



PG 509
Pulse
Generator

INSTRUCTION MANUAL

Tektronix, Inc.
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Product Group 75

Serial Number _____

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The information in the remaining sections of this manual is for qualified service personnel only. Refer to the "Service Safety Summary" located later in this manual.

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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 and do 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 markings, 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.

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 making any connections 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 insulated) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

Use the Proper Fuse

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

Do Not Operate in Explosive Atmospheres

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

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the instrument without the covers and panels properly installed.

SERVICING 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 exist at several points in this product. To avoid personal injury, do not touch exposed connections or 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 does 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.

SPECIFICATION

INTRODUCTION

The PG 509 Pulse Generator is a fast-risetime pulse source producing narrow rectangular pulses at a repetition rate of 50 KHz. The PG 509 can deliver a continuous pulse train at an amplitude of 25 volts into an output load of 50 ohms.

The PG 509 Pulse Generator is a TM 500 Series plug-in instrument. All functional electronics are included, but it requires insertion in a TM 500 or TM 5000 Series Power Module Mainframe for interfacing to basic power supplies.

The PG 509 Pulse Generator was primarily designed to be an integral part of a test system. Figure 1-1 shows primary components and connections immediately related to the Pulse Generator in a typical system. Other than the System Controller, Device Under Test, and PG 509, these are:

- A programmable attenuator (TEKTRONIX AT 5010, or equivalent); used to provide system selection for the degree of attenuation required.
- A high frequency multiplexer/switcher (TEKTRONIX SI 5010, or equivalent); used to route inputs and outputs between instruments and test devices while under system control.

Note that while the PG 509 is not under direct GPIB control, it is typically directed by instruments that are. In a mostly Tektronix instrument configuration, this would typically mean that the PG 509 be installed in a TM 5000 (programmable plug-in compatible) Power Module, as is required for the other two devices.

Standard Accessory

- 1 Instruction manual

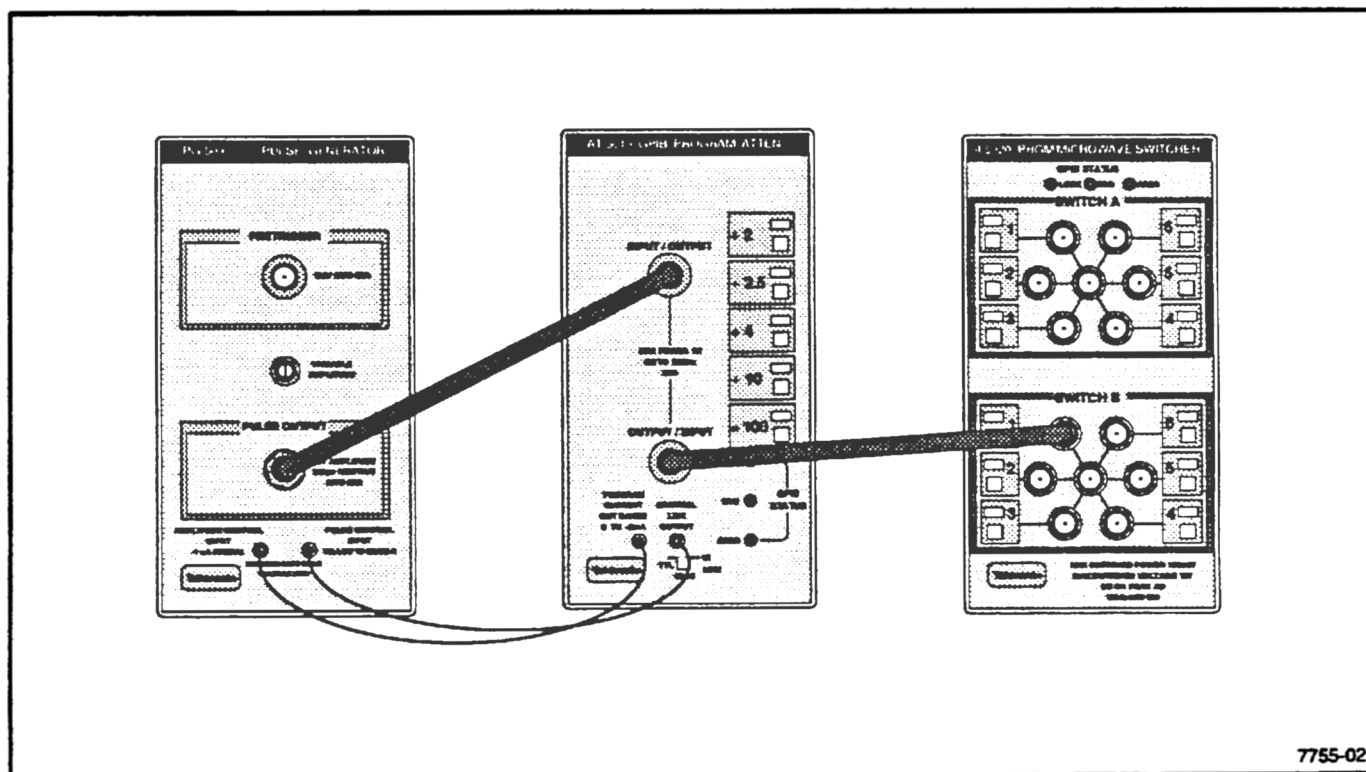


Figure 1-1. PG 509 typical system installation.

Specification

PERFORMANCE CONDITIONS

The PG 509 must be in an environment whose limits are described under Environmental Characteristics (Table 1-2).

The limits stated in the Performance Requirements column of Table 1-1 are valid only if the PG 509 is operated in an ambient temperature between 0°C and + 50°C, unless otherwise stated.

Allow at least 15 minutes warm-up time for operation to specified accuracy, 60 minutes after storage in high humidity environment.

**Table 1-1
Electrical Characteristics**

Characteristics	Performance Requirements	
Output Amplitude	25 V Into 50 Ω.	
Variable Amplitude Range		
Front Panel Adjustment Range	±5%.	
Amplitude Control Input	Maximum safe input voltage ≤ 10 V.	
	Input Current	Output Voltage
	< -0.15 mA	Output is controlled by the front panel VARIABLE AMPLITUDE adjustment.
	-0.5 mA	26.25 V ±2%.
	-1.0 mA	25.00 V ±2%.
	-1.5 mA	23.75 V ±2%.
Pulse Output Frequency	50 kHz ±10%.	
Pulse Width	44 ns ±2 ns (measured at 50% points).	
Pulse Disable	TTL logic low to disable; maximum safe input voltage ≤ 10 V.	
Rise Time	350 ps ±50 ps (measured at System output connector).	
PRETRIGGER Out	220 mV ±20% (into 50 Ω).	
PRETRIGGER signal before PULSE OUTPUT signal	115 ns ±25% (delay factor).	

**Table 1-2
Environmental Characteristics^a**

Characteristics	Description
Temperature	Meets MIL-T-28800B, class 5.
Operating	0°C to +50°C.
Non-operating	-55°C to +75°C.
Humidity	Meets MIL-T-28800B, class 5.
	95% RH, 0°C to +30°C 75% RH, to 40°C 45% RH, to 50°C.
Altitude	Meets MIL-T-28800B, class 5.
Operating	4.6 km (15,00 ft).
Non-operating	15 km (50,000 ft).
Vibration ^b	Meets MIL-T-28800B, class 5, when installed in qualified power modules ^c .
	0.38 mm (0.015 in) peak to peak, 5 Hz to 55 Hz, 75 minutes.
Shock	Meets MIL-T-28800B, class 5, when installed in qualified power modules ^c .
	20 g's (1/2 sine), 11 ms duration, 3 shocks in each direction along 3 major axes, 18 total shocks.
Bench Handling ^d	Meets MIL-T-28800B, class 5, when installed in qualified power modules ^c .
	12 drops from 45°, 4 in or equilibrium, whichever occurs first.
Transportation	Qualified under National Safe Transit Association Preshipment Test Procedures 1A-B-1 and 1A-B-2.
EMC	Within limits of FCC Regulations, Part 15, Subpart J, Class A; VDE0871; and MIL-461A tests RE01, RE02, CE01, CE03, RS01, RS03, CS01, and CS02.
Electrical Discharge	20 kV maximum charge applied to instrument case.

^aWith power module.

^bRequires retainer clip.

^cRefer to TM 5000 Power Module specifications.

^dWithout Power Module.

**Table 1-3
Mechanical Characteristics**

Characteristics	Description
Nominal Overall Dimensions	
Height	4.961 in (126.0mm).
Width	2.63 in (66.8 mm).
Length	11.493 in (291.9 mm).
Net Weight	2 lb (0.907 kg).
Finish (front panel)	Plastic/aluminum laminate.

SYSTEM INSTALLATION

PREPARATION FOR USE

Operating Environment

The PG 509 should be operated in a clean, controlled environment that does not exceed the environmental limitations listed in Section 1, Table 1-2.

NOTE

Before installation, refer to the Operators Safety Summary in the front of this manual and to the Change Information section at the rear of this manual. Also refer to the power module instruction manual for line voltage requirements and power module operation.

The instrument operates in any compartment of a TM 500 or TM 5000 Series Power Module. Refer to the TM 500/5000 Series Power Module Instruction Manuals for module connector information, as well as details on line voltages and general power module operation.

The PG 509 must be calibrated in the system it will be used with. The specifications listed in the previous section are for the PG 509 at the system output, not at the PG 509 front panel.

Installation and Removal



To prevent damage to the PG 509, turn off the power module before installation or removal. Do not use excessive force when installing or removing the PG 509. Refer to the Operator Safety Summary at the front of this manual and check the change information at the back of this manual for additional safety notes.

Figure 2-1 shows the installation and removal procedure. Check to see if the plastic barrier on the interconnecting jack of the selected power module compartments matches the cut-out in the circuit board edge connectors at the rear interface.

Align the chassis of the plug-in unit with the upper and lower guide rails of the selected compartments. Push inward and press firmly to seat the circuit board edge connectors in the interconnecting jacks.

System Installation

To remove the PG 509, turn off the power module and pull on the release latch (front panel, lower left corner) until the interconnecting jacks disengage. Pull straight forward to remove the plug-in from the power module.

Power-Up and Front Panel Indications

Apply power to the PG 509 by activating the POWER switch on the TM 500/TM 5000-Series power module.

There is no indication on the front panel that power is applied.

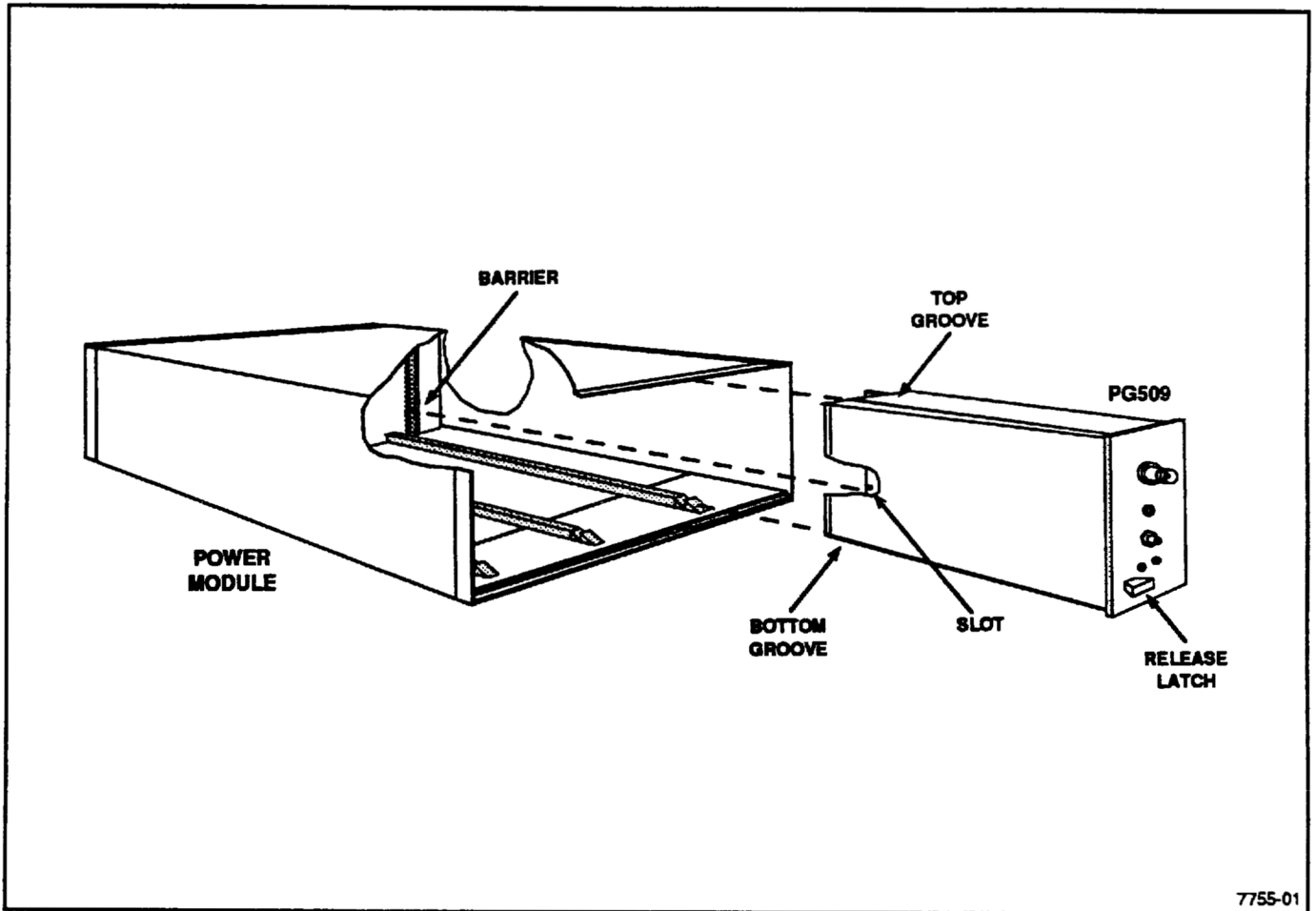


Figure 2-1. Installation and Removal.

FRONT PANEL CONTROLS AND CONNECTORS

See Figure 2-2 for the PG 509 front panel controls and connectors.

Connections to the front panel PULSE OUTPUT SMA-type connector should be made using a high quality semi-rigid 50- Ω coaxial cable, such as Tektronix part number 015-1015-00, or better.

For best vswr (voltage-standing wave ratio) and maximum power transfer conditions, the signal source output impedance should match the input load impedance of the signal receiving device. Unmatched source and load impedances degrade the vswr specifications. If terminators are used, they should be placed at the signal source or load (or both), never at the front panel PULSE OUTPUT SMA-type connector.

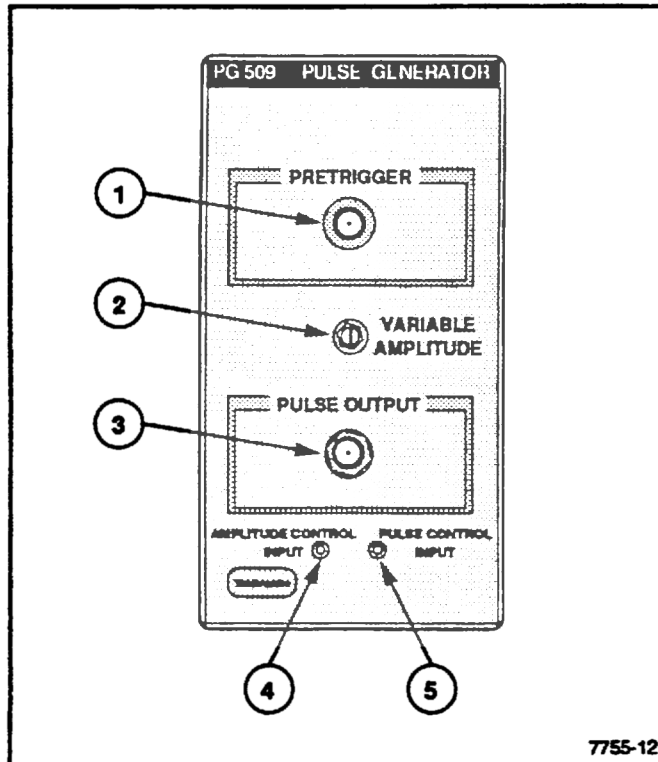


Figure 2-2. PG 509 front panel controls and connectors.

① PRETRIGGER Connector

Outputs a trigger pulse in advance of the output pulse (from the PULSE OUTPUT connector) to properly trigger related calibration equipment.

② VARIABLE AMPLITUDE Adjustment

This adjustment varies the output level of the PULSE OUTPUT connector signal.

③ PULSE OUTPUT Connector

SMA-type plug-in output signal connector.

④ AMPLITUDE CONTROL INPUT Connector

This connector provides a means of controlling the output amplitude of the generator via an input current source that varies between 0 mA and -2 mA. For currents less than -0.15 mA, the generator output level is controlled by the front panel VARIABLE AMPLITUDE adjustment. This input is also at the rear module connector.

⑤ PULSE CONTROL INPUT Connector

This input enables or disables the generator output signal. When the signal to the connector is a TTL LO, then generator output signal is disabled; when a TTL HI, the generator output signal is enabled. This input is also at the rear module connector.

REPACKAGING INFORMATION

If the 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 the individual at your firm that can be contacted
- Complete instrument description and its serial number
- A description of the service required

If the original package is not fit to use or not available, repackage the instrument as follows:

- Surround the instrument with polyethylene sheeting, or other suitable material, to protect the exterior finish.
- Obtain a carton of corrugated cardboard of adequate strength that has inside dimensions no less than six inches more than the instrument dimensions.
- Cushion the instrument by tightly packing dunnage or urethane foam between the carton and the instrument, on all sides.
- Seal the carton with shipping tape or an industrial stapler.

The carton test strength for your instrument is 200 pounds.

APPLICATIONS

SYSTEM FUNDAMENTALS

Some fundamental factors to consider when preparing the PG 509 Pulse Generator for use in a system will be covered in this section. These systems provide a basis for the development of other specialized systems as required by specific applications.

Pulse Definitions

The following terms are commonly used in describing pulse characteristics and are defined here for convenience. The terms are illustrated and applied in Figure 3-1. The other waveforms represent typical output waveforms in order to show the relationships. The terms and their definitions are:

- Risetime t_r : The time interval during which the amplitude of the output voltage changes from 10% to 90% of the rising portion of the pulse.
- Falltime t_f : The time interval during which the amplitude of the output voltage changes from 90% to 10% of the falling portion of the waveform.

- Pulse Width (or Duration) t_w : The time duration of the pulse measured between the 50% amplitude levels of the rising and falling portions of the waveform.
- Tilt: A measure of the tilt of the full amplitude, flat-top portion of pulse. The tilt measurement is usually expressed as a percentage of the amplitude of the rising portion of the pulse.
- Overshoot: A measure of the overshoot occurring generally above the 100% amplitude level. This measurement is also expressed as a percentage of the pulse rise.

Bear in mind that these definitions are for guide purposes only. When the pulses are very irregular (such as excessive tilt, overshoot, etc.) the definitions may become ambiguous. In such cases, a more complete description of the pulse will probably be necessary.

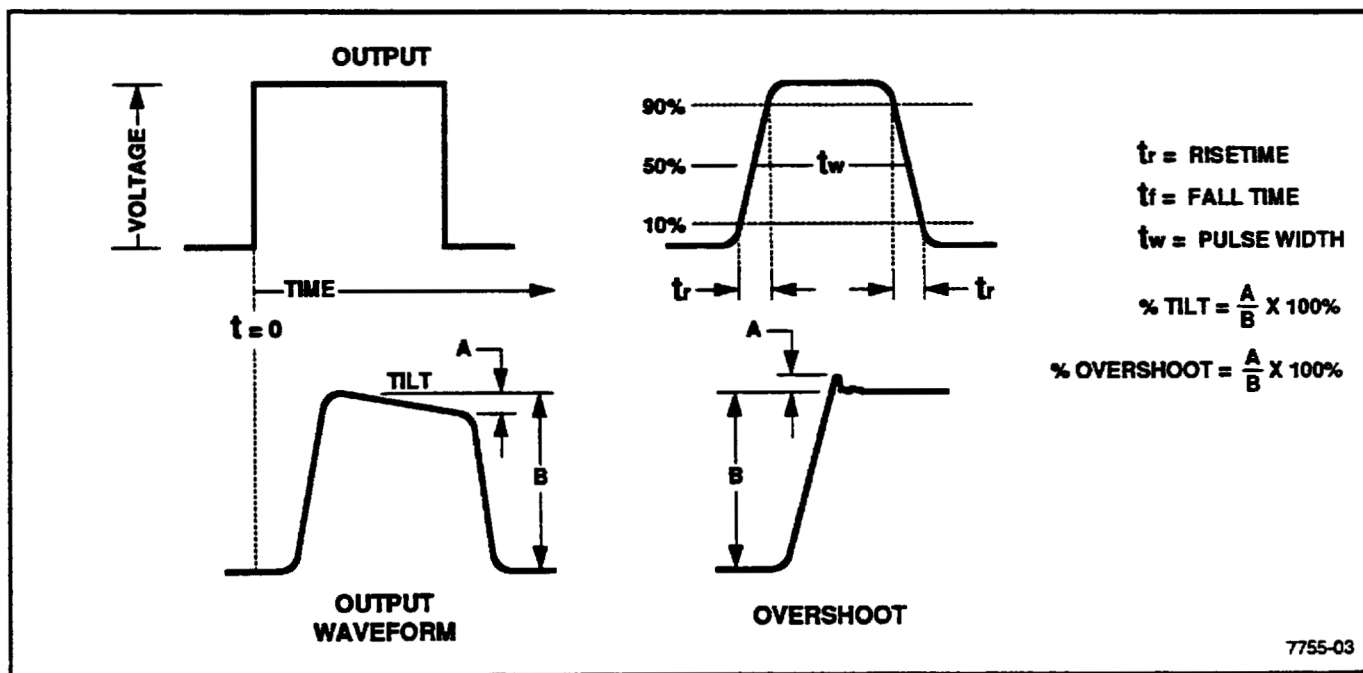


Figure 3-1. Terms used in describing pulse characteristics.

Applications

Rise Time

The rise time of any particular assembly of the PG 509, an oscilloscope (conventional or sampling), and accessory pieces such as coax cables, is a variable depending upon the cable characteristics as well as individual risetimes. The "root of the square" method can generally be applied as an approximation method only, as skin effect losses of the cables do not add properly using this method. (The root-sum-squares method applies accurately to Gaussian systems only.)

As a general rule, if the equipment or signal being measured has a rise time 10 times slower than the PG 509 and other related measuring equipment, the error is 1%. This amount is small and can be considered to be negligible. If the equipment being measured has a rise time three times slower than the related measuring equipment, the error is slightly less than 6%. By keeping these relationships in mind, the results can be interpreted intelligently.

Waveforms

The illustration shown in Figure 3-2 can be used as a guideline for the following general considerations:

- Oscilloscopes should have a vertical system rise time about one-seventh of the fastest signal applied to keep system errors to a minimum. Conversely, if the signal rise time is at least seven times faster than the rise time of the oscilloscope vertical system, the displayed (observed) waveform will have a rise time that is very close to the rise time of the vertical system.
- The displayed rise time is related to total system bandwidth. A system with limited high-frequency response will produce a displayed rise time that is slower than expected. If a fast-step signal produces a crt display with little or not overshoot or ringing, the product of oscilloscope rise time and oscilloscope bandwidth should result in a factor whose value lies between 0.329 and 0.350.

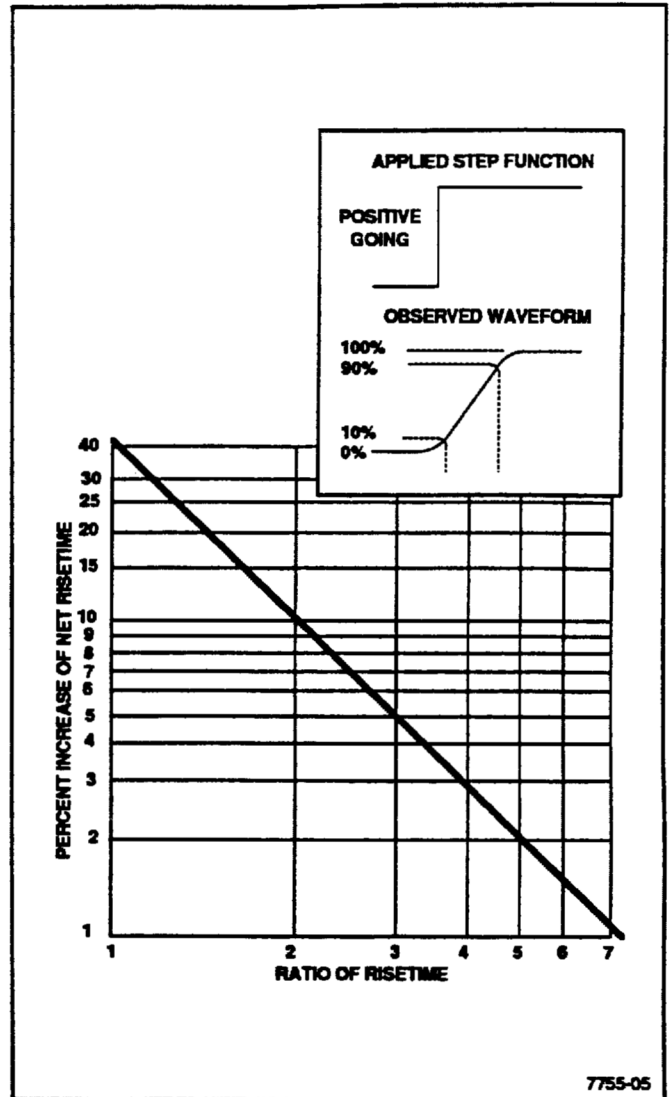


Figure 3-2. Rise time difference for two cascaded devices.

Figure 3-3 illustrates waveform distortion due to incorrect high-frequency compensations. Ringing indicates incorrect peaking adjustments or undesired inductive effects. Excessive overshoot and rolloff indicates incorrect capacitive adjustments. Limited high-frequency response is also indicated by rise time measurements that are much slower than expected. Impedance mismatching will usually show up as excessive aberrations somewhere along the flat portion of the waveform.

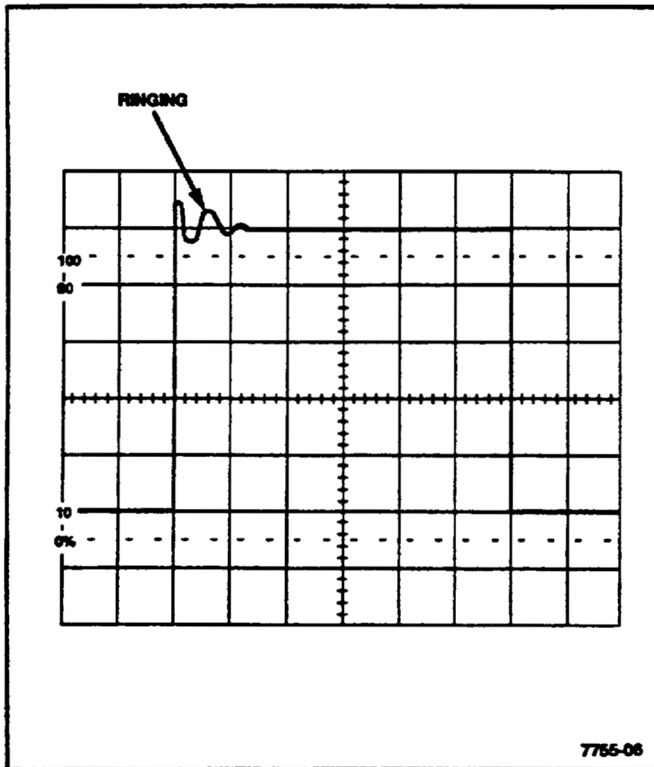


Figure 3-3. Typical high-frequency distortion effect.

Basic Precautions

For faithful reproduction of the pulse, certain precautions should be followed. These are summarized below:

- Use proper types of cables, terminations, attenuators, and impedance matching networks. Low-impedance coaxial cables are used with the PG 509 as signal conductors. It is important that these cables be terminated in their characteristic impedance (50 ohms) to prevent reflections and standing waves unless you deliberately wish to improperly terminate the cables. One application for improper termination would be to boost the signal to an amplifier input by leaving the end of a transmission line unterminated.
- Keep unshielded wires of uncertain impedance short so that reflection and/or cross-coupling effects are not introduced. Keep ground-return paths short and direct.

- Shield measuring equipment leads to prevent undesired coupling to other parts of the circuit. Shielding is especially required where radiation is a problem and where high-impedance dividers or circuits are involved.
- Choose components which function properly at frequencies and rise times encountered.
- Keep in mind inherent parameters in circuit components such as inductance present in capacitors or resistors.
- Consider the possible nonlinear behavior of circuit components due to changes in voltage or temperature coefficients.
- Consider the input impedance of measuring equipment. The impedance may be enough to cause loading effects, detuning, or undesirable reflections.

TYPICAL APPLICATION

Measuring DUT Rise Time

The PG 509 can be used in conjunction with an oscilloscope to determine the rise time of a Device Under Test (DUT). Rise time is normally measured between the 10% and 90% amplitude levels on the leading edge of a waveform. The rise time of a displayed waveform is shown in Figure 3-1.

Before measuring the rise time of a device under test, the combined rise time of the PG 509 output signal and the oscilloscope vertical amplifier system must be known. Refer to Figure 3-1 for the percentage error to be expected when the two devices are cascaded. For example, a 2-ns oscilloscope monitoring a 10-ns signal (5:1 ratio) would permit an observation error of 2%. Note that if the rise times are equal, the error is 41.4%.

THEORY OF OPERATION

INTRODUCTION

This section provides a discussion of the major elements incorporated in the schematic for the PG 509 Pulse Generator. The circuit consists of six major elements: Clock and Pretrigger, Pulse Delay, Strobe Generator, Output Pulse and Regulator, Charge Line, and Power Supplies. An illustration showing the relationship of the circuit elements, as well as major control and output locations, is provided in Figure 4-1.

The PG 509 Pulse Generator produces narrow, fast rise, rectangular pulses at a repetition rate of 50 kHz. The method used in this generator charges a length of coaxial cable which is then switched to the 50-ohm load with a transistor switch operating in avalanche mode. The charge line contained within the unit develops a pulse width equal to twice the electrical length of the line. For the model, this width is equivalent to 44 ns. The nominal output amplitude of the pulse is 25 V into 50 ohms.

A foldout schematic is located in the Diagrams section near the back of this manual. The following paragraphs describe the individual elements.

CLOCK AND PRETRIGGER

Transistors Q30 and Q35 form a Schmitt Oscillator producing a low-duty cycle, positive-going pulse at the collector of Q30. The repetition rate is set by Q40, a 0.9 mA current source, and C28, a 0.1 μ F capacitor in Q40's collector. A positive-going ramp of approximately 2 volts is supplied to the base of Q35, turning it off when the base goes more positive than the base of Q30. The voltage step at the collector of Q30 turns Q45 on, discharging C28, resetting the Pretrigger Schmitt, and supplying a pulse from the emitter of Q45 to the Pretrigger Schmitt circuit.

The Pretrigger Schmitt circuit, Q50 and Q58, outputs a positive voltage pulse of 220 mV at J55 into a 50-ohm load and a 2 V

pulse to the anode of CR20. The purpose of this circuit is to supply a trigger pulse in advance of the output pulse to properly trigger calibration equipment.

PULSE DELAY CIRCUIT

The positive going Pretrigger pulse turns off Q60 and Q65. This allows C25 to start charging in a negative direction. When the voltage becomes sufficiently negative to turn on CR16, the current from current source Q70 is switched to Q75.

The resistor chain in the base of Q75 determines where Q75 turns on, and therefore the time after the Pretrigger pulse. This provides a nominal delay of 115 ns. A pulse is coupled from Q75 to the base of Q80 through transformer T2, turning on Q80. The negative portion of the Pretrigger pulse at the anode of CR20 is zero volts. This allows Q60 to conduct, turning on Q65 which discharges C25 and resets the delay circuit. Diodes CR17, CR18 and CR19 prevent Q65 from saturating, thereby ensuring a fast turn-off.

STROBE GENERATOR

Transistors Q83 and Q90 form a regulated power supply from the +150 V unregulated input. This is used to supply +110 volts to the collector of Q80 which is biased to operate in the avalanche mode.

Transistor Q80 will avalanche when a pulse from T2 forward biases its base-emitter junction. Capacitor C20 is then discharged through R64, R99, and the primary of T1. This produces a voltage in the secondary which is sufficient to forward bias the base-emitter junction of Q100, the output switching transistor.

OUTPUT

Transistor Q100 is biased to operate as an avalanche transistor switch which connects DL100, a charged 50-ohm coaxial cable (Charge Line), into a 50-ohm load when conducting.

The output pulse is peak detected and applied to the gate of Q160A. It is compared with a reference voltage received at the gate of Q160B from the collector of Q210/TP1. This reference voltage, nominally 23.4 V, can be varied by adjusting R18, the voltage at pin 2 of J25, or the current at pin 2 of J5.

The amplifier consisting of transistors Q110, Q120, Q130, Q140, Q150, Q160, and U210A adjusts the voltage at the collector of Q100 until the output pulse is similar to the reference from Q210.

Varying the nominal -1 mA of current input to J5 pin 2 by ± 0.5 mA will vary the output voltage $\pm 5\%$. Decreasing the current to approximately -0.15 mA or less will cause the output of U210C to switch positive, turning off Q224B, disabling the input from J5-2/P1B-15, and turning on Q224A, enabling the front panel VARIABLE AMPLITUDE control through J25.

Transistor Q200, CR203 and R44 limit the maximum current that Q110 can supply, to about 10 mA. Diode VR210, a 75-volt Zener, and CR11 limit the Q100 collector voltage to about 100 volts in the absence of an output pulse. Note that without control, the voltage on the Charge Line center conductor can go to the unregulated value of about +200 V, depending on the line voltage. Pin 1 of J5 provides a means to disable the output when a TTL logical LO is supplied by the attenuator, AT 5010, so that

switch contacts will not be damaged as various ranges are selected.

CHARGE LINE

The Charge Line is a high quality, teflon dielectric, 50-ohm coaxial cable, installed in a coil within the module. The line is connected to J100 at one end and left open terminated at the other. The line has a total physical length of approximately 15-1/2 feet and an electrical length of about 22 ns. The Output Pulse width is equal to twice the electrical length of the line; thus the pulse from Q100 results in a pulse width of approximately 44 ns. Capacitors C101, C102, and C103 are in parallel with the Charge Line and are used to adjust the flatness and aberrations of the pulse.

POWER SUPPLIES

The unregulated +150-V supply is made by connecting some of the TM 5000 power module transformer windings in series and then doubling the result.

All other voltages used by the PG 509 Pulse Generator are regulated on the circuit board. Voltages used, as well as principal integrated circuits associated with each voltage regulation, are provided below:

U20A +9V
U20B -9V
U10A +18V
U20A -18V

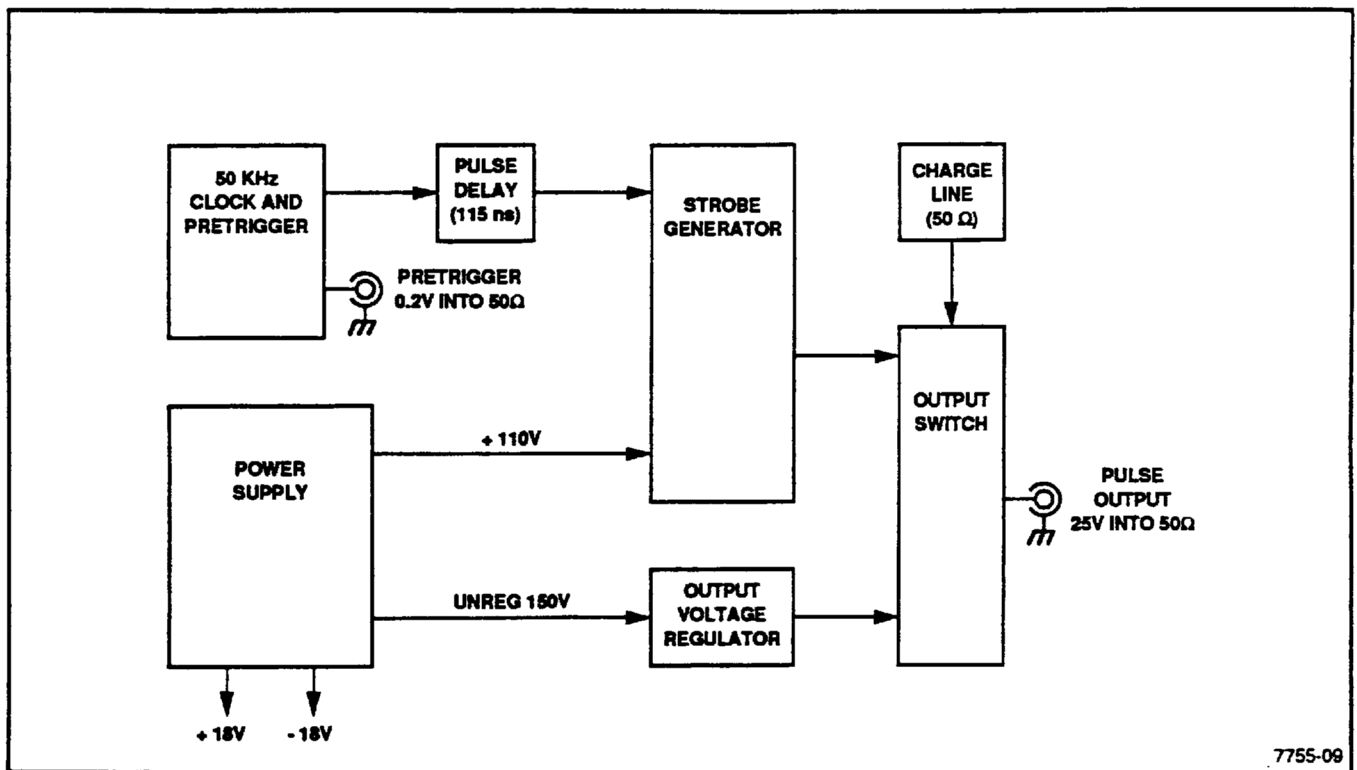


Figure 4-1. PG 509 block diagram.

PERFORMANCE CHECK PROCEDURES

INTRODUCTION

This procedure is used to verify proper operation of the instrument and its controls. These checks may also be used as an acceptance test and as a preliminary troubleshooting aid.

PREPARATION

Test equipment items listed in Table 5-1 are required to perform this procedure.

PERFORMANCE CHECK INTERVAL

To ensure instrument accuracy, check the calibration of the PG 509 every 1000 hours of operation, or every six months if used infrequently.

Table 5-1
Test Equipment Required

Item and Description	Use	Examples of Applicable Test Equipment
1. Test oscilloscope with probe and sampling head	Transient response and amplitude verification.	TEKTRONIX 11801 with SD-26 Sampling Head.
2. Power Module	Power plugins.	TEKTRONIX TM 500/5000-Series Power Module.
3. Digital Voltmeter	Amplitude check.	TEKTRONIX DM501A DMM with leads.
4. Calibration Generator	Oscilloscope characterization.	TEKTRONIX Calibration Generator (part number 067-1338-00).
5. Programmable Attenuator	Transient response and amplitude verification.	TEKTRONIX AT 5010 Programmable Attenuator.
6. SMA 10X Attenuator	All tests.	TEKTRONIX Attenuator (part number 015-1003-00).
7. SMA-to-BNC Adaptors (2 required)	Transient response and amplitude verification.	TEKTRONIX Adaptors (part number 015-1018-00).
8. BNC-to-BNC cable	All tests.	TEKTRONIX Cable 42" long (part number 012-0057-00).
9. Semi-rigid SMA-to-SMA cable	Transient response and amplitude adjustment.	TEKTRONIX Cable (part number 015-1015-00).
10. Power Supply	Amplitude verification.	TEKTRONIX PS 503A Power Supply.
11. 10 k Ω resistor	Amplitude verification.	TEKTRONIX 321-0289-00.

CHARACTERIZATION OF THE 11801 OSCILLOSCOPE



The input sampling bridge diodes in the SD-26 modules are of the very high frequency, low capacitance variety. An electrostatic discharge to the center conductor of the input connector will destroy these diodes. It is highly recommended that this procedure be performed only at a static-free workstation with the operator properly grounded at all times.

1. Perform the "Calibrating a Sampling Head" procedure as outlined on page 2-7 of the 11801 Service Manual.

NOTE

The following section will store a 50-division signal at 5 mV/div and 5 ns/div to use as a reference to adjust the PG 509 transient response.

2. Connect the Calibration Generator remote head to SD-26 Channel 1 (CH1) and the 11801 INTERNAL CLOCK output to the Calibration Generator TRIGGER INPUT. Push the CH 1 channel select button. Note that the light comes on.
3. Push TRIGGER MENU. Touch SOURCE. Touch INTERNAL CLOCK.
4. Push AUTO SETUP. A triggered 5-division calibrator waveform should be displayed on the screen at 10 ps/div.
5. Push WAVEFORM MENU button. Touch SAMPLING HEAD Fnc's. Touch SMOOTHING on. Touch EXIT.
6. Touch ACQUIRE DESC. Touch AVERAGE N to on. Touch SET AVGN.
7. Adjust AVERAGE N to 8 (upper knob).
8. Touch Horizontal Icon.
9. Set MAIN SIZE to 5 ns/div. Adjust MAIN POS knob so the rising edge of the pulse is at the second division.
10. Touch the Vertical Icon.
11. Adjust VERT OFFSET so the GND arrow is at the center division.
12. Adjust the VERT SIZE to 5 mV/div.

13. Adjust VERT OFFSET so the trace is 3 divisions up from the center of the graticule.
14. Push STORE/RECALL menu.
15. Touch STORE TRACE. Touch TRACE 1. Touch RECALL TRACE. Touch STO1. Touch the waveform on the screen to make CH 1 active.
16. Adjust MAIN POS to see if the waveform has been properly stored.
17. Connect the SMA 10X attenuator to the SD-26 input.
18. Disconnect the Calibration Generator.

TRANSIENT RESPONSE AND AMPLITUDE VERIFICATION



The 25-volt pulse from the PG 509 is easily capable of destroying the input sampling bridge diodes. It is strongly recommended that a 10X attenuator be connected to the input at all times.

1. Connect the SMA X10 attenuator of known accuracy and a SMA-to-BNC adaptor to the CH 1 input of the 11801.
2. Connect the PG 509 PRETRIGGER output to the TRIGGER INPUT on the 11801 through the 42-inch BNC cable and a SMA-to-BNC adaptor.
3. Set the AT 5010 to provide a 10X attenuation (X10 light on) in the signal path and close all appropriate signal paths to connect the signal to CH 1 of the SD-26. Connect the appropriate cable to CH 1 of the SD-26.
4. Push TRIGGER MENU
5. Touch SOURCE. Touch EXTERNAL.
6. Push AUTOSSET. A triggered 5-division waveform should be on screen at this time at 200 ps/div.
7. Set MAIN SIZE to 10 ns. Adjust MAIN POS to center the pulse.
8. Touch VERT Icon.
9. Push WAVEFORM button

10. Touch VERT OFFSET. Touch FINE.
11. Adjust VERT OFFSET to place the left (zero volt) portion of the waveform on a graticule line.
12. CHECK - That the pulse amplitude is 4.9 to 5.1 divisions, excluding the error of the X10 attenuator.
13. Set the front-panel VARIABLE AMPLITUDE control to produce a pulse that is exactly 5 divisions in amplitude.
14. Touch HORIZ Icon. Adjust MAIN POS as needed to keep the rising edge on screen while setting the MAIN SIZE to 5 ns/div.
15. Touch VERT Icon. Touch VERT OFFSET. Touch COARSE. Adjust VERT OFFSET so that the GND pointer is at the bottom graticule line. Set the VERT SIZE to 5 mV/div.
16. Adjust VERT OFFSET and MAIN POS to position the active signal so the first 7 ns overlays the stored waveform.

NOTE

The display will now be showing the top of a stored 50-division signal for reference and the top of a 50-division signal from the PG 509 with the vertical at 5 mV/div and horizontal at 5 ns/div. The vertical sensitivity is 2%/div.

17. CHECK - The PG 509 waveform for deviation from the stored waveform to the specifications listed below:
 - Aberations $\leq +3\%$, -1% for the first 1 ns.
 - Tilt $\leq 2\%$, 1 ns to 40 ns.

Aberation and tilt times are measured from the 50% point of the rising edge.
18. Use MAIN POS and VERT OFFSET to position the active trace on top of the stored reference trace so they overlay 7 ns back from the front corner. As the active trace is tilted, it will not fully overlay past 7 ns.
19. CHECK - That the first 7 ns approximates the character of the stored waveform. The pulse will have an overshoot of about 2% on the very front corner that will not match the stored waveform.
20. Set VERT SIZE to 50 mV/div and VERT OFFSET so the GND arrow is 2 divisions up from the bottom of the graticule.
21. Set MAIN SIZE to 200 ps/div while using MAIN POS to keep the rising edge centered on the screen.
22. Push the MEASURE menu button.

23. Touch MEASUREMENT. Touch RISE and WIDTH icons. Touch EXIT.
24. CHECK - That the rise time is between 300 ps and 400 ps. The 11800 will have trouble resolving the rise time if the pulse on screen is moving relative to the pretrigger pulse. This will be seen as a change in the rise time numbers and horizontal movement on screen. This in no way affects the actual rise time of the PG 509 which will be the number in the center of the extremes of the rise times as measured and displayed by the 11801.
25. Set MAIN SIZE to 10 ns/div.
26. CHECK - That the width is between 42 ns and 46 ns.
27. Push WAVEFORM button
28. Touch ACQUIRE DESC. Touch SET AvgN. Touch EXIT.
29. Adjust AVERAGE N to 2.
30. Adjust MAIN POS to horizontally center the pulse and the VERT OFFSET to adjust the bottom of the pulse to a graticule line.

NOTE

The following portion of the procedure will check the PG 509 circuits that are controlled by signals normally supplied by the AT 5010. Ensure that the AT 5010 is not outputting signals to the PG 509 through the backplane connectors while using this procedure.

31. Connect a wire from chassis GND to the PULSE AMPLITUDE CONTROL input. The output from the PG 509 should cease. Remove the wire.
32. Set the DM501A to the 2 mA range.
33. Connect a lead from the common of the PS503A 0 to -20 volt supply to the PG 509 GND. Connect the Green connector from the PS503A to the DM501A HI connector. Connect a wire in series with a 10 k Ω resistor from the DM501A LO input to the PG 509 AMPLITUDE CONTROL input. Push the PS503A OUTPUT switch to ON.
34. Adjust the output voltage of the PS503A until the DM501A reads -1 mA. Adjust the oscilloscope display for a 5-division display.
35. Adjust the output voltage of the PS503A until the DM501A reads -1.5 mA.
36. CHECK - That the oscilloscope display is approximately 4.75 divisions in amplitude.
37. Adjust the output voltage of the PS503A until the DM501A reads -0.5 mA.

Performance Check Procedures

38. CHECK - That the oscilloscope display is approximately 5.25 divisions in amplitude.
39. Adjust the output voltage of the PS503A until the DM501A reads ≤ 0.4 mA.
40. CHECK - That the oscilloscope display amplitude is now controlled by the front-panel VARIABLE AMPLITUDE control.

ADJUSTMENT PROCEDURES

INTRODUCTION

The information in this section is provided for users who require calibration of their PG 509 Pulse Generator but who may not have access to a Tektronix Field Service or Factory Service Center. The information accessible to Field Offices may be more up to date than contained here. If a large interval of time has passed since purchase of this instrument, contact your nearest Field Office or representative for further information.

infrequently. Before calibration, thoroughly clean and inspect the instrument.

PREPARATION

Test equipment items listed in Table 6-1 are required to perform this procedure. The adjustment locations for the PG 509 are shown in Figure 6-1.

PERFORMANCE CHECK INTERVAL

To ensure instrument accuracy, check the calibration of the PG 509 every 2000 hours of operation, or every one year if used

Table 6-1
Test Equipment Required

Item and Description	Use	Examples of Applicable Test Equipment
1. Test oscilloscope with probe and sampling head	Transient response and amplitude adjustment/verification.	TEKTRONIX 11801 with SD-26 Sampling Head.
2. Power Module	Power plugins.	TEKTRONIX TM 500/5000-Series Power Module.
3. Digital Voltmeter	Amplitude check.	TEKTRONIX DM501A DMM with leads.
4. Extender Cable	Externally power plugins.	TEKTRONIX Extender Cable (part number 067-0645-01).
5. Calibration Generator	Oscilloscope characterization.	TEKTRONIX Calibration Generator (part number 067-1338-00).
6. Programmable Attenuator	Transient response and amplitude adjustment/verification.	TEKTRONIX AT 5010 Programmable Attenuator.
7. SMA 10X Attenuator	All tests.	TEKTRONIX Attenuator (part number 015-1003-00).
8. SMA-to-BNC Adaptors (2 required)	Transient response and amplitude adjustment/verification.	TEKTRONIX Adaptors (part number 015-1018-00).
9. BNC-to-BNC cable	All tests.	TEKTRONIX Cable 42" long (part number 012-0057-00).
10. Semi-rigid SMA-to-SMA cable	Transient response and amplitude adjustment.	TEKTRONIX Cable (part number 015-1015-00).
11. Low Capacitance Adjustment Tool	Transient response and amplitude adjustment/verification.	TEKTRONIX Tool (part number 003-1364-00).
12. Power Supply	Amplitude adjustment/verification.	TEKTRONIX PS 503A Power Supply.
13. 10 k Ω resistor ³	Amplitude adjustment/verification.	TEKTRONI 321-0289-00.

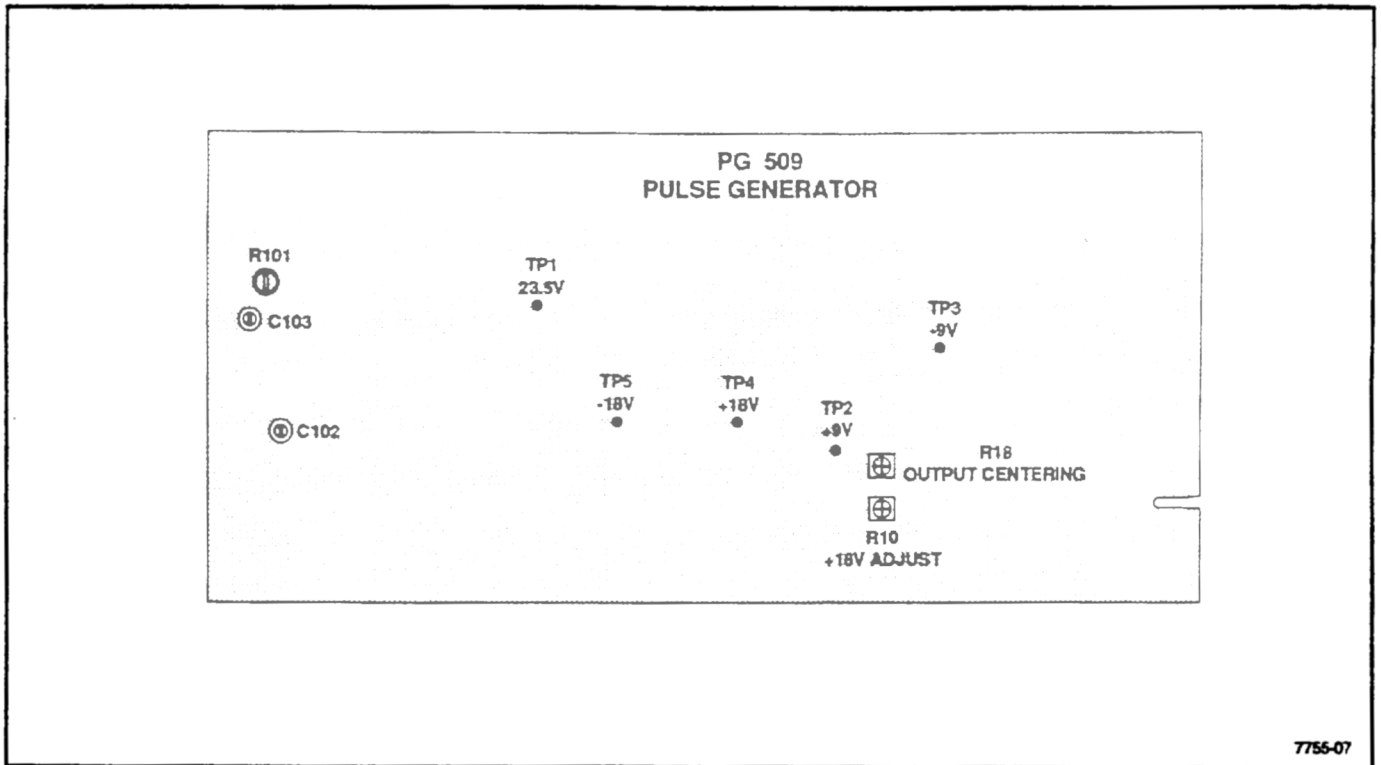


Figure 6-1. PG 509 adjustment locations.

POWER SUPPLY VERIFICATION/ADJUSTMENT



Dangerous voltages are present on the PG 509 board. Only qualified personnel should remove the side covers.

1. Remove the PG 509 right side cover.
2. Connect the DM501A LO probe to board ground.
3. Turn on the power module.
4. Connect the HI lead from a DM501A to the following test points and CHECK that the power supplies are within the limits shown in Table 6-2.
5. If any of the supplies measured in Step 4 are out of tolerance, ADJUST R10 to adjust the +18 V supply to +18.000 and recheck the power supplies.
6. Connect the HI DM501A lead to TP1.

NOTE

The -9 V and -18 V tolerances include the +18 V tolerance of 0.15% as this supply is the reference for them. This supply is adjustable by R10 so this tolerance can be removed if desired. The +9 V supply is Zener referenced and not adjustable.

Table 6-2
Power Supply Verification

Test Point	Power Supply	DMM Reading (V)
TP4	+18 V	+17.975 to +18.025
TP5	-18 V	-17.91 to -18.09
TP2	+9 V	+8.55 to +9.45
TP3	-9 V	-8.93 to -9.065

7. ADJUST the front panel control VARIABLE AMPLITUDE fully clockwise. Note the reading.

Adjustment Procedures

- ADJUST the VARIABLE AMPLITUDE control fully counterclockwise.
- Subtract the second reading from the first and check for a 2.44 V differential (2.39 V to 2.48 V to include tolerances). The nominal voltage at TP1 with R18 centered is 23.4 V, so this represents a range of 10%. This adjustment range can also be observed on an oscilloscope for 5 divisions of signal ± 0.25 division.
- Connect the DM501A HI lead to J25 pin 2 and ADJUST the VARIABLE AMPLITUDE control for zero volts.
- Disconnect all equipment.

- Push WAVEFORM MENU button. Touch SAMPLING HEAD Fnc's. Touch SMOOTHING on. Touch EXIT.
- Touch ACQUIRE DESC. Touch AVERAGE N to on. Touch SET AVGN.
- Adjust AVERAGE N to 8 (upper knob).
- Touch Horizontal Icon.
- Set MAIN SIZE to 5 ns/div. Adjust MAIN POS knob so the rising edge of the pulse is at the second division.
- Touch the Vertical Icon.
- Adjust VERT OFFSET so the GND arrow is at the center division.
- Adjust the VERT SIZE to 5 mV/div.
- Adjust VERT OFFSET so the trace is 3 divisions up from the center of the graticule.
- Push STORE/RECALL menu.
- Touch STORE TRACE. Touch TRACE 1. Touch RECALL TRACE. Touch STO1. Touch the waveform on the screen to make CH 1 active.
- Adjust MAIN POS to see if the waveform has been properly stored.
- Connect the SMA 10X attenuator to the SD-26 input.
- Disconnect the Calibration Generator.

CHARACTERIZATION OF THE 11801 OSCILLOSCOPE



The input sampling bridge diodes in the SD-26 modules are of the very high frequency, low capacitance variety. An electrostatic discharge to the center conductor of the input connector will destroy these diodes. It is highly recommended that this procedure be performed only at a static-free workstation with the operator properly grounded at all times.

- Perform the "Calibrating a Sampling Head" procedure as outlined on page 2-7 of the 11801 Service Manual.

NOTE

The following section will store a 50-division signal at 5 mV/div and 5 ns/div to use as a reference to adjust the PG 509 transient response.

- Connect the Calibration Generator remote head to SD-26 Channel 1 (CH1) and the 11801 INTERNAL CLOCK output to the Calibration Generator TRIGGER INPUT. Push the CH 1 channel select button. Note that the light comes on.
- Push TRIGGER MENU. Touch SOURCE. Touch INTERNAL CLOCK.
- Push AUTO SETUP. A triggered 5-division calibrator waveform should be displayed on the screen at 10 ps/div.

TRANSIENT RESPONSE AND AMPLITUDE VERIFICATION/ADJUSTMENT



The 25-volt pulse from the PG 509 is easily capable of destroying the input sampling bridge diodes. It is strongly recommended that a 10X attenuator be connected to the input at all times.

Remove the PG 509 from the system. Connect the PG 509 to the Power Module via the Extender Cable, and to the AT 5010 through a SMA-to-SMA semi-rigid cable (part number 015-1015-00) that is 4.5 inches long, or a similar cable. The quality and length of the cable is critical to the fidelity of the pulse and the accuracy of the calibration.

1. Connect the SMA X10 attenuator of known accuracy and a SMA-to-BNC adaptor to the CH 1 input of the 11801.
2. Connect the PG 509 PRETRIGGER output to the TRIGGER INPUT on the 11801 through the 42-inch BNC cable and a SMA-to-BNC adaptor.
3. Set the AT 5010 to provide a 10X attenuation (X10 light on) in the signal path and close all appropriate signal paths to connect the appropriate system output cable to CH 1 of the SD-26.
4. Push TRIGGER MENU
5. Touch SOURCE. Touch EXTERNAL.
6. Push AUTOSET. A triggered 5-division waveform should be on screen at this time at 200 ps/div.
7. Set MAIN SIZE to 10 ns. Adjust MAIN POS to center the pulse.
8. Touch VERT icon.
9. Push WAVEFORM button
10. Touch VERT OFFSET. Touch FINE.
11. Adjust VERT OFFSET to place the left (zero volt) portion of the waveform on a graticule line.
12. CHECK - That the pulse amplitude is 4.9 to 5.1 divisions, excluding the error of the X10 attenuator.
13. If the pulse amplitude is within these limits, proceed to Step 16. If adjustment is needed or desired, go to Step 14.

NOTE

Adjust the pulse amplitude by one of two methods. The first method (Step 14) uses the front panel VARIABLE AMPLITUDE control. The second method (step 15) calibrates the entire system.

14. ADJUST - The front-panel VARIABLE AMPLITUDE control to produce a pulse that is exactly 5 divisions in amplitude. Proceed to step 16.
15. ADJUST - The front-panel VARIABLE AMPLITUDE control so the voltage at J25 pin 2 is zero volts. Adjust R18 so the that center of the top of the pulse is exactly five divisions from the zero volt portion. This adjustment will need to be modified by the amount of error in the X10 attenuator.
16. Touch HORIZ icon. Adjust MAIN POS as needed to keep the rising edge on screen while setting the MAIN SIZE to 5 ns/div.
17. Touch VERT icon. Touch VERT OFFSET. Touch COARSE. Adjust VERT OFFSET so that the GND pointer is at the bottom graticule line. Set the VERT SIZE to 5 mV/div.
18. Adjust VERT OFFSET and MAIN POS to position the active signal so the first 7 ns overlays the stored waveform.

NOTE

The display will now be showing the top of a stored 50-division signal for reference and the top of a 50-division signal from the PG 509 with the vertical at 5 mV/div and horizontal at 5 ns/div. The vertical sensitivity is 2%/div.

19. CHECK - The PG 509 waveform for deviation from the stored waveform to the specifications listed below:

Aberrations $\leq +3\%$, -1% for the first 1 ns.
Tilt $\leq 2\%$, 1 ns to 40 ns.

Aberration and tilt times are measured from the 50% point of the rising edge.

If the above criteria is met, go to step 22. Otherwise, continue with this procedure.
20. ADJUST - R101 to nearly fully clockwise and C103 to continue the slope of the top of the waveform.

21. ADJUST - C102 to position the first 1 ns of the waveform as a natural extension of the top of the waveform. At this time the waveform should have an overshoot on the front corner of about 2% that lasts about $1/2 + ns$ followed by an undershoot of about $1/2 + ns$ that lasts about $1/2 + ns$ and then dampen to flat. The top of the pulse should have a linear tilt of about 1%.
22. Use MAIN POS and VERT OFFSET to position the active trace on top of the stored reference trace so they overlay 7 ns back from the front corner. As the active trace is tilted, it will not fully overlay past 7 ns.
23. ADJUST - C103 and R101 so that the first 7 ns approximates the character of the stored waveform. The pulse will have an overshoot of about 2% on the very front corner that will not match the stored waveform. C102 should not need adjustment past Step 21.

NOTE

R101 will probably be near fully counterclockwise.

24. Repeat Steps 19 through 23 as necessary.
25. Set VERT SIZE to 50 mV/div and VERT OFFSET so the GND arrow is 2 divisions up from the bottom of the graticule.
26. Set MAIN SIZE to 200 ps/div while using MAIN POS to keep the rising edge centered on the screen.
27. Push the MEASURE menu button.
28. Touch MEASUREMENT. Touch RISE and WIDTH icons. Touch EXIT.
29. CHECK - That the rise time is between 300 ps and 400 ps. The 11800 will have trouble resolving the rise time if the pulse on screen is moving relative to the pretrigger pulse. This will be seen as a change in the rise time numbers and horizontal movement on screen. This in no way affects the actual rise time of the PG 509 which will be the number in the center of the extremes of the rise times as measured and displayed by the 11801.
30. Set MAIN SIZE to 10 ns/div.
31. CHECK - That the width is between 42 ns and 46 ns.
32. Push WAVEFORM button
33. Touch ACQUIRE DESC. Touch SET AvgN. Touch EXIT.
34. Adjust AVERAGE N to 2.
35. Adjust MAIN POS to horizontally center the pulse and the VERT OFFSET to adjust the bottom of the pulse to a graticule line.

NOTE

The following portion of the procedure will check the PG 509 circuits that are controlled by signals normally supplied by the AT 5010. Ensure that the AT 5010 is not outputting signals to the PG 509 through the backplane connectors while using this procedure.

36. Connect a wire from chassis GND to the PULSE AMPLITUDE CONTROL input. The output from the PG 509 should cease. Remove the wire.
37. Set the DM501A to the 2 mA range.
38. Connect a lead from the common of the PS503A 0 to -20 volt supply to the PG 509 GND. Connect the Green connector from the PS503A to the DM501A HI connector. Connect a wire in series with a 10 k Ω resistor from the DM501A LO input to the PG 509 AMPLITUDE CONTROL input. Push the PS503A OUTPUT switch to ON.
39. Adjust the output voltage of the PS503A until the DM501A reads -1 mA. Adjust the oscilloscope display for a 5-division display.
40. Adjust the output voltage of the PS503A until the DM501A reads -1.5 mA.
41. CHECK - That the oscilloscope display is approximately 4.75 divisions in amplitude.
42. Adjust the output voltage of the PS503A until the DM501A reads -0.5 mA.
43. CHECK - That the oscilloscope display is approximately 5.25 divisions in amplitude.
42. Adjust the output voltage of the PS503A until the DM501A reads ≤ 0.4 mA.
43. CHECK - That the oscilloscope display amplitude is now controlled by the front-panel VARIABLE AMPLITUDE control.

MAINTENANCE AND DIAGNOSTICS

GENERAL MAINTENANCE



There is 200 V present on the circuit board. Only qualified personnel should remove the covers.

Static-Sensitive Components



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 7-1 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:

- Minimize handling of static-sensitive components.
- 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.
- Discharge the static voltage from your body by wearing a wrist strap while handling these components.
- Service static-sensitive assemblies or components only at static-free workstations by qualified service personnel.
- Nothing capable of generating or holding a static charge should be allowed on the work station surface.
- Keep the component leads shorted together whenever possible.

- Pick up components by the body, never by the leads.
- Do not slide the components over any surface.
- Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge.
- Use a soldering iron that is connected to earth ground.
- Use only special antistatic suction type or wick type desoldering tools.

Table 7-1
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.)

Maintenance and Diagnostics

Cleaning

This instrument should be cleaned as often as operating conditions require. Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small brush. Remove dirt that remains with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.



To clean the front panel use freon, isopropyl alcohol, or denatured ethyl alcohol. Do not use petroleum-based cleansing agents. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (approximately 5 lb/in²) or use a soft brush or cloth dampened with a mild detergent and water solution.

Hold the board so the cleaning residue runs away from the connectors. Do not scrape or use an eraser to clean the edge connector contacts. Abrasive cleaning can remove the gold plating.



Circuit boards and components must be dry before applying power.

Obtaining Replacement Parts

Electrical and mechanical parts can be obtained through your local Tektronix Field Office or representative. However, it may be possible to obtain many of the standard electronic components from a local commercial source. Before purchasing or ordering a part from a source other than Tektronix, Inc., check the Replaceable Electrical Parts list for the proper value, rating, tolerance, and description.

NOTE

When selecting replacement parts, remember that the physical size and shape of a component may affect its performance in the instrument.

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 instrument have been manufactured by Tektronix, Inc. To determine the manufacturer, refer to the Replaceable Parts List and the Cross Reference Index, Mfr. Code Number to Manufacturer.

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

1. Instrument type and option number.
2. Instrument serial number.
3. A description of the part (if electrical, include complete circuit number).
4. Tektronix part number.

Soldering Techniques

A rectangular box with a solid border containing the word "WARNING" in bold, uppercase letters.

WARNING

To avoid electric-shock hazard, disconnect the instrument from the power source before soldering.

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts. General soldering techniques which apply to maintenance of any precision electronic equipment should be used when working on this instrument. Use only 60/40 rosin-core, electronic grade solder. The choice of soldering iron is determined by the repair to be made.



All circuit boards in the instrument are multilayer-type boards with a conductive path laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to this conductive path. Only experienced maintenance personnel should attempt to repair these boards.

When soldering on circuit boards or small wiring, use only a 15-watt, pencil type soldering iron. A higher wattage soldering iron can cause the etched circuit wiring to separate from the board base material and melt the insulation from small wiring. Always keep the soldering iron tip properly tinned to ensure the best heat transfer to the solder joint. Apply only enough heat to remove the component or to make a good solder joint. To protect heat sensitive components, hold the component lead with a pair of long-nose pliers between the component body and the solder joint. Use a solder removing wick to remove excess solder from connections or to clean circuit board pads.

Integrated Circuits

To remove in-line integrated circuits use an extracting tool. This tool is available from Tektronix, Inc.; order Tektronix Part Number 003-0619-00. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the pins. Pull slowly and evenly on both ends of the integrated circuit. Try to avoid disengaging one end before the other end.

Multipin Connectors

The pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the wires. To replace damaged multipin connectors, remove the old pin connector from the holder. Do this by inserting a scribe between the connector and the holder and prying the connector from the holder. Clamp the replacement connector to the wire. Reinstall the connector in the holder.

If the individual end lead pin connectors are removed from the plastic holder, note the order of the individual wires for correct replacement in the holder. For proper replacement, see Figure 7-1.

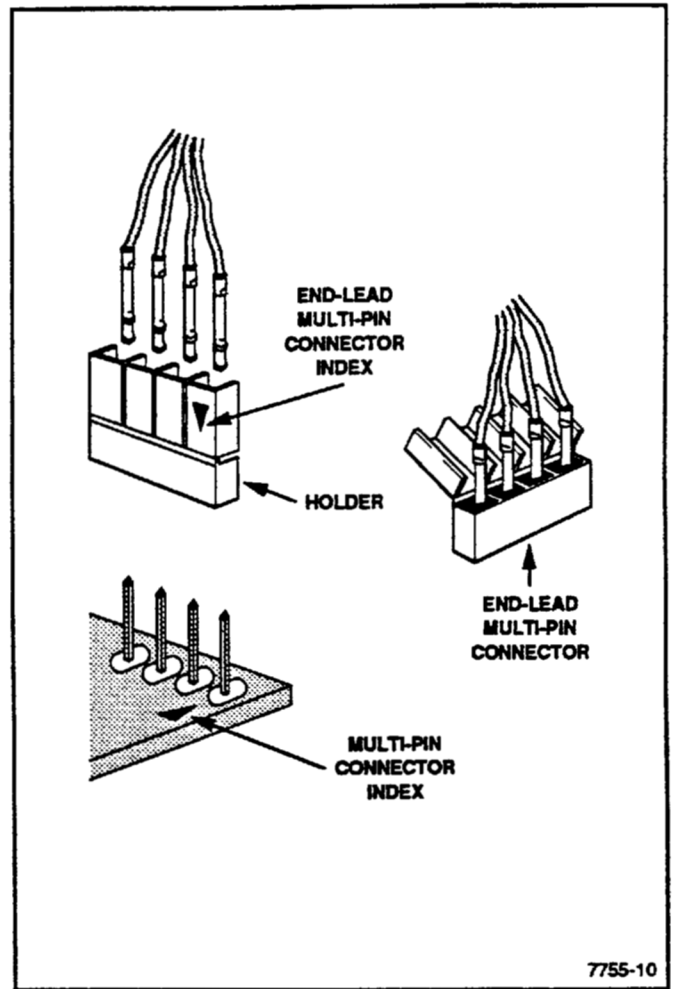


Figure 7-1. Orientation and disassembly of multipin connectors.

CIRCUIT BOARD REMOVAL AND INSTALLATION

SIDE COVERS

Before the Main board can be removed, the side covers must first be removed from the sides of the instrument chassis. Turn the side cover quarter turn fasteners, then lift the covers slightly and separate them from the notch at the rear of instrument.

MAIN BOARD

To remove the Main board from the instrument, perform these steps:

1. Disconnect the 2 multi-pin connectors from near the front of the Main board. Then disconnect the Peltola connector near the bottom-front of the Main board.
2. Remove the semi-rigid coax cable (left side of instrument) with a 5/16-inch open end wrench.

3. Remove the rear panel by removing the two guide pin fasteners at the bottom of the panel and two screws at the top of the panel. Use a 3/16-inch wrench on the guide pin fasteners.
4. Remove 4 screws connecting the Main board to the instrument chassis.
5. Lift the Main board forward and out of the instrument chassis.

To reinsert the Main board into the chassis, perform the reverse of the preceding steps.



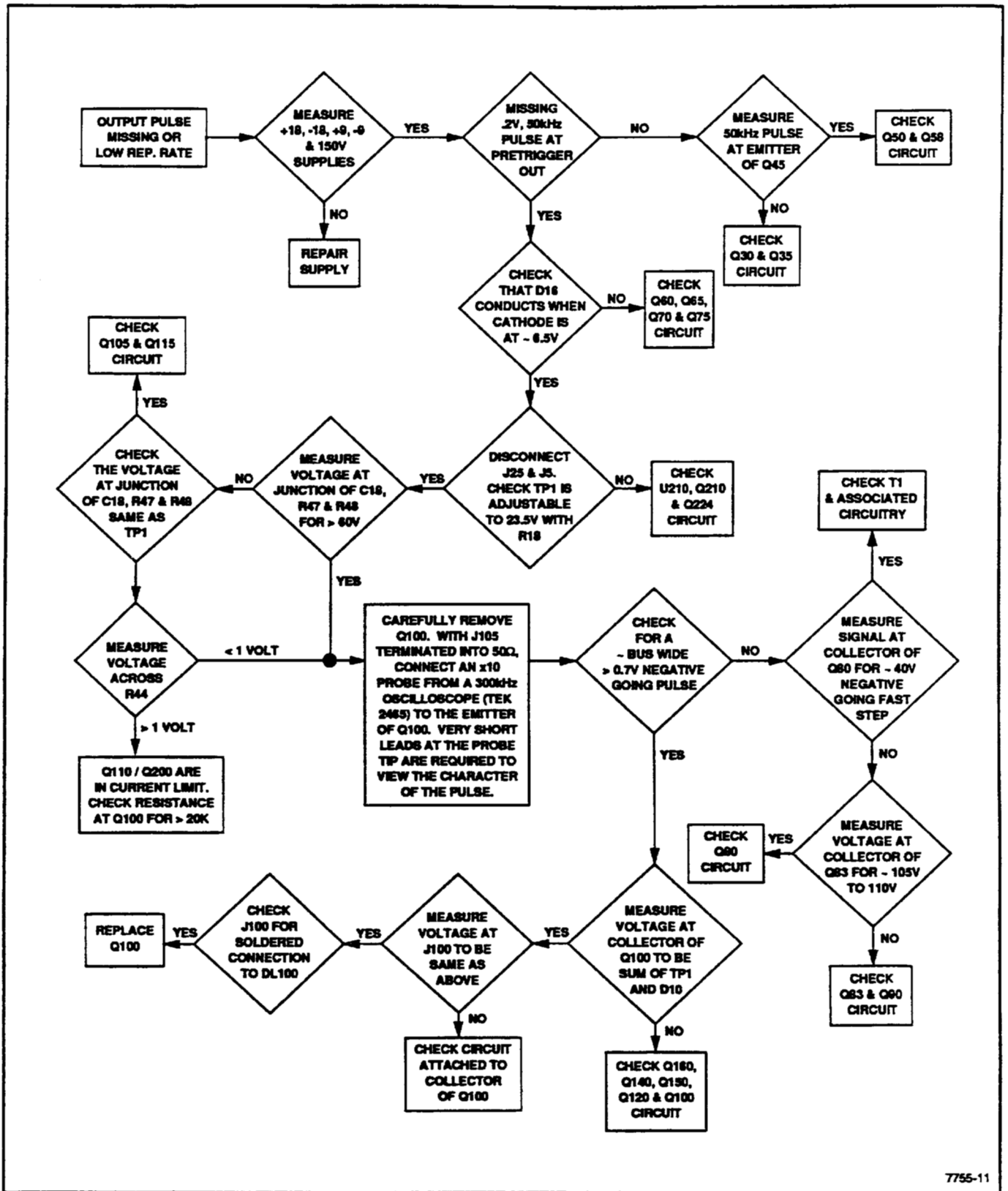
Use extreme care when extracting the circuit board as many of its components may touch the frame of the instrument.

TROUBLESHOOTING

Troubleshooting the Main board is straightforward. Review *Theory of Operation* for an understanding of the circuit operation. Completing the Performance Check procedures in this manual may aid the diagnostic procedure.

Figure 7-2 provides a troubleshooting tree for most likely service problem encounters. For power supply problems, refer to the

TM 500 or TM 5000 Instruction Manuals. For unresolved or parts replacement problems, refer to the nearest Tektronix, Inc. Sales and Service Office (check at the back of your Tektronix Product Catalog).



7755-11

Figure 7-2. Troubleshooting Flowchart.

OPTIONS

No options are available.

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.

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

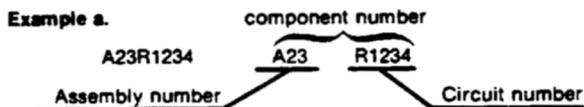
The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

ABBREVIATIONS

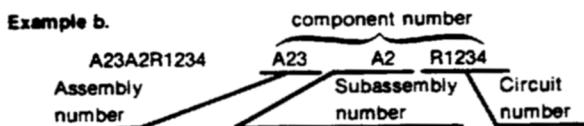
Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:



Read: Resistor 1234 of Assembly 23



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

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.

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
01121	ALLEN-BRADLEY CO	1201 S 2ND ST	MILWAUKEE WI 53204-2410
01295	TEXAS INSTRUMENTS INC SEMICONDUCTOR GROUP	13500 N CENTRAL EXPY PO BOX 655012	DALLAS TX 75265
03508	GENERAL ELECTRIC CO SEMI-CONDUCTOR PRODUCTS DEPT	W GENESEE ST	AUBURN NY 13021
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008-4229
05397	UNION CARBIDE CORP MATERIALS SYSTEMS DIV	11901 MADISON AVE	CLEVELAND OH 44101
05828	GENERAL INSTRUMENT CORP GOVERNMENT SYSTEMS DIV	600 W JOHN ST	HICKSVILLE NY 11802
07263	FAIRCHILD SEMICONDUCTOR CORP NORTH AMERICAN SALES SUB OF SCHLUMBERGER LTD MS 118	10400 RIDGEVIEW CT	CUPERTINO CA 95014
12969	UNITRODE CORP	5 FORBES RD	LEXINGTON MA 02173-7305
14433	ITT SEMICONDUCTORS DIV		WEST PALM BEACH FL
14552	MICROSEMI CORP	2830 S FAIRVIEW ST	SANTA ANA CA 92704-5948
19396	ILLINOIS TOOL WORKS INC PAKTRON DIV	1205 MCCONVILLE RD PO BOX 4539	LYNCHBURG VA 24502-4535
19701	MEPCO/CENTRALAB A NORTH AMERICAN PHILIPS CO MINERAL WELLS AIRPORT	PO BOX 760	MINERAL WELLS TX 76067-0760
22526	DU PONT E I DE NEMOURS AND CO INC DU PONT CONNECTOR SYSTEMS DIV MILITARY PRODUCTS GROUP	515 FISHING CREEK RD	NEW CUMBERLAND PA 17070-3007
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
51406	MURATA ERIE NORTH AMERICA INC HEADQUARTERS AND GEORGIA OPERATIONS	2200 LAKE PARK DR	SMYRNA GA 30080
56289	SPRAGUE ELECTRIC CO WORLD HEADQUARTERS	92 HAYDEN AVE	LEXINGTON MA 02173-7929
57668	ROHM CORP	8 WHATNEY PO BOX 19515	IRVINE CA 92713
73138	BECKMAN INDUSTRIAL CORP BECKMAN ELECTRONIC TECHNOLOGIES SUB OF EMERSON ELECTRIC	4141 PALM ST	FULLERTON CA 92635
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
91637	DALE ELECTRONICS INC	2064 12TH AVE PO BOX 609	COLUMBUS NE 68601-3632
TK1450	TOKYO COSMOS ELECTRIC CO LTD	2-268 SOBUDAI ZAWA	KANAGAWA 228 JAPAN

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscort	Name & Description	Mfr. Code	Mfr. Part No.
A6	671-0628-00		CIRCUIT BD ASSY:PULSE GEN	80009	671-0628-00
A6C1	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C2	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C3	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C4	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A6C5	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C6	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C7	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A6C8	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C10	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C11	290-1238-00		CAP,FXD,ELCTLT:68PF,250VDC	80009	290-1238-00
A6C12	290-1238-00		CAP,FXD,ELCTLT:68PF,250VDC	80009	290-1238-00
A6C13	281-0788-00		CAP,FXD,CER DI:470PF,10%,100V	04222	SA102C471KAA
A6C14	281-0788-00		CAP,FXD,CER DI:470PF,10%,100V	04222	SA102C471KAA
A6C15	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A6C16	281-0797-00		CAP,FXD,CER DI:15PF,10%,100V	04222	SA106A150KAA
A6C17	281-0814-00		CAP,FXD,CER DI:100 PF,10%,100V	04222	MA101A101KAA
A6C18	283-0208-00		CAP,FXD,CER DI:0.22UF,10%,200V	04222	SR502C224KAA
A6C20	281-0814-00		CAP,FXD,CER DI:100 PF,10%,100V	04222	MA101A101KAA
A6C21	281-0814-00		CAP,FXD,CER DI:100 PF,10%,100V	04222	MA101A101KAA
A6C22	281-0788-00		CAP,FXD,CER DI:470PF,10%,100V	04222	SA102C471KAA
A6C23	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C24	290-0517-00		CAP,FXD,ELCTLT:6.8UF,20%,35V	05397	T3688685M035AZ
A6C25	281-0797-00		CAP,FXD,CER DI:15PF,10%,100V	04222	SA106A150KAA
A6C26	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C27	281-0797-00		CAP,FXD,CER DI:15PF,10%,100V	04222	SA106A150KAA
A6C28	285-0598-00		CAP,FXD,PLASTIC:0.01UF,5%,100V	19396	DU490B103J
A6C29	281-0814-00		CAP,FXD,CER DI:100 PF,10%,100V	04222	MA101A101KAA
A6C30	281-0814-00		CAP,FXD,CER DI:100 PF,10%,100V	04222	MA101A101KAA
A6C31	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C32	290-0517-00		CAP,FXD,ELCTLT:6.8UF,20%,35V	05397	T3688685M035AZ
A6C100	281-0893-00		CAP,FXD,CER DI:4.7PF,+/-0.5PF,100V	04222	MA101A4R7DAA
A6C102	281-0151-00		CAP,VAR,CER DI:1-3PF,100V	51406	DVJ5126
A6C103	281-0151-00		CAP,VAR,CER DI:1-3PF,100V	51406	DVJ5126
A6C115	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A6C190	290-0517-00		CAP,FXD,ELCTLT:6.8UF,20%,35V	05397	T3688685M035AZ
A6C192	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C200	290-0517-00		CAP,FXD,ELCTLT:6.8UF,20%,35V	05397	T3688685M035AZ
A6C201	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C202	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A6C211	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A6C220	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C222	281-0775-00		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C226	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A6CR3	152-0066-00		SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
A6CR5	152-0066-00		SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
A6CR6	152-0107-00		SEMICON DVC,DI:RECT,SI,400 V,400MA,A1	12969	"G727"
A6CR7	152-0107-00		SEMICON DVC,DI:RECT,SI,400 V,400MA,A1	12969	"G727"
A6CR11	152-0323-00		SEMICON DVC,DI:SW,SI,35V,0.1A,DO-7	14433	WG1518
A6CR12	152-0323-01		SEMICON DVC,DI:SW,SI,50V,25PA AT 20V,20PF	14552	MT5127
A6CR13	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR14	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR15	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR16	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR17	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR18	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR19	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR20	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)

Replaceable Electrical Parts

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Discort	Name & Description	Mfr. Code	Mfr. Part No.
A6CR21	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR22	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR23	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR203	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR203	152-0323-00			SEMICON DVC,DI:SW,SI,35V,0.1A,DO-7	14433	WG1518
A6CR211	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR212	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR240	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR241	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR242	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6CR243	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A6F1	159-0159-00			FUSE,WIRE LEAD:1.5A,125V,5 SEC	75915	25501.5
A6F2	159-0159-00			FUSE,WIRE LEAD:1.5A,125V,5 SEC	75915	25501.5
A6F3	159-0159-00			FUSE,WIRE LEAD:1.5A,125V,5 SEC	75915	25501.5
A6J5	131-1425-00			CONN,RCPT,ELEC:RTANG HEADER,1 X 36,0.1 SP (2 LOCATIONS)	22526	65521-136
A6J25	131-1425-00			CONN,RCPT,ELEC:RTANG HEADER,1 X 36,0.1 SP (3 LOCATIONS)	22526	65521-136
A6J55	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A6J105	131-0663-00			CONN,RCPT,ELEC:3MM CKT BD MT	24931	39JR162-1
A6Q10	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q20	151-0188-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A6Q30	151-0188-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A6Q35	151-0188-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A6Q40	151-0188-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A6Q45	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q50	151-0369-00			TRANSISTOR:PMP,SI,X-55	04713	SPS8273
A6Q58	151-0369-00			TRANSISTOR:PMP,SI,X-55	04713	SPS8273
A6Q60	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q65	151-0188-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A6Q70	151-0302-00			TRANSISTOR:NPN,SI,TO-18	04713	ST899
A6Q75	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q80	151-0302-00			TRANSISTOR:NPN,SI,TO-18	04713	ST899
A6Q83	151-0350-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0350-00
A6Q90	151-0347-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0347-00
A6Q100				PART NUMBER TO BE DETERMINED		
A6Q105	151-0347-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0347-00
A6Q110	151-0311-01			TRANSISTOR:NPN,SI,TO-126	04713	SJE908
A6Q115	151-0350-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0350-00
A6Q120	151-0350-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0350-00
A6Q130	151-0347-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0347-00
A6Q140	151-0347-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0347-00
A6Q150	151-0347-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0347-00
A6Q160	151-1041-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	04713	SFD1041
A6Q190	151-0188-00			TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A6Q200	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q201	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q210	151-0347-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0347-00
A6Q220	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q221	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q223	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A6Q224	151-1041-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	04713	SFD1041
A6R1	322-3218-00			RES,FXD,FILM:1.82K OHM,1%,0.2W,TC=TO	57668	CRB20 FXE 1K82
A6R2	322-3097-00			RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO	57668	CRB20 FXE 100E
A6R3	307-0104-00			RES,FXD,CMPSM:3.3 OHM,5%,0.25W	01121	CB3365
A6R4	322-3218-00			RES,FXD,FILM:1.82K OHM,1%,0.2W,TC=TO	57668	CRB20 FXE 1K82
A6R5	322-3306-00			RES,FXD,FILM:15K OHM,1%,0.2W,TC=TO	57668	CRB20 FXE 15K0
A6R6	322-3193-00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO	57668	CRB20 FXE 1K00

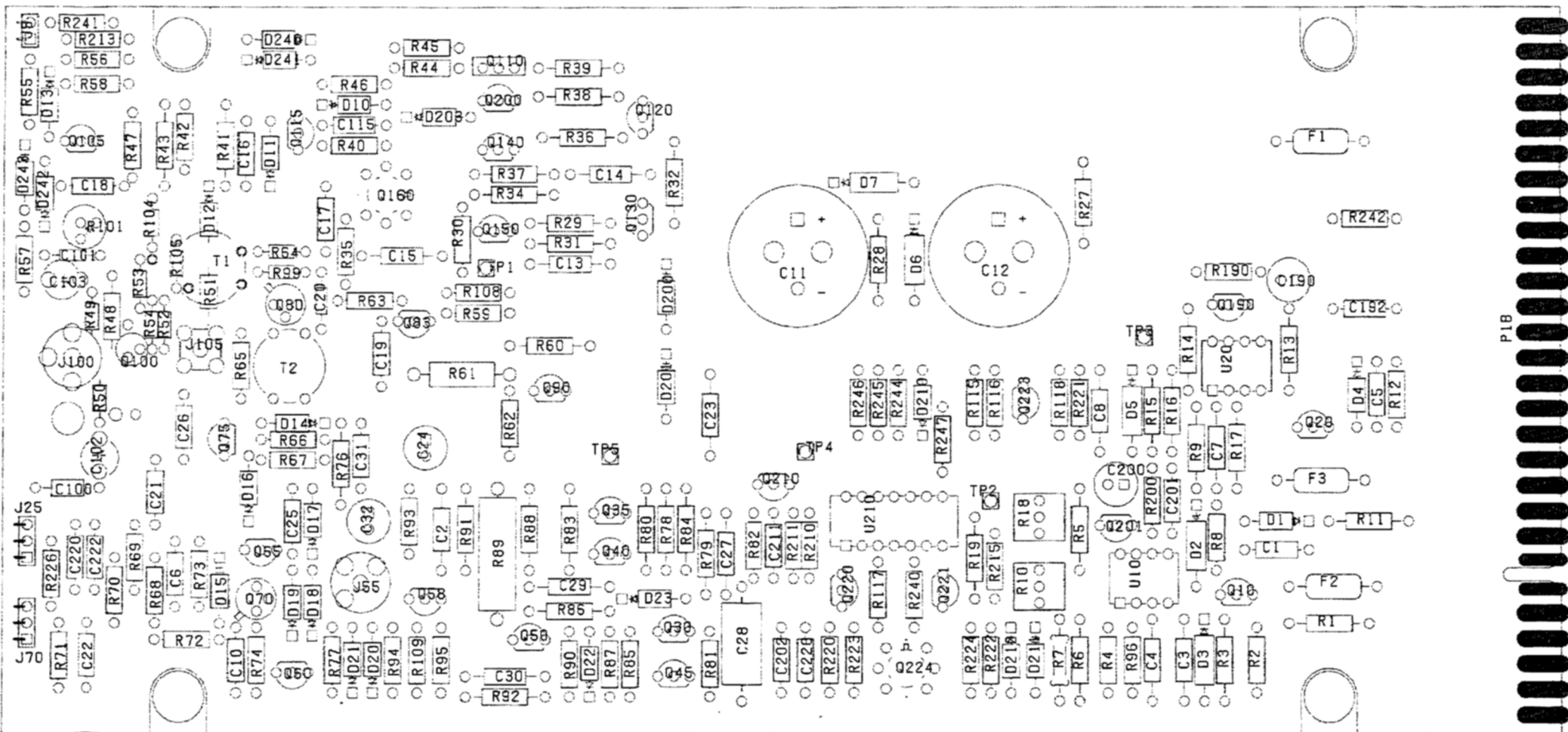
Component No.	Tektronix	Serial/Assembly No.		Name & Description	Mfr.	Mfr. Part No.
	Part No.	Effective	Discort		Code	
A6R7	322-3306-00			RES, FXD, FILM: 15K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 15K0
A6R8	322-3193-00			RES, FXD, FILM: 1K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K00
A6R9	321-0603-07			RES, FXD, FILM: 15K OHM, 0.1%, 0.125W, TC=T9	19701	5033RE15K00B
A6R10	311-2236-00			RES, VAR, NONMW: TRMR, 20K OHM, 20%, 0.5W LINEAR	TK1450	6F06UT 20K
A6R11	322-3218-00			RES, FXD, FILM: 1.82K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K82
A6R12	322-3097-00			RES, FXD, FILM: 100 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100E
A6R13	307-0104-00			RES, FXD, CMPSN: 3.3 OHM, 5%, 0.25W	01121	CB33G5
A6R14	322-3218-00			RES, FXD, FILM: 1.82K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K82
A6R15	321-0603-07			RES, FXD, FILM: 15K OHM, 0.1%, 0.125W, TC=T9	19701	5033RE15K00B
A6R16	321-0603-07			RES, FXD, FILM: 15K OHM, 0.1%, 0.125W, TC=T9	19701	5033RE15K00B
A6R17	321-0816-07			RES, FXD, FILM: 5K OHM, 0.1%, 0.125W, TC=T9	19701	5033RE5K000B
A6R18	311-2236-00			RES, VAR, NONMW: TRMR, 20K OHM, 20%, 0.5W LINEAR	TK1450	6F06UT 20K
A6R19	322-3481-00			RES, FXD, FILM: 1M OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1M00
A6R27	322-3450-00			RES, FXD, FILM: 475K OHM, 1%, 0.2W, TC=TO	91637	CCF50164753F
A6R28	322-3450-00			RES, FXD, FILM: 475K OHM, 1%, 0.2W, TC=TO	91637	CCF50164753F
A6R29	322-3289-00			RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R30	322-3289-00			RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R31	322-3289-00			RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R32	322-3450-00			RES, FXD, FILM: 475K OHM, 1%, 0.2W, TC=TO	91637	CCF50164753F
A6R34	322-3289-00			RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R35	322-3354-00			RES, FXD, FILM: 47.5K OHM, 1%, 0.2W, TC=TO	80009	322-3354-00
A6R36	322-3193-00			RES, FXD, FILM: 1K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K00
A6R37	322-3243-00			RES, FXD, FILM: 3.32K OHM, 1%, 0.2W, TC=TO	80009	322-3243-00
A6R38	322-3289-00			RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R39	322-3481-00			RES, FXD, FILM: 1M OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1M00
A6R40	322-3354-00			RES, FXD, FILM: 47.5K OHM, 1%, 0.2W, TC=TO	80009	322-3354-00
A6R41	321-0983-00			RES, FXD, FILM: 4.5 MEG OHM, 1%, 0.125W, TC=TO	91637	CMF55116-645003F
A6R42	322-3243-00			RES, FXD, FILM: 3.32K OHM, 1%, 0.2W, TC=TO	80009	322-3243-00
A6R43	322-3481-00			RES, FXD, FILM: 1M OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1M00
A6R44	322-3097-00			RES, FXD, FILM: 100 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100E
A6R45	322-3385-00			RES, FXD, FILM: 100K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100K
A6R46	322-3450-00			RES, FXD, FILM: 475K OHM, 1%, 0.2W, TC=TO	91637	CCF50164753F
A6R47	322-3097-00			RES, FXD, FILM: 100 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100E
A6R48	315-0472-03			RES, FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
A6R49	322-3148-00			RES, FXD, FILM: 340 OHM, 1%, 0.2W, TC=TO	80009	322-3148-00
A6R50	322-3105-00			RES, FXD, FILM: 121 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 121E
A6R51	317-0222-00			RES, FXD, CMPSN: 2.2K OHM, 5%, 0.125W	01121	BB2225
A6R52	322-3162-00			RES, FXD, FILM: 475 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 475E
A6R53	322-3162-00			RES, FXD, FILM: 475 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 475E
A6R54	322-3069-00			RES, FXD, FILM: 51.1 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 51E1
A6R55	322-3289-00			RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R56	322-3450-00			RES, FXD, FILM: 475K OHM, 1%, 0.2W, TC=TO	91637	CCF50164753F
A6R57	322-3354-00			RES, FXD, FILM: 47.5K OHM, 1%, 0.2W, TC=TO	80009	322-3354-00
A6R58	322-3281-00			RES, FXD, FILM: 8.25K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 8K25
A6R59	322-3273-00			RES, FXD, FILM: 6.81K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 6K81
A6R60	322-3289-00			RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R61	301-0683-00			RES, FXD, FILM: 68K OHM, 5%, 0.5W	19701	5053CX68K00J
A6R62	322-3289-00			RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R63	315-0472-03			RES, FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
A6R64	322-3069-00			RES, FXD, FILM: 51.1 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 51E1
A6R65	315-0202-02			RES, FXD, CMPSN: 2K OHM, 5%, 0.25W	01121	CB2025
A6R66	322-3154-00			RES, FXD, FILM: 392 OHM, 1%, 0.2W, TC=TO	57668	RB20FX392E
A6R67	322-3354-00			RES, FXD, FILM: 47.5K OHM, 1%, 0.2W, TC=TO	80009	322-3354-00
A6R68	322-3097-00			RES, FXD, FILM: 100 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100E
A6R69	322-3169-00			RES, FXD, FILM: 562 OHM, 1%, 0.2W, TC=TO	91637	CCF-50-5620-F
A6R70	322-3281-00			RES, FXD, FILM: 8.25K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 8K25
A6R71	322-3193-00			RES, FXD, FILM: 1K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K00
A6R72	322-3162-00			RES, FXD, FILM: 475 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 475E

Replaceable Electrical Parts

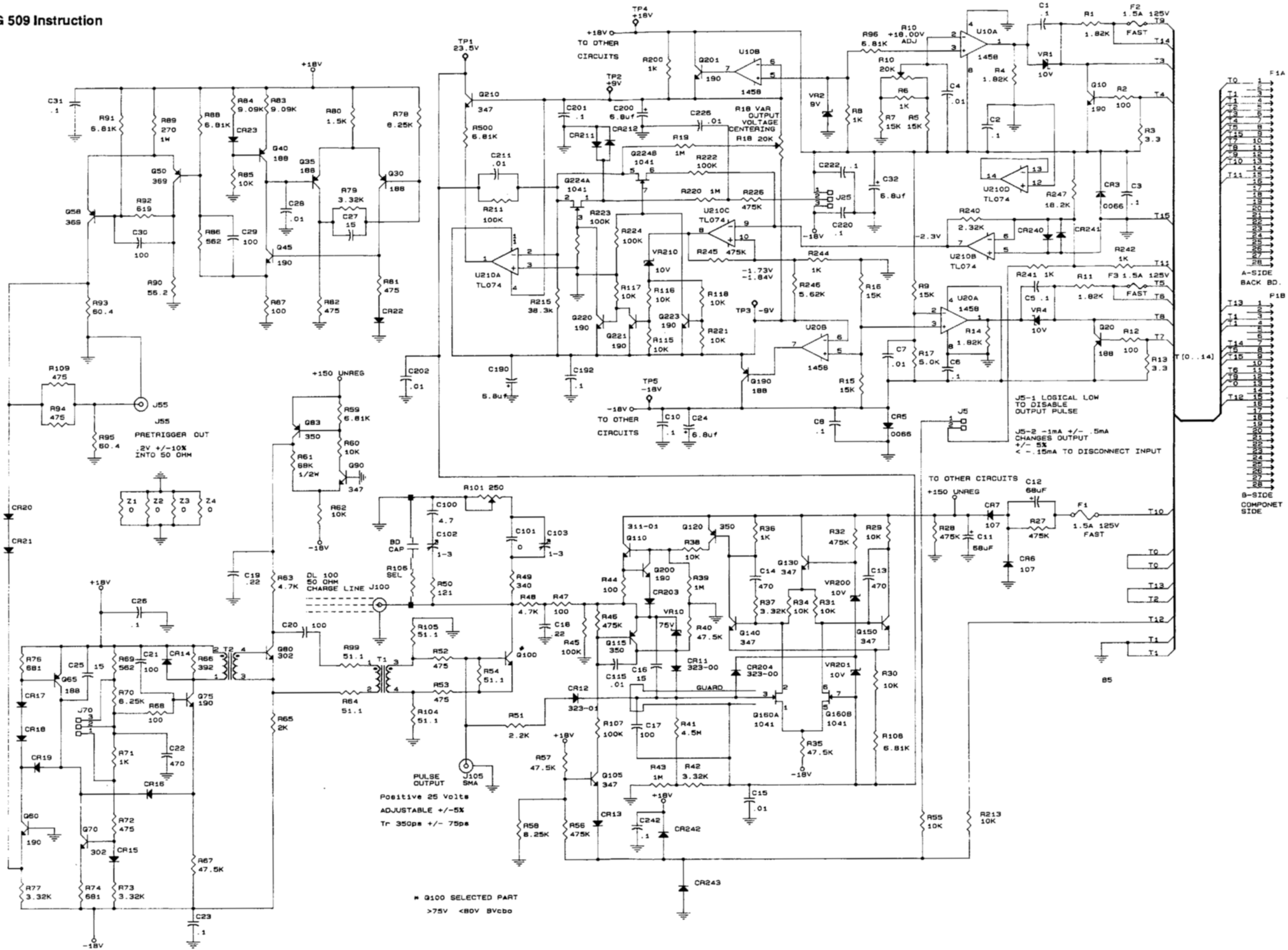
Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discort	Name & Description	Mfr. Code	Mfr. Part No.
A6R73	322-3243-00		RES, FXD, FILM: 3.32K OHM, 1%, 0.2W, TC=TO	80009	322-3243-00
A6R74	322-3177-00		RES, FXD, FILM: 681 OHM, 1%, 0.2W, TC=TO	91637	CCF50-26681R0F
A6R76	322-3177-00		RES, FXD, FILM: 681 OHM, 1%, 0.2W, TC=TO	91637	CCF50-26681R0F
A6R77	322-3243-00		RES, FXD, FILM: 3.32K OHM, 1%, 0.2W, TC=TO	80009	322-3243-00
A6R78	322-3281-00		RES, FXD, FILM: 8.25K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 8K25
A6R79	322-3243-00		RES, FXD, FILM: 3.32K OHM, 1%, 0.2W, TC=TO	80009	322-3243-00
A6R80	322-3210-00		RES, FXD, FILM: 1.5K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K50
A6R81	322-3162-00		RES, FXD, FILM: 475 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 475E
A6R82	322-3162-00		RES, FXD, FILM: 475 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 475E
A6R83	322-3285-00		RES, FXD, FILM: 9.09K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 9K09
A6R84	322-3285-00		RES, FXD, FILM: 9.09K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 9K09
A6R85	322-3289-00		RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R86	322-3169-00		RES, FXD, FILM: 562 OHM, 1%, 0.2W, TC=TO	91637	CCF-50-5620-F
A6R87	322-3097-00		RES, FXD, FILM: 100 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100E
A6R88	322-3273-00		RES, FXD, FILM: 6.81K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 6K81
A6R89	303-0271-00		RES, FXD, CMPSM: 270 OHM, 5%, 1W	01121	6B2715
A6R90	322-3073-00		RES, FXD, FILM: 56.2 OHM, 1%, 0.2W, TC=TO	80009	322-3073-00
A6R91	322-3273-00		RES, FXD, FILM: 6.81K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 6K81
A6R92	322-3173-00		RES, FXD, FILM: 619 OHM, 1%, 0.2W, TC=TO	80009	322-3173-00
A6R93	321-0076-00		RES, FXD, FILM: 60.4 OHM, 1%, 0.125W, TC=TO	91637	CMF55116G0R40F
A6R94	322-3162-00		RES, FXD, FILM: 475 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 475E
A6R95	321-0076-00		RES, FXD, FILM: 60.4 OHM, 1%, 0.125W, TC=TO	91637	CMF55116G0R40F
A6R96	322-3273-00		RES, FXD, FILM: 6.81K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 6K81
A6R99	322-3069-00		RES, FXD, FILM: 51.1 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 51E1
A6R101	311-0978-00		RES, VAR, NONMW: TRMR, 250 OHM, 0.5W	73138	82PR250-37C
A6R104	322-3069-00		RES, FXD, FILM: 51.1 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 51E1
A6R105	322-3069-00		RES, FXD, FILM: 51.1 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 51E1
A6R107	322-3385-00		RES, FXD, FILM: 100K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100K
A6R108	322-3273-00		RES, FXD, FILM: 6.81K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 6K81
A6R109	322-3162-00		RES, FXD, FILM: 475 OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 475E
A6R115	322-3289-00		RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R116	322-3289-00		RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R117	322-3289-00		RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R118	322-3289-00		RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R190	322-3193-00		RES, FXD, FILM: 1K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K00
A6R210	322-3273-00		RES, FXD, FILM: 6.81K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 6K81
A6R211	322-3385-00		RES, FXD, FILM: 100K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100K
A6R213	322-3289-00		RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R215	321-0345-00		RES, FXD, FILM: 38.3K OHM, 1%, 0.125W, TC=TO	19701	5043ED38K30F
A6R220	322-3481-00		RES, FXD, FILM: 1M OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1M00
A6R221	322-3289-00		RES, FXD, FILM: 10K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 10K0
A6R222	322-3385-00		RES, FXD, FILM: 100K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100K
A6R223	322-3385-00		RES, FXD, FILM: 100K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100K
A6R224	322-3385-00		RES, FXD, FILM: 100K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 100K
A6R226	322-3450-00		RES, FXD, FILM: 475K OHM, 1%, 0.2W, TC=TO	91637	CCF50164753F
A6R240	322-3228-00		RES, FXD, FILM: 2.32K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 2K32
A6R241	322-3193-00		RES, FXD, FILM: 1K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K00
A6R242	322-3193-00		RES, FXD, FILM: 1K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K00
A6R244	322-3193-00		RES, FXD, FILM: 1K OHM, 1%, 0.2W, TC=TO	57668	CRB20 FXE 1K00
A6R245	322-3450-00		RES, FXD, FILM: 475K OHM, 1%, 0.2W, TC=TO	91637	CCF50164753F
A6R246	322-3265-00		RES, FXD, FILM: 5.62K OHM, 1%, 0.2W, TC=TO	80009	322-3265-00
A6R247	322-3314-00		RES, FXD, FILM: 18.2K OHM, 1%, 0.2W, TC=TO	80009	322-3314-00
A6T1	120-0544-00		XFMR, TOROID:	80009	120-0544-00
A6T2	120-0550-00		XFMR, TOROID:	80009	120-0550-00
A6U10	156-0158-00		MICROCKT, LINEAR: BIPOLAR, DUAL OPNL AMPL	04713	MC1458P1/MC1458U
A6U20	156-0158-00		MICROCKT, LINEAR: BIPOLAR, DUAL OPNL AMPL	04713	MC1458P1/MC1458U
A6U210	156-1200-00		MICROCKT, LINEAR: BIFET, QUAD OPNL AMPL	01295	TL074CN
A6VR1	152-0149-00		SEMICOND DVC, DI: ZEN, S1, 10V, 5%, 0.4W, DO-7	04713	1N961B

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Discont	Name & Description	Mfr. Code	Mfr. Part No.
A6VR2	152-0212-00			SEMICOND DVC,DI:ZEN,SI,9V,5%,0.5W,DO-7	04713	SZ50646RL
A6VR4	152-0149-00			SEMICOND DVC,DI:ZEN,SI,10V,5%,0.4W,DO-7	04713	1N961B
A6VR10	152-0580-00			SEMICOND DVC,DI:ZEN,SI,75V,2%,0.4W,DO-7	04713	SZ14358RL
A6VR200	152-0149-00			SEMICOND DVC,DI:ZEN,SI,10V,5%,0.4W,DO-7	04713	1N961B
A6VR201	152-0149-00			SEMICOND DVC,DI:ZEN,SI,10V,5%,0.4W,DO-7	04713	1N961B
A6VR210	152-0149-00			SEMICOND DVC,DI:ZEN,SI,10V,5%,0.4W,DO-7	04713	1N961B

DIAGRAMS



Main board.



PULSE OUTPUT
J105 SMA

Positive 25 Volts
ADJUSTABLE +/-5%
Tr 350ps +/- 75ps

* Q100 SELECTED PART
>75V <80V BVcdo

J5-1 LOGICAL LOW
TO DISABLE
OUTPUT PULSE

J5-2 -1mA +/- .5mA
CHANGES OUTPUT
+/- 5%
< -15mA TO DISCONNECT INPUT

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.

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.

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

END ATTACHING PARTS

Detail Part of Assembly and/or Component

Attaching parts for Detail Part

END ATTACHING PARTS

Parts of Detail Part

Attaching parts for Parts of Detail Part

END ATTACHING PARTS

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.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

Abbreviations conform to American National Standards Institute Y1.1

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
12697	CLAROSTAT MFG CO INC	LOWER WASHINGTON ST	DOVER NH 03820
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
26805	M/A-COM OMNI SPECTRA INC MICROWAVE CONNECTOR DIV SUB OF M/A-COM INC	140 4TH AVE	WALTHAM MA 02154-7507
71279	INTERCONNECTION PRODUCTS INC	2601 S GARNSEY ST	SANTA ANA CA 92707-3338
77900	ILLINOIS TOOL WORKS SHAKEPROOF DIV	ST CHARLES RD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
83385	MICRODOT MFG INC GREER-CENTRAL DIV	3221 W BIG BEAVER RD	TROY MI 48098
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181
TK1326	NORTHWEST FOURSIDE INC	18224 SW 100TH CT	TUALATIN OR 97062
TK1465	BEAVERTON PARTS MFG CO	1800 NW 216TH AVE	HILLSBORO OR 97124-6629
TK2278	COMTEK MANUFACTURING OF OREGON (METALS)	PO BOX 4200	BEAVERTON OR 97076-4200

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345 Name & Description	Mfr.	
		Effective	Discont			Code	Mfr. Part No.
1-	105-0865-00			1	BAR, LATCH RLSE:	80009	105-0865-00
	105-0866-00			1	LATCH, RETAINING: SAFETY	80009	105-0866-00
	105-0932-00			1	LATCH, PANEL: SIDE	80009	105-0932-00
	119-3682-00			1	CHARGE LINE AS: PG509	80009	119-3682-00
	119-3749-00			1	CABLE, COAXIAL: SEMI RIGID, 2.5 L W/RTANG	80009	119-3749-00
	131-0850-00			1	CONN, FEEDTHRU: 3MM FEMALE EA END	26805	2084-5059-02
	131-1315-01			1	CONN, RCPT, ELEC: BNC, FEMALE	80009	131-1315-01
	131-4920-00			1	CONN, RCPT, ELEC: COPPER CHARGE LINE	80009	131-4920-00
	136-0387-00			2	JACK, TIP: U/W 0.04 DIA PIN, GRAY	71279	4504352010318
	175-5597-00			1	CABLE ASSY, RF: 50 OHM COAX, 6.5 L, 9-0	80009	175-5597-00
	175-5813-01			1	CA ASSY, SP, ELEC: 2, 26 AWG, 6.5 L, RIBBON	80009	175-5813-01
	175-7571-00			1	CA ASSY, SP, ELEC: 3, 26 AWG, 4.5 L, RIBBON	80009	175-7571-00
	210-0046-00			1	WASHER, LOCK: 0.261 ID, INTL, 0.018 THK, STL	77900	1214-05-00-0541C
	211-0101-00			3	SCREW, MACHINE: 4-40 X 0.25, FLH, 100 DEG, STL	93907	ORDER BY DESCR
	211-0114-00			1	SCREW, MACHINE: 4-40 X 0.438, FLH, 100 DEG, STL	83385	ORDER BY DESCR
	213-0146-00			4	SCREW, TPG, TF: 6-20 X 0.312, TYPE B, PNH, STL	83385	ORDER BY DESCR
	213-0793-00			2	SCREW, TPG, TF: 6-32 X 0.4375, TAPTITE, FILH	83486	239-006-406043
	214-3143-00			1	SPRING, HLEXT: 0.125 OD X 0.545 L, XLOOP	80009	214-3143-00
	214-3364-00			1	FASTENER, LATCH: ACETAL, SIL GRAY	80009	214-3364-00
	214-3406-00			1	SPRING, FLAT: 1.48 L X 0.125 W, CU BE	TK1326	ORDER BY DESCR
	220-0510-00			1	NUT, PLAIN, HEX: 0.25 X 0.312 HEX, AL	80009	220-0510-00
	220-0787-00			1	NUT, PLAIN, HEX: 0.25-36 X 0.312 HEX, SST	24931	HN109-10
	311-0170-00			1	RES, VAR, NONMW: PNL, 20K OHM, 0.5W	12697	381-0M26546
	333-3765-00			1	PANEL, FRONT:	80009	333-3765-00
	337-3039-00			2	SHIELD, ELEC: SIDE	TK2278	ORDER BY DESCR
	337-3627-00			1	SHIELD, ELEC: SUBPANEL, PG509	80009	337-3627-00
	342-0900-00			1	INSULATOR: FIBER, CHARGE LINE, PG509	80009	342-0900-00
	358-0342-00			1	BSHG, MACH THD: 0.25-32 X 0.159 ID, AL ANDZ	80009	358-0342-00
	366-1851-00			1	KNOB, LATCH: SIL GY, 0.625 X 0.25 X 1.09	80009	366-1851-00
	386-3657-01			2	SUPPORT, PLUG-IN:	80009	386-3657-01
	386-4910-00			1	SUPPORT, FRAME: REAR	80009	386-4910-00
	386-5985-00			1	SUBPANEL, FRONT:	80009	386-5985-00
	407-3905-00			2	BRACKET, MTG: 0.25 X 0.5, ALUMINUM	TK1465	ORDER BY DESCR
	426-0724-25			1	FR SECT, PLUG-IN: BOTTOM	80009	426-0724-25
	426-0725-24			1	FR SECT, PLUG-IN: TOP	80009	426-0725-24