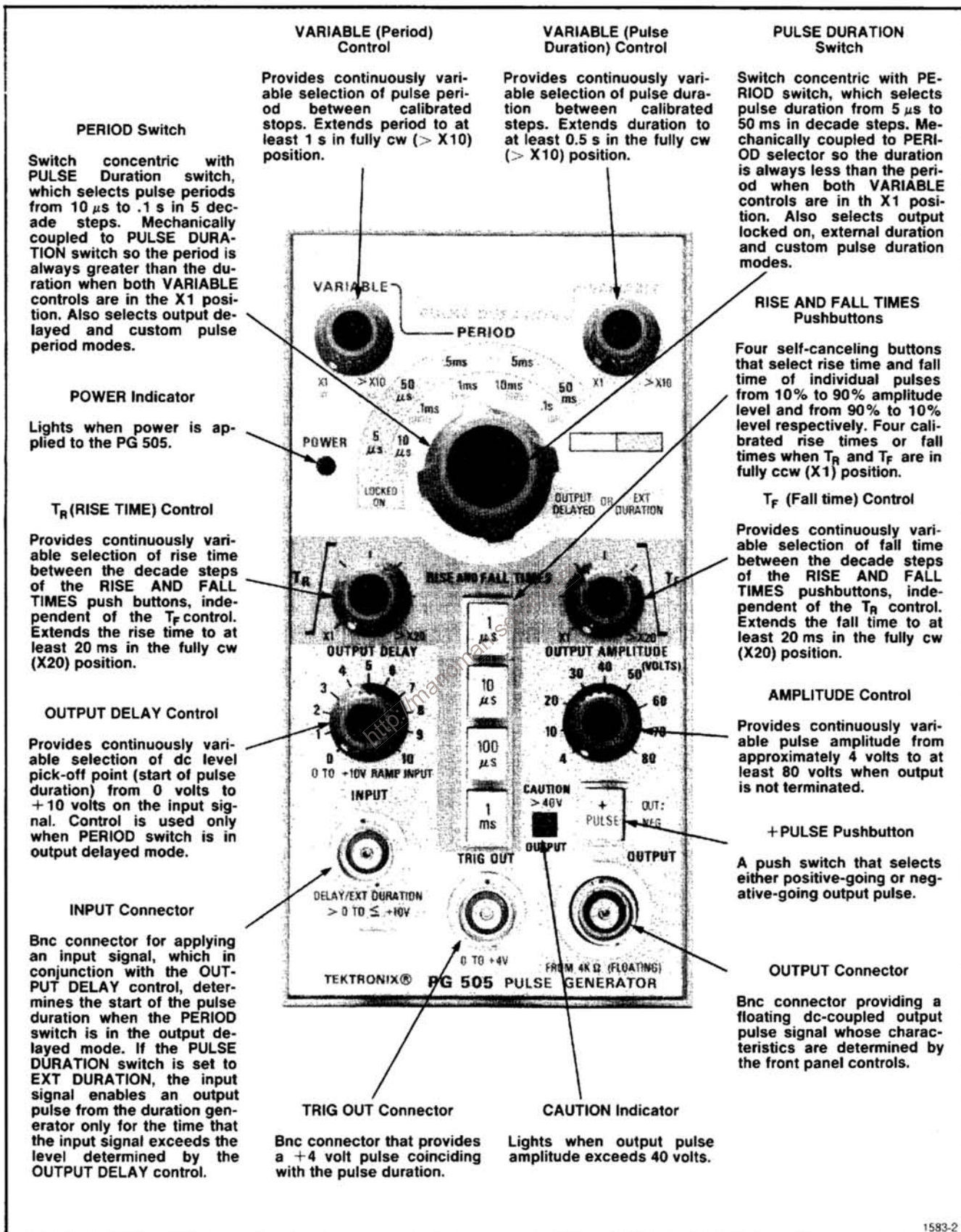


Fig. 2-2. Controls and Connectors.

OPERATING CONSIDERATIONS

Output Connections

The output of the PG 505 is designed to operate as a voltage source with a 4 k Ω resistor in series.

Pulse characteristics can be preserved by observing the following precautions:

1. Use high quality 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. Ensure that attenuators, terminations, etc., have adequate power handling capabilities for the output pulse. Power output is determined by the duty factor of output pulse current.

NOTE

The PG 505 has been designed so that the output bnc connector may be floated for floating-common operation by removing the wire connecting the bnc shell to the ground lug located at the front bottom circuit board mounting screw. If the output is to be elevated to a dangerous potential, or if local safety regulations prohibit use of floating bnc connectors, replace the bnc output connector. A suitable connector and mating plug are the Tektronix 131-1011-00 and 131-1012-00. The PG 505 may be ordered with this connector factory installed by specifying Mod 818C.

Risetime and Falltime

If the output pulse from the PG 505 is used for measuring the rise and 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 505 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.

If there is a dc voltage across the output load, the output pulse amplitude will be compressed, or in some cases, the output may be short circuited. 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.

OPERATING MODES

Normal

In the normal mode, the period generator free runs at the rate selected by the PERIOD switch and VARIABLE control. The duration of the output pulse (see Definitions of Pulse Characteristics) is selected by the PULSE DURATION switch and its associated VARIABLE control. Amplitude is set by the AMPLITUDE control. The pulse polarity from a reference is selected by the + PULSE push button. The PERIOD and PULSE 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 PULSE DURATION selector is in the LOCKED ON position, the output remains locked at a dc level selected by the AMPLITUDE control and the + PULSE push button (<4 to 80 V).

External Duration

When the PULSE DURATION switch is in the EXT DURATION position, the period generator is disabled. The output pulse now turned on by applying a positive-going signal to the INPUT connector. The OUTPUT DELAY control becomes the input threshold control. The external signal applied must rise to an amplitude approximately equal to the setting of the OUTPUT DELAY control before an output pulse is generated. The PG 505 output returns to zero when the signal on the INPUT connector falls to the setting of the OUTPUT DELAY control. Thus, the period and duration of the output pulse are dependent on the period and duration of the external signal applied to the INPUT connector. (See Fig. 2-3).

Output Delayed

The period generator is disabled when the PERIOD switch is in the OUTPUT DELAYED position. The start of the pulse duration is controlled by picking a voltage point, with the OUTPUT DELAY control, on a 0 to +10 V ramp waveform connected via the INPUT connector. The duration of the output pulse is selected by the PULSE DURATION switch and its associated VARIABLE control, while the period is dependent on the repetition rate of the ramp (see Fig. 2-4).

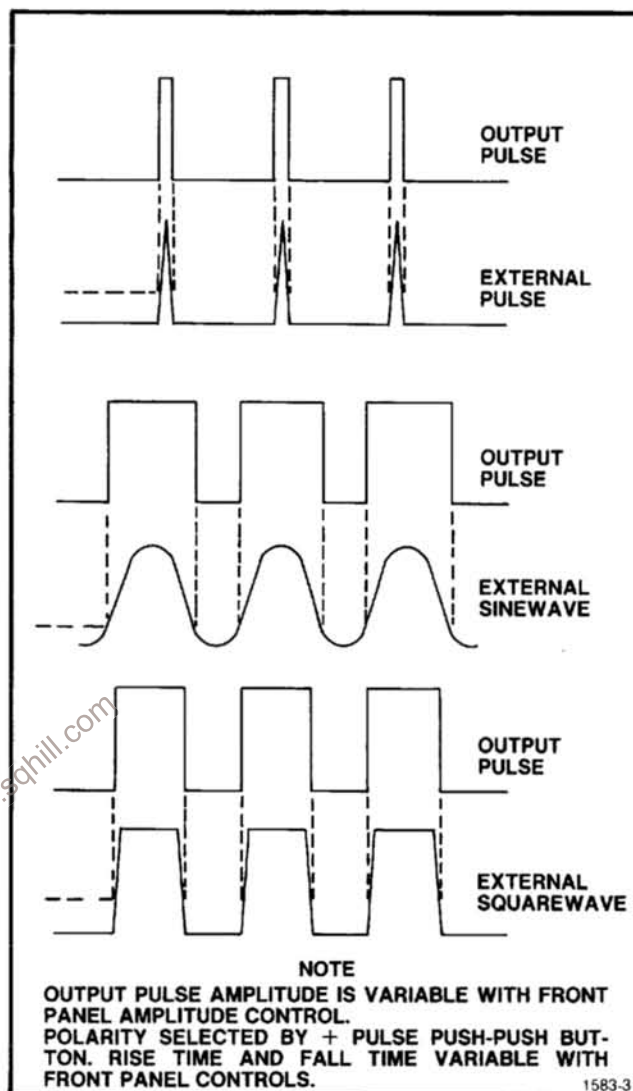


Fig. 2-3. Pulse duration and period being controlled by various external signals.

Custom Period and Pulse Duration

A special switch position is provided on the PERIOD and PULSE DURATION switches that provides a unique (custom selected) period and/or pulse duration. The electrical characteristics in section 1 define the period and pulse duration limits. The locations of the added capacitors are shown in Fig. 2-5.

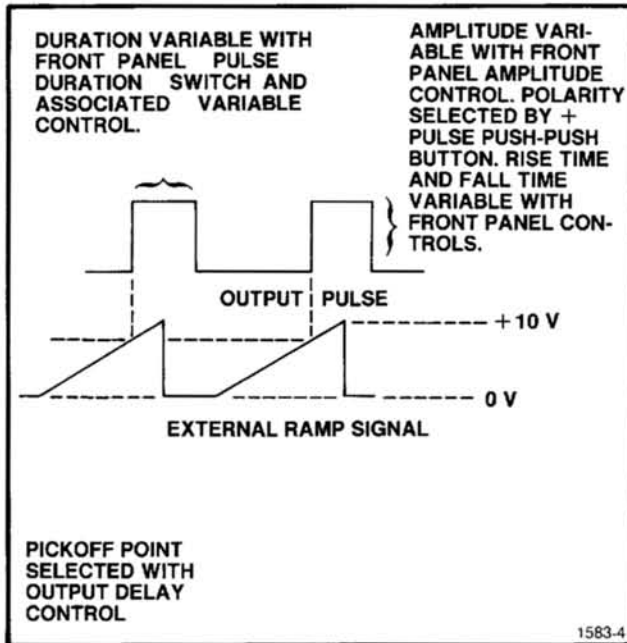


Fig. 2-4. Start of output pulse being controlled by selected pick-off voltage point on ramp signal.

The custom range positions on the PERIOD and DURATION controls permit user-selected period and duration times. To determine the approximate capacitor value for the desired period, multiply the period time in seconds by 5×10^{-5} . The result is the value of the capacitor in Farads. For example, a 50 ms period times 5×10^{-5} equals 250×10^{-8} or $2.5 \mu\text{F}$. This capacitor must be nonpolarized and have at least a 6 V rating. Solder this capacitor in the position shown in Fig. 2-5.

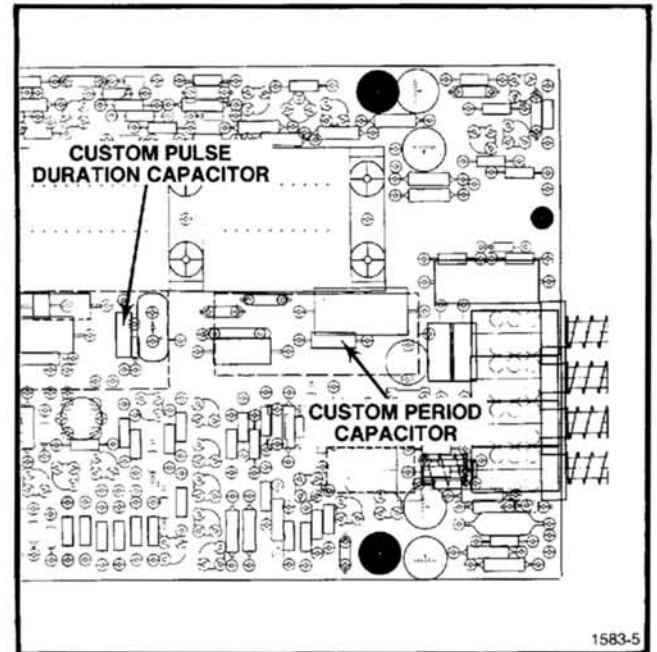


Fig. 2-5. Locations for custom period and pulse duration capacitors.

To determine the capacitor value for the duration time desired, multiply the duration time by 2×10^{-3} . For example a 50 ms duration time requires 50 ms times 2×10^{-3} or a 100 μF capacitor. If a polarized capacitor is used, observe the correct polarity. Use at least a 6 V rated capacitor. Connect this capacitor as shown in Fig. 2-5.

FUNCTIONS AVAILABLE AT REAR CONNECTOR

Unassigned pins are available at the rear connector for routing signals to and from the PG 505 for specialized applications (see Rear Connector Pin Assignments in Section 5). 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. 2-6.

Amplitude—The maximum absolute peak value of a pulse, regardless of sign and excluding unwanted aberrations or overshoot, from the zero axis. Amplitude is 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. 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 that is simultaneous to the leading and trailing edge of the pulse.

Period—The term 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 that precedes the step function. It may be of the same or opposite polarity as the pulse.

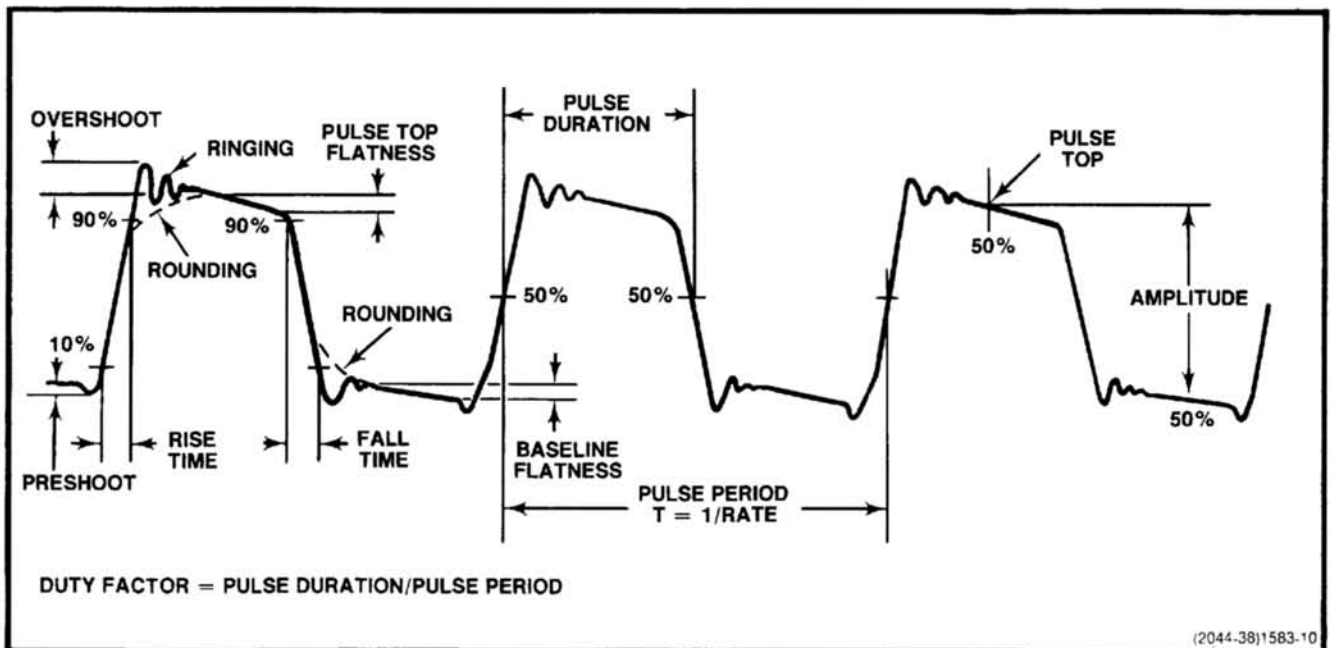


Fig. 2-6. Pulse characteristics.

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 (-).

Ringing—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.)

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:

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Refer to the following table for carton test strength requirements.
2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.
3. Cushion the instrument on all sides by tightly packaging dunnage or urethane foam between carton and instrument, allowing three inches on all sides.
4. Seal carton with shipping tape or industrial stapler.

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.

SHIPPING CARTON TEST STRENGTH

Gross Weight (lb)	Carton Test Strength (lb)
0-10	200
10-30	275
30-120	375
120-140	500
140-160	600

THEORY OF OPERATION

DIAGRAM

Delay Pickoff Trigger Comparator

The delay pickoff trigger comparator is composed of differential amplifier Q100-Q102, OUTPUT DELAY control R110, and switching transistor Q115.

Delayed Output Operation

To use this circuit for a delayed output, the PERIOD switch is set to its OUTPUT DELAYED position. The INPUT connector J100 (or rear interface pin 24B) connects the input signal (usually a ramp) to the base of Q100.

The reference voltage for the differential amplifier is supplied to the base of Q102 from the OUTPUT DELAY control. As long as the signal at the base of Q100 is more negative than the reference voltage at the base of Q102, Q100 and Q115 conduct. As soon as the base of Q100 becomes more positive than the base of Q102, Q100 and Q115 turn off. This applies a high to pin 3 of U175, triggering the duration generator one-shot multivibrator.

External Duration Operation

Set the PULSE DURATION switch to EXT DURATION to use this circuit for an externally controlled duration. The INPUT connector J100 (or rear interface pin 24B) connects the input signal (usually a pulse) to the base of Q100.

The reference voltage for the differential amplifier is supplied to the base of Q102 from the OUTPUT DELAY control. As long as the signal at the base of Q100 is more negative than the reference voltage at the base of Q102, Q100 and Q115 conduct. With Q115 conducting, the period generator output is low. (The PG 505 output state is determined by the period generator's transitions). As soon as the base of Q100 becomes more positive than the base of Q102, Q100 and Q115 turn off. This causes the period generator to go high and stay high as long as Q115 is turned off.

PERIOD GENERATOR

The period generator is a free-running multivibrator that consists of operational amplifier Q140-Q142-Q144, timing capacitors C126 through C134, and timing resistors R128 through R136 and R148 through R152.

The period generator free-runs in all positions of the PERIOD switch and in all but the EXT DURATION position of the PULSE DURATION switch. The period generator sets the basic timing for the pulse generator.

The PULSE DURATION and PERIOD switches are interlocked to prevent the period from exceeding the duration.

In the EXT DURATION position of the PULSE DURATION switch, the negative input to the period generator (base of Q140) is connected to either the INPUT connector J100 or pin 24B of the rear interface connector. The period generator timing components and the output of the duration generator are disconnected. The output of the period generator (and therefore the PG 505 output) goes high and stays high only as long as Q115 remains turned off.

When the PERIOD switch is set to , a selected capacitor may be connected between two circuit board pads to obtain a custom period.

The free-running period generator can be gated off by applying a 5 volt positive-going pulse whose duration is the same as the off time desired. The +5 volt input pulse at pin 21B of the rear interface connector causes CR122 to be forward biased. With CR122 forward biased, Q140 base is held at about a +2.5 V level, thus stopping the free-running generator.

Using the external gating circuit described above may cause some time distortion to the first and last pulse of a pulse-string.

DURATION GENERATOR

The duration generator is a retriggerable one-shot multivibrator consisting of integrated circuit U175, timing capacitors C180 through C188, and timing resistors R176 through R186.

A high applied to pin 3 of U175 triggers the one-shot multivibrator to produce a single, positive-going pulse at pin 8. The width of the pulse is determined by the timing capacitors and resistors. When the PULSE DURATION switch is set to , a selected capacitor may be

Theory of Operation—PG 505

connected between two circuit board pads to obtain a custom duration.

A low from the delay pickoff comparator disables the duration generator until the input ramp causes the output of the delay pickoff comparator to switch to its high state. The high at pin 3 of U175 enables the duration generator. The duration generator now operates as it would normally. The period of the pulse is determined by the repetition rate of the input signal to the delay pickoff comparator.

The duration generator output is disconnected from the remainder of the PG 505 circuitry in the EXT DURATION position of the PULSE DURATION switch.

TRIGGER OUTPUT

Emitter follower Q164, inverter-amplifier Q160, and one-half of coupling transformer T190 compose the trigger output. Q164 provides a low impedance point for the trigger output signal from either the front panel TRIG OUT J170 connector or pin 27B on the rear interface.

Q160 is inserted into the circuit (to invert the output of the period generator) whenever the PULSE DURATION switch is set to its EXT DURATION position.

DIAGRAM

Signal Restorer

The Signal Restorer circuit is composed of Q190 and Q200, a Schmitt multivibrator.

The alternating, differentiated, positive and negative peaks applied to the base of Q190 result in a square wave at the collector of Q200, since a positive peak at the base of Q190 causes the collector of Q200 to be high, while a low at the base of Q190 causes the collector of Q200 to be low.

In the LOCKED ON position of the PULSE DURATION switch, the base of Q200 is tied to a negative voltage, causing the collector of Q200 to remain high. The output of the PG 505 is now a dc level controlled by the AMPLITUDE control.

RISETIME AND FALLTIME CURRENT SWITCH

Emitter coupled switch Q212-Q214-Q220 make up the risetime and falltime current switch.

The square-wave output of the signal restorer is coupled to the input of the emitter coupled switch, which is an active pull-up, pull-down switch. When the square wave at the base of Q212 is high, Q220 conducts (Q214 is turned off) and the common collector point with Q214 is high. When the square wave goes low at the base of Q212, Q214 conducts (Q220 is now turned off) and the common collector point with Q220 is low.

RISETIME AND FALLTIME CURRENT SOURCES

The risetime and falltime current sources are composed of amplitude limiting Zener diodes VR220-VR222, diode bridge CR234 through CR240, risetime constant current source Q230, T_R control R230, falltime constant current source Q240, and T_F control R240.

VR220 and VR222 limit the square wave to the diode bridge to 20 volts peak-to-peak. A positive-going 10-volt square wave at the input to the diode bridge forward biases CR238. With CR238 turned on, all the current the falltime constant current source can supply is demanded by Q220. The risetime constant current source now supplies current, at a rate determined by T_R control R230, to charge a capacitor (C250 through C258), via CR236, to the same voltage that is at the input to the diode bridge. CR240 acts in this condition to limit the maximum voltage the capacitor can attain. A negative-going 10-volt square wave at the diode bridge input forward biases CR234. All of the risetime constant current source current is now demanded by Q214. The falltime constant current source now supplies current to charge the capacitor (via CR240) negatively to the same voltage that is at the diode bridge input. CR236 in this case acts to limit the maximum capacitor charge voltage.

OUTPUT AMPLIFIER

The output amplifier is composed of source follower Q260, emitter followers Q262-Q280, complementary-symmetry stage Q286-288, operational amplifier Q290-Q310-Q316-Q320-Q330-Q346-Q354, constant current source Q300, indicator control transistors Q382, Q390, and Q394, and output reference supplies Q370 and Q360.

Field effect transistor (FET) Q260A, connected as a source follower, presents a high impedance to the input signal from the current sources and a low impedance to the base of Q262. FET Q260B is connected as a current source; this minimizes dc level shift between the gate and source of Q260A since both FET halves are alike in characteristics. Q262 and Q280 are both emitter followers; one is a PNP type and the other a NPN type transistor to eliminate any V_{VE} problem. Q286 and Q288 form a complementary-symmetry circuit to drive the input resistance of the output amplifier.

Q290, Q310, Q316, Q320, Q330, Q346, and Q354 compose an operational amplifier stage whose gain is about 4.0. With the front-panel + PULSE pushbutton pushed in (positive-going pulse output), the feedback resistors for the operational amplifier are R340 and R306, while the effective input resistance is R306 (actual stage input resistor is R292). When the + PULSE pushbutton is in its extended position (negative-going pulse output), the feedback resistor is R340 while R308 is the input resistor. Q346 and Q354 form a complementary-symmetry circuit to drive low input resistance that might be connected to OUTPUT connector J340.

Q300 forms a constant current source that furnishes current to the normal (Q290) and inverted (Q310) inputs to the operational amplifier.

The CAUTION indicator turns on whenever the base of Q382 is about 0 volts with respect to floating ground, which turns on Q382, Q390, and Q394. The approximate 0 volts at the base of Q382 is equivalent to an output voltage of about 40 volts or more.

To achieve the large amplitude swing required of the amplifier, two reference supplies (referenced to internal floating ground) are used to establish the baseline of the signal. The Q360 emitter follower -48 volt supply is connected to the shield part of OUTPUT connector J340 whenever the + PULSE pushbutton is in for a positive-going pulse. The +48 volt supply is the reference supply for negative-going pulses. The -10 volts that is connected to one end of the AMPLITUDE control offsets the squarewave so it will match the baseline reference voltage at the OUTPUT connector.

DIAGRAM

Power Supplies

Ground Reference Power Supplies

+20 Volt Supply. The regulator for the +20 volt supply consists of Q520, an error sensing and amplifier transistor, Q530, and error amplifier and regulator transistor, and the series pass transistor that is located in the power module mainframe. The supply voltage is established by comparing the supply voltage sample, which is established by R520 (+20 V cal) at the base of Q520, with the reference voltage established by VR520 at the emitter of Q520. Any difference between the Q520 base and emitter voltage is amplified by Q520 and Q530, and used to change the conduction of the series pass transistor to correct the output voltage. R514 provides current limiting for Q520 in case Q530 fails. C514 prevents regulator oscillation.

+12 Volt Supply. The +12 volt supply is derived from the +20 volt supply. The supply consists of voltage dropping resistor R534, and Zener diode VR 534.

+5 Volt Supply. The 5 volt supply is derived from the +20 volt supply. The supply consists of voltage dropping resistor R542, Zener diode VR542, emitter follower transistor (located in the power module mainframe), and the temperature compensation diode CR542.

-6 Volt Supply. The -6 volt supply is derived from the TM 500 Series Power Module -33.5 volt unregulated supply. Zener diode VR550 sets the base voltage of emitter follower Q550 and provides regulation. CR550 provides temperature compensation.

Floating Power Supplies

-48 Volt Supply. Two 25 volt AC windings are connected in series to supply about 50 volts AC from the TM 500 Series Power Module to the -48 volt regulator. The regulator for the -48 volt supply consists of operational amplifier U610A, series pass transistor Q642, and level shifting Zener diode VR646. The gain of the amplifier is set by R656, R658 and R660. R656 is the input resistor while R658 and R660 are the feedback resistors for the operational amplifier. The gain of the amplifier is set to about eight times by R658 (-48 V cal). The supply voltage is established by comparing the voltage at the negative input of U610A with the voltage reference at the positive input. Any differences between the negative and positive inputs to U610A causes a change in the conduction of Q642 to correct for the output error. Level shifting Zener diode VR646 allows U610A, which has a V_{cc} of 30 volts, to be used to regulate a much higher voltage. Q646 protects the supply in the event of a current overload. The overload will cause Q646 to turn on, which biases Q642 off, shutting the -48 volts supply down. R640 is a shunt resistor for Q642 to bypass part of the current and reduce its temperature.

-20 Volt Supply. The -20 volt supply is derived from the -48 volt supply. The supply consists of voltage divider resistors R626-R624 and operational amplifier Q620-Q622. The operational amplifier has unity gain. The supply voltage is established by comparing the voltage at the collector of Q622 with the reference voltage at the base of Q620. Any differences between the two voltages will cause a change in the output that corrects the output error.

Output Balance Reference. (-10 V supply) The reference is derived from the -48 volt supply. The reference consists of voltage divider resistors R617-R615-R614, operational amplifier U610B, and emitter follower Q610. The operational amplifier has unity gain. The output balance reference voltage is established by comparing the voltage at the negative input of U610B with the reference voltage at the positive input, which is set by R615 (-10 V cal). Any differences between the two inputs of U610B will cause a change in its output so as to correct for the output error.

Theory of Operation—PG 505

+48 Volt Supply. The regulator for the +48 volt supply consists of Q566 (an error sensing and amplifier transistor), Q576 (an error amplifier and regulator transistor), and Q580, the series pass transistor. The supply voltage is established by comparing the supply voltage sample, that is established by R570 + (+48 V cal) at the base of Q566 with the reference voltage established by the -48 volt supply and diode CR566 at the emitter of Q566. Any difference between ground and the Q566 base and emitter

voltage is amplified by Q566 and Q576 and used to change the conduction of Q580 to correct output voltage. R564 provides current limiting for Q566 in case Q576 fails. C564 prevents regulator oscillation. R579 is a shunt resistor for Q580 to bypass part of the current and reduce its temperature.

+20 Volt Supply. The +20 volt and -20 volt supplies are similar in operation.

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CALIBRATION PROCEDURE

PERFORMANCE CHECK PROCEDURE

Introduction

The performance check procedure checks the electrical performance requirements listed in the Specification section in this manual. Perform the Adjustment procedure if the instrument fails to meet these checks. If recalibration does not correct the discrepancy, troubleshooting is indicated. This procedure may be used to determine acceptability of performance in an incoming inspection facility.

For convenience, some steps in the procedure check the performance of this instrument at only one value in the specified performance range. Performance requirements for various temperature ranges are listed in this procedure. When performing the procedure, use only the limits listed for the ambient temperature that the instrument is operating in.

Calibration Interval

To ensure instrument accuracy, check the calibration every 2000 hours of operation or at a minimum of every six months if used infrequently.

Services Available

Tektronix, Inc. provides complete instrument repair and adjustment at local field service centers and at the factory service center. Contact your local Tektronix field office or representative for further information.

Test Equipment Required

The following test equipment or equivalent is suggested to perform the Performance Check and Adjustment Procedure.

Table 4-1

TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Suggested Equipment
Power Module		TEKTRONIX TM503 or TM 504
Oscilloscope Main Frame	DC—10 MHz	TEKTRONIX 7704A, 7504
Vertical Amplifier	DC—10 MHz (high dynamic range)	7A26
Time Base	1 sec/div—1 μ sec/div	7B70,7B50
Counter	10 Hz—1 MHz	DC 503A
Function Generator	0—15 V Ramp/500 Hz	FG 501A
50 Ω Terminator	50 $\Omega \pm 1\%$	Tektronix 011-0049-01
Bnc "T" Connector		Tektronix 103-0030-00
50 Ω Cables (3)		Tektronix 012-0057-01
X10 Probe		Tektronix 010-0128-00
4K Resistor	0.5 W, 1%	Tektronix 323-0251-00
Clip Lead Adapter	Bnc to clip leads	Tektronix 013-0076-00
Bnc Male to Male Adapter	Bnc	Tektronix 103-0029-00
600 Ω Resistor	1 W, 1%	
10K Resistor	1W, 1%	

Calibration Procedure—PG 505

Performance Check

Preliminary Procedure

With the power module turned off, install the PG 505, the digital voltmeter and the frequency counter in the power module. Turn all equipment on and allow at least 20 minutes to warm up.

Initial control settings. During warm-up, set the PG 505 controls as follows:

PULSE PERIOD	.1 ms
PULSE DURATION	50 μ s
PERIOD VARIABLE	Fully ccw
DURATION VARIABLE	Fully ccw
T _r Variable	Fully ccw
T _f Variable	Fully ccw
RISE and FALL TIMES	1 μ s in
OUTPUT DELAY	Fully ccw
OUTPUT AMPLITUDE	Fully ccw
+ PULSE	In

1. Check Caution Indicator

- Connect a 10X probe to the oscilloscope input.
- Connect the 10X probe to the PG 505 OUTPUT connector.
- CHECK that the CAUTION indicator light comes on before the output reaches 40 V and goes out before the output becomes less than 20 V.

2. Check Output Amplitude

- Set the PG 505 to the initial control settings.
- Connect the 10X probe from the oscilloscope to the PG 505 OUTPUT.
- Adjust the OUTPUT AMPLITUDE control fully cw.
- CHECK for at least + and - 80 V as the +PULSE button is pushed in and released.
- Rotate the OUTPUT AMPLITUDE control fully ccw.
- CHECK that the output amplitude is less than + and - 4 V as the +PULSE pushbutton is pushed in and released.

3. Check Residual DC Offset

- Set the PG 505 to the initial control settings.
- Connect a 10X probe from the oscilloscope to the output of the PG 505.
- Adjust the OUTPUT of the PG 505 for 80 V.
- Remove the 10X probe and connect a coaxial cable from the OUTPUT of the PG 505 to the input of the oscilloscope.
- Set the Oscilloscope to 0.5 V/Div.
- CHECK that the residual dc level is less than 0.8 divisions away from the ground level on the crt. Check the - output pulse for <0.8 divisions of shift from the ground reference line.

4. Check Rise Time and Fall Time

- Set the PG 505 to the initial control settings.
- Connect the equipment as shown in Fig. 4-1.
- Adjust the PG 505 OUTPUT for a 6 division display.
- Set the PULSE PERIOD to 10 μ s and the PULSE DURATION to 5 μ s.
- CHECK that the 10% to 90% rise time and fall time is 1 μ s +0%, -10%.
- Set the PG 505 as follows and check rise and fall time as indicated:

PULSE PERIOD	PULSE DURATION	RISE/FALL TIME	(0% to 100%)
.1 ms	50 μ s	10 μ s	\pm 5%
1 ms	.5 ms	100 μ s	\pm 5%
10 ms	5 ms	1 ms	\pm 5%

5. Check Rise and Fall Time Variables

- Set the PG 505 to the initial control settings.
- Set the T_r control fully cw.

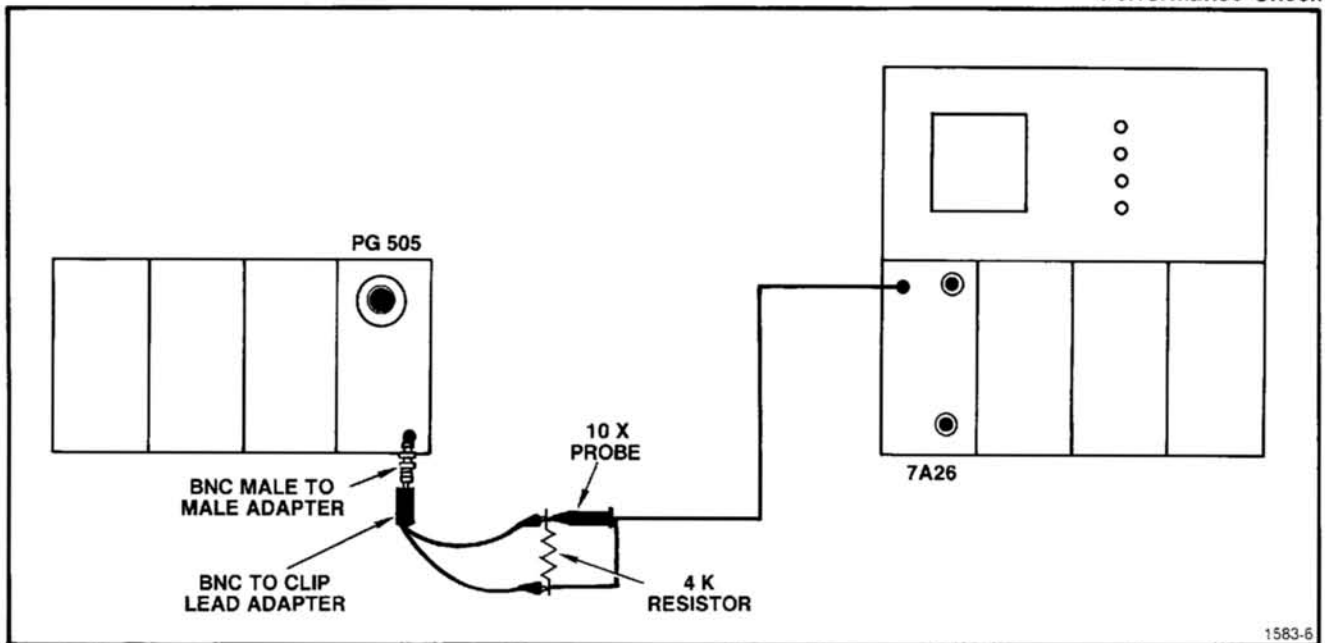


Fig. 4-1. Rise Time Check.

c. CHECK that the pulse rise time is $20 \mu\text{s}$ or more.

d. Set the T_r control fully cw.

e. CHECK that the pulse fall time is $20 \mu\text{s}$ or more.

6. Check Pulse Aberrations

a. Set the PG 505 to the initial control settings.

b. Set the pulse PERIOD to $10 \mu\text{s}$ and the pulse DURATION to $5 \mu\text{s}$.

c. Connect the equipment as shown in Fig. 4-1.

d. Set the OUTPUT for 4 divisions of deflection with the oscilloscope set to 0.5 V/div .

e. CHECK the front corner of the pulse for no more than 0.2 divisions of overshoot or waveform aberration.

f. Repeat for the $-$ pulse.

7. Check Trigger Output Amplitude

a. Set the PG 505 to the initial control settings.

b. Connect the equipment as shown in Fig. 4-1, but change to the $10 \text{ k}\Omega$ resistor instead of the $4 \text{ k}\Omega$ resistor and connect it from the TRIG OUT instead of from the OUTPUT of the PG 505.

c. CHECK that the trigger output amplitude is 4 V or more.

d. Remove the $10 \text{ k}\Omega$ resistor and replace it with a 600Ω resistor.

e. CHECK that the output amplitude of the trigger is 3 V or more.

8. Check Pulse Period and Duration

a. Set the PG 505 to the initial control settings.

b. Connect the equipment as shown in Fig. 4-2. Set the DC 503A to measure period B.

c. Use the following table to measure the pulse and duration accuracy. ($\pm 5\%$)

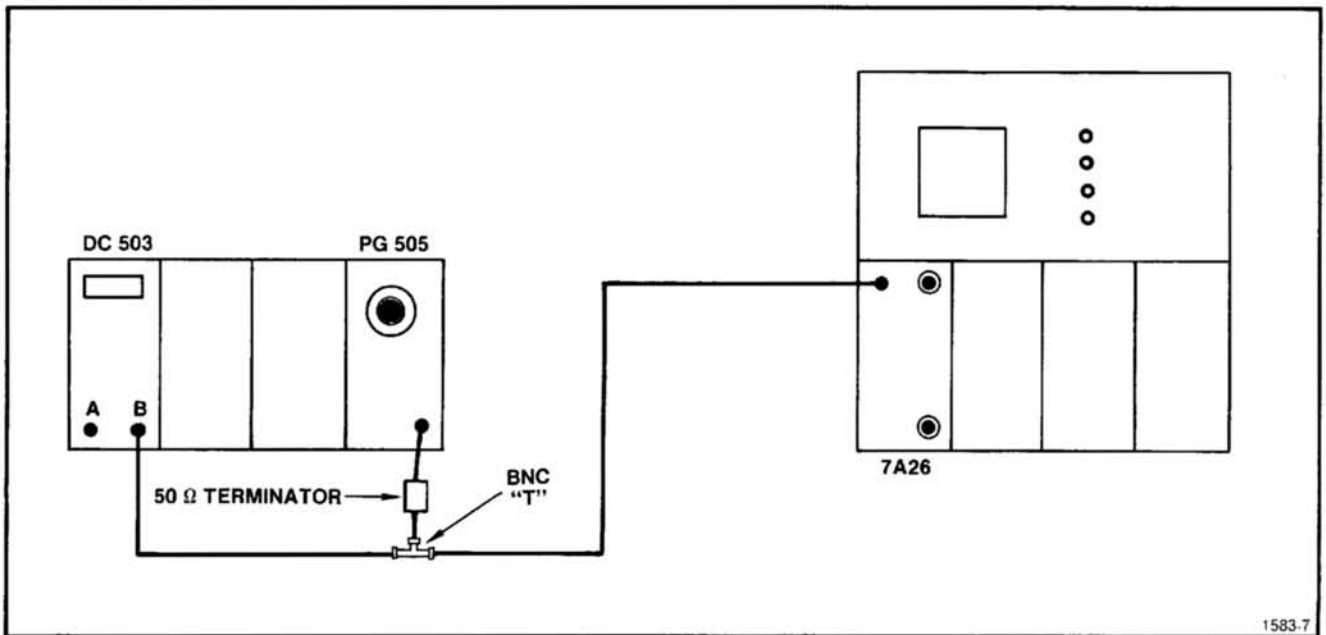


Fig. 4-2. Pulse Period and Duration Check.

DURATION Switch	PERIOD Switch	DC 503A AVGS	PERIOD Limits	OSCILLOSCOPE Time/Div	PULSE Width
5 μ s	10 μ s	10 ₃	9.5 — 10.0 μ s	1 μ s	4.75 — 5.0 μ s
50 μ s	.1 ms	10 ₃	95 — 105 μ s	10 μ s	47.5 — 52.5 μ s
.5 ms	1 ms	10	.95 — 1.05 ms	.1 ms	475 — 525 μ s
5 ms	10 ms	10	9.5 — 10.5 ms	1 ms	4.75 — 5.25 ms
50 ms	.1 s	10	95 — 105 ms	10 ms	40 — 60 ms (\pm 20%)

9. Check the PERIOD and DURATION Variables

- a. Set the PG 505 to the initial control settings.
- b. Connect the equipment as shown in Fig. 4-2. Set the DC 503 to measure Period. Use the settings in the second line of the table in the preceding step.
- c. Turn the PERIOD and PULSE DURATION controls cw.
- d. CHECK that the pulse and period readings increase by 10 times or more.

10. Check Output Delay Range

- a. Set the PG 505 to the initial control settings.
- b. Connect the equipment as shown in Fig. 4-3.

- c. Set the PG 505 PERIOD to OUTPUT DELAYED and the DURATION to .5 ms.
- d. Set the oscilloscope channel 1 to 0.5 V/div and channel 2 to 5.0 V/div.
- e. Set the FG 501A to a 500 Hz positive ramp with an amplitude of 15 V.
- f. Position the scope Channel 2 trace to the center of the graticule for a zero reference.
- g. Use the FG 501A OFFSET to adjust the bottom of the ramp approximately 0.4 V below the graticule center.
- h. CHECK that the PG 505 output pulse begins at the point where the ramp signal crosses the graticule center line within .1 div.

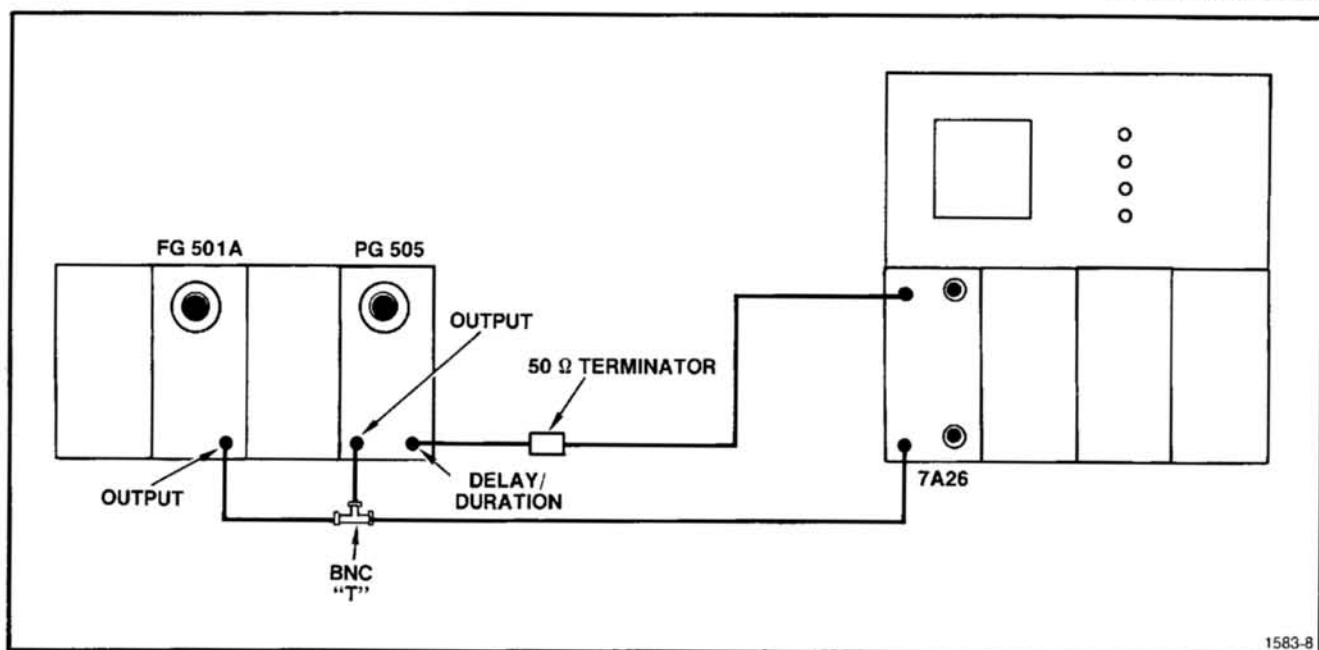


Fig. 4-3. Output Delay Range Check.

- i. Set the PG 505 OUTPUT DELAY cw.
- j. CHECK that the PG 505 output pulse begins at the point where the ramp signal crosses the 10 V level (2 divisions above the graticule center) within .1 division.

11. Check External Duration

- a. Set the PG 505 to the initial control settings.
- b. Connect the equipment as shown in Fig. 4-3.
- c. Adjust the FG 501 for a 0.5 V output pulse, positive-going from 0 V.
- d. Set the PG 505 DURATION switch to EXT DURATION.

- e. Check the test oscilloscope for a square wave display.

12. Check LOCKED ON

- a. Connect a 50-ohm cable and a 50-ohm terminator from the PG 505 OUTPUT to the oscilloscope Channel 1 input.
- b. Set the oscilloscope Channel 1 for 0.5 V/div.
- c. Set the PG 505 PULSE DURATION to the LOCKED ON position, all other settings to the initial control settings.
- d. Adjust the oscilloscope Channel 1 position to place the trace at graticule center.
- e. Adjust the PG 505 OUTPUT AMPLITUDE fully cw and observe that the trace on the test scope moves up approximately 2 divisions.
- f. This completes the performance check.

ADJUSTMENT PROCEDURE

Introduction

Use this Adjustment Procedure to restore the PG 505 to original performance requirements. This Adjustment Procedure need not be performed unless the instrument fails to meet the Performance Requirements of the electrical characteristics listed in the Specification section or if the Performance Check procedure cannot be completed satisfactorily. If the instrument has undergone repairs, the Adjustment Procedure is recommended.

Satisfactory completion of all adjustment steps in this procedure ensures that the instrument will meet the Performance Requirements.

Test Equipment Required

The test equipment (or equivalent) listed in Table 4-1 is required for adjustment of the PG 505. All test equipment is assumed to be correctly calibrated and operating within specifications.

If other test equipment is substituted, the adjustment procedure may need to be altered to meet the requirements of the equipment used.

Preparation

Access to the internal adjustments is easiest when the PG 505 is connected to the power module with a flexible plug-in extender. Make adjustments at an ambient temperature between 21°C and 25°C (70°F and 77°F). Allow at least 30 minutes of warm up time.

WARNING

Dangerous voltages exist at several points in this instrument. When the instrument is operated with the covers removed, do not touch exposed connections and components. Disconnect power before cleaning the instrument or replacing parts.

Refer to the Adjustment Locations fold-out page in section 8 of this manual. Install a 50 Ω terminator on the PG 505 OUTPUT connector.

1. Adjust +20 V Power Supply (R520)

- Connect the dc voltmeter between the -20 V test point and ground.

- Check for a voltage between 19.9 V and 20.1 V.
- Adjust R520 for the proper voltage.
- Check the following supplies:

+12 V	(+11 V — +13 V)
+5 V	(+4.8 V — +5.4 V)
-6 V	(-5.8 V — -6.6 V)

2. Adjust Floating 48 Volt Power Supplies (R570 and R658)

- Connect the dc voltmeter between each test point and the floating ground test point.
- Check for a voltage between 47.9 and 48.1 volts at each test point.
- Adjust R570 (+48 V) and R658 (-48 V) for the proper voltage.
- Check the following floating supplies:

+20 V	(+19.5 V — +20.5 V)
-20 V	(-19.5 V — -20.5 V)
-10 V	(-9 V — -11 V)

3. Adjust Output Balance (R360, R370, and R615)

- Remove the 50 Ω terminator from the PG 505 OUTPUT connector.
- Set the oscilloscope to 0.5 V/div. Set the trace to the graticule center.
- Set the PG 505 controls to:

DURATION	5 μs
PERIOD	10 ms
+PULSE	in
OUTPUT AMPLITUDE	cw
RISE/FALL TIME	1 μs
All other controls	ccw
- Connect a 50 Ω cable from the PG 505 OUTPUT to the input of the oscilloscope.
- Adjust R360 (+Adjust) to place the bottom of the display to the graticule center within 0.2 div.

- f. Set the PG 505 +PULSE switch out.
- g. Adjust R370 (–ADJ.) to place the top of the display at the graticule center within 0.2 div.
- h. Set the OUTPUT AMPLITUDE ccw.
- i. Adjust R615 (BAL Adj.) to place the display at the graticule center.

4. Adjust Rise/Fall Times (R241 and C250)

- a. Connect a 50 Ω cable terminated with a 50 Ω terminator from the PG 505 OUTPUT to the input of the oscilloscope.
- b. Set the PG 505 controls to:

OUTPUT AMPLITUDE	Full cw
PULSE DURATION	5 ms
PERIOD	10 ms
RISE and FALL TIMES	1 ms
All other controls	ccw
- c. Adjust R241 (Rise Time and Fall Time Range Adjust) for a rise time of 1 ms between the 0% and 100% points.
- d. Set the PG 505 DURATION switch to 5 μs.
- e. Set the PG 505 PERIOD switch to 10 μs.
- f. Set the PG 505 Rise and Fall Times switch to 1 μs.
- g. Adjust C250 (1 μs rise time) for a rise time of 1 μs between the 10% and 90% points.
- h. Set the controls as indicated below and check that the rise times and fall times are within limits for each group of settings.

DURATION Switch	PERIOD Switch	RISE and FALL TIMES Switch	Check Points	Oscilloscope Displayed Rise and Fall Time Limits
5 μs	10 μs	1 μs	10 — 90%	0.90 — 1.00 μs
50 μs	.1 ms	10 μs	0 — 100%	9.5 — 10.5 μs
.5 ms	1 ms	100 μs	0 — 100%	95 — 1.05 μs
5 ms	10 ms	1 ms	0 — 100%	0.95 — 1.05 ms

5. Adjust Pulse Period and Duration (R135, R150 and R180)

- a. Set the PG 505 controls as follows:

PULSE DURATION	.5 ms
PERIOD	1 ms
+ PULSE	In
OUTPUT AMPLITUDE	Fully ccw
All Other Controls	Fully ccw

- b. Connect a 50 Ω terminator, a bnc "T" connector and two 50 Ω coaxial cables to the OUTPUT connector of the PG 505. Connect one cable to the vertical input of the oscilloscope and the other cable to the frequency counter.
- c. Adjust the OUTPUT AMPLITUDE control fully cw.
- d. Adjust R135 (1 ms Adj) for a digital frequency counter reading of 1 kHz (±20 Hz).
- e. Adjust R180 (.5 ms Adj) for an oscilloscope pulse display of exactly 0.5 ms (±0.01 μs).
- f. Switch the PG 505 PULSE DURATION to 5 μs and the PERIOD switch to 10 μs.
- g. Adjust R150 (10 μs Adj) for a digital frequency counter reading of 100 kHz (±5 kHz).
- h. To verify the operation of all ranges and functions, use the Performance Check.
- i. This completes the adjustment procedure.

MAINTENANCE

GENERAL

Introduction

This section of the manual is meant to support the entire TM 500 Series family with a general coverage of the most commonly-needed service information pertinent to preventive maintenance, troubleshooting, ordering parts, and replacing components and sub-assemblies.

Cabinet Removal

WARNING

Dangerous potentials exist at several points throughout the system. When the system must be operated with the cabinet removed, do not touch exposed connections or components. Some transistors have voltage present on their cases. Disconnect power before cleaning the system or replacing parts.

Cleaning

CAUTION

Avoid using chemical cleaning agents that might damage plastic parts. Avoid chemicals containing benzene, toluene, xylene, acetone, or similar solvents.

Exterior. Loose dust may be removed with a soft cloth or a dry brush.

Interior. Cleaning the interior of a unit should precede calibration since the cleaning processes could alter the settings of calibration adjustments. Use low-velocity compressed air to blow off accumulated dust. Hardened dirt can be removed with a soft brush, cotton-tipped swab, or a cloth dampened in a solution of water and mild detergent.

Preventive Maintenance

Preventive maintenance steps performed on a regular basis will enhance the reliability of the instrumentation systems. However, periodic checks of the semiconductors

in the absence of a malfunction are not recommended as preventive maintenance measures. See the semiconductor checking information under Troubleshooting Techniques which follow. A convenient time to perform preventive maintenance is just before instrument calibration.

Calibration

To ensure accurate signal generation and measurement, the performance of individual units in the system should be checked periodically. Refer to the Instruction Manual for each unit for complete calibration and verification procedures.

TROUBLESHOOTING AIDS

Introduction

The following is provided to augment information contained elsewhere in this and other TM 500 series family manuals when troubleshooting becomes necessary.

Circuit Description

Each manual has a section devoted to explaining circuit operating theory. Used with the schematics, this can be a powerful analytic tool.

Diagrams

Block diagrams and detailed circuit schematics are located on foldout pages in the service section of most of the TM 500 Series Family manuals. The schematic diagrams show the component values and assigned circuit reference numbers of each part necessary to the circuit design. Usually the first page of the service section defines the circuit symbols and reference designators used in that particular instrument. Major circuits are usually identifiable by a series of component numbers. Important waveforms and voltages may be shown within the diagrams or on adjoining aprons. Those portions of the circuits located on circuit boards are enclosed with a dark outline.

Cam Switch Charts

Cam switches on the diagrams are coded on charts to locate the cam number of the switch contact in the complete switch assembly, counting from the front, or

knob end, toward the rear of the switch. The charts indicate with a solid dot when each contact is closed.

Circuit Board Illustrations

Line illustrations showing component locations keyed with a grid scheme for each circuit board are usually placed on the back of a foldout page and sequenced as close as possible to an associated schematic. The GRID LOC columns, located near the Parts Location Grid, keys each component to easy location on the board.

Component and Wiring Color Codes

Color stripes or dots on electrical components signify electrical values, tolerances, etc., according to EIA standards. Components not color-coded usually have information printed on the body. The wiring coding follows the same EIA standards with the exception of the ac power cord of the Power Modules. It is coded like this:

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

Testing Equipment

Generally, a wide-band oscilloscope, a probe, and a multimeter are all that is needed to perform basic waveform and voltage checks for diagnostic purposes. The calibration procedures list specific test equipment and the features necessary to adequately check out the module.

TROUBLESHOOTING TECHNIQUES

Introduction

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding to extensive troubleshooting.

Control Settings

Incorrect control settings can appear to be trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section of the manual for the instrument involved.

System and Associated Equipment

Before proceeding with troubleshooting the TM 500 Series system, check that the instruments in the system

are operating correctly. Check for proper interconnection between the power module and the plug-in modules. Check the line voltage at the power source. Verify that the signal is properly connected and that the interconnecting cables and signal source are not defective.

The associated plug-in modules can be checked for proper operation quickly by substituting other like units known to be operating properly. If the trouble persists after substitution, then the power module is probably at fault. Moving a properly operating plug-in from compartment to compartment will help determine if one or more compartments have a problem.

Visual Check

Inspect the portion of the system in which the trouble is suspected. Many troubles can be located by visual clues such as unsoldered connections, broken wires, damaged circuit board, damaged components, etc.

Instrument Calibration

Check the calibration of the suspected plug-in module or the affected circuit if the trouble is obviously in a certain circuit. The trouble may only be a result of misadjustment or may be corrected by re-calibration. Complete calibration instructions are given in the manual for each instrument in the system.

Circuit Isolation

Note the trouble symptoms. These often identify the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by making waveform and voltage measurements.

Incorrect operation of all circuits often means trouble in the power supplies. Using a multimeter, check first for correct voltages of the individual regulated supplies according to the plug-in module schematics and calibration procedures. Then check the unregulated supplies of the power modules. Defective components elsewhere in the instruments can appear as power supply problems. In these instances, suspected circuits should be disconnected from apparently bad power supplies one at a time to narrow the search.

Voltages and Waveforms

Often defective components can be located by using waveform and voltage indications when they appear on the schematic or in the calibration procedures. Such waveforms and voltage labels are typical indications and will vary between instruments. To obtain operating con-

ditions similar to those used to take these readings, refer to the first diagram in the service sections.

Component Checking

If a component cannot be disconnected from its circuit, then the effects of the associated circuitry must be considered when evaluating the measurement. Except for soldered-in transistors and integrated circuits, most components can be lifted at one end from the circuit board.

Transistors and IC's. Turn the power switch off before removing or replacing any semiconductor. See Fig. 5-1.

A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been checked previously). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions. An anti-static suction-type desoldering tool must be used to remove soldered-in transistors; see component replacement procedure for details.

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits using IC's. Operating waveforms, logic levels, and other operating information for the IC's are given in the circuit description information of the appropriate manual. Use care when checking voltages and waveforms around the IC's so that the adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin in-line IC's is with an integrated circuit test clip. This device also doubles as an extraction tool.

DIODE COLOR CODE. The cathode end of each glass encased diode is indicated by a stripe, a series of stripes, or a dot. For most silicon or germanium diodes with a series of stripes, the color code identifies the three significant digits of the Tektronix Part Number using the resistor color-code system (e.g., a diode color-coded pink or blue-, brown - gray - green indicates Tektronix Part Number 152-0185-00). The cathode and anode ends of metal-encased diodes can be identified by the diode symbol marked on the body.

Diodes. A diode can be checked for an open or a short circuit by measuring the resistance between terminals with an ohmmeter set to the R X 1k scale. The diode resistance should be very high in one direction and very

low when the meter leads are reversed. Do not check tunnel diodes or back diodes with an ohmmeter.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode. Do not measure tunnel diodes with an ohmmeter; use a dynamic tester (such as a TEKTRONIX Type 576 Transistor-Curve Tracer). Checks on diodes can be performed in much the same manner as on transistor emitter-to-base junctions. Silicon diodes should have 0.6 to 0.8 volt across the junction when conducting. Higher readings indicate that they are either back biased or defective, depending on polarity.

Resistors. Check the resistors with an ohmmeter. Resistor tolerances are given in the Replaceable Electrical Parts List in every manual. Resistors do not normally need to be replaced unless the measured value varies widely from the specified value.

Capacitors. A leaky or shorted capacitor can be detected by checking resistance with an ohmmeter on the highest scale. Use an ohmmeter that will not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacity meter, or by checking whether it passes ac signals.

PARTS ORDERING AND REPLACING

Ordering

Obtaining Replacement Parts. Most electrical and mechanical parts can be obtained through your local Tektronix field office or representative. However, you should be able to obtain many of the standard electronic components from a local commercial source in your area. Before your purchase or order a part from a source other than Tektronix, Inc., please check the electrical parts list for the proper value, rating tolerance and description.

Special Parts. Some parts are manufactured or selected by Tektronix, Inc., to satisfy particular requirements, or are manufactured for Tektronix, Inc., to our specifications. Most of the mechanical parts used in this system have been manufactured by Tektronix, Inc. Order all special parts directly from the local Tektronix Field Office or representative.

Ordering Procedure. When ordering replacement parts from Tektronix, Inc., please include the following information:

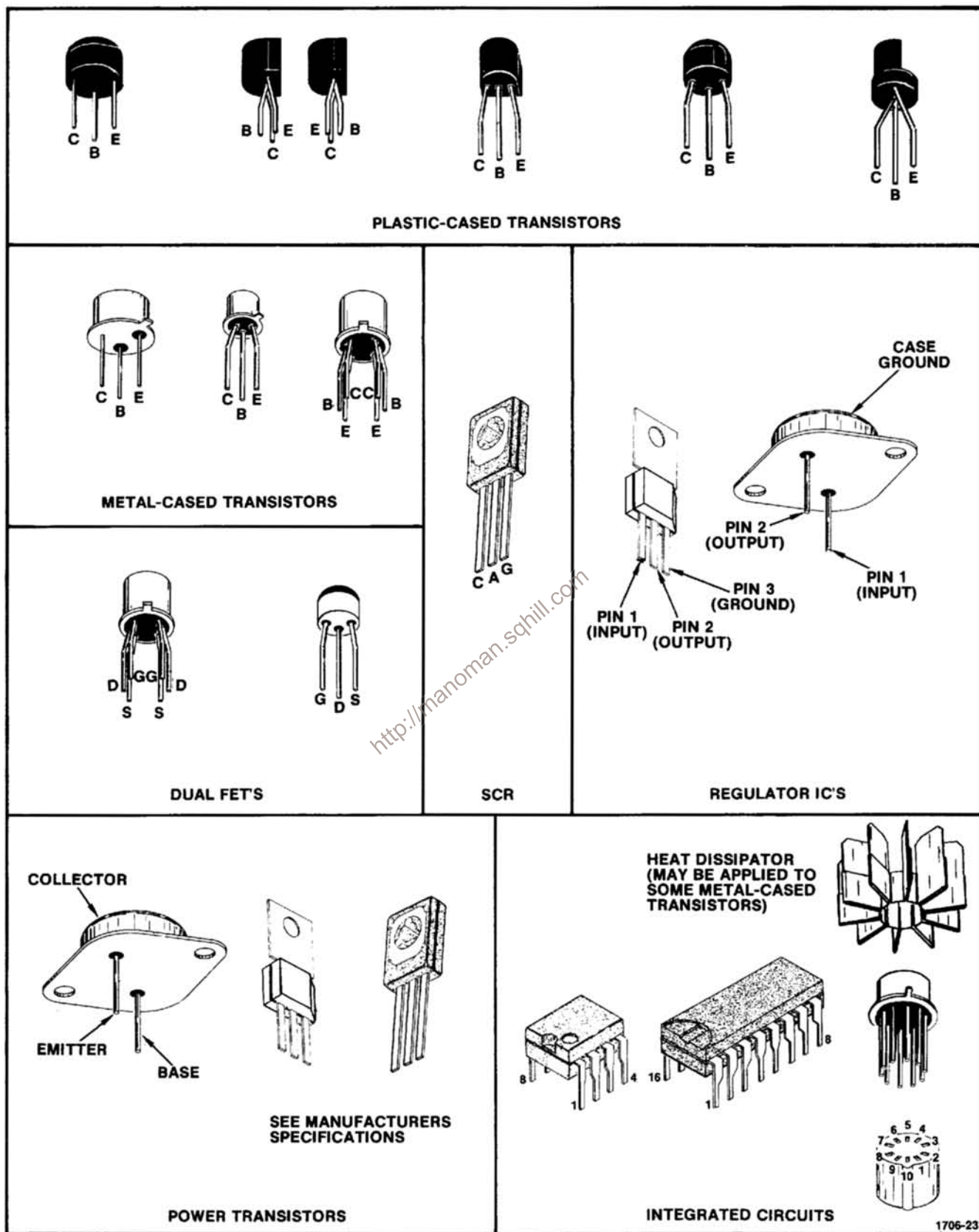


Fig. 5-1. Semiconductor device lead configurations found in the TM 500 family.

1. Instrument Type (PS 501, SG 502, DC 501, etc.)
2. Instrument Serial Number (for example, B010251)
3. A description of the part (if electrical include the circuit number)
4. Tektronix part number

Please do not return any instruments or parts before receiving directions from Tektronix, Inc.

A listing of Tektronix Field Offices, Service Centers and Representatives can be found in the Tektronix Product Catalog and Supplements.

Replacing

The exploded view drawings associated with the Replaceable Mechanical Parts List, located to the rear of most manuals, may be especially helpful when disassembling or reassembling individual components or sub-assemblies.

Circuit Boards. If a circuit board is damaged beyond repair, the entire assembly including all soldered-on components, can be replaced.

To remove or replace a board, proceed as follows:

1. Disconnect all leads connected to the board (both soldered lead connections and solderless pin connections).
2. Remove all screws holding the board to the chassis or other mounting surface. Some boards may be held fast by plastic mounting clips around the board edges. For these, push the mounting clips away from the circuit board edges to free the board. Also, remove any knobs, etc. that would prevent the board from being lifted out of the instrument.
3. Lift the circuit board out of the unit. Do not force or bend the board.
4. To replace the board, reverse the order of removal. Use care when replacing pin connectors. If forced into place incorrectly positioned, the pin connectors may be damaged.

Transistors and IC's. Transistors and IC's should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance, return

them to their original sockets. Unnecessary replacement or switching of semiconductor devices may affect the calibration of the instruments. When a transistor is replaced, check the operation of the part of the instrument that may be affected.

Replacement semiconductors should be of the original type or a direct replacement. Figure 5-1 shows the lead configurations of the semiconductors used in this instrument system. When removing soldered-in transistors, use a suction-type desoldering tool to remove the solder from the holes in the circuit board.

An extracting tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the IC. Try to avoid having one end of the IC disengage from the socket before the other end.

Static-Sensitive Components

CAUTION

Static discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 5-1 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.
3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Keep the component leads shorted together whenever possible.
6. Pick up components by the body, never by the leads.
7. Do not slide the components over any surface.
8. Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge.
9. Use a soldering iron that is connected to earth ground.
10. Use only special antistatic suction type or wick type desoldering tools.

Test Equipment

Before using any test equipment to make measurements on static-sensitive components or assemblies, be certain that any voltage or current supplied by the test equipment does not exceed the limits of the component to be tested.

Interconnecting Pins. To replace a pin that is mounted on a circuit board, first disconnect any pin connectors. Then, unsolder the damaged pin and pull it out of the board with a pair of pliers. Be careful not to damage the wiring on the board with too much heat. Ream out the hole in the circuit board with a 0.031-inch drill. Remove the ferrule from the new interconnecting pin and press the new pin into the hole in the circuit board. Position the pin in the same manner as the old pin and solder it in. If the old pin was bent at an angle to mate with a connector, bend the new pin to match the associated pins.

NOTE

A pin replacement kit including necessary tools, instructions, and replacement pins is available from Tektronix, Inc.

Cam Switch Repair and Replacement

A cam switch is an assembly consisting of a cam rotated by a front panel control, and a set of contacts on an adjacent circuit board.

CAUTION

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

Cleaning. If the contact is not obviously damaged, try cleaning it before replacing. Follow the cleaning procedures in the order given; the first ones are the easiest.

CAUTION

When cleaning cam switch contacts:

1. *Do not use cleaners, detergents, or lubricants that leave a residue. The residue can interfere with the high-frequency response of the contact. Also, the residue will attract dust and cause the contact to require frequent cleaning.*
2. *Do not use any cleaners that contain fluoro-carbons. These will damage the cam portion of the switch. Fluorocarbons also damage the circuit board material used in some instruments.*
3. *Do not use anything (such as a cotton swab) that could snag the contact.*
4. *Do not scrape the pad. If the gold is removed from the pad, the pad will oxidize and cause future problems.*
5. *Do not bend the contacts. While this may temporarily fix the problem, bending the contact damages its self-cleaning action and causes problems in the future.*

Use the following procedures to clean the contacts:

1. Operate the switch several times. The wiping action may clean the contacts.
2. Blow low-pressure air in the area of the contact while operating the switch.

3. Flush the contact with isopropyl alcohol and blow it dry with low-pressure air. Isopropyl alcohol is flammable; avoid its use near open flame or other potential sources of ignition.

Table 5-1
RELATIVE SUSCEPTIBILITY TO
STATIC DISCHARGE DAMAGE

Semiconductor Classes	Relative Susceptibility Levels^a
MOS or CMOS microcircuits or discretes, or linear microcircuits with MOS inputs (Most Sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFETs	6
Linear Microcircuits	7
Low-power Schottky TTL	8
TTL (Least Sensitive)	9

^aVoltage equivalent for levels:

1 = 100 to 500 V 4 = 500 V 7 = 400 to 1000 V (est.)
 2 = 200 to 500 V 5 = 400 to 600 V 8 = 900 V
 3 = 250 V 6 = 600 to 800 V 9 = 1200 V

(Voltage discharged from a 100 pF capacitor through a resistance of 100 ohms.)

Table 5-2

REAR CONNECTOR PIN ASSIGNMENTS

	B		A	
Not Used	28	Signal source barrier slot	28	Not Used
Trigger Out †	27		27	Not Used
Not Used	26		26	Not Used
Not Used	25		25	Not Used
External Delay Input †	24		24	Not Used
Not Used	23		23	Not Used
Not Used	22		22	Not Used
External Gating Input †	21		21	Not Used
Not Used	20		20	Not Used
Not Used	19		19	Not Used
Not Used	18		18	Not Used
Not Used	17		17	Not Used
Not Used	16		16	Not Used
Not Used	15		15	Not Used
Not Used	14		14	Not Used
25 Vac Winding	*13		13*	25 Vac Winding
+33.5 V Filtered dc	12		12*	+33.5 V Filtered dc
Collector of Series Pass Transistor	*11		11*	Base of Series Pass Transistor
Transformer Shield	10	TM 500 barrier slot	10*	Emitter of Series Pass Transistor
33.5 V Common	9		9*	33.5 V Common
-33.5 V Filtered dc	* 8		8	-33.5 V Filtered dc
-33.5 V Filtered dc	* 7		7*	Emitter of Series Pass Transistor
Not Used	6		6*	Base of Series Transistor
17.5 Vac Winding	5		5	17.5 Vac Winding
+11.5 V Common	* 4	4	+11.5 V Common	
+11.5 V Common	3		3	+11.5 V Common
+11.5 V Filtered dc	2		2*	+11.5 V Filtered dc
25 Vac Winding	* 1		1*	25 Vac Winding

Rear-view of plug-in

* Assignments listed for pins 1A—13A and 1B—13B are available in all power modules; however only those pins marked with an asterisk (*) are used by the PG 505.

† NOTE: Use contacts 9A or 9B for common ground.

Table 5-3
MAINTENANCE AIDS

The following maintenance aids include items required for some maintenance procedures in this instrument. Equivalent products may be substituted for examples given providing characteristics are similar.

Description	Specifications	Use	Example
1. Soldering Iron	15 Watt	General soldering and unsoldering	ANTEX PRECISION Model C
2. Screwdriver	Phillips #1 tip	Assembly and Disassembly	Xcelite Model X108
3. Screwdriver	Phillips #2 tip	Assembly and Disassembly	Xcelite Model X102
4. Screwdriver	Three-inch shaft, 3/32 inch flat bit	General	Xcelite R3323
5. Torque Screwdriver	1.5 inch-pounds	FUNCTION switch assembly	Sturtevant-Richmont Torque Products Model PM-5-Roto-Torq
6. Nutdrivers	1/4 inch, 5/16 inch 3/8 inch, 7/16 inch	General	Xcelite #8, #10, #12 and #14
7. Open End Wrench	11/16 inch	General	
8. Solder Wick		Unsoldering	Hex Wik #887-10
9. Lubricant	Versilube	FUNCTION switch lubrication	Tektronix Part No. 006-1353-00
10. Spray Cleaner	No Noise	FUNCTION switch pad cleaning	Tektronix Part No. 006-0442-02
11. Vacuum Desoldering Tool	Antistatic	General	Tektronix Part No. 003-0795-00
12. I.C. Extracting Tool		General	Tektronix Part No. 003-0619-00
13. Cam Switch Repair Kit		Cam switches	Tektronix Part No. 040-0541-00
14. Extender Cables		General	Tektronix Part No. 067-0645-02

OPTIONS

Mod 818C. Factory installed grounded output connector.

<http://manoman.sqhill.com>

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
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD, PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
71450	CTS CORP.	905 N. WEST BLVD	ELKHART, IN 46514
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
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
91836	KINGS ELECTRONICS CO., INC.	40 MARLEDALS ROAD	TUCKAHOE, NY 10707

<http://manoman.sghill.com>

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-2927-00	B010100	B022039	CKT BOARD ASSY:MAIN	80009	670-2927-00
A1	670-2927-01	B022040	B023189	CKT BOARD ASSY:MAIN	80009	670-2927-01
A1	670-2927-02	B023190		CKT BOARD ASSY:MAIN	80009	670-2927-02
C100	281-0600-00			CAP., FXD, CER DI: 35PF, 10%, 500V	72982	308-000C0G0350K
C120	283-0000-00			CAP., FXD, CER DI: 0.001UF, +100-0%, 500V	72982	831-516E102P
C126	283-0660-00			CAP., FXD, MICA D: 510PF, 2%, 500V	00853	D155F511G0
C128	283-0695-00			CAP., FXD, MICA D: 4440PF, 1%, 300V	00853	D193F4441F0
C129	283-0660-00			CAP., FXD, MICA D: 510PF, 2%, 500V	00853	D155F511G0
C130	285-1066-00			CAP., FXD, PLSTC: 0.05UF, 1%, 200V	14752	230B1C503F
C132	285-1067-00			CAP., FXD, PLSTC: 0.5UF, 1%, 200V	14752	230B1C504F
C134	285-1068-00			CAP., FXD, PLSTC: 5UF, 1%, 200V	14752	230B1C505F
C156	283-0000-00			CAP., FXD, CER DI: 0.001UF, +100-0%, 500V	72982	831-516E102P
C175	281-0550-00			CAP., FXD, CER DI: 120PF, 10%, 500V	04222	7001-1373
C180	290-0531-00	B010100	B023189	CAP., FXD, ELCLTLT: 100UF, 20%, 10V	90201	TDC107M010WLC
C180	290-0297-00	B023190		CAP., FXD, ELCLTLT: 39UF, 10%, 10V	56289	150D396X9010B2
C181	290-0830-00	XB023190		CAP., FXD, ELCLTLT: 10 UF, 5%, 20V	56289	150D106X5020BZ
C182	285-1052-00	B010100	B023189	CAP., FXD, PLSTC: 10UF, 1%, 100V	14752	230B1B106F
C182	285-1068-00	B023190		CAP., FXD, PLSTC: 5UF, 1%, 200V	14752	230B1C505F
C184	285-1051-00	B010100	B023189	CAP., FXD, PLSTC: 1UF, 1%, 200V	14752	230B1C105F
C184	285-1067-00	B023190		CAP., FXD, PLSTC: 0.5UF, 1%, 200V	14752	230B1C504F
C186	285-1050-00	B010100	B023189	CAP., FXD, PLSTC: 0.1UF, 1%, 200V	14752	230B1C104F
C186	285-1066-00	B023190		CAP., FXD, PLSTC: 0.05UF, 1%, 200V	14752	230B1C503F
C187	283-0646-00	XB023190		CAP., FXD, MICA D: 170PF, 1%, 100V	00853	D151E171F0
C188	285-1049-00	B010100	B023189	CAP., FXD, PLSTC: 0.01UF, 1%, 200V	14752	230B1C103F
C188	283-0695-00	B023190		CAP., FXD, MICA D: 4440PF, 1%, 300V	00853	D193F4441F0
C198	281-0519-00			CAP., FXD, CER DI: 4.7PF, +/-4.7PF, 500V	72982	308-000C0G0470K
C210	283-0000-00			CAP., FXD, CER DI: 0.001UF, +100-0%, 500V	72982	831-516E102P
C250	281-0092-00			CAP., VAR, CER DI: 9-35PF, 200V	72982	538-011 D9-35
C252	281-0549-00			CAP., FXD, CER DI: 68PF, 10%, 500V	72982	301-000U2J0680K
C254	285-0918-00	B010100	B022039	CAP., FXD, PLSTC: 0.001UF, 5%, 200 V	56289	LP66A1C102J002
C254	283-0594-00	B022040		CAP., FXD, MICA D: 0.001UF, 1%, 100V	00853	D151F102F0
C256	285-1049-00			CAP., FXD, PLSTC: 0.01UF, 1%, 200V	14752	230B1C103F
C258	285-1050-00			CAP., FXD, PLSTC: 0.1UF, 1%, 200V	14752	230B1C104F
C334	281-0542-00			CAP., FXD, CER DI: 18PF, 10%, 500V	72982	301-002C0G0180K
C340	281-0658-00			CAP., FXD, CER DI: 6.2PF, +/-0.25PF, 500V	72982	301-000C0H0629C
C350	281-0542-00			CAP., FXD, CER DI: 18PF, 10%, 500V	72982	301-002C0G0180K
C360	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C370	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C386	283-0000-00	B010100	B022039X	CAP., FXD, CER DI: 0.001UF, +100-0%, 500V	72982	831-516E102P
C390	283-0057-00	B010100	B022039X	CAP., FXD, CER DI: 0.1UF, +80-20%, 200V	56289	274C10
C392	283-0057-00	XB022040		CAP., FXD, CER DI: 0.1UF, +80-20%, 200V	56289	274C10
C514	281-0546-00			CAP., FXD, CER DI: 330PF, 10%, 500V	04222	7001-1380
C534	290-0525-00			CAP., FXD, ELCLTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C545	290-0525-00			CAP., FXD, ELCLTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C550	290-0525-00			CAP., FXD, ELCLTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C555	290-0585-00			CAP., FXD, ELCLTLT: 350UF, +75-10%, 75V	90201	PPF351MN1J3P2
C557	290-0585-00			CAP., FXD, ELCLTLT: 350UF, +75-10%, 75V	90201	PPF351MN1J3P2
C564	281-0546-00			CAP., FXD, CER DI: 330PF, 10%, 500V	04222	7001-1380
C566	283-0000-00			CAP., FXD, CER DI: 0.001UF, +100-0%, 500V	72982	831-516E102P
C580	290-0194-00			CAP., FXD, ELCLTLT: 10UF, +50-10%, 100V	56289	30D106F100DC4
C598	290-0525-00			CAP., FXD, ELCLTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C610	290-0536-00			CAP., FXD, ELCLTLT: 10UF, 20%, 25V	90201	TDC106M025FL
C620	290-0525-00			CAP., FXD, ELCLTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C640	290-0159-00			CAP., FXD, ELCLTLT: 2UF, +50-10%, 150V	56289	30D205F150BB9
CR100	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	01295	1N4152R
CR102	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	01295	1N4152R

Replaceable Electrical Parts—PG 505

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR120	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR122	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR154	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR180	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR220	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR222	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR232	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR234	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR236	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR238	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR240	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR244	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR280	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR282	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR320	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR324	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR382	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR392	152-0061-00	XB022040		SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR394	152-0061-00	XB022040		SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR530	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR542	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR550	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR555	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR557	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR566	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR576	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR580	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR640	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
DS390	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS540	150-0048-01			LAMP, INCAND:5V,0.06A,SEL	08806	683AS15
J100	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J170	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J340	131-0274-00			CONNECTOR,RCPT,:BNC	91836	KC79-67
Q100	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q102	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q115	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q140	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q142	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q144	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q160	151-0432-00	B010100	B022039	TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q160	151-0190-00	B022040		TRANSISTOR:SILICON,NPN	07263	S032677
Q164	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q190	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q200	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q212	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q214	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q220	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q230	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q240	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q260A,B	151-1054-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	80009	151-1054-00
Q262	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q280	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q286	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q288	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q290	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q300	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q310	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q316	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q320	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q330	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q346	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q354	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q360	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q370	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q382	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q390	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q394	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q520	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q530	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q550	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q566	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q576	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q580	151-0335-00			TRANSISTOR:SILICON,PNP	04713	SJE917
Q590	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q592	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q610	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q620	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q622	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q642	151-0429-00			TRANSISTOR:SILICON,PNP	04713	SJE957
Q646	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
R100	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R102	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R105	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R106	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R108	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R110	311-1460-00			RES.,VAR, NONWIR:10K OHM,20%,1W	01121	73J1G040L103M
R112	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R114	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R116	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R118	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R120	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R122	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R124	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R126	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R128	321-0241-00	B010100	B022039	RES.,FXD,FILM:3.16K OHM,1%,0.125W	91637	MFF1816G31600F
R128	321-0193-00	B022040		RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R130	311-1483-00			RES.,VAR, NONWIR:100K OHM,20%,1W	01121	73A1G040L104M
R132	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R135	311-1560-00			RES.,VAR, NONWIR:5K OHM,20%,0.50W	73138	91-82-0
R136	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R138	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R141	315-0511-00	XB022040		RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R142	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R146	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R148	321-0301-00	B010100	B022039	RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R148	321-0292-00	B022040		RES.,FXD,FILM:10.7K OHM,1%,0.125W	91637	MFF1816G10701F
R150	311-1557-00			RES.,VAR, NONWIR:25K OHM,20%,0.50W	73138	91-79-00
R151	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R152	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R154	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R156	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R160	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R164	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005

Replaceable Electrical Parts—PG 505

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R166	315-0201-00			RES., FXD, CMPSN: 200 OHM, 5%, 0.25W	01121	CB2015
R168	315-0201-00			RES., FXD, CMPSN: 200 OHM, 5%, 0.25W	01121	CB2015
R176	315-0300-00			RES., FXD, CMPSN: 30 OHM, 5%, 0.25W	01121	CB3005
R180	311-1563-00	B010100	B023189	RES., VAR, NONWIR: 1K OHM, 20%, 0.50W	73138	91-85-0
R180	311-1562-00	B023190		RES., VAR, NONWIR: 2K OHM, 20%, 0.50W	73138	91-84-0
R185	311-1220-00	B010100	B019999	RES., VAR, NONWIR: 20K OHM, 30%, 0.25W	71450	OBD
R185	311-0170-00	B020000	B023189	RES., VAR, NONWIR: PNL, 20K OHM, 0.5W	12697	381-CM26546
R185	311-0580-00	B023190		RES., VAR, NONWIR: 50K OHM, 20%, 0.50W	11237	300SF-41695
R186	321-0173-00	B010100	B023189	RES., FXD, FILM: 619 OHM, 1%, 0.125W	91637	MFF1816G619R0F
R186	321-0210-00	B023190		RES., FXD, FILM: 1.5K OHM, 1%, 0.125W	91637	MFF1816G15000F
R190	315-0331-00			RES., FXD, CMPSN: 330 OHM, 5%, 0.25W	01121	CB3315
R192	315-0471-00			RES., FXD, CMPSN: 470 OHM, 5%, 0.25W	01121	CB4715
R196	321-0201-00			RES., FXD, FILM: 1.21K OHM, 1%, 0.125W	91637	MFF1816G12100F
R198	321-0314-00			RES., FXD, FILM: 18.2K OHM, 1%, 0.125W	91637	MFF1816G18201F
R200	321-0319-00			RES., FXD, FILM: 20.5K OHM, 1%, 0.125W	91637	MFF1816G20501F
R202	315-0473-00			RES., FXD, CMPSN: 47K OHM, 5%, 0.25W	01121	CB4735
R204	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R208	315-0242-00			RES., FXD, CMPSN: 2.4K OHM, 5%, 0.25W	01121	CB2425
R210	315-0153-00			RES., FXD, CMPSN: 15K OHM, 5%, 0.25W	01121	CB1535
R212	315-0122-00			RES., FXD, CMPSN: 1.2K OHM, 5%, 0.25W	01121	CB1225
R218	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R220	315-0122-00			RES., FXD, CMPSN: 1.2K OHM, 5%, 0.25W	01121	CB1225
R222	315-0133-00			RES., FXD, CMPSN: 13K OHM, 5%, 0.25W	01121	CB1335
R224	315-0752-00			RES., FXD, CMPSN: 7.5K OHM, 5%, 0.25W	01121	CB7525
R230	311-1365-00			RES., VAR, NONWIR: 50K OHM, 20%, 1W	01121	11M164
R231	315-0104-00	XB022040		RES., FXD, CMPSN: 100K OHM, 5%, 0.25W	01121	CB1045
R232	321-0216-00			RES., FXD, FILM: 1.74K OHM, 1%, 0.125W	91637	MFF1816G17400F
R234	321-0252-00	B010100	B022039	RES., FXD, FILM: 4.12K OHM, 1%, 0.125W	91637	MFF1816G41200F
R234	321-0241-00	B022040		RES., FXD, FILM: 3.16K OHM, 1%, 0.125W	91637	MFF1816G31600F
R236	321-0309-00			RES., FXD, FILM: 16.2K OHM, 1%, 0.125W	91637	MFF1816G16201F
R240	311-0580-00			RES., VAR, NONWIR: 50K OHM, 20%, 0.50W	11237	300SF-41695
R241	311-1552-00	XB022040		RES., VAR, NONWIR: 500K OHM, 20%, 0.50W	73138	91-74-0
R242	321-0216-00			RES., FXD, FILM: 1.74K OHM, 1%, 0.125W	91637	MFF1816G17400F
R244	321-0252-00	B010100	B022039	RES., FXD, FILM: 4.12K OHM, 1%, 0.125W	91637	MFF1816G41200F
R244	321-0241-00	B022040		RES., FXD, FILM: 3.16K OHM, 1%, 0.125W	91637	MFF1816G31600F
R246	321-0309-00			RES., FXD, FILM: 16.2K OHM, 1%, 0.125W	91637	MFF1816G16201F
R260	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R262	315-0511-00			RES., FXD, CMPSN: 510 OHM, 5%, 0.25W	01121	CB5115
R264	315-0620-00			RES., FXD, CMPSN: 62 OHM, 5%, 0.25W	01121	CB6205
R266	301-0332-00			RES., FXD, CMPSN: 3.3K OHM, 5%, 0.50W	01121	EB3325
R268	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R270	311-1095-00			RES., VAR, NONWIR: 10K OHM, 20%, 0.50W	12697	382-CM40386
R272	315-0511-00	B010100	B022039X	RES., FXD, CMPSN: 510 OHM, 5%, 0.25W	01121	CB5115
R280	315-0101-00			RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R282	315-0203-00			RES., FXD, CMPSN: 20K OHM, 5%, 0.25W	01121	CB2035
R284	315-0512-00			RES., FXD, CMPSN: 5.1K OHM, 5%, 0.25W	01121	CB5125
R286	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R288	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R292	321-0256-00			RES., FXD, FILM: 4.53K OHM, 1%, 0.125W	91637	MFF1816G45300F
R294	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R296	315-0202-00			RES., FXD, CMPSN: 2K OHM, 5%, 0.25W	01121	CB2025
R300	315-0133-00			RES., FXD, CMPSN: 13K OHM, 5%, 0.25W	01121	CB1335
R302	315-0303-00			RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R304	315-0163-00			RES., FXD, CMPSN: 16K OHM, 5%, 0.25W	01121	CB1635
R306	321-0268-00			RES., FXD, FILM: 6.04K OHM, 1%, 0.125W	91637	MFF1816G60400F
R308	321-0256-00			RES., FXD, FILM: 4.53K OHM, 1%, 0.125W	91637	MFF1816G45300F
R310	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505

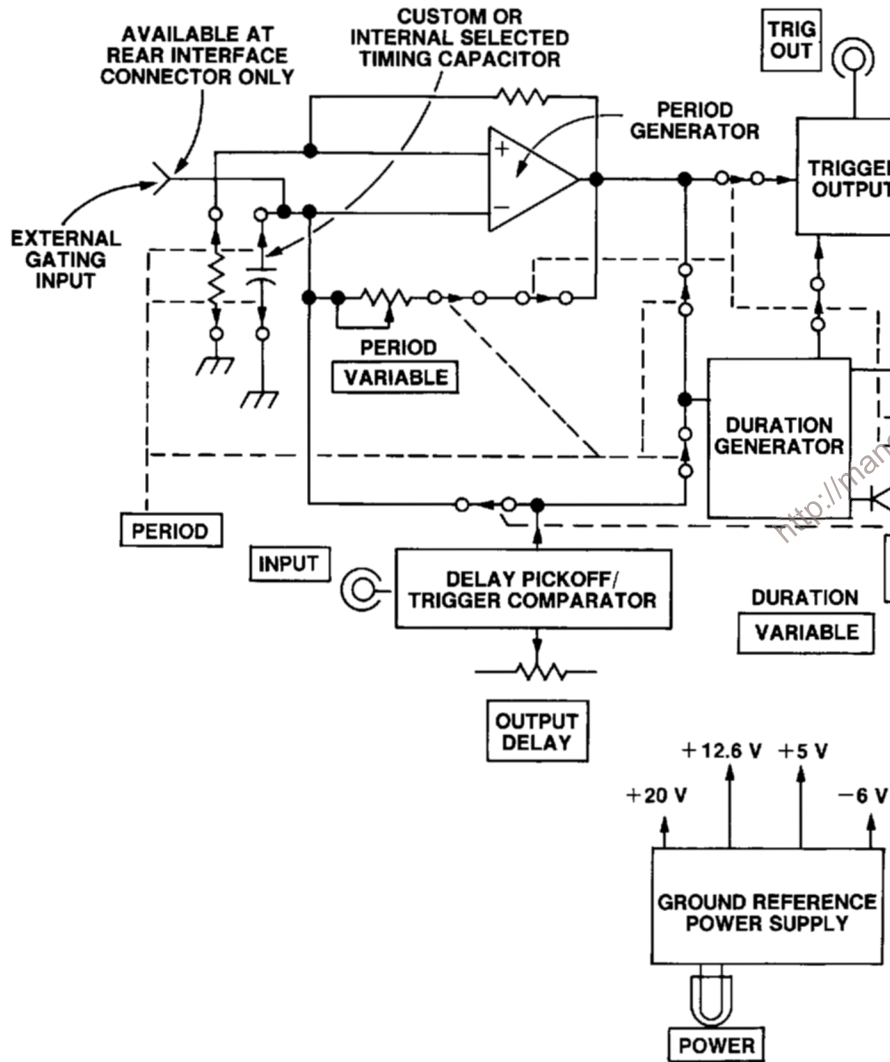
Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R314	315-0362-00			RES., FXD, CMPSN: 3.6K OHM, 5%, 0.25W	01121	CB3625
R316	315-0302-00			RES., FXD, CMPSN: 3K OHM, 5%, 0.25W	01121	CB3025
R320	315-0751-00			RES., FXD, CMPSN: 750 OHM, 5%, 0.25W	01121	CB7515
R324	315-0822-00			RES., FXD, CMPSN: 8.2K OHM, 5%, 0.25W	01121	CB8225
R326	315-0152-00			RES., FXD, CMPSN: 1.5K OHM, 5%, 0.25W	01121	CB1525
R330	315-0751-00			RES., FXD, CMPSN: 750 OHM, 5%, 0.25W	01121	CB7515
R334	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R336	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R340	321-0314-00			RES., FXD, FILM: 18.2K OHM, 1%, 0.125W	91637	MFF1816G18201F
R342	308-0293-00			RES., FXD, WW: 4K OHM, 5%, 3W	91637	RS2B-B40000J
R346	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R350	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R354	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R359	321-0243-00			RES., FXD, FILM: 3.32K OHM, 1%, 0.125W	91637	MFF1816G33200F
R360	311-1560-00			RES., VAR, NONWIR: 5K OHM, 20%, 0.50W	73138	91-82-0
R361	321-0331-00			RES., FXD, FILM: 27.4K OHM, 1%, 0.125W	91637	MFF1816G27401F
R369	321-0243-00			RES., FXD, FILM: 3.32K OHM, 1%, 0.125W	91637	MFF1816G33200F
R370	311-1560-00			RES., VAR, NONWIR: 5K OHM, 20%, 0.50W	73138	91-82-0
R371	321-0331-00			RES., FXD, FILM: 27.4K OHM, 1%, 0.125W	91637	MFF1816G27401F
R380	315-0223-00			RES., FXD, CMPSN: 22K OHM, 5%, 0.25W	01121	CB2235
R382	315-0434-00			RES., FXD, CMPSN: 430K OHM, 5%, 0.25W	01121	CB4345
R386	315-0563-00			RES., FXD, CMPSN: 56K OHM, 5%, 0.25W	01121	CB5635
R388	315-0563-00			RES., FXD, CMPSN: 56K OHM, 5%, 0.25W	01121	CB5635
R390	315-0334-00			RES., FXD, CMPSN: 330K OHM, 5%, 0.25W	01121	CB3345
R392	315-0563-00			RES., FXD, CMPSN: 56K OHM, 5%, 0.25W	01121	CB5635
R394	315-0205-00	XB022040		RES., FXD, CMPSN: 2M OHM, 5%, 0.25W	01121	CB2055
R396	315-0104-00			RES., FXD, CMPSN: 100K OHM, 5%, 0.25W	01121	CB1045
R500	307-0093-00			RES., FXD, CMPSN: 1.2 OHM, 5%, 0.50W	01121	EB12G5
R510	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R512	315-0621-00			RES., FXD, CMPSN: 620 OHM, 5%, 0.25W	01121	CB6215
R514	315-0132-00			RES., FXD, CMPSN: 1.3K OHM, 5%, 0.25W	01121	CB1325
R516	315-0132-00			RES., FXD, CMPSN: 1.3K OHM, 5%, 0.25W	01121	CB1325
R518	321-0252-00			RES., FXD, FILM: 4.12K OHM, 1%, 0.125W	91637	MFF1816G41200F
R520	311-1564-00			RES., VAR, NONWIR: TRMR, 500 OHM, 0.5W	73138	91-86-0
R522	321-0222-00			RES., FXD, FILM: 2K OHM, 1%, 0.125W	91637	MFF1816G20000F
R528	315-0822-00			RES., FXD, CMPSN: 8.2K OHM, 5%, 0.25W	01121	CB8225
R530	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R532	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R534	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R540	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R542	315-0132-00			RES., FXD, CMPSN: 1.3K OHM, 5%, 0.25W	01121	CB1325
R545	301-0104-00			RES., FXD, CMPSN: 100K OHM, 5%, 0.5W	01121	EB1045
R550	315-0132-00			RES., FXD, CMPSN: 1.3K OHM, 5%, 0.25W	01121	CB1325
R552	315-0472-00			RES., FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
R555	315-0104-00			RES., FXD, CMPSN: 100K OHM, 5%, 0.25W	01121	CB1045
R557	315-0104-00			RES., FXD, CMPSN: 100K OHM, 5%, 0.25W	01121	CB1045
R560	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R562	315-0621-00			RES., FXD, CMPSN: 620 OHM, 5%, 0.25W	01121	CB6215
R564	315-0472-00			RES., FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
R566	315-0243-00			RES., FXD, CMPSN: 24K OHM, 5%, 0.25W	01121	CB2435
R568	321-0343-00			RES., FXD, FILM: 36.5K OHM, 1%, 0.125W	91637	MFF1816G36501F
R570	311-1562-00			RES., VAR, NONWIR: 2K OHM, 20%, 0.50W	73138	91-84-0
R572	321-0343-00			RES., FXD, FILM: 36.5K OHM, 1%, 0.125W	91637	MFF1816G36501F
R574	301-0133-00			RES., FXD, CMPSN: 13K OHM, 5%, 0.50W	01121	EB1335
R576	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R578	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R579	303-0162-00			RES., FXD, CMPSN: 1.6 OHM, 5%, 1W	01121	GB1625

Replaceable Electrical Parts—PG 505

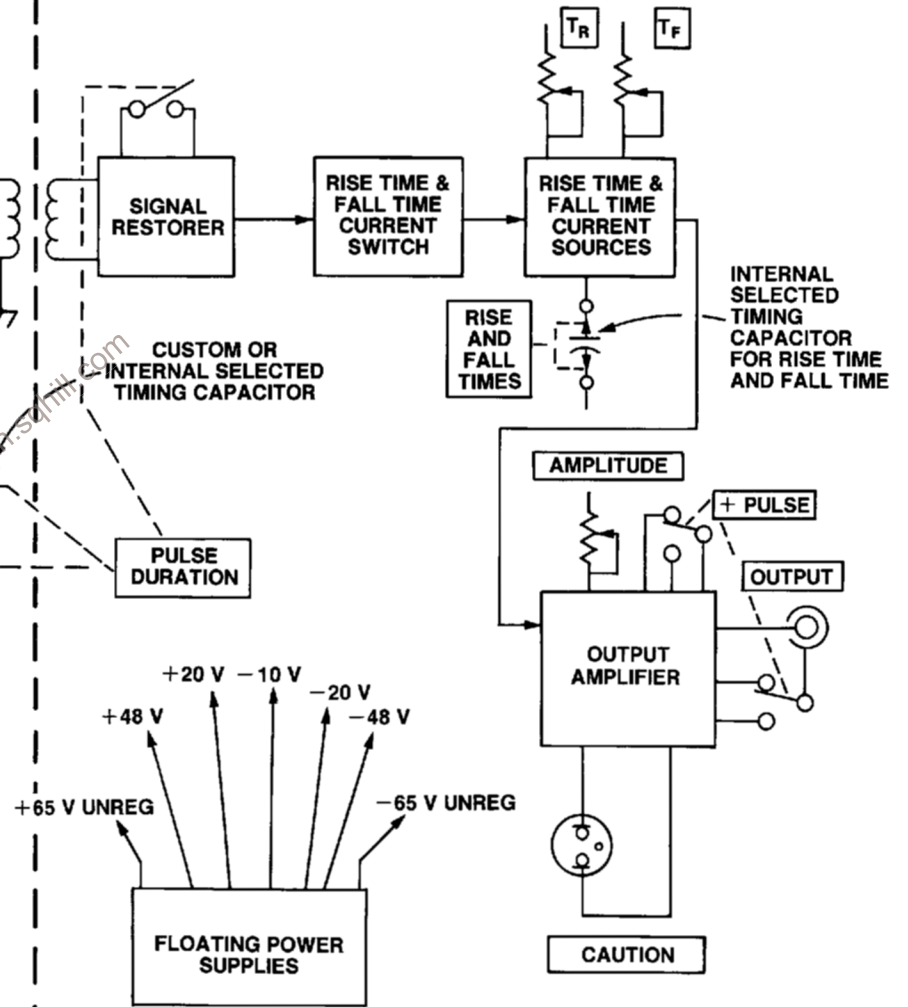
Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R580	315-0150-00			RES., FXD, CMPSN: 15 OHM, 5%, 0.25W	01121	CB1505
R590	305-0621-00			RES., FXD, CMPSN: 620 OHM, 5%, 2W	01121	HB6215
R592	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R594	321-0301-00			RES., FXD, FILM: 13.3K OHM, 1%, 0.125W	91637	MFF1816G13301F
R596	321-0289-00			RES., FXD, FILM: 10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R598	315-0393-00			RES., FXD, CMPSN: 39K OHM, 5%, 0.25W	01121	CB3935
R610	315-0512-00			RES., FXD, CMPSN: 5.1K OHM, 5%, 0.25W	01121	CB5125
R611	301-0182-00			RES., FXD, CMPSN: 1.8K OHM, 5%, 0.5W	01121	EB1825
R612	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R614	321-0268-00			RES., FXD, FILM: 6.04K OHM, 1%, 0.125W	91637	MFF1816G60400F
R615	311-1562-00			RES., VAR, NONWIR: 2K OHM, 20%, 0.50W	73138	91-84-0
R617	321-0326-00			RES., FXD, FILM: 24.3K OHM, 1%, 0.125W	91637	MFF1816G24301F
R620	315-0393-00			RES., FXD, CMPSN: 39K OHM, 5%, 0.25W	01121	CB3935
R624	321-0289-00			RES., FXD, FILM: 10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R626	321-0301-00			RES., FXD, FILM: 13.3K OHM, 1%, 0.125W	91637	MFF1816G13301F
R628	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R630	308-0314-00			RES., FXD, WW: 680 OHM, 5%, 3W	91637	RS2B-B680ROJ
R640	308-0314-00			RES., FXD, WW: 680 OHM, 5%, 3W	91637	RS2B-B680ROJ
R642	307-0114-00			RES., FXD, CMPSN: 6.2 OHM, 5%, 0.25W	01121	CB6265
R644	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R646	315-0362-00			RES., FXD, CMPSN: 3.6K OHM, 5%, 0.25W	01121	CB3625
R648	315-0562-00			RES., FXD, CMPSN: 5.6K OHM, 5%, 0.25W	01121	CB5625
R650	315-0472-00			RES., FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
R652	301-0562-00			RES., FXD, CMPSN: 5.6K OHM, 5%, 0.50W	01121	EB5625
R656	321-0256-00			RES., FXD, FILM: 4.53K OHM, 1%, 0.125W	91637	MFF1816G45300F
R658	311-1562-00			RES., VAR, NONWIR: 2K OHM, 20%, 0.50W	73138	91-84-0
R660	321-0343-00			RES., FXD, FILM: 36.5K OHM, 1%, 0.125W	91637	MFF1816G36501F
S130A, B	263-1015-00			SW CAM ACTR AS: PERIOD	80009	263-1015-00
S250	260-1607-00	B010100	B020649	SWITCH, PUSH: 1US/10US/100US/1MS	80009	260-1607-00
S250	260-1423-00	B020650		SWITCH, PUSH: 4 STA, INTERLOCK, NON-SHORT	80009	260-1423-00
S290	260-1445-00			SWITCH, PUSH: 1 STA, NON-SHORT	80009	260-1445-00
T190	120-0900-00			XMFR, TOROID: TWO 6 TURN WINDINGS	80009	120-0900-00
U175	156-0081-00			MICROCIRCUIT, LI: SGL RETRIGGERABLE MV	07263	9601 (PC OR DC)
U610	156-0158-00			MICROCIRCUIT, LI: DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
VR112	152-0279-00			SEMICONV DEVICE: ZENER, 0.4W, 5.1V, 5%	04713	SZG35010RL
VR120	152-0278-00			SEMICONV DEVICE: ZENER, 0.4W, 3V, 5%	04713	SZG35009K20
VR210	152-0282-00			SEMICONV DEVICE: ZENER, 0.4W, 30V, 5%	04713	1N972B
VR220	152-0514-00			SEMICONV DEVICE: ZENER, 0.4W, 10V, 1%	80009	152-0514-00
VR222	152-0514-00			SEMICONV DEVICE: ZENER, 0.4W, 10V, 1%	80009	152-0514-00
VR520	152-0280-00			SEMICONV DEVICE: ZENER, 0.4W, 6.2V, 5%	80009	152-0280-00
VR534	152-0168-00			SEMICONV DEVICE: ZENER, 0.4W, 12V, 5%	04713	SZG35009K4
VR542	152-0279-00			SEMICONV DEVICE: ZENER, 0.4W, 5.1V, 5%	04713	SZG35010RL
VR550	152-0280-00			SEMICONV DEVICE: ZENER, 0.4W, 6.2V, 5%	80009	152-0280-00
VR610	152-0282-00			SEMICONV DEVICE: ZENER, 0.4W, 30V, 5%	04713	1N972B
VR646	152-0282-00			SEMICONV DEVICE: ZENER, 0.4W, 30V, 5%	04713	1N972B
VR650	152-0461-00			SEMICONV DEVICE: ZENER, 0.4W, 6.2V, 5%	04713	1N821

BLOCK DIAGRAM

NON-FLOATING CIRCUITRY



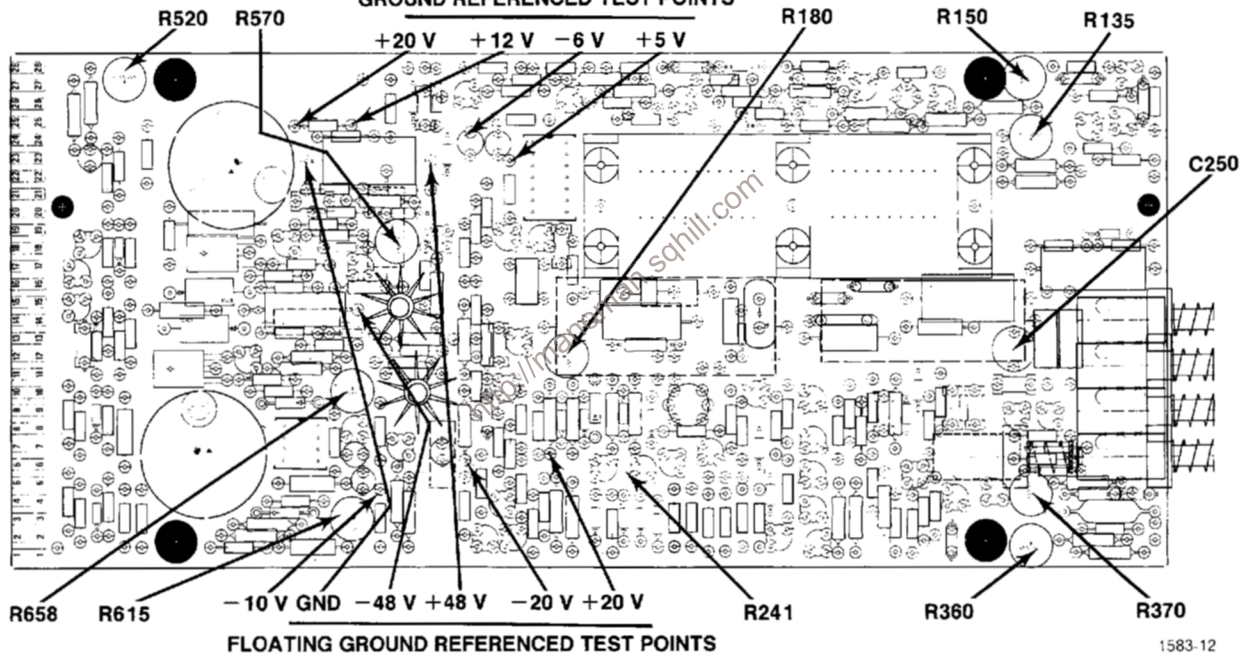
FLOATING CIRCUITRY



ADJUSTMENT LOCATIONS

PG 505

GROUND REFERENCED TEST POINTS



DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols

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 is in 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.

American National Standard Institute
1430 Broadway
New York, New York 10018

Component Values

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

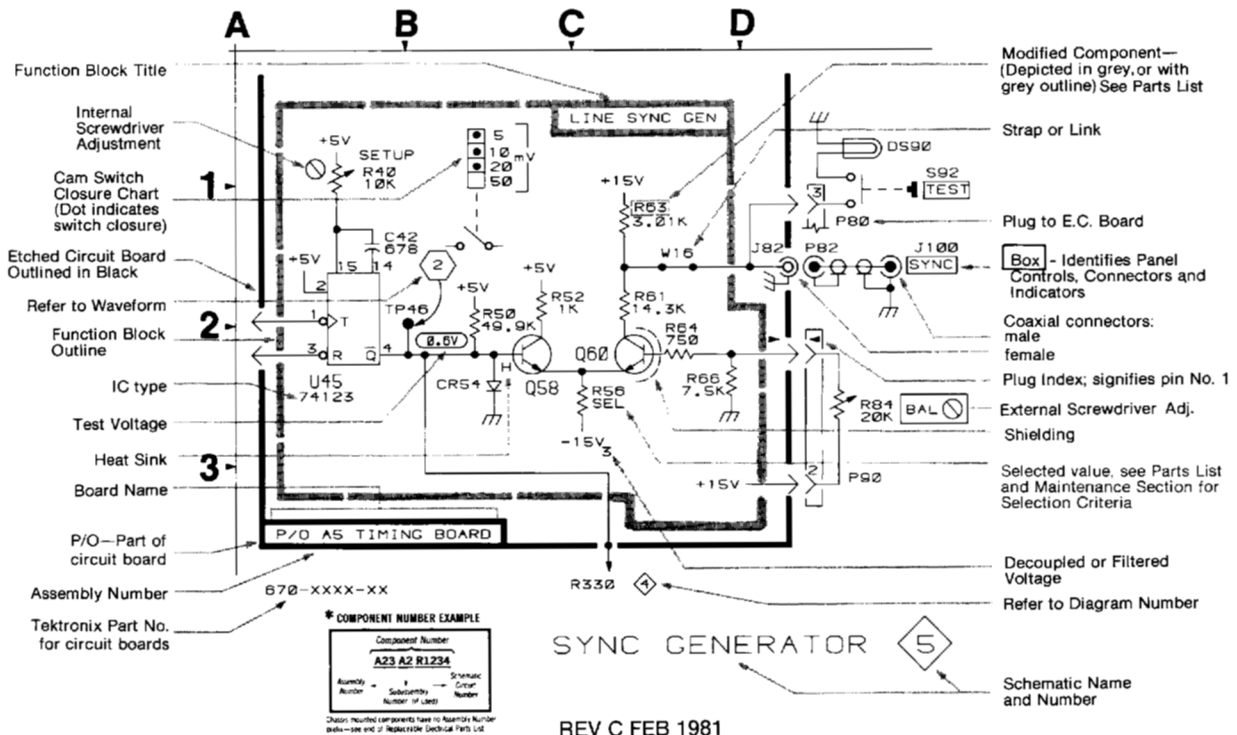
- Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μ F).
- Resistors = Ohms (Ω).

— The information and special symbols below may appear in this manual. —

Assembly Numbers and Grid Coordinates

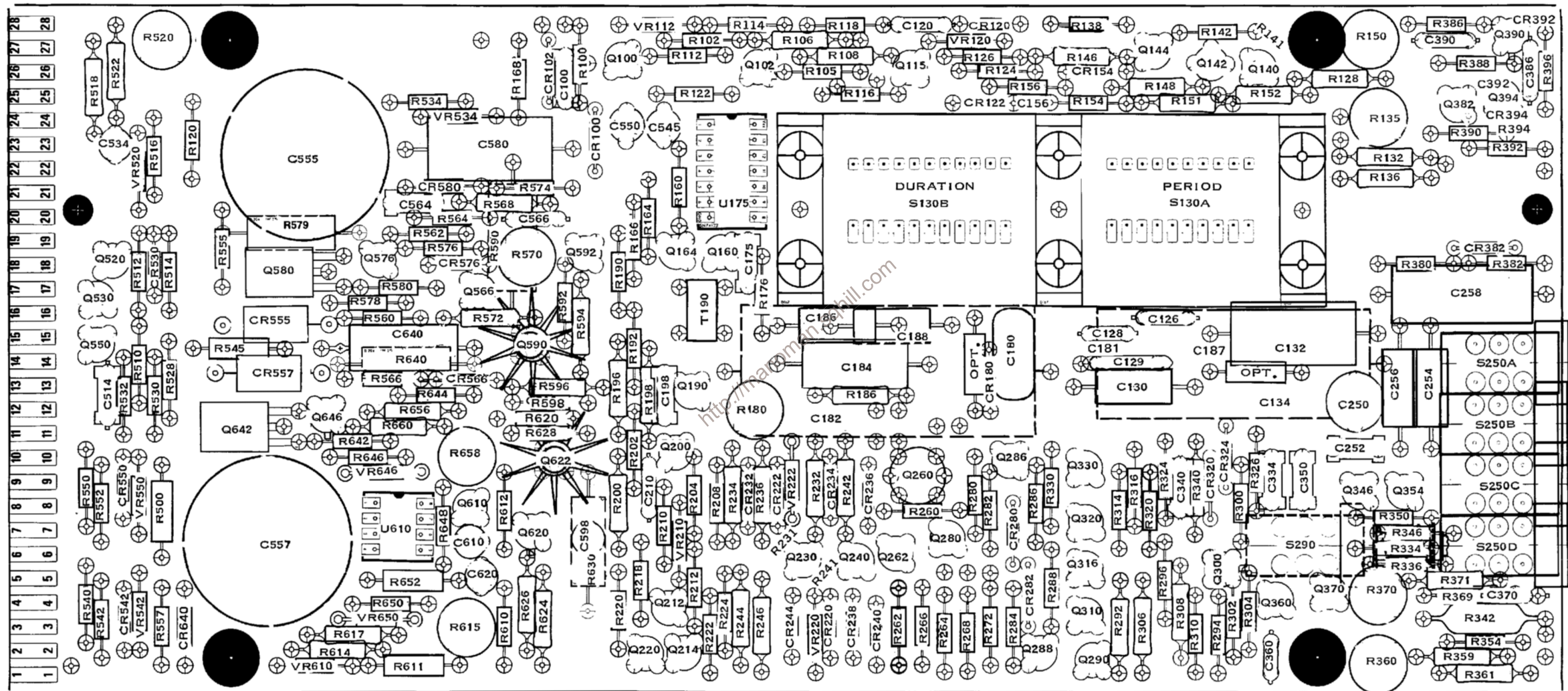
Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number *(see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.



A B C D E F G H J K L M N

1
2
3
4
5
6



CIRCUIT BOARD PARTS LOCATION

REV JUL 1981

1583-13A

Table 8-1

P/O A1 ASSY			GENERATOR AND TRIGGER		
CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C100	B3	E1	R118	C4	G1
C120	C5	H1	R120	B5	B2
C126	D6	K3	R122	B6	F1
C128	D6	J3	R124	B6	J1
C129	D5	K3	R126	C5	H1
C130	D6	K4	R128	E6	L1
C132	E6	L3	R132	E7	M2
C134	E6	L4	R135	F7	M2
C156†	H5	J1	R136	F7	M2
C175	K4	G3	R138	F6	J1
C180	H3	J3	R141*	F5	L1
C181†	H3	J3	R142	F5	K1
C182	H3	G4	R146	G6	J1
C184	H3	G4	R148	F5	K1
C186	H4	G3	R150	F6	L1
C187†	H4	K3	R151	F6	K1
C188	H4	H3	R152	F6	L1
CR100	B3	E2	R154	H5	J1
CR102	B3	E1	R156	H5	J1
CR120	C5	H1	R160	J5	F2
CR122	B6	H1	R164	K5	F2
CR154	G5	J1	R166	K5	F3
CR180	H3	H4	R168	K5	E1
Q100	B3	F1	R176	G4	G3
Q102	C3	G1	R180	G2	G4
Q115	C5	H1	R186	H2	G4
Q140	E6	L1			
Q142	F5	K1	S130B	F1	H2
Q144	G5	K1			
Q160	J5	F3	U175	H4	F2
Q164	K5	F3			
			VR112	B5	F1
R100	B3	E1	VR120	D5	H1
R102	B3	F1			
R105	C3	G1	J100	A3	CHASSIS
R106	C3	G1	J170	L5	CHASSIS
R108	D3	G1	R110	C3	CHASSIS
R112	B5	F1	R130	E7	CHASSIS
R114††	B4	G1	R185	G2	CHASSIS
R116	C5	G1			

P/O A1 ASSY also shown on  & 

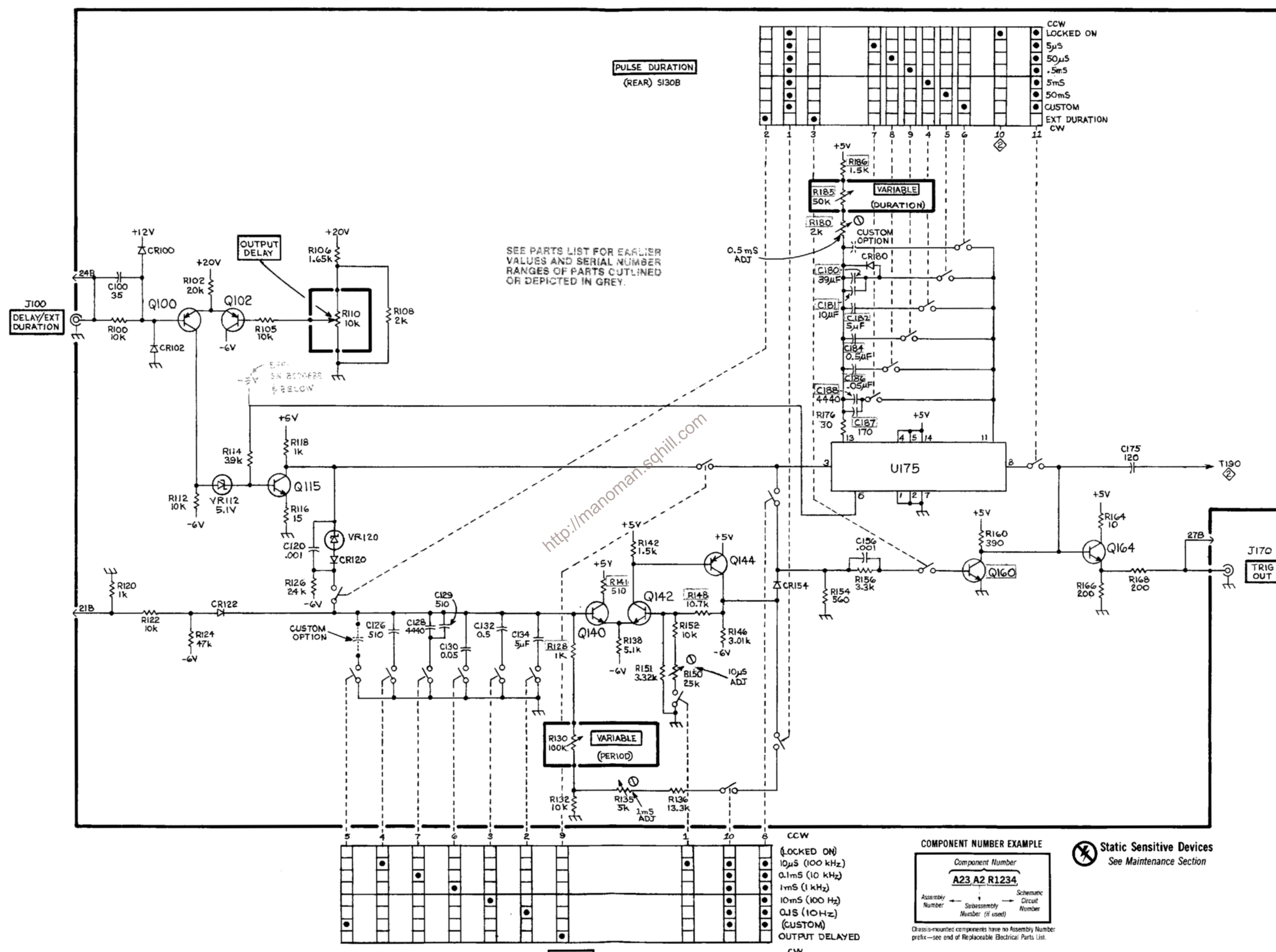
* See Parts List for serial number ranges.

† Located on back of board.

†† Moved to back of board (eff. SN B020890-up).

A B C D E F G H J K L

1
2
3
4
5
6
7
8



PULSE DURATION
(REAR) S130B

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

<http://manoman.sghill.com>

PERIOD

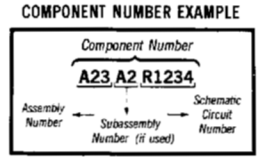
S130A (FRONT)
REV NOV 1981
1583-14

2	1	3	7	8	9	4	5	6	10	11
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•

CCW
LOCKED ON
5µs
50µs
.5ms
5ms
50ms
CUSTOM
EXT DURATION
CW

5	4	7	6	3	2	9	1	20	8
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•


CCW
(LOCKED ON)
10µs (100 kHz)
0.1ms (10 kHz)
1ms (1 kHz)
10ms (100 Hz)
0.1s (10 Hz)
(CUSTOM)
OUTPUT DELAYED
CW



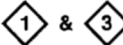
Static Sensitive Devices
See Maintenance Section

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Table 8-2

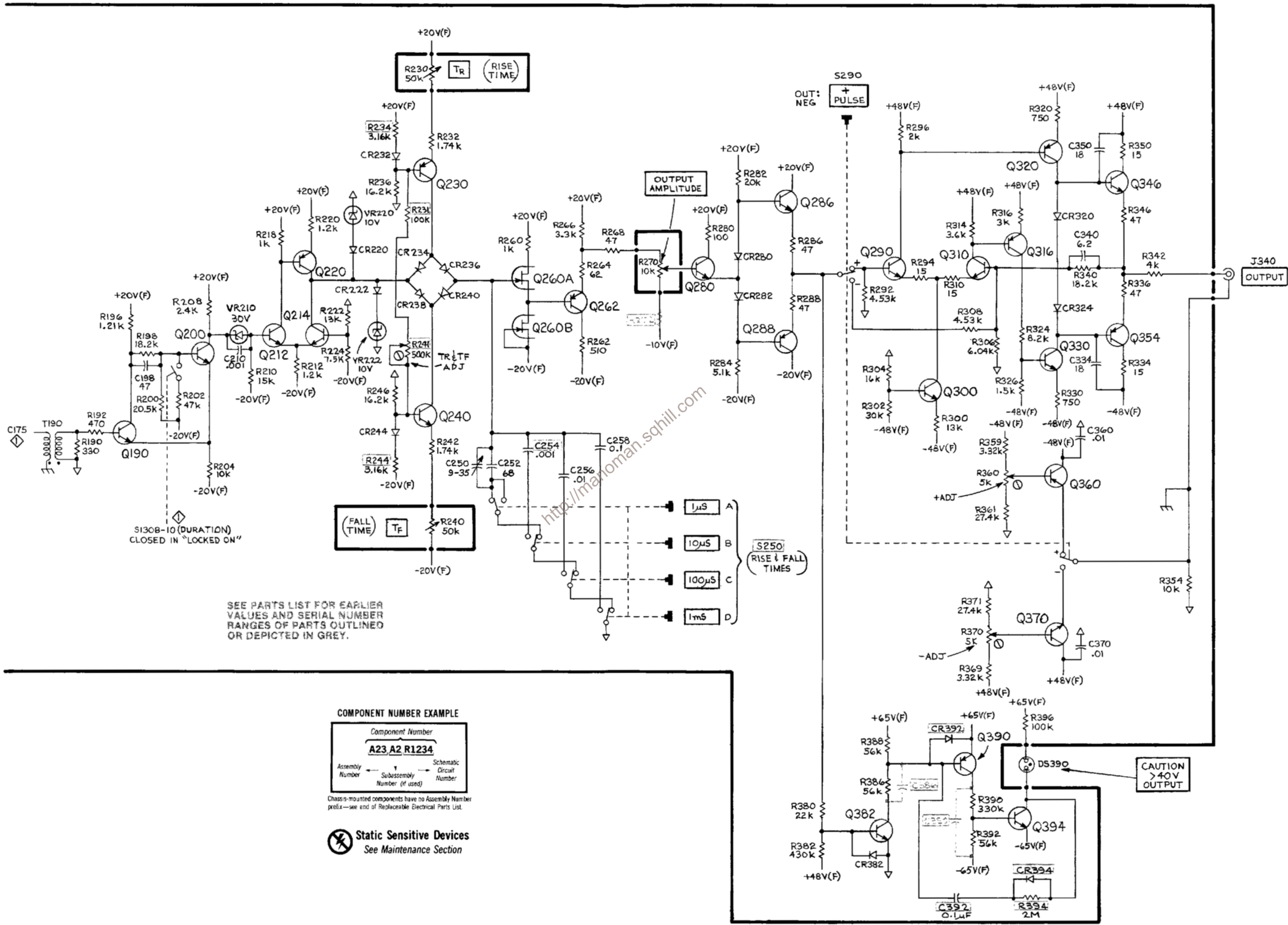
P/O A1 ASSY						OUTPUT 		
CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C198	B4	F4	Q330	J3	J4	R310	H3	K5
C210	B4	F4	Q346	K2	L4	R314	H3	J5
C250	D4	L4	Q354	K3	M4	R316	J2	K4
C252	E4	L4	Q360	J5	L5	R320	J2	K4
C254	E4	M4	Q370	J6	L5	R324	J3	K4
C256	E5	M4	Q382	H7	M1	R326	J4	L4
C258	F4	M3	Q390	J7	N1	R330	J4	J4
C334	J4	L4	Q394	J7	N1	R334	K4	M5
C340	K3	K4				R336	K3	M5
C350	J2	L4	R190	A4	F3	R340	K3	K4
C360	K4	L6	R192	A4	F3	R342	K3	M5
C370	K6	M5	R196	A3	F4	R346	K2	M5
C386*	H7	N1	R198	B3	F4	R350	K2	M5
C390*	H7	M1	R200	B4	F4	R354	K5	M6
C392*†	H8	M1	R202	B4	F4	R359	J4	M6
			R204	B4	F4	R360	J5	M6
CR220	D3	G6	R208	B3	F4	R361	J5	M6
CR222	C3	G4	R210	C4	F5	R369	J6	M5
CR232	D2	G4	R212	C4	F5	R370	J6	M5
CR234	D3	G4	R218	C3	F5	R371	J6	M5
CR236	D3	H4	R220	C2	F5	R380	G7	M3
CR238	D3	G5	R222	C3	F6	R382	G8	N3
CR240	D3	H5	R224	C4	F5	R386	H7	M1
CR244	D4	G5	R231*†	D2	G5	R388	H7	M1
CR280	G3	J5	R232	D2	G4	R390	J7	M2
CR282	G3	J5	R234*	D2	F4	R392	J7	N2
CR320	J2	K4	R236	D2	G4	R394*†	J8	M2
CR324	J3	K4	R241*†	D3	G5	R396	J7	N1
CR382	H8	M3	R242	D4	G4			
CR392*†	H7	N1	R244	D4	G5	S130A		K2
CR394*†	J8	M2	R246	D4	G5	S130B	B5	H2
			R260	E3	H5	S250A	G5	M4
Q190	B4	F4	R262	E3	H5	S250B	G5	M4
Q200	B3	F4	R264	E3	H5	S250C	G5	M4
Q212	C4	F5	R266	E3	H5	S250D	G6	M5
Q214	C3	F6	R268	F3	H5	S290	H1	L5
Q220	C3	F6	R272*	F3	H5			
Q230	D2	G5	R280	F3	H4	T190	A4	F3
Q240	D4	G5	R282	G2	H5			
Q260A	E3	H4	R284	F4	J5	VR210	B3	F5
Q260B	E3	H4	R286	G3	J5	VR220	D2	G5
Q262	E3	H5	R288	G3	J5	VR222	D4	G4
Q280	F3	H5	R292	H3	J5			
Q286	G2	J4	R294	H3	K6	DS390	J7	CHASSIS
Q288	G3	J6	R296	H2	K5	J340	L3	CHASSIS
Q290	H3	J6	R300	H4	K5	R230	D1	CHASSIS
Q300	H4	K5	R302	H4	K5	R240	D5	CHASSIS
Q310	H3	J5	R304	H4	K5	R270	F3	CHASSIS
Q316	J3	J5	R306	J3	K5			
Q320	J2	J5	R308	J3	K5			

P/O A1 ASSY also shown on

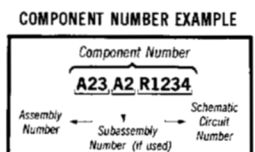


*See Parts List for serial number ranges.

†Located on back of board.



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



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

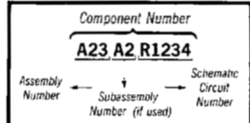
Static Sensitive Devices
See Maintenance Section

Table 8-3

P/O A1 ASSY			POWER SUPPLY 3		
CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C514	C3	B4	R550	C7	A4
C534	D4	B2	R552	C7	A5
C545	B6	F2	R555	F2	B3
C550	C6	F2	R557	F2	B5
C555	F2	C2	R560	G2	D3
C557	E2	C5	R562	G2	D2
C564	G3	D2	R564	G2	D2
C566	G3	E2	R566	G3	D4
C580	H3	D2	R568	F3	E2
C598	J4	E5	R570	F3	E3
C610	J4	D5	R572	F3	D3
C620	J5	D5	R574	G3	E2
C640	G6	D3	R576	G2	D3
			R578	H2	D3
CR530	C3	B3	R579	J2	C2
CR542	B5	B5	R580	H2	D3
CR550	C7	B4	R590	J3	E3
CR555	F1	C3	R592	H3	E3
CR557	E2	C4	R594	H4	E3
CR566	G3	D4	R596	H4	E4
CR576	H2	D3	R598	H4	E4
CR580	H3	D2	R610	J4	E5
CR640	H7	B5	R611	G4	D6
			R612	J5	E5
Q520	B4	B3	R614	G5	C6
Q530	C3	A3	R615	G5	D6
Q550	C7	A3	R617	G5	C6
Q566	G3	D3	R620	H5	E4
Q576	H2	D3	R624	H6	E5
Q580	H3	C3	R626	H6	E5
Q590	J4	E3	R628	J6	E4
Q592	H4	E3	R630	J6	E5
Q610	J5	D4	R640	J7	D3
Q620	H6	E5	R642	H7	C4
Q622	J6	E4	R644	H7	D4
Q642	H7	C4	R646	H7	D4
Q646	H7	C4	R648	G7	D5
			R650	F7	D5
R500	E2	B5	R652	F7	D5
R510	B3	B3	R656	F7	D4
R512	B3	B3	R658	F7	D4
R514	B3	B3	R660	F8	D4
R516	C4	B2			
R518	B3	A1	U610A	G7	D5
R520	B4	B1	U610B	H5	D5
R522	B4	B1			
R528	C4	B4	VR520	C4	B2
R530	C3	B4	VR534	D4	D2
R532	D3	B4	VR542	B5	B5
R534	D4	D1	VR550	C6	B4
R540	B5	A5	VR610	G4	C6
R542	B5	B5	VR646	G7	D4
R545	B6	B3	VR650	F7	D5

P/O A1 ASSY also shown on 1 & 2

COMPONENT NUMBER EXAMPLE



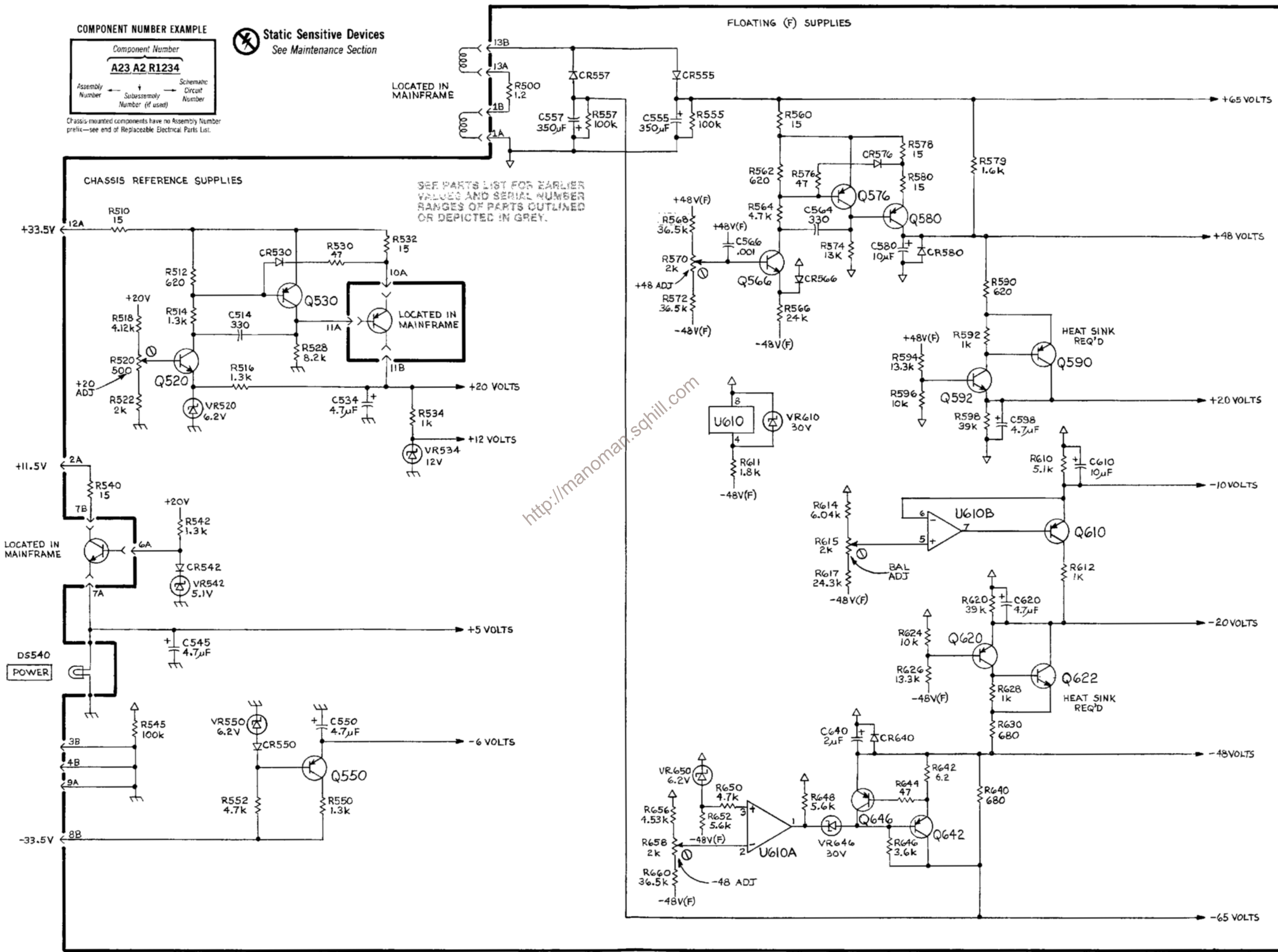
Cassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section

LOCATED IN MAINFRAME

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

FLOATING (F) SUPPLIES



REPLACEABLE MECHANICAL 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

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

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

```

1 2 3 4 5           Name & Description
Assembly and/or Component
Attaching parts for Assembly and/or Component
    --- * ---
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
    --- * ---
Parts of Detail Part
Attaching parts for Parts of Detail Part
    --- * ---
  
```

Attaching Parts always appear 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. The separation symbol --- * --- indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

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

"	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
#	NUMBER SIZE	ELEC	ELECTRICAL	INCAND	INCANDESCENT	SECT	SECTION
ACTR	ACTUATOR	ELECTL	ELECTROLYTIC	INSUL	INSULATOR	SEMICON	SEMICONDUCTOR
ADPTR	ADAPTER	ELEM	ELEMENT	INTL	INTERNAL	SHLD	SHIELD
ALIGN	ALIGNMENT	EPL	ELECTRICAL PARTS LIST	LPHLDR	LAMPHOLDER	SHLDR	SHOULDERED
AL	ALUMINUM	EQPT	EQUIPMENT	MACH	MACHINE	SKT	SOCKET
ASSEM	ASSEMBLED	EXT	EXTERNAL	MECH	MECHANICAL	SL	SLIDE
ASSY	ASSEMBLY	FIL	FILLISTER HEAD	MTG	MOUNTING	SLFLKG	SELF-LOCKING
ATTEN	ATTENUATOR	FLEX	FLEXIBLE	NIP	NIPPLE	SLVG	SLEEVING
AWG	AMERICAN WIRE GAGE	FLH	FLAT HEAD	NON WIRE	NOT WIRE WOUND	SPR	SPRING
BD	BOARD	FLTR	FILTER	OBD	ORDER BY DESCRIPTION	SO	SQUARE
BRKT	BRACKET	FR	FRAME or FRONT	OD	OUTSIDE DIAMETER	SST	STAINLESS STEEL
BRS	BRASS	FSTNR	FASTENER	OVH	OVAL HEAD	STL	STEEL
BRZ	BRONZE	FT	FOOT	PH BRZ	PHOSPHOR BRONZE	SW	SWITCH
BSHG	BUSHING	FXD	FIXED	PL	PLAIN or PLATE	T	TUBE
CAB	CABINET	GSKT	GASKET	PLSTC	PLASTIC	TERM	TERMINAL
CAP	CAPACITOR	HDL	HANDLE	PN	PART NUMBER	THD	THREAD
CER	CERAMIC	HEX	HEXAGON	PNH	PAN HEAD	THK	THICK
CHAS	CHASSIS	HEX HD	HEXAGONAL HEAD	PWR	POWER	TNSN	TENSION
CKT	CIRCUIT	HEX SOC	HEXAGONAL SOCKET	RCPT	RECEPTACLE	TPG	TAPPING
COMP	COMPOSITION	HLCPS	HELICAL COMPRESSION	RES	RESISTOR	TRH	TRUSS HEAD
CONN	CONNECTOR	HLEXT	HELICAL EXTENSION	RGD	RIGID	V	VOLTAGE
COV	COVER	HV	HIGH VOLTAGE	RLF	RELIEF	VAR	VARIABLE
CPGL	COUPLING	IC	INTEGRATED CIRCUIT	RTRNR	RETAINER	W/	WITH
CRT	CATHODE RAY TUBE	ID	INSIDE DIAMETER	SCH	SOCKET HEAD	WSHR	WASHER
DEG	DEGREE	IDNT	IDENTIFICATION	SCOPE	OSCILLOSCOPE	XFMR	TRANSFORMER
DWR	DRAWER	IMPLR	IMPELLER	SCR	SCREW	XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
45722	USM CORP., PARKER-KALON FASTENER DIV.		CAMPBELLSVILLE, KY 42718
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
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
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111

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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	366-0494-00			6						KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00			6						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-3	366-1201-00			1						KNOB:GRAY	80009	366-1201-00
	213-0153-00			1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-4	366-1202-00			1						KNOB:GRAY	80009	366-1202-00
	213-0153-00			1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-5	366-1257-51			1						PUSH BUTTON:GRAY--1US	80009	366-1257-51
-6	366-1257-60			1						PUSH BUTTON:GRAY--10US	80009	366-1257-60
-7	366-1257-50			1						PUSH BUTTON:GRAY--100US	80009	366-1257-50
-8	366-1257-49			1						PUSH BUTTON:GRAY--1MS	80009	366-1257-49
-9	366-1489-56			1						PUSH BUTTON:GRAY-- + PULSE	80009	366-1489-56
-10	426-0681-00			5						FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-11	214-1840-00	B010100	B021999X	1						PIN,KNOB SECRG:0.094 OD X 0.120 INCH LONG	80009	214-1840-00
-12	366-1422-01	B010100	B021999	1						KNOB:LATCH	80009	366-1422-01
	366-1690-00	B022000		1						KNOB:SIL GY,0.53 X0.23 X 1.059	80009	366-1690-00
-13	-----			1						RESISTOR,VAR:(SEE R130 REPL) (ATTACHING PARTS)		
-14	210-0583-00			1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-15	210-0940-00			1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL - - - * - - -	79807	OBD
-16	-----			1						RESISTOR,VAR:(SEE R230 REPL) (ATTACHING PARTS)		
-17	210-0583-00			1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-18	210-0940-00			1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL - - - * - - -	79807	OBD
-19	-----			1						RESISTOR,VAR:(SEE R110 REPL) (ATTACHING PARTS)		
-20	210-0583-00			1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-21	210-0940-00			1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL - - - * - - -	79807	OBD
-22	-----			1						RESISTOR,VAR:(SEE R185 REPL) (ATTACHING PARTS)		
-23	210-0583-00			1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-24	210-0940-00			1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-25	210-0046-00			1						WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS - - - * - - -	78189	1214-05-00-0541C
-26	-----			1						RESISTOR,VAR:(SEE R240 REPL) (ATTACHING PARTS)		
-27	210-0583-00			1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-28	210-0940-00			1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL - - - * - - -	79807	OBD
-29	-----			1						RESISTOR,VAR:(SEE R270 REPL) (ATTACHING PARTS)		
-30	210-0583-00			1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-31	210-0940-00			1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL - - - * - - -	79807	OBD
-32	131-0955-00			2						CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-33	131-0274-00			1						CONNECTOR,RCPT,:BNC	91836	KC79-67
-34	333-1768-00			1						PANEL,FRONT:PG505	80009	333-1768-00
-35	378-0703-00			1						LENS,LIGHT:HOLDER,CLEAR	80009	378-0703-00
-36	200-0935-00			1						BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-37	378-0602-00			1						LENS,LIGHT:GREEN	80009	378-0602-00
-38	352-0157-00			1						LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-39	214-1513-01	B010100	B021999	1						LCH,PLUG-IN RET:	80009	214-1513-01
	105-0719-00	B022000		1						LATCH,RETAINING:PLUG-IN (ATTACHING PARTS)	80009	105-0719-00
-40	213-0254-00			1						SCREW,TPG,TF:2-32 X 0.250,100 DEG,FLH - - - * - - -	45722	OBD
	105-0718-00	XB022000	B022369	1						BAR,LATCH RLSE:	80009	105-0718-00
	105-0718-01	B022370		1						BAR,LATCH RLSE:	80009	105-0718-01
-41	386-2643-00			1						SUBPANEL,FRONT: (ATTACHING PARTS)	80009	386-2643-00
-42	213-0229-00	B010100	B022439	4						SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL	93907	OBD
	213-0123-00	B022440		4						SCREW,TPG,TF:6-32 X 0.375,SPCL TYPE,FLH - - - * - - -	93907	OBD

Replaceable Mechanical Parts—PG 505

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-43	337-1848-00		1		SHLD,ELECTRICAL:FRONT SUBPANEL	80009	337-1848-00
-44	384-1099-00		1		EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
	672-0431-00		1		CKT BOARD ASSY:PULSE GEN	80009	672-0431-00
					(ATTACHING PARTS)		
-45	213-0146-00		3		SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
	211-0507-00		1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0202-00		1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
	210-0407-00		1		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
					- - - * - - -		
	-----		-		CKT BOARD ASSY W/CAM SWITCH INCLUDES:		
-46	-----		1		. CKT BOARD ASSY:--MAIN(SEE A1 REPL)		
-47	131-0604-00		21		. . CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-48	136-0269-02		1		. . SKT,PL-IN ELEC:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	136-0235-00		1		. . SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-49	136-0514-00		1		. . SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-50	214-0579-00		5		. . TERM,TEST POINT:BRZ CD PL	80009	214-0579-00
-51	214-0498-00		2		. . HEAT SINK,XSTR:TO-18,AL BLACK ANODIZED	05820	201-AB
-52	-----		1		TRANSISTOR:(SEE Q580 REPL)		
					(ATTACHING PARTS)		
-53	211-0097-00		1		. . SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-54	210-0406-00		1		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-55	210-1122-00		1		. . WASHER,LOCK:0.12 ID,DISHED,0.025 THK	86928	OBD
-56	210-0921-00		1		. . WASHER,MICA:0.50 X 0.141 XO.005 INCH THK	80009	210-0921-00
					- - - * - - -		
-57	-----		1		. . TRANSISTOR:(SEE Q642 REPL)		
					(ATTACHING PARTS)		
-58	211-0097-00		1		. . SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-59	210-0406-00		1		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-60	210-1122-00		1		. . WASHER,LOCK:0.12 ID,DISHED,0.025 THK	86928	OBD
					- - - * - - -		
-61	-----		1		. . SWITCH,PUSH:(SEE S290 REPL)		
-62	361-0384-00		2		. . SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
-63	-----		1		. . SWITCH,PUSH:(SEE S250 REPL)		
-64	361-0383-00		8		. . SPACER,PB SW:CHARCOAL,0.33 INCH LONG	80009	361-0383-00
	198-2193-00		1		. . WIRE SET,ELEC:	80009	198-2193-00
-65	175-0825-00		PT		. . WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-66	175-0828-00		PT		. . WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
-67	175-0830-00		PT		. . WIRE,ELECTRICAL:7 WIRE RIBBON	08261	SS-0726-710610C
	263-1015-00		1		. SW CAM ACTR AS:PERIOD	80009	263-1015-00
					(ATTACHING PARTS)		
-68	211-0116-00	B010100 B023139	6		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0292-00	B023140	6		. SCR,ASSEM WSHR:4-40 X 0.29, BRS NI PL	78189	OBD
					- - - * - - -		
	-----		-		. ACTUATOR ASSY INCLUDES:		
-69	200-1623-00		1		. . COVER,CAM SW:10 & 11 ELEMENTS	80009	200-1623-00
					(ATTACHING PARTS)		
-70	211-0008-00		6		. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-71	210-0004-00		6		. . WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	OBD
					- - - * - - -		
-72	354-0391-00		2		. . RING,RETAINING:0.395"FREE ID X 0.025" STL	97464	3100-43-CD
-73	401-0081-02		2		. . BEARING,CAM SW:FRONT	80009	401-0081-02
-74	210-0406-00		12		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-75	214-1139-03		2		. . SPRING,FLAT:RED COLORED	80009	214-1139-03
-76	214-1139-02		1		. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-77	214-1139-00		1		. . SPRING,FLAT:0.885 X 0.156CU BE GLD CLR	80009	214-1139-00
-78	214-1127-00		4		. . ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-79	105-0514-00		1		. . ACTUATOR,CAM SW:PULSE PERIOD	80009	105-0514-00
-80	105-0515-00		1		. . ACTUATOR,CAM SW:PULSE DURATION	80009	105-0515-00
-81	401-0115-00		1		. . BEARING,CAM SW:CENTER	80009	401-0115-00
	386-3657-00	XB020670 B022529	2		SUPPORT,PLUG-IN:	80009	386-3657-00
	386-3657-01	B022530	2		SUPPORT,PLUG IN:	93907	OBD
	210-1270-00	XB020670	2		WASHER,FLAT:0.141 ID X 0.04 THK,AL	80009	210-1270-00
-82	426-0724-04		1		FR SECT,PLUG-IN:BOTTOM	80009	426-0724-04
-83	214-1061-00		1		SPRING,GROUND:FLAT	80009	214-1061-00
-84	426-0725-05		1		FR SECT,PLUG-IN:TOP	80009	426-0725-05

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
ACCESSORIES												
	070-1583-01			1						MANUAL, TECH: SERVICE	80009	070-1583-01

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