

TEKTRONIX
PG 502

TEKTRONIX®

PG 502

250 MHz

PULSE GENERATOR

FOR REFERENCE PURPOSES ONLY

INSTRUCTION MANUAL

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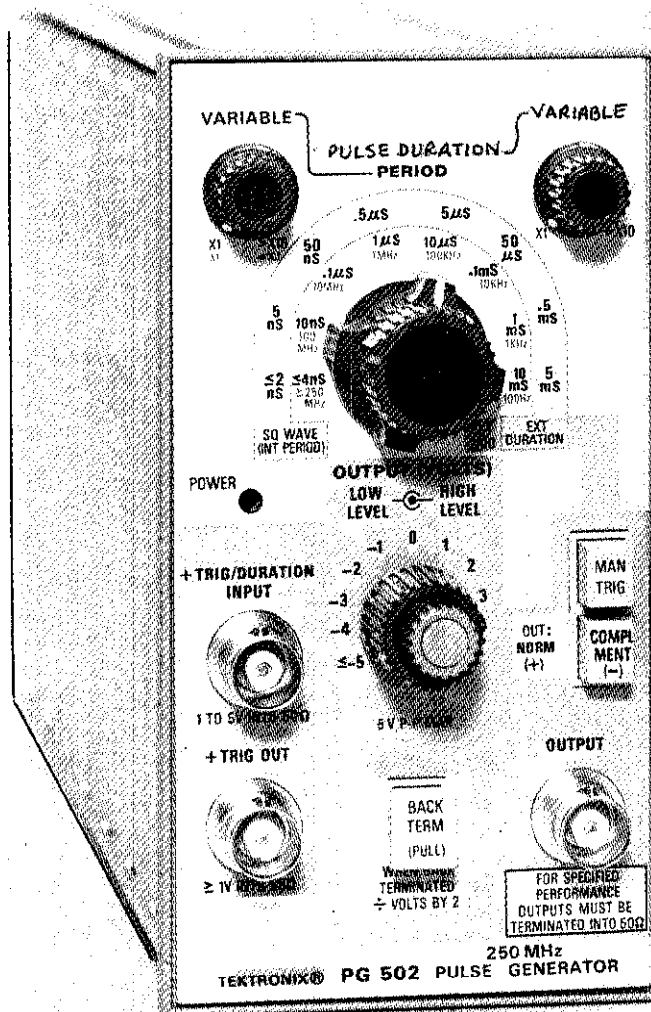
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OPERATING INSTRUCTIONS

INTRODUCTION

Instrument Description

The PG 502 is a 250 MHz general purpose pulse generator for use in the TM 500 series power modules. Major capabilities of this instrument include high repetition rate, narrow pulse width, fast risetime, and independent pulse top and bottom level controls. Front panel controls provide manual trigger, square wave output, and complementary pulse output for high duty factors.

A selectable 50 Ω back termination in the pulse output circuitry is also provided. All other inputs and outputs are internally terminated in 50 Ω .

Triggers preceding the output pulse are available at the front panel. The pulse output may also be externally triggered.

The front panel is color coded for easy reference to controls and their associated functions. Orange denotes pulse duration controls and settings; green, triggering functions; and yellow is used for an operating caution note. Alpha-numerics done in red are the frequency equivalents for the pulse period settings.

Installation and Removal

The PG 502 is calibrated and ready for use when received. It operates in any compartment of a TM 500 series power module. See the power module instruction manual for line voltage requirements and power module operation. Fig. 1-1 shows the installation and removal procedure. Check that the PG 502 is fully inserted in the power module. Pull the power switch on the power module. The POWER light on the PG 502 front panel should now be on. Refer to the Controls and Adjustments foldout page in Section 3 of this manual, for a complete description of the front panel controls.

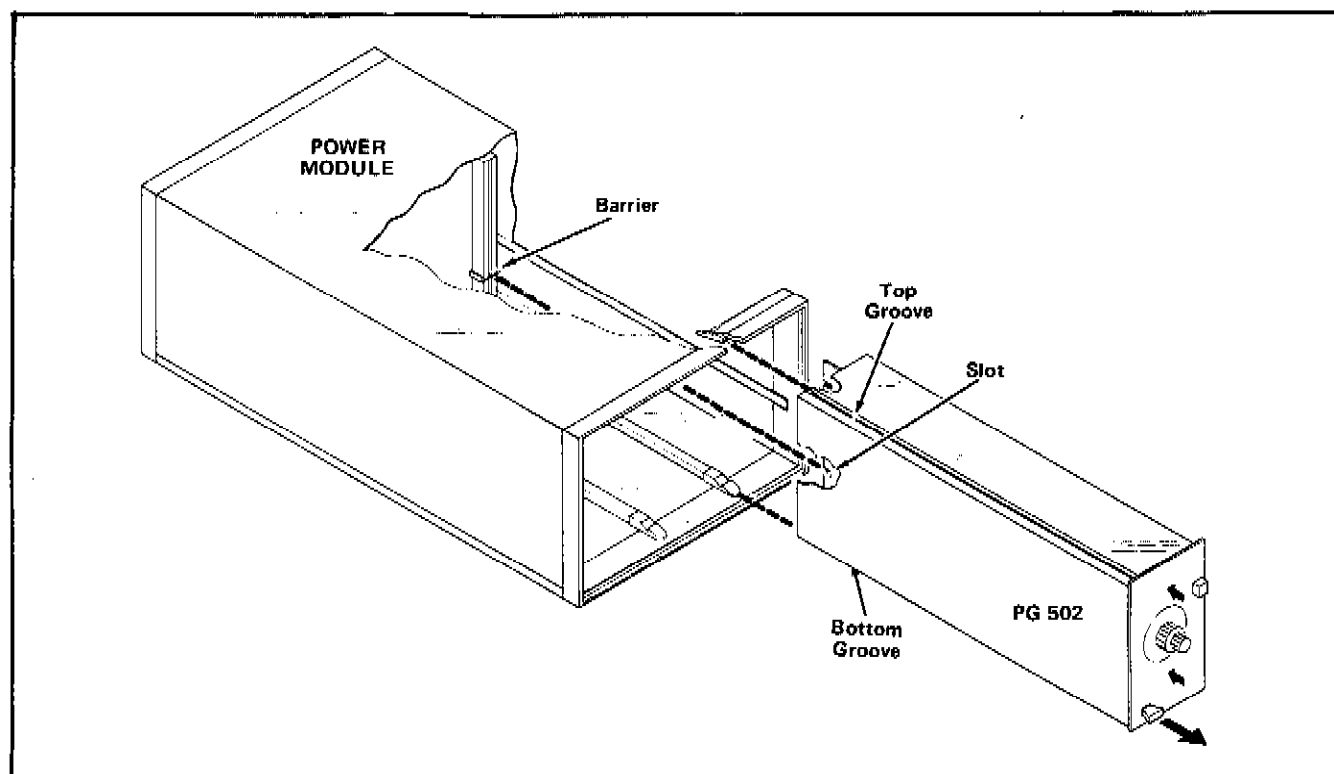


Fig. 1-1. PG 502 Installation and Removal.

OPERATING CONSIDERATIONS

Output Terminations and Connections

The output of the PG 502 operates as a 100 mA current source. It is designed to operate into an external 50 Ω load. An unterminated or improperly terminated output causes aberrations on the output pulse (see Impedance Matching). Loads less than 50 Ω reduce the pulse amplitude. Loads greater than 50 Ω increase the amplitude. An external 50 Ω load also provides a DC return path for the output current.

A selectable 50 Ω back termination is provided [pull the button labeled BACK TERM (PULL) on the front panel]. The back termination also helps to absorb reflections. The output voltage is divided by two when using the back termination. The back termination provides the DC return path for the output when driving high impedance or capacitively-coupled loads. If the output of the PG 502 drives a high impedance load using the back termination, the output voltage is limited to approximately ± 5 V.

A DC current in the 50 Ω output load causes the output pulse to be offset. Do not apply voltages greater than plus or minus 5 V to the output of the PG 502. If the load has a DC voltage across it greater than the maximum allowed, connect a blocking capacitor in series with the OUTPUT connector and the load. Use the back termination to provide a DC return path for the output current. Make certain the time constant of the capacitor and the load is large enough to maintain pulse flatness. The output circuitry of the PG 502 is fully protected against any voltage transients in the output resulting from passive loads.

Under certain conditions, it is possible to operate the PG 502 into a high impedance load without using the internal termination. Pulse amplitudes up to about 18 V (-9 V to $+9$ V) can be obtained in this manner with load impedances in excess of 180 Ω . The PG 502 is not specified when operating in this mode. To use the instrument in this manner, view the output with an oscilloscope while adjusting the OUTPUT (VOLTS) controls for the desired waveform.

Maintaining Pulse Fidelity

Due to the extremely fast pulse risetimes obtained from the PG 502, special consideration must be given to preservation of pulse fidelity. Even at low repetition rates, 1 GHz frequency components are present in the output waveform. Use high quality coaxial cables, attenuators, and terminations.

RG 58 type coaxial cable and typical BNC connectors exhibit impedance tolerances which may cause visible

reflections. For maximum fidelity, use the special three foot long 50 Ω coaxial cable with special BNC connectors supplied as a standard accessory (Tektronix Part No. 012-0482-00). Use the internal back termination whenever possible.

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

Make certain the attenuators and terminations used can safely handle the maximum PG 502 power output of 0.5 Watts.

When making connections that are not in a 50 Ω environment, keep all lead lengths short, 1/4 inch or less. Accessory filters to increase risetimes and reduce the need for high quality attenuators and terminations are available. See your Tektronix Representative for more information.

Impedance Matching

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

A simple resistive minimum attenuation impedance-matching network that can be used to match the PG 502 output into relatively low impedances is shown in Fig. 1-2. To match impedances with the illustrated network, the following conditions must exist:

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

and

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

Therefore:

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

or

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

and

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

For example; to match a 50Ω system to a 125Ω system, Z_1 equals 50Ω and Z_2 equals 125Ω .

Therefore:

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

and

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

Though the network in Fig. 1-2 provides minimum attenuation, for a purely resistive impedance-matching device, the attenuation as seen from one does not equal that seen from the other end. A signal (E_1), applied from the lower impedance source, encounters a voltage attenuation (A_1) which is greater than 1 and less than 2, as follows:

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

A signal (E_2) applied from the higher impedance source (Z_2) encounters a greater voltage attenuation (A_2) which is greater than 1 and less than $2(Z_2/Z_1)$:

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

In the example of matching 50Ω to 125Ω ,

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

and

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

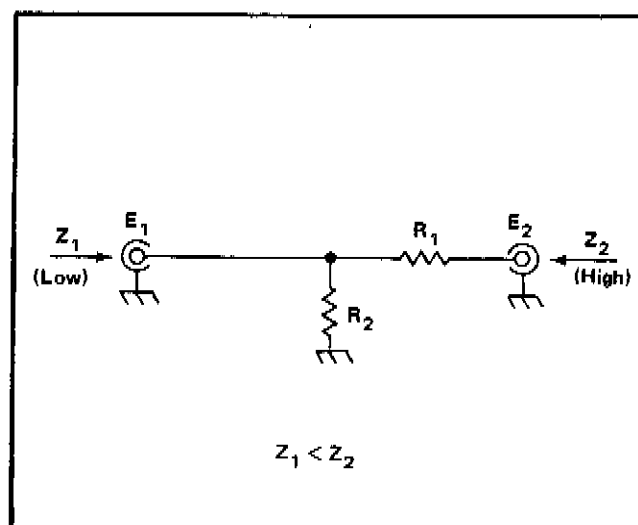


Fig. 1-2. Impedance matching network that provides minimum attenuation.

The illustrated network can be modified to provide different attenuation ratios by adding another resistor (less than R_1) between Z_1 and the junction of R_1 and R_2 .

When constructing such a device, the environment surrounding the components should also be designed to provide smooth transition between the impedances. Acceptable performance can be obtained with discrete components using short lead lengths; however, a full coaxial environment is preferred.

The characteristic impedance of a coaxial device is determined by the ratio between the outside diameter of the inner conductor to the inside diameter of the outer conductor expressed as:

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

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

Further information on attenuator design may be found in Reference Data For Radio Engineers, Fifth Edition, Howard W. Sams & Co. Inc., New York, N.Y., Chapt. 10, or other suitable reference work.

Consider carefully the effects of impedance mismatches or discontinuities in transmission lines and terminations. Short lengths of wire exhibit inductance causing pulse aberrations. Use 50Ω environments or, if this is impossible, keep all lead lengths as short as possible ($1/4$ inch or shorter).

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If the PG 502 is driving the 1 MΩ capacitively-shunted vertical input of an oscilloscope, connect a 50 Ω termination to the oscilloscope input. Connect the coaxial cable from the PG 502 to a 50 Ω 10X attenuator, and connect the attenuator to the termination. The attenuator isolates the input capacity, providing an improved termination for the cable. Another method is to back terminate the PG 502 by pulling the BACK TERM (PULL) pushbutton on the front panel, and connecting the coaxial cable to the oscilloscope input through a 50 Ω termination.

Risetime Measurements in Linear Systems

Consider the rise and falltime of associated equipment when measuring the rise or falltime of a linear device. If the risetime of the device under test is at least ten times slower than the combined risetimes of the PG 502, the monitoring oscilloscope, and associated cables, the error introduced will not exceed 1%, and usually may be ignored. If the rise or falltime of the test device is less than ten times slower than the combined risetimes of the testing system, determine the actual risetime of the device under test by using the following formula:

$$R_t = \sqrt{R_1^2 + R_2^2 + R_3^2 + \dots}$$

R_t equals the overall rise or falltime of the entire measurement system and R_1, R_2, R_3 , etc. are the risetimes or falltimes of the individual components comprising the system.

Variable Pulse Delay

Variable pulse delays may be obtained using another PG 502, or other suitable pulse generator. For example, using two PG 502s, push the COMPLEMENT button and, using an oscilloscope, set the OUTPUT (VOLTS) LOW LEVEL control on the delay generator for 0 V. Set the HIGH LEVEL control for +1 V. Some fine tuning of the output levels of this generator may be necessary to achieve 250 MHz operation. Connect the OUTPUT from the delay generator to the +TRIG/DURATION INPUT connector on the output generator. Take the pulse output from the OUTPUT connection on the output generator, and the trigger from the + TRIG OUT connector on the delay generator.

The PERIOD controls on the delay generator now set the period of the output waveform, and the DURATION controls set the delay. The output pulse duration and voltage levels are set by the appropriate controls on the output generator. See Fig. 1-3.

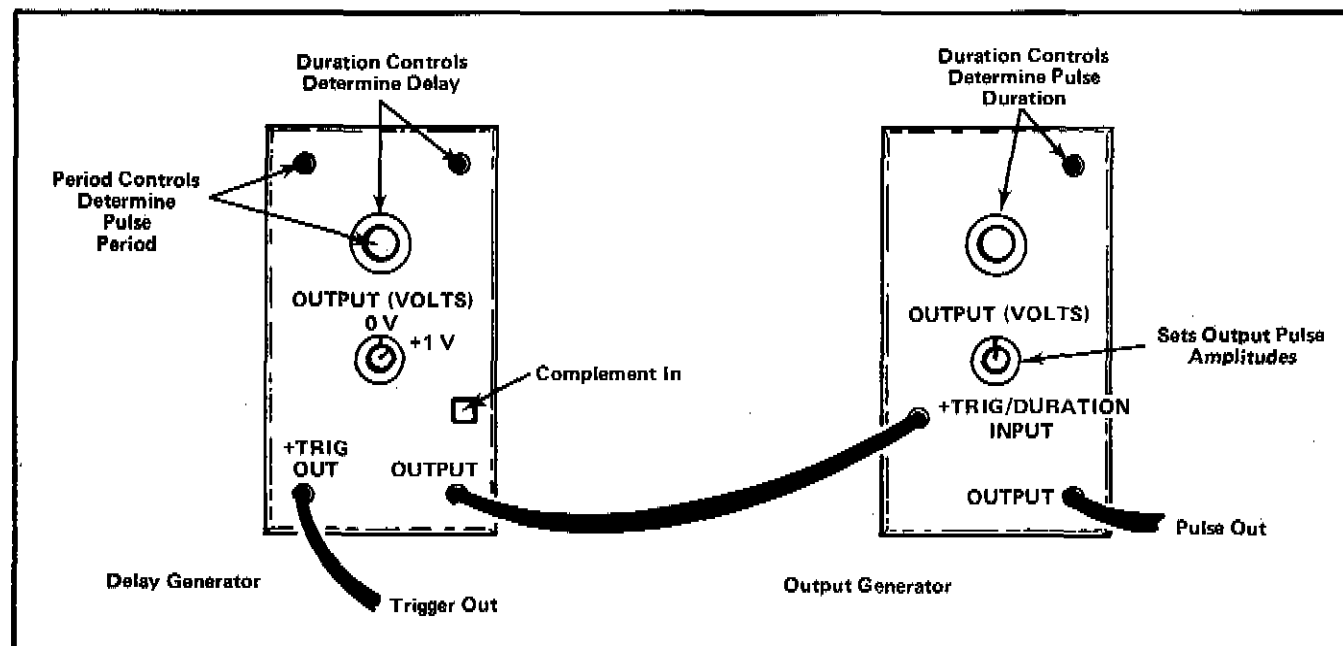


Fig. 1-3. Setup using two PG 502s to obtain Variable Pulse Delay.

OPERATING MODES

Period and Duration Selection

The period generator free runs at the rate set by the PERIOD selector and the PERIOD VARIABLE control in all modes except SQ WAVE and EXT DURATION. The duration of the output pulse is set by the PULSE DURATION selector and its associated PULSE DURATION VARIABLE control. The PERIOD and PULSE DURATION selectors are mechanically coupled, so the duty factor cannot exceed 50% with the VARIABLE controls in the X1 positions. Under most circumstances, duty factors far in excess of the specified 50% may be obtained in the NORM mode using the VARIABLE controls. Excessive duty factor is indicated by any of the following pulse abnormalities: (1) pulse output period in multiples of the trigger output period, and (2) alternate pulses with durations less than the pulse duration setting.

Duty factors approaching 100% may be obtained by switching to the complement mode. Set the PULSE DURATION control for a pulse width equal to the desired pulse off time and push the front panel COMPLEMENT (—) pushbutton.

In the square wave mode, the duration is automatically set to approximately 50% of the period setting.

Output Levels

The output amplitude and offset are selected by independent pulse HIGH LEVEL and pulse LOW LEVEL controls. Use the front panel voltage calibration marks when the load resistance is 50 Ω , and the back termination is not used. The output voltage is one half of the voltage indicated by the dial calibration when the back termination is used. The OUTPUT (VOLTS) controls are interlocked so that it is impossible to set the HIGH LEVEL control more negative than the low level. It is also impossible to set the controls for more than about 5.5 V P-P output amplitude into 50 Ω . Pulse amplitude always equals the pulse high level minus the pulse low level. Offset may be the high level or the low level, whichever is used as the baseline reference level. The flexibility of this method of controlling the output amplitude and offset is useful in certain applications such as logic testing, i.e., either the high or low level can be varied without disturbing the other.

Use of the normal complement function allows interchanging the pulse on-off times without varying the voltage levels.

External Trigger

The period generator is disabled when the PERIOD selector is in the EXT TRIG position. An external positive-going signal applied to the TRIG/DURATION IN connector, triggers the duration generator. The pulse duration of the output pulse varies with the front-panel pulse DURATION selector and VARIABLE control. The period of the output waveform is the period of the triggering signal. See Fig. 1-4. The external trigger signal must remain above the recognition threshold for at least 2 ns. It must also remain below the reset threshold for at least 2 ns to reset the generator for the next trigger.

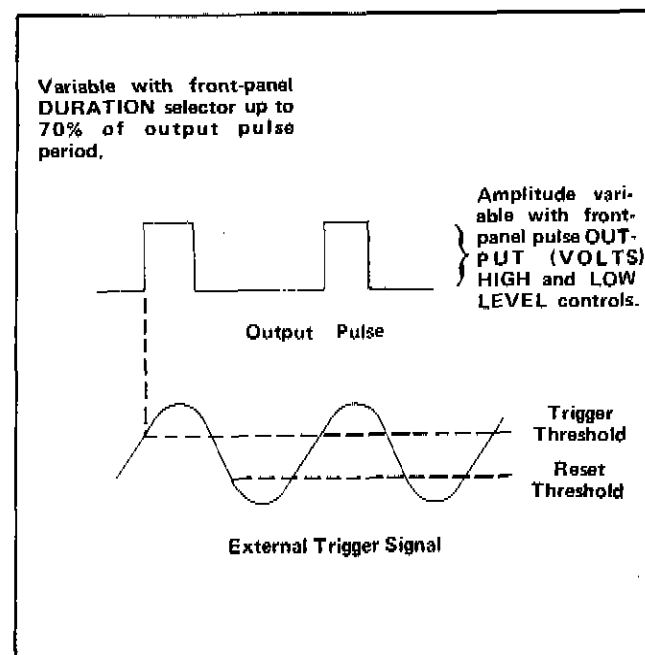


Fig. 1-4. External trigger signal and output pulse in EXT TRIG mode.

A manual trigger is available for single pulse operation. Disconnect any external trigger input when not in use.

External Duration

The period generator and duration generator are disabled when the DURATION selector is in the EXT DURATION position. A voltage exceeding the recognition level applied to the TRIG/DURATION INPUT connector will activate the output of the PG 502. The period and duration of the output will depend on the period and duration of the externally-applied voltage. See Fig. 1-5. When operating in this mode, the output of the PG 502 is activated as long as the MAN TRIG pushbutton is depressed.

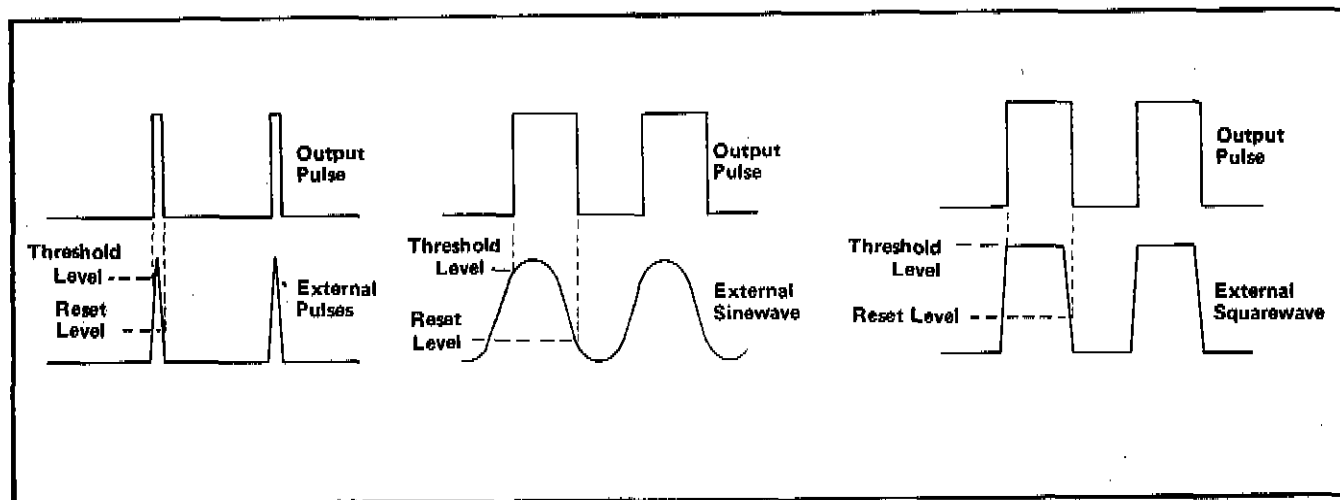


Fig. 1-5. External gating signals and output pulses in EXT DURATION mode.

FUNCTIONS AVAILABLE AT REAR CONNECTOR

Refer to the rear connector assignment illustration in the Service Section at the rear of this manual for suggested pin assignments. These connections are not factory wired.

To obtain a trigger out signal complementary to the front panel trigger out pulse, connect one end of a coaxial cable to the pads on the Timing Board marked Internal Trig Out. Connect the other end to appropriate pins as shown in the illustration. Connections made to the Internal Trig Out pads do not interfere with the front panel + TRIG OUT signals. A one-half volt signal into 50 Ω is available at the Internal Trig Out pads.

To obtain the + TRIG OUT signal at the rear interface connector, disconnect the coaxial cable from the front panel + TRIG OUT connector and the coaxial connector labeled Trig Out on the Timing Board. Replace this cable with another 50 Ω cable about ten inches long, with a similar coaxial connector on one end. Solder the other end to the holes located as shown in the illustration.

To obtain Trigger/Duration input capabilities at the rear interface connector, remove the coaxial cable from the front panel connector and the coaxial connector on the Timing Board. Use a new piece of coax about ten inches long with suitable connection. Solder the free end of this cable to the rear interface pads located as shown in the illustration.

Remember, when planning to use the rear interface connectors, pulse fidelity may be disturbed due to the impedance mismatch the signals are subjected to in passing through the connectors.

A slot between pins 23 and 24 on the rear connector identifies the PG 502 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 should specialized connections be made to that compartment. Consult the *Building A System* section of the power module manual for further information.

DEFINITIONS OF PULSE CHARACTERISTICS

The following is a glossary of common pulse characteristics used in this manual. They are illustrated in Fig. 1-6.

Amplitude. The maximum absolute peak value of a pulse measured from the baseline regardless of sign, and

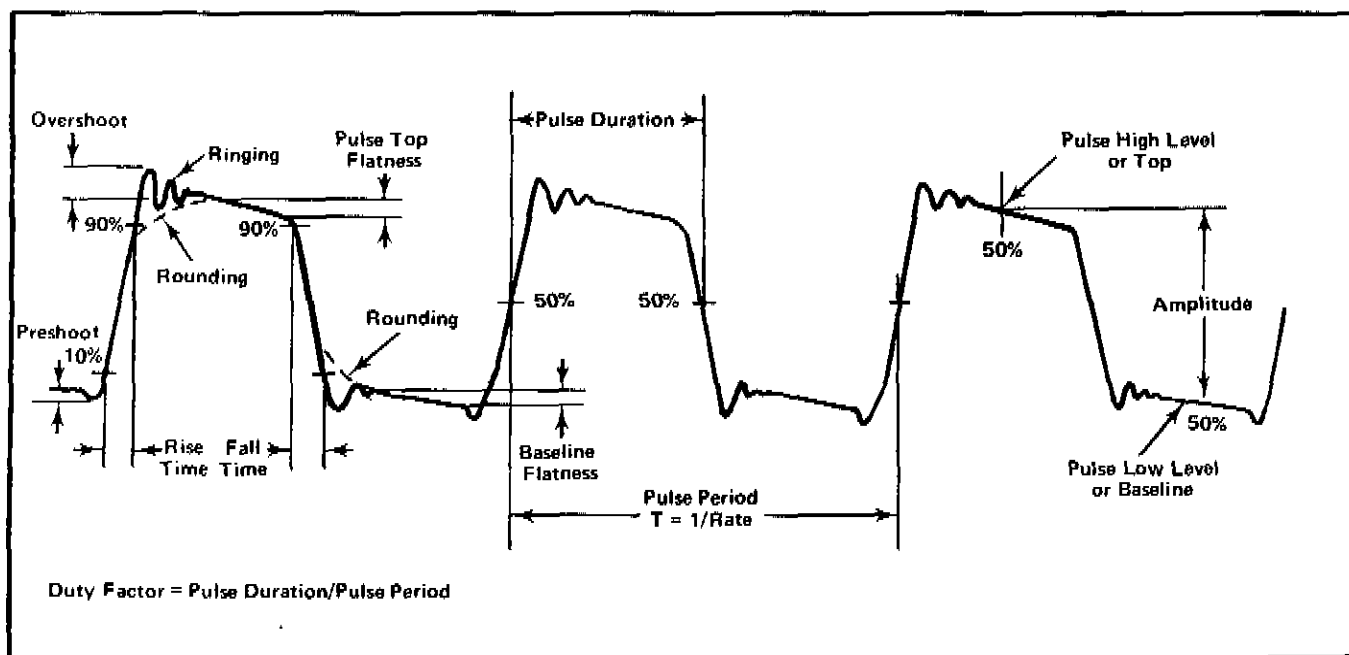


Fig. 1-6. Pulse characteristics.

excluding unwanted aberrations or overshoot. Measurement points are at 50% of the pulse duration time (pulse high level) and on the baseline (pulse low level) at 50% of the off time (the pulse period minus the pulse duration).

Aberrations. 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.

Complementary Pulse. Normal pulse with high and low levels interchanged. Pulse on-time becomes pulse off-time.

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 in % = Duration/Period X 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.

High Level. The most positive value of a pulse, regardless of unwanted aberrations or overshoot, measured at a point that is located at 50% of the pulse duration.

Low Level. The most negative value of a pulse, regardless of unwanted aberrations or overshoot, measured at a point that is at 50% of the off time.

Offset. A DC potential of either polarity applied to the waveform to bias the baseline to an amplitude other than zero.

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

Period. The time interval for a full pulse cycle, inverse of frequency or repetition rate, or the 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.

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.

Operating Instructions—PG 502

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

Ring. 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 the 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).

SPECIFICATIONS

Performance Conditions

The electrical characteristics are valid only if the PG 502 is calibrated at an ambient temperature between +20°C and +30°C and operated between 0°C and +50°C. Specifications apply only with 50 Ω output load impedances.

PERIOD:

Range: ≤ 4 ns, 10 ns to 10 ms in decade steps. Variable control allows overlap on all ranges and extends period to ≥ 100 ms.

Accuracy: 5% in calibrated positions, from 10 ns to 1 ms, 15% on 10 ms range.

Jitter: $\leq 0.1\% + 50$ ps.

TRIGGER IN:

Amplitude: Trigger threshold ≤ 1 V, reset threshold ≥ 0.1 V maximum input 5 V DC + peak AC. Derate to 2 V P-P @ 250 MHz.

TRIGGER OUT:

Amplitude: ≥ 1 V into 50 Ω .

DELAY:

Fixed: ≈ 10 ns from trigger out to pulse out.

DURATION:

Range: ≤ 2 ns, 5 ns to 5 ms in decade steps. Variable control allows overlap on all ranges, and extends duration to ≥ 50 ms.

Accuracy: 5% from 5 ns to .5 ms, 15% of 5 ms range, with both period and duration variables in calibrated positions. Duration may vary not more than 3% + 0.5 ns for any duty factor less than 50%.

Duty Factor: At least 50% in normal pulse mode; 100% in complement mode. Minimum off time 2 ns.

External Duration: Leading edge threshold level ≤ 1 V, trailing edge reset level ≥ 0.1 V. Maximum input, 5 V, DC + peak AC. Derate to 2 V P-P @ 250 MHz.

Jitter: $\leq 0.1\% + 50$ ps.

OUTPUT:

Amplitude: Pulse high and low levels independently adjustable over a -5 V to $+5$ V range, with pulse amplitude limited between ≥ 0.5 V and ≤ 5 V. Complement switch inverts pulse between same two selected voltage levels. Front panel selectable 50 Ω internal back termination divides output levels by two.

Risetime: ≤ 1 ns.

Falltime: ≤ 1 ns.

Aberrations: $< +$ and -5% at 5 V P-P amplitude, except negative transition aberrations may exceed 5% for durations less than 5 ns.

Pulse Top Flatness: $\geq 2\%$, beginning 10 ns after transition.

INTERNAL POWER DISSIPATION: 14 watts maximum.

should be $\leq 20\%$.

THEORY OF OPERATION

Introduction

Use the block diagram in the foldout pages of this manual, along with the detailed schematic diagrams, and the following discussion to understand the operation of the PG 502. Integrated circuits U150, U180, and U260 use emitter-coupled logic (ECL). This logic is non-saturating for high speed operation. The high level is approximately 4.4 V above ground and the low level is 3.6 V.

Low Frequency Period Generator

U150B operates as an astable multivibrator for settings of the PERIOD switch of 10 ns and longer. See Fig. 2-1 for a simplified diagram of the Low Frequency Period Generator. When any input of the OR/NOR gate is high, the

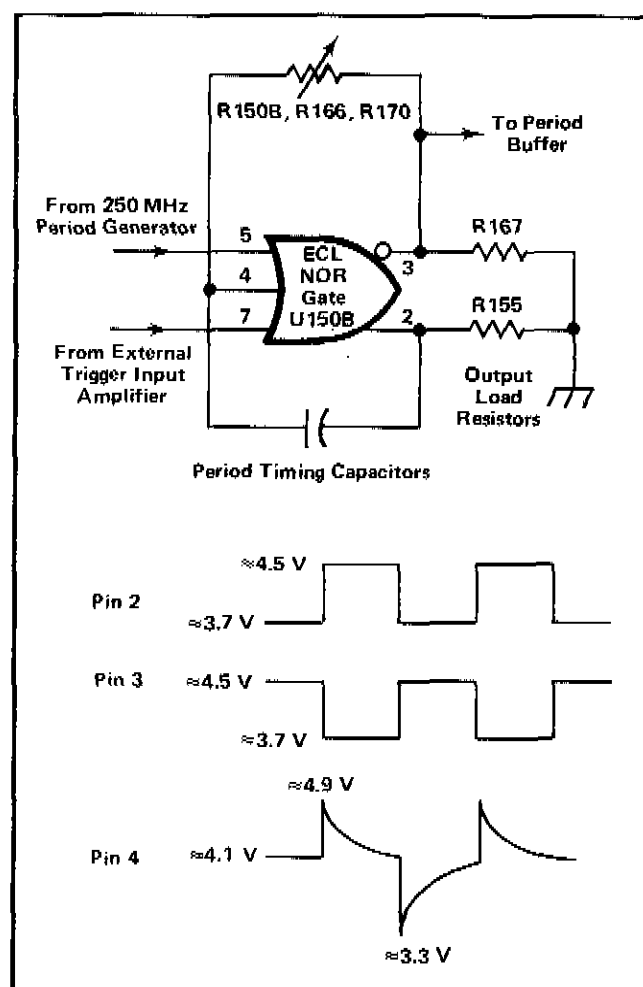


Fig. 2-1. Simplified Low Frequency Period Generator with associated waveforms.

output (pin 2) is high. The switched timing capacitances are connected from pin 2 to pin 4 of U150B. The capacitors are switched by the period range switch. R150B, the PERIOD VARIABLE control, varies the resistance in the negative feedback loop.

To start the period cycle, assume pin 2 of U150B goes high. This positive step is coupled through the Period timing capacitor to pin 4. Pin 3 goes low. As the timing capacitor discharges through the PERIOD VARIABLE resistance, the voltage at pin 4 decays at a rate determined by the timing capacitor and the PERIOD VARIABLE resistance. When the switching level (approximately 4 V) is reached, pin 2 goes low and pin 3 goes high. The negative step at pin 2 is coupled through the timing capacitor, and appears at pin 4. The capacitor now charges through the PERIOD VARIABLE resistance until the switching level is reached, and the period cycle repeats.

A slight offset current is applied through the Symmetry Adj control to compensate for the input current in U150B. This current controls the symmetry of the trigger output pulse. Output to the trigger buffer is taken from pin 3.

4 ns Period Generator

In the ≤ 4 ns position of the PERIOD selector, the feedback for U150B is disconnected via contact 3 of S150A. Contact 13F of S150A opens enabling U150A. U150A operates exactly as U150B, in the Low Frequency Period Generator. The associated circuitry is optimized for high speed operation.

External Trigger Duration Buffer

When the PG 502 is operated in the EXT TRIG or EXT DURATION mode, U150B operates as an externally-triggered Schmitt multivibrator with positive feedback through R158 and contact 12F of S150A. Q125 and Q130 serve as a high gain comparator-amplifier for external trigger-duration input signals. The base of Q130 is set by R135 and R136 at about 0.5 V. A trigger-duration input signal greater than about 0.5 V causes a negative-going output step at the collector of Q125. This step is transmitted through the strip line to the Low Frequency Period Generator. CR130 provides temperature compensation. CR122, CR123, CR125, and R122 protect the input against excessive voltages.

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Manual Trigger Multivibrator

This circuit, an emitter-coupled Schmitt multivibrator, eliminates false triggers due to contact bounce in the MAN TRIG front panel switch. The PULSE PERIOD switch must be in the EXT TRIG position for this circuit to operate. When the switch is pushed, the base of Q100 is connected to the +15 V supply through R100. This turns Q100 off and Q110 on. The collector of Q110 goes positive, causing a positive-going trigger at the base of Q125 in the External Trigger Input circuitry. Q106 provides positive feedback to hold the collector of Q110 positive during the contact bounce interval.

Period and Trigger Out Buffers

U180A, an OR/NOR gate, serves as a buffer to drive Q185 and Q190. These transistors operate as an emitter-coupled amplifier. The collector of Q185 drives the front panel + TRIG OUT BNC connector. The collector of Q190 is connected to the Internal Trig Out connection on the Output circuit board.

Trigger Shaper

The output from the Trigger Buffer is also fed to OR/NOR gate U180B. Q210, Q220, Q230, and Q240 serve as emitter-coupled trigger amplifiers. These amplifiers supply a fast rise current step to the trigger differentiator, Q245. When troubleshooting this circuit, any capacitance greater than about 2 pF connected between TP1 and ground renders this circuit inoperative.

A current step applied to the emitter of Q245 produces a voltage step at the collector. The collector-to-base feedback capacitance of the transistor causes this step to appear at the base, and subsequently the emitter. The base and emitter voltages decay toward their initial values. The decay time is set by R248, R249, and the transistor capacitance.

When pin 13 is in the high state, during square wave or external duration operation, the trigger shaper is disabled, and the external duration pulse is fed directly to the Output Buffer through R266.

Duration Generator

The positive-going trigger pulse, applied to pin 10 of U260A, causes pin 14 to go low and pin 15 high. Pin 15 is held high by positive feedback through R262. The low at the base of Q270 turns Q270 off. The emitter of Q270 goes negative at a rate allowed by the timing capacitor and the variable timing current source, Q290. As the emitter of Q270 goes negative, it pulls pin 12 of U260A negative through Q288. When pin 12 reaches the switching threshold (approximately +4 V), pin 14 goes positive and the mono-

stable duration generator resets until the next positive-going trigger pulse repeats the process. Output is taken from U260A, pin 15.

Output Buffer

This OR/NOR gate, U260B, shapes the signal fed to the Output board. The timing waveform at pin 3 of U260B, is essentially the waveform seen at the output of the PG 502. In the square wave mode, or external duration mode, the waveform at pin 7 controls the output of U260B, (the trigger having been disabled at U180B). The push-pull timing waveform is applied to the bases of Q320 and Q335, connected as an emitter-coupled amplifier. Their collectors are connected to the bases of a second emitter-coupled amplifier, Q350 and Q354, through zener diodes, VR320 and VR335. These diodes change the voltage to a more appropriate level for the following circuitry.

Output Driver

U360 is the output driver amplifier. It also performs the normal complement pulse switching function. Q390 is a variable output current source that tracks the output current to provide a constant ratio of driver current to output current. Q406 supplies one-half the value of current supplied by Q390, to provide a reference level for U400. This reference level lies halfway between the high and low voltage levels at the output of U360.

Output Amplifier

U400 switches up to 100 mA between either the external load (terminating resistance), or R442 and R443. Q470 is the variable output current source. The amplitude of the output pulse is proportional to the current supplied by Q470.

Output Level Programmer

Q504 and Q508 supply up to ± 100 mA of current to the output load, L446, L447, L450, L451, R447 and R450 decouple the source from the output pulse. The offset level of the output pulse is proportional to the current supplied by Q504 and Q508.

The output programming circuitry takes input from the pulse HIGH LEVEL and LOW LEVEL controls to provide proper control current to the amplitude (Q390, Q470) and offset (Q504, Q508) current sources.

When the amplifier output, U400 pin 2, is in the high state (amplifier off), the output voltage is proportional to the offset current. Turning the HIGH LEVEL control clockwise causes pin 3 of U480A to go negative. The

emitters of Q516 and Q520 also go negative due to the action of U480A, an operational amplifier. Conduction is increased in Q520 and decreased in Q516. Current flow is increased in Q504 and decreased in Q508. This action causes an absolute magnitude current increase in the load resistance (collectors of Q504 and Q508 move in the positive direction). This current change is sensed through R502 and R508 and fed back to pin 2 of U480A, causing a stable condition at its input. The output current (pulse high level) is proportional to the setting of the HIGH LEVEL control.

The output amplifier is on when the pulse output is in the low state. The output voltage is proportional to the sum of the offset current and the switched output current.

Manual control of the pulse low level occurs by varying the voltage at pin 5 of U480B with the front panel LOW LEVEL control. Turning the LOW LEVEL control CW causes pin 7 of U480B to go more positive. This increases the current through Q470 and consequently the pulse amplitude. The output high level is unchanged as the low level goes lower. Pin 6 of U480B, connected to the emitter of Q470 through R493, also goes more positive, until the voltage between pins 5 and 6 of U480B is zero.

If the pulse high level is raised, more current must flow in the output amplifier to keep the pulse low level at the same voltage. When the collectors of Q504 and Q508 go positive, their emitters go negative. This change is coupled through R495 to pin 6 of U480B. Pin 7 of U480B goes positive, increasing current flow through the Output Amplifier, and effectively increasing pulse amplitude. The pulse low level is unaffected by adjustment of the pulse HIGH LEVEL control. The Low Level Bal, internal adjustment, is provided to optimize the tracking of the output level programming circuitry.

Diodes CR445, VR445, CR446, CR448, CR449, and VR449 protect U400 against voltage reflections from reactive loads.

Power Supply

U640 is a precision voltage regulator for the +5 V supply. R645 sets the value of the output voltage however, it is adjusted for accuracy of the +15 V supply, as this is the most critical voltage in the PG 502. Internal reference voltage from U640 is available at pin 6. Operating voltage at pin 12 is pre-regulated by VR616, for reduced ripple. 11.5 V DC is applied to the collectors of Q650. The +5 V is

taken from the emitter. If the current to the PG 502 is increased, pin 4 of U640, connected to the emitter of Q650, goes negative. This causes pin 10 to go positive, increasing current flow through Q650, and restoring the voltage to its preset value. Should the current supplied increase excessively, the voltage drop across R650 causes Q650 to decrease conduction through internal action in U640, limiting the current to a safe value.

Q606 and Q610 serve as a comparator for the +15 V supply. If the +15 V supply goes negative, due to increased load, Q606 will decrease conduction. Its collector will go positive increasing conduction in Q600. This will increase current flow in emitter follower Q612, which is connected to the series pass transistor in the main frame. The series pass transistor will increase current available to the load, and the voltage is restored to the correct value. R615 sets the maximum current available from the supply. If the +15 V is shorted, Q600 saturates with its collector approximately 3 V (due to VR600) below the unregulated supply. This drop is reduced, by the base emitter drops of Q612, and the series pass transistor in the main frame, to about 1.6 V across R615. This drop limits the maximum current available from the supply. F600 additionally protects the components from overcurrent.

The -20 V supply is connected to the base of Q660. If the -20 V goes more negative, conduction increases in Q660. This reduces conduction in Q670, and Q674 connected to the base of the series pass transistor in the main frame. The series pass transistor reduces conduction, restoring the -20 V to its preset level. Current is limited through R676. If the supply is shorted, Q660 reduces conduction, saturating Q670 with its collector approximately 3 V from the unregulated voltage. The drop across the base emitter junction of Q674, and the series pass transistor in the main frame, sets the voltage across R676, at which the series pass transistor limits the current available. Fuse F670 further protects components from abnormal currents. CR675 prevents the -20 V supply from going positive with respect to ground.

Additional protection for the PG 502 is provided by Q626, and its associated components. If the +15 V supply goes to about 17 V, Q620 conducts, causing the gate of Q626 to move in the positive direction. When the gate of Q626 is about 1 V positive with respect to the cathode, the diode conducts, shorting the +15 V, +5 V and the -20 V supplies together. If the -20 V supply goes several volts more negative, Q632 conducts, causing the same action in Q626, and shorting the +15 V, and -20 V and +5 supplies.

If the fault remains, the current limits in the +15 V, -20 V and +5 V supplies protect the circuitry. Should the current limits fail, fuses F600 and F670 will open.



SERVICE INFORMATION

SYMBOLS AND REFERENCE DESIGNATORS

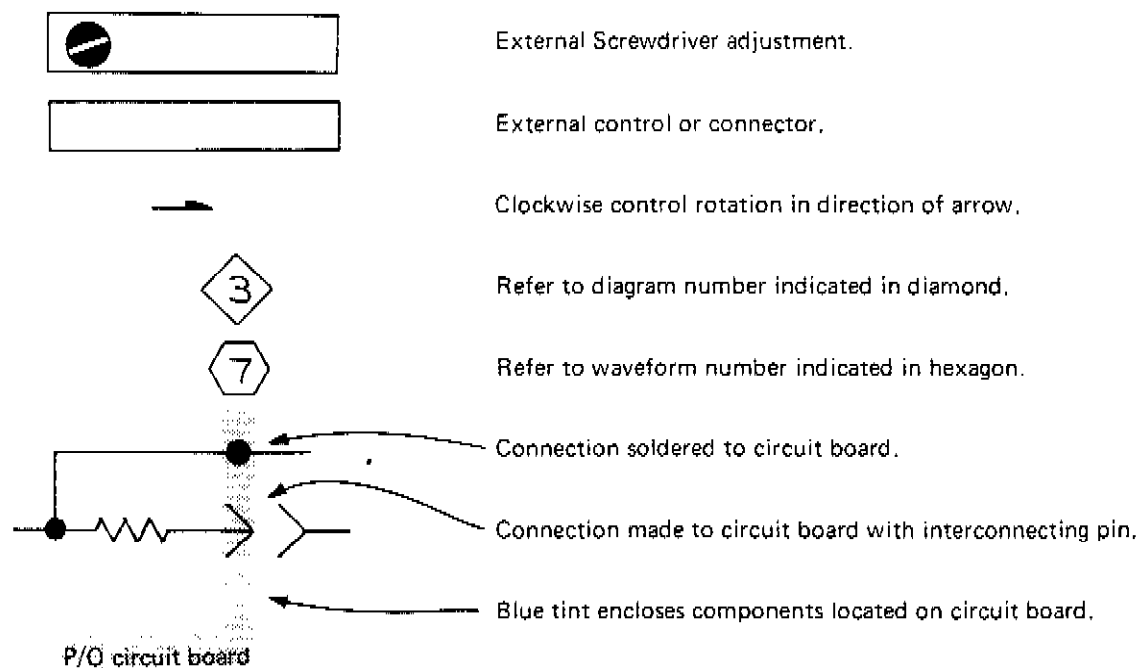
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Symbols used on the diagrams are based on ANSI Y32.2 — 1970.

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

The following special symbols are used on the diagrams:



PIN ASSIGNMENT

INPUT-OUTPUT ASSIGNMENTS FOR PLUG-IN REAR INTERFACE CONNECTOR

	B		A	
Trigger Out Ground	28		28	Trigger Out
Trigger Out	27		27	Trigger Out Ground
	26		26	
External Trigger In Ground	25	Signal Source	25	
External Trigger In	24	Family Barrier	24	
	23		23	
	22		22	
	21		21	
	20		20	
	19		19	The connections shown above are not factory wired. Refer to text under heading Functions Available at Rear Connector.
	18		18	
	17		17	
	16		16	
	15		15	
	14		14	
25 VAC winding	13		13	25 VAC winding
+33.5 V filtered DC	*12		12*	+33.5 V filtered DC
Collector lead of PNP Series-Pass	*11		11*	Base lead of PNP Series-Pass
Transformer shield lead	10		10*	Emitter lead of PNP Series-Pass
±33.5 V common return	*9		9*	±33.5 V common return
-33.5 V filtered DC	*8	TM 500	8*	-33.5 V filtered DC
Collector lead of NPN Series-Pass	*7	Barrier	7*	Emitter lead of NPN Series-Pass
No connection	6	slot	6*	Base lead of NPN Series-Pass
17.5 VAC winding	5		5	17.5 VAC winding
+11.5 V common return	4		4	+11.5 V common return
+11.5 V common return	*3		3*	+11.5 V common return
+11.5 V filtered DC	*2		2*	+11.5 V filtered DC
25 VAC winding	1		1	25 VAC winding
	B		A	

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 502.

ELECTRICAL REPLACEABLE PARTS LIST

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	SEMICON	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	SEP	SEPARATELY
FXD	FIXED	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 Co.	1201 2nd St.	Milwaukee, WI 53212
01295	Texas Instruments, Inc., Components Group	P. O. Box 5012	Dallas, TX 75222
02735	RCA Corp., Solid State Division	Route 202	Somerville, NY 08876
03508	General Electric Co., Semi-Conductor Products Dept., Electronics Park		Syracuse, NY 13201
04713	Motorola, Inc., Semiconductor Products Div.	5005 E. McDowell Rd.	Phoenix, AZ 85008
07263	Fairchild Semiconductor, A Div. of Fairchild Camera and Instrument Corp.	464 Ellis St.	Mountain View, CA 94040
07910	Teledyne Semiconductor	12515 Chadron Ave.	Hawthorne, CA 90250
08806	General Electric Co., Miniature Lamp Dept.	Nela PK.	Cleveland, OH 44112
11139	Deutsch Co., Electronic Components Div.	700 S. Hathaway Municipal Arpt.	Banning, CA 92220
12697	Clarostat Mfg. Co., Inc.	Lower Washington St.	Dover, NH 03820
13715	Fairchild Semiconductor, A Div. of Fairchild Camera and Instrument Corp.	4300 Redwood HWY.	San Rafael, CA 94903
14752	Electro Cube Inc.	1710 S. Del Mar Ave.	San Gabriel, CA 91776
18324	Signetics Corp.	811 E. Arques	Sunnyvale, CA 94086
18796	Erie Technological Products, Inc. State College Division		State College, PA 16801
34335	Advanced Micro Devices	901 Thompson Pl.	Sunnyvale, CA 94086
56289	Sprague Electric Co.		North Adams, MA 01247
71400	Bussman Mfg., Division of McGraw Edison Co.	2536 W. University St.	St. Louis, MO 63107
72136	Electro Motive Mfg. Co., Inc., The	South Park and John Streets	Willimantic, CT 06226
72982	Erie Technological Products, Inc.	644 W. 12th St.	Erie, PA 16512
73138	Beckman Instruments, Inc., Helipot Div.	2500 Harbor Blvd.	Fullerton, CA 92634
75042	TRW Electronic Components, IRC Philadelphia Div.	401 N. Broad St.	Philadelphia, PA 19108
78526	Stanwyck Winding Div., San Fernando Electric Mfg. Co., Inc.	139 Walsh Ave.	Newburgh, NY 12550
80009	Tektronix, Inc.	P. O. Box 500	Beaverton, OR 97005
80294	Bourns, Inc.	1200 Columbia Ave.	Riverside, CA 92507
81483	International Rectifier Corp.	9220 Sunset Blvd.	Los Angeles, CA 90069
90201	Mallory Capacitor Co.	3029 E. Washington St.	Indianapolis, IN 46206
91637	Dale Electronics, Inc.	P. O. Box 609	Columbus, NB 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-2771-00		CKT BOARD ASSY:--TIMING	80009	670-2771-00
A2	670-2949-00		CKT BOARD ASSY:--OUTPUT	80009	670-2949-00
C122	281-0510-00		CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	72982	301-000C0G0220M
C127	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C130	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C136	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	56289	40C626
C140	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C144	281-0593-00		CAP.,FXD,CER DI:3.9PF,10%	72982	301-000C0J399C
C150	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C151	283-0156-00		CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208E102Z
C155	281-0167-00		CAP.,VAR,CER DI:9-45PF,200V	72982	538-011D15-45
C156	283-0628-00		CAP.,FXD,MICA D:410PF,1%,500V	72136	DM15F411F0500
C158	283-0695-00		CAP.,FXD,MICA D:4440PF,1%,300V	72136	DM19F4441F0300
C159	283-0622-00		CAP.,FXD,MICA D:450PF,1%,300V	00853	D15-3F451F0
C162	285-1066-00		CAP.,FXD,PLSTC:0.05UF,1%,200V	14752	230B1C503F
C164	285-1067-00		CAP.,FXD,PLSTC:0.5UF,1%,200V	14752	230B1C504F
C166	285-1068-00		CAP.,FXD,PLSTC:5UF,1%,200V	14752	230B1C505F
C168	290-0302-00		CAP.,FXD,ELCTLT:100UF,10%,20V	56289	150D107X9020S2
C169	290-0302-00		CAP.,FXD,ELCTLT:100UF,10%,20V	56289	150D107X9020S2
C180	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C187	283-0110-00		CAP.,FXD,CER DI:0.005UF,+80-20%,150V	18796	855547Z5U0502Z
C223	283-0156-00		CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208E102Z
C225	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C240	281-0628-00		CAP.,FXD,CER DI:15PF,5%,600V	72982	301-000C0G150J
C249	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C260	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C262	281-0634-00		CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374-011C0G0100C
C266	281-0510-00		CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	72982	301-000C0G0220M
C268	281-0634-00		CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374-011C0G0100C
C270	290-0527-00		CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C275	281-0634-00		CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374-011C0G0100C
C276	283-0642-00		CAP.,FXD,MICA D:33PF,+/-0.5PF,300V	72136	DM10F330G0
C278	285-1066-00		CAP.,FXD,PLSTC:0.05UF,1%,200V	14752	230B1C503F
C280	285-1067-00		CAP.,FXD,PLSTC:0.5UF,1%,200V	14752	230B1C504F
C282	283-0660-00		CAP.,FXD,MICA D:510PF,2%,500V	72136	DM15F511G0500
C283	281-0562-00		CAP.,FXD,CER DI:39PF,500V	72982	301000U2J390X
C284	285-1068-00		CAP.,FXD,PLSTC:5UF,1%,200V	14752	230B1C505F
C285	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C286	290-0312-00		CAP.,FXD,ELCTLT:47UF,10%,35V	56289	150D476X9035S2
C288	283-0695-00		CAP.,FXD,MICA D:4440PF,1%,300V	72136	DM19F4441F0300
C289	283-0622-00		CAP.,FXD,MICA D:450PF,1%,300V	00853	D15-3F451F0
C294	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C300	290-0215-00		CAP.,FXD,ELCTLT:100UF,25V	56289	30D107G025DD4
C302	290-0201-00		CAP.,FXD,ELCTLT:100UF,15V	56289	30D107G015DC4
C304	290-0215-00		CAP.,FXD,ELCTLT:100UF,25V	56289	30D107G025DD4
C325 ¹	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C356 ¹					
C359 ¹	283-0156-00		CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208E102Z
C362 ¹					
C365	283-0156-00		CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208E102Z
C368	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C370	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C393 ¹	283-0156-00		CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208E102Z
C410 ¹					
C412 ¹					
C418	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C420	283-0156-00		CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208E102Z
C422	283-0156-00		CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208E102Z
C424	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M

¹Part of Circuit Board.

Electrical Parts List—PG 502

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
C435	283-0156-00		CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208E102Z
C472	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C480	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C503	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C504	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C511	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C512	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C516	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	56289	40C626
C520	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	56289	40C626
C524	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C612	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	56289	40C626
C615	290-0215-00		CAP.,FXD,ELCTLT:100UF,25V	56289	30D107G025DD4
C624	283-0220-00		CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075C103M
C626	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131-050651104M
C628	283-0220-00		CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075C103M
C640	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	56289	40C626
C645	290-0527-00		CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C650	290-0527-00		CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C652	283-0220-00		CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075C103M
C674	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	56289	40C626
C675	290-0215-00		CAP.,FXD,ELCTLT:100UF,25V	56289	30D107G025DD4
CR100	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	CD8220
CR122	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	CD8220
CR123	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	CD8220
CR125	152-0153-00		SEMICONV DEVICE:SILICON,15V,50MA	13715	FD7003
CR130	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	CD8220
CR249	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	CD8220
CR250	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	CD8220
CR397	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	CD8220
CR445	152-0322-00		SEMICONV DEVICE:SILICON,15V	01295	A1108
CR446	152-0322-00		SEMICONV DEVICE:SILICON,15V	01295	A1108
CR448	152-0333-00		SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH6012
CR449	152-0333-00		SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH6012
CR615	152-0066-00		SEMICONV DEVICE:SILICON,400V,750MA	02735	IN3194
CR635	152-0066-00		SEMICONV DEVICE:SILICON,400V,750MA	02735	IN3194
CR650	152-0066-00		SEMICONV DEVICE:SILICON,400V,750MA	02735	IN3194
CR660	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	CD8220
CR675	152-0066-00		SEMICONV DEVICE:SILICON,400V,750MA	02735	IN3194
DS630	150-0048-00		LAMP,INCAND:5V,60MA	08806	683
F600	159-0022-00		FUSE,CARTRIDGE:1A,3AG,FAST-BLO	71400	AGC2
F645	159-0114-00		FUSE,CARTRIDGE:1A,125VAC,FAST-BLO	71400	GFA1
F670	159-0022-00		FUSE,CARTRIDGE:1A,3AG,FAST-BLO	71400	AGC2
J120	131-1315-00		CONN,RCPT,ELEC:FEMALE,BNC	11139	29J8235-1
J122	131-1003-00		CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J190	131-1003-00		CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J192	131-1315-00		CONN,RCPT,ELEC:FEMALE,BNC	11139	28J8235-1
J260	131-1003-00		CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J262	131-1003-00		CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J320	131-1003-00		CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J340	131-1003-00		CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J435	131-1003-00		CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J436	131-1315-00		CONN,RCPT,ELEC:FEMALE,BNC	11139	28J8235-1
L159	276-0543-00		SHIELDING BEAD:	80009	276-0543-00
L187	108-0317-00		COIL,FIXED:15UH	78526	7150LM
L196	108-0327-00		COIL,FIXED:0.06UH	80009	108-0327-00
L320	276-0569-00		CORE,TOROID:	80009	276-0569-00
L335	276-0569-00		CORE,TOROID:	80009	276-0569-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
L416	276-0543-00		SHIELDING BEAD:	80009	276-0543-00
L417	276-0543-00		SHIELDING BEAD:	80009	276-0543-00
L435	276-0543-00		SHIELDING BEAD:	80009	276-0543-00
L436	276-0543-00		SHIELDING BEAD:	80009	276-0543-00
L446	108-0683-00		COIL, FIXED: 900MH	80009	108-0683-00
L447	108-0146-00		COIL, FIXED: 5UH	80009	108-0146-00
L450	108-0317-00		COIL, FIXED: 15UH	78526	71501M
L451	108-0317-00		COIL, FIXED: 15UH	78526	71501M
Q100	151-0410-00		TRANSISTOR: SILICON, PNP	04713	SPS6765
Q106	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q110	151-0410-00		TRANSISTOR: SILICON, PNP	04713	SPS6765
Q125	151-0367-00		TRANSISTOR: SILICON, NPN, SEL FROM 3571TP	80009	151-0367-00
Q130	151-0367-00		TRANSISTOR: SILICON, NPN, SEL FROM 3571TP	80009	151-0367-00
Q185	151-0271-00		TRANSISTOR: SILICON, PNP	01295	SRA4504
Q190	151-0271-00		TRANSISTOR: SILICON, PNP	01295	SRA4504
Q210	151-0225-00		TRANSISTOR: SILICON, NPN	07910	CS23365
Q220	151-0225-00		TRANSISTOR: SILICON, NPN	07910	CS23365
Q230	151-0438-00		TRANSISTOR: SILICON, PNP	80009	151-0438-00
Q240	151-0438-00		TRANSISTOR: SILICON, PNP	80009	151-0438-00
Q245	151-0438-00		TRANSISTOR: SILICON, PNP	80009	151-0438-00
Q270	151-0367-00		TRANSISTOR: SILICON, NPN, SEL FROM 3571TP	80009	151-0367-00
Q288	151-0438-00		TRANSISTOR: SILICON, PNP	80009	151-0438-00
Q290	151-0225-00		TRANSISTOR: SILICON, NPN	07910	CS23365
Q320	151-0438-00		TRANSISTOR: SILICON, PNP	80009	151-0438-00
Q335	151-0438-00		TRANSISTOR: SILICON, PNP	80009	151-0438-00
Q350	151-0438-00		TRANSISTOR: SILICON, PNP	80009	151-0438-00
Q354	151-0438-00		TRANSISTOR: SILICON, PNP	80009	151-0438-00
Q376	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q390	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q406	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q430	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q470	151-0260-00		TRANSISTOR: SILICON, NPN	02735	2N5189
Q504	151-0440-00		TRANSISTOR: SILICON, PNP	80009	151-0440-00
Q508	151-0439-00		TRANSISTOR: SILICON, NPN	80009	151-0439-00
Q516	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q520	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q600	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q606	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q610	151-0190-00		TRANSISTOR: SILICON, NPN	04713	2N3904
Q612	151-0134-00		TRANSISTOR: SILICON, PNP	04713	2N2905A
Q620	151-0410-00		TRANSISTOR: SILICON, PNP	04713	SPS6765
Q626	151-0515-01		THYRISTOR: 50V, 8A	04713	2N4441
Q632	151-0410-00		TRANSISTOR: SILICON, PNP	04713	SPS6765
Q650	151-0352-00		TRANSISTOR: SILICON, NPN	03508	X44C282
Q660	151-0410-00		TRANSISTOR: SILICON, PNP	04713	SPS6765
Q670	151-0410-00		TRANSISTOR: SILICON, PNP	04713	SPS6765
Q674	151-0103-00		TRANSISTOR: SILICON, NPN	04713	5N2219A
R100	315-0103-00		RES., FXD, COMP: 10K OHM, 5%, 0.25W	01121	CB1035
R102	315-0103-00		RES., FXD, COMP: 10K OHM, 5%, 0.25W	01121	CB1035
R103	315-0822-00		RES., FXD, COMP: 8.2K OHM, 5%, 0.25W	01121	CB8225
R105	315-0182-00		RES., FXD, COMP: 1.8 OHM, 5%, 0.25W	01121	CB1825
R106	315-0472-00		RES., FXD, COMP: 4.7K OHM, 5%, 0.25W	01121	CB4725
R108	315-0332-00		RES., FXD, COMP: 3.3K OHM, 5%, 0.25W	01121	CB3325
R110	315-0512-00		RES., FXD, COMP: 5.1K OHM, 5%, 0.25W	01121	CB5125
R120	301-0510-00		RES., FXD, COMP: 51 OHM, 5%, 0.50W	01121	EB5105
R122	315-0471-00		RES., FXD, COMP: 470 OHM, 5%, 0.25W	01121	CB4715
R125	315-0102-00		RES., FXD, COMP: 1K OHM, 5%, 0.25W	01121	CB1025
R127	301-0162-00		RES., FXD, COMP: 1.6K OHM, 5%, 0.50W	01121	EB1625
R130	315-0101-00		RES., FXD, COMP: 100 OHM, 5%, 0.25W	01121	CB1015

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
R132	315-0101-00		RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R135	315-0122-00		RES.,FXD,COMP:1.2K OHM,5%,0.25W	01121	CB1225
R136	315-0131-00		RES.,FXD,COMP:130 OHM,5%,0.25W	01121	CB1315
R140	311-1560-00		RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A-50000M
R142	317-0683-00		RES.,FXD,COMP:68K OHM,5%,0.125W	01121	BB6835
R144	315-0271-00		RES.,FXD,COMP:270 OHM,5%,0.25W	01121	CB2715
R146	315-0181-00		RES.,FXD,COMP:180 OHM,5%,0.25W	01121	CB1815
R147	315-0202-00		RES.,FXD,COMP:2K OHM,5%,0.25W	01121	CB2025
R149	317-0180-00		RES.,FXD,COMP:18 OHM,5%,0.125W	01121	BB1805
R150A,B	311-1573-00		RES.,VAR,NONWIR:5K OHM,10%,0.125W	01121	GD8173
R153	315-0271-00		RES.,FXD,COMP:270 OHM,5%,0.25W	01121	CB2715
R155	315-0391-00		RES.,FXD,COMP:390 OHM,5%,0.25W	01121	CB3915
R158	315-0151-00		RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R160	311-1258-00		RES.,VAR,NONWIR:50 OHM,10%,0.50W	80294	3326P-L58-500
R162	317-0510-00		RES.,FXD,COMP:51 OHM,5%,0.125W	01121	BB5105
R164	315-0683-00		RES.,FXD,COMP:68K OHM,5%,0.25W	01121	CB6835
R166	317-0430-00		RES.,FXD,COMP:43 OHM,5%,0.125W	01121	BB4305
R167	315-0271-00		RES.,FXD,COMP:270 OHM,5%,0.25W	01121	CB2715
R170	315-0472-00		RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R182	315-0131-00		RES.,FXD,COMP:130 OHM,5%,0.25W	01121	CB1315
R183	315-0131-00		RES.,FXD,COMP:130 OHM,5%,0.25W	01121	CB1315
R185	315-0820-00		RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R187	301-0431-00		RES.,FXD,COMP:430 OHM,5%,0.50W	01121	EB4315
R188	315-0101-00		RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R189	301-0431-00		RES.,FXD,COMP:430 OHM,5%,0.50W	01121	EB4315
R190	317-0220-00		RES.,FXD,COMP:22 OHM,5%,0.125W	01121	BB2205
R192	315-0820-00		RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R195	315-0100-00		RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R196	315-0510-00		RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R198	315-0100-00		RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R199	315-0270-00		RES.,FXD,COMP:27 OHM,5%,0.25W	01121	CB2705
R210	315-0271-00		RES.,FXD,COMP:270 OHM,5%,0.25W	01121	CB2715
R212	315-0271-00		RES.,FXD,COMP:270 OHM,5%,0.25W	01121	CB2715
R214	315-0751-00		RES.,FXD,COMP:750 OHM,5%,0.25W	01121	CB7515
R217	317-0220-00		RES.,FXD,COMP:22 OHM,5%,0.125W	01121	BB2205
R220	315-0751-00		RES.,FXD,COMP:750 OHM,5%,0.25W	01121	CB7515
R223	315-0750-00		RES.,FXD,COMP:75 OHM,5%,0.25W	01121	CB7505
R225	315-0621-00		RES.,FXD,COMP:620 OHM,5%,0.25W	01121	CB6215
R227	315-0750-00		RES.,FXD,COMP:75 OHM,5%,0.25W	01121	CB7505
R230	315-0910-00		RES.,FXD,COMP:91 OHM,5%,0.25W	01121	CB9105
R232	315-0681-00		RES.,FXD,COMP:680 OHM,5%,0.25W	01121	CB6815
R234	317-0220-00		RES.,FXD,COMP:22 OHM,5%,0.125W	01121	BB2205
R236	315-0681-00		RES.,FXD,COMP:680 OHM,5%,0.25W	01121	CB6815
R238	315-0103-00		RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R240	315-0820-00		RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R245	315-0151-00		RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R248	315-0361-00		RES.,FXD,COMP:360 OHM,5%,0.25W	01121	CB3615
R249	317-0151-00		RES.,FXD,COMP:150 OHM,5%,0.125W	01121	BB1515
R262	317-0121-00		RES.,FXD,COMP:120 OHM,5%,0.125W	01121	BB1215
R264	315-0271-00		RES.,FXD,COMP:270 OHM,5%,0.25W	01121	CB2715
R266	315-0510-00		RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R268	317-0510-00		RES.,FXD,COMP:51 OHM,5%,0.125W	01121	BB5105
R270	317-0220-00		RES.,FXD,COMP:22 OHM,5%,0.125W	01121	BB2205
R275	317-0470-00		RES.,FXD,COMP:47 OHM,5%,0.125W	01121	BB4705
R283	317-0100-00		RES.,FXD,COMP:10 OHM,5%,0.125W	01121	BB1005
R285	317-0390-00		RES.,FXD,COMP:39 OHM,5%,0.125W	01121	BB3905
R286	315-0471-00		RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R288	317-0100-00		RES.,FXD,COMP:10 OHM,5%,0.125W	01121	BB1005
R289	315-0220-00		RES.,FXD,COMP:22 OHM,5%,0.25W	01121	CB2205
R290	315-0101-00		RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015

Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Discont			
R292	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325
R294	315-0821-00			RES.,FXD,COMP:820 OHM,5%,0.25W	01121	CB8215
R295	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A-20000M
R297	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A-20000M
R298	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R300	311-1365-00			RES.,VAR,NONWIR:50K OHM,20%,1W	01121	11M164
R320	315-0131-00			RES.,FXD,COMP:130 OHM,5%,0.25W	01121	CB1315
R322	317-0100-00			RES.,FXD,COMP:10 OHM,5%,0.125W	01121	BB1005
R323	315-0820-00			RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R325	317-0220-00			RES.,FXD,COMP:22 OHM,5%,0.12	01121	BB2205
R328	323-0185-00			RES.,FXD,FILM:825 OHM,1%,0.50W	75042	CECT0-8250F
R332	317-0220-00			RES.,FXD,COMP:22 OHM,5%,0.12	01121	BB2205
R334	315-0820-00			RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R335	317-0100-00			RES.,FXD,COMP:10 OHM,5%,0.125W	01121	BB1005
R337	317-0102-00			RES.,FXD,COMP:1K OHM,5%,0.125W	01121	BB1025
R340	315-0131-00			RES.,FXD,COMP:130 OHM,5%,0.25W	01121	CB1315
R342	315-0510-00			RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R344	323-0185-00			RES.,FXD,FILM:825 OHM,1%,0.50W	75042	CECT0-8250F
R346	315-0510-00			RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R350	321-0191-00			RES.,FXD,FILM:953 OHM,1%,0.125W	75042	CEAT0-9530F
R352	317-0220-00			RES.,FXD,COMP:22 OHM,5%,0.12	01121	BB2205
R354	321-0191-00			RES.,FXD,FILM:953 OHM,1%,0.125W	75042	CEAT0-9530F
R356	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R359	321-0125-00			RES.,FXD,FILM:196 OHM,1%,0.125W	75042	CEAT0-1960F
R362	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R364	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R368	315-0750-00			RES.,FXD,COMP:75 OHM,5%,0.25W	01121	CB7505
R370	315-0750-00			RES.,FXD,COMP:75 OHM,5%,0.25W	01121	CB7505
R372	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R374	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R375	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R377	321-0194-00			RES.,FXD,FILM:1.02K OHM,1%,0.125W	75042	CEAT0-1021F
R378	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	75042	CEAT0-3921F
R380	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R382	315-0122-00			RES.,FXD,COMP:1.2K OHM,5%,0.25W	01121	CB1225
R384	315-0620-00			RES.,FXD,COMP:62 OHM,5%,0.25W	01121	CB6205
R386	315-0620-00			RES.,FXD,COMP:62 OHM,5%,0.25W	01121	CB6205
R390	321-0058-00			RES.,FXD,FILM:39.2 OHM,1%,0.125W	75042	CEAT0-39R20F
R392	311-1555-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91A-10002M
R393	315-0512-00			RES.,FXD,COMP:5.1K OHM,5%,0.25W	01121	CB5125
R395	315-0511-00			RES.,FXD,COMP:510 OHM,5%,0.25W	01121	CB5115
R397	315-0511-00			RES.,FXD,COMP:510 OHM,5%,0.25W	01121	CB5115
R400	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R402	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R406	321-0087-00			RES.,FXD,FILM:78.7 OHM,1%,0.125W	75042	CEAT0-78R70F
R408	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R410	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R412	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R416	301-0101-00			RES.,FXD,COMP:100 OHM,5%,0.50W	01121	EB1015
R417	301-0101-00			RES.,FXD,COMP:100 OHM,5%,0.50W	01121	EB1015
R424	315-0202-00			RES.,FXD,COMP:2K OHM,5%,0.25W	01121	CB2025
R430	315-0750-00			RES.,FXD,COMP:75 OHM,5%,0.25W	01121	CB7505
R432	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	75042	CEAT0-3921F
R433	321-0275-00			RES.,FXD,FILM:7.15K OHM,1%,0.125W	75042	CEAT0-7151F
R435	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R438	315-0510-00			RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R439	315-0510-00			RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R442	301-0101-00			RES.,FXD,COMP:100 OHM,5%,0.50W	01121	EB1015
R443	301-0101-00			RES.,FXD,COMP:100 OHM,5%,0.50W	01121	EB1015
R445	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
R447	315-0751-00		RES.,FXD,COMP:750 OHM,5%,0.25W	01121	CB7515
R449	315-0103-00		RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R450	315-0102-00		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R456	321-0085-00		RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R458	317-0047-00		RES.,FXD,COMP:4.7 OHM,5%,0.125W	01121	BB47G5
R460	321-0085-00		RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R462	321-0085-00		RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R464	321-0085-00		RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R472	323-0081-00		RES.,FXD,FILM:68.1 OHM,1%,0.50W	91637	MFF1226G68R10F
R473	323-0081-00		RES.,FXD,FILM:68.1 OHM,1%,0.50W	91637	MFF1226G68R10F
R480	315-0102-00		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R484	321-0253-00		RES.,FXD,FILM:4.22K OHM,1%,0.125W	75042	CEAT0-4221F
R485A, B	311-1162-00		RES.,VAR, NONWIR:2 X 10K OHM,10%,1W	12697	381-CM39691
R487	321-0259-00		RES.,FXD,FILM:4.87K OHM,1%,0.125W	75042	CEAT0-4871F
R488	321-0193-00		RES.,FXD,FILM:1K OHM,1%,0.125W	75042	CEAT0-1001F
R489	321-0182-00		RES.,FXD,FILM:768 OHM,1%,0.125W	75042	CEAT0-7680F
R493	321-0278-00		RES.,FXD,FILM:7.68K OHM,1%,0.125W	75042	CEAT0-7681F
R495	311-1563-00		RES.,VAR, NONWIR:1K OHM,20%,0.50W	73138	91A-10000M
R500	321-0291-00		RES.,FXD,FILM:10.5K OHM,1%,0.125W	75042	CEAT0-1052F
R502	321-0291-00		RES.,FXD,FILM:10.5K OHM,1%,0.125W	75042	CEAT0-1052F
R504	308-0720-00		RES.,FXD,WW:50 OHM,1%,3W	91637	RS2B-B50R00F
R506	315-0911-00		RES.,FXD,COMP:910 OHM,5%,0.25W	01121	CB9115
R508	321-0320-00		RES.,FXD,FILM:21K OHM,1%,0.125W	75042	CEAT0-2102F
R510	321-0320-00		RES.,FXD,FILM:21K OHM,1%,0.125W	75042	CEAT0-2102F
R512	308-0756-00		RES.,FXD,WW:100 OHM,1%,3W	91637	RS2B-B100R0F
R514	321-0355-00		RES.,FXD,FILM:48.7K OHM,1%,0.125W	75042	CEAT0-4872F
R516	321-0210-00		RES.,FXD,FILM:1.5K OHM,1%,0.125W	75042	CEAT0-1501F
R518	321-0326-00		RES.,FXD,FILM:24.3K OHM,1%,0.125W	75042	CEAT0-2432F
R520	321-0193-00		RES.,FXD,FILM:1K OHM,1%,0.125W	75042	CEAT0-1001F
R524	315-0102-00		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R526	321-0410-00		RES.,FXD,FILM:182K OHM,1%,0.125W	75042	CEAT0-1823F
R528	321-0214-00		RES.,FXD,FILM:1.65K OHM,1%,0.125W	75042	CEAT0-1651F
R529	321-0222-00		RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEAT0-2001F
R600	315-0472-00		RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R602	315-0682-00		RES.,FXD,COMP:6.8K OHM,5%,0.25W	01121	CB6825
R604	321-0249-00		RES.,FXD,FILM:3.83K OHM,1%,0.125W	75042	CEAT0-3831F
R606	321-0222-00		RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEAT0-2001F
R608	315-0362-00		RES.,FXD,COMP:3.6K OHM,5%,0.25W	01121	CB3625
R610	315-0132-00		RES.,FXD,COMP:1.3K OHM,5%,0.25W	01121	CB1325
R612	315-0560-00		RES.,FXD,COMP:56 OHM,5%,0.25W	01121	CB5605
R615	308-0459-00		RES.,FXD,WW:1.1 OHM,5%,3W	91637	RS2B-D1R100J
R616	301-0222-00		RES.,FXD,COMP:2.2K OHM,5%,0.50W	01121	EB2225
R620	315-0103-00		RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R622	321-0267-00		RES.,FXD,FILM:5.9K OHM,1%,0.125W	75042	CEAT0-5901F
R623	321-0285-00		RES.,FXD,FILM:9.09K OHM,1%,0.125W	75042	CEAT0-9091F
R626	315-0102-00		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R630	315-0100-00		RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R632	315-0103-00		RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R634	321-0267-00		RES.,FXD,FILM:5.9K OHM,1%,0.125W	75042	CEAT0-5901F
R635	321-0303-00		RES.,FXD,FILM:14K OHM,1%,0.125W	75042	CEAT0-1402F
R640	315-0152-00		RES.,FXD,COMP:1.5K OHM,5%,0.25W	01121	CB1525
R642	315-0182-00		RES.,FXD,COMP:1.8 OHM,5%,0.25W	01121	CB1825
R645	311-1563-00		RES.,VAR, NONWIR:1K OHM,20%,0.50W	73138	91A-10000M
R647	315-0472-00		RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R650	308-0677-00		RES.,FXD,WW:1 OHM,5%,2W	75042	BWH-1R000J
R662	315-0362-00		RES.,FXD,COMP:3.6K OHM,5%,0.25W	01121	CB3625
R664	321-0222-00		RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEAT0-2001F
R665	321-0279-00		RES.,FXD,FILM:7.87K OHM,1%,0.125W	75042	CEAT0-7871F
R668	315-0472-00		RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R670	315-0682-00		RES.,FXD,COMP:6.8K OHM,5%,0.25W	01121	CB6825

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
R672	315-0102-00		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R674	301-0162-00		RES.,FXD,COMP:1.6K OHM,5%,0.50W	01121	EB1625
R676	308-0459-00		RES.,FXD,WW:1.1 OHM,5%,3W	91637	RS2B-D1R100J
S100A,B	260-1425-00		SWITCH,PUSH:MANTRIG/COMPLIMENT	80009	260-1425-00
S150A	263-1009-00		ACTR ASSY,CAM S:PERIOD	80009	263-1009-00
S150B	263-1010-00		ACTR ASSY,CAM S:PULSE DURATION	80009	263-1010-00
S435	105-0423-00		ACTR ASSY,SL SW:BACK TERM	80009	105-0423-00
U150	156-0282-00		INTEGRATED CKT:DUAL 4-INPUT OR NOR GATE	04713	MC16602
U180	156-0282-00		INTEGRATED CKT:DUAL 4-INPUT OR NOR GATE	04713	MC16602
U260	156-0282-00		INTEGRATED CKT:DUAL 4-INPUT OR NOR GATE	04713	MC16602
U360	155-0078-06		INTEGRATED CKT:MONOLITHIC,VERT AMPL,SEL	80009	155-0078-06
U400	155-0064-00		INTEGRATED CKT:HYBRID,OUT AMPL W/STUD	80009	155-0064-00
U480	156-0158-00		INTEGRATED CKT:DUAL OPERATIONAL AMPLIFIER	18324	S5558V
U640	156-0071-00		INTEGRATED CKT:VOLTAGE REGULATOR	34335	723DC
VR320	152-0280-00		SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A
VR335	152-0280-00		SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A
VR424	152-0175-00		SEMICONV DEVICE:ZENER,0.4W,5.6V,5%	04713	1N752A
VR425	152-0175-00		SEMICONV DEVICE:ZENER,0.4W,5.6V,5%	04713	1N752A
VR445	152-0576-00		SEMICONV DEVICE:ZENER,1W,8.2V,5%	04713	1N3018B
VR449	152-0576-00		SEMICONV DEVICE:ZENER,1W,8.2V,5%	04713	1N3018B
VR480	152-0243-00		SEMICONV DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR600	152-0278-00		SEMICONV DEVICE:ZENER,0.4W,7.5V,5%	07910	1N4372A
VR616	152-0168-00		SEMICONV DEVICE:ZENER,0.4W,12V,5%	04713	1N963B
VR620	152-0280-00		SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A
VR632	152-0280-00		SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A
VR670	152-0278-00		SEMICONV DEVICE:ZENER,0.4W,7.5V,5%	07910	1N4372A



INTERNAL ADJUSTMENT PROCEDURE

Sht. 1 of 3

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.

Maintenance

Refer to the TM 500 series power module manual for complete maintenance information. When replacing cam switch contacts order High Frequency Cam Switch Repair Kit, Tektronix Part No. 003-0708-00.

Test Equipment

For complete calibration of the PG 502, the following equipment is recommended:

Digital voltmeter with ranges greater than +15 V DC and -20 V DC, Tektronix DM 501 or equivalent.

Digital counter capable of counting frequencies to 100 MHz, Tektronix DC 501, or equivalent.

Complete oscilloscope system, sampling and real time, capable of faithful reproduction of 250 MHz pulses. Tektronix type 7704 main frame, 7A16 real time vertical plug-in, 7B50 real time sweep plug-in, 7S11 sampling unit with S1 and S6 sampling heads and 7T11 sampling sweep unit suggested.

One three foot head extender for sampling heads, Tektronix Part Number 012-0124-00.

50 Ω , 5X attenuator, BNC connectors, Tektronix Part Number 011-0060-01, or equivalent.

50 Ω , 10X attenuator, BNC connectors, Tektronix Part Number 011-0059-01, or equivalent.

50 Ω termination, SMA connectors, Tektronix Part Number 015-1022-00, or equivalent (used with the S6 sampling head).

BNC male to GR adapter, Tektronix Part Number 017-0064-00 or equivalent.

SMA male to GR adapter, Tektronix Part Number 015-1007-00, or equivalent.

50 Ω 42 inch coaxial cable with BNC connectors, Tektronix Part Number 012-0057-01, or equivalent.

General

The PG 502 can be calibrated either fully installed in a TM 500 series power module, or connected to the power module via a flexible plug-in extender (Tektronix Part No. 067-0645-01). Remove the power module cabinet to make adjustments to the PG 502 inside the power module. PG 502 adjustments are located on the outside of both boards. Make adjustments at an ambient temperature between +20°C +30°C.

To check or reset the OUTPUT (VOLTS) control knobs, use the following procedure. Connect an oscilloscope to the PG 502 OUTPUT connector. Set the PULSE DURATION control to the SQ WAVE position, and the PERIOD control at the 10 ms position. Set the HIGH LEVEL knob for an output level of +1 V on the oscilloscope, and the LOW LEVEL for 0 V. If the LOW LEVEL knob does not point to 0, loosen the set screw and reset the knob to the 0 mark on the front panel. Now set the LOW LEVEL knob for a reading of -1 V on the oscilloscope, and the HIGH LEVEL for 0 V. If the HIGH LEVEL knob does not point to 0, loosen the set screw and readjust.

1. Adjust +15 V supply

Connect the negative lead of the voltmeter to ground and the positive lead to the +15 V test point. Adjust R645, Set +15 V, for a reading of 15 V.

2. Adjust Symmetry

Set the vertical deflection factor of the sampling oscilloscope, using the S1, to 50 mV/div., and the horizontal deflection factor at 2 ns/div. Set the sampling oscilloscope for internal triggering. Connect a coaxial cable from the + TRIG OUT connector on the PG 502 through a 5X attenuator to the vertical input of the sampling oscilloscope. Set the PG 502 controls as follows: PERIOD, 4 ns, with PERIOD VARIABLE control fully cw. Set the sampling oscilloscope controls for a stable display. Adjust R140, Symmetry Adj., for a 50% duty factor.

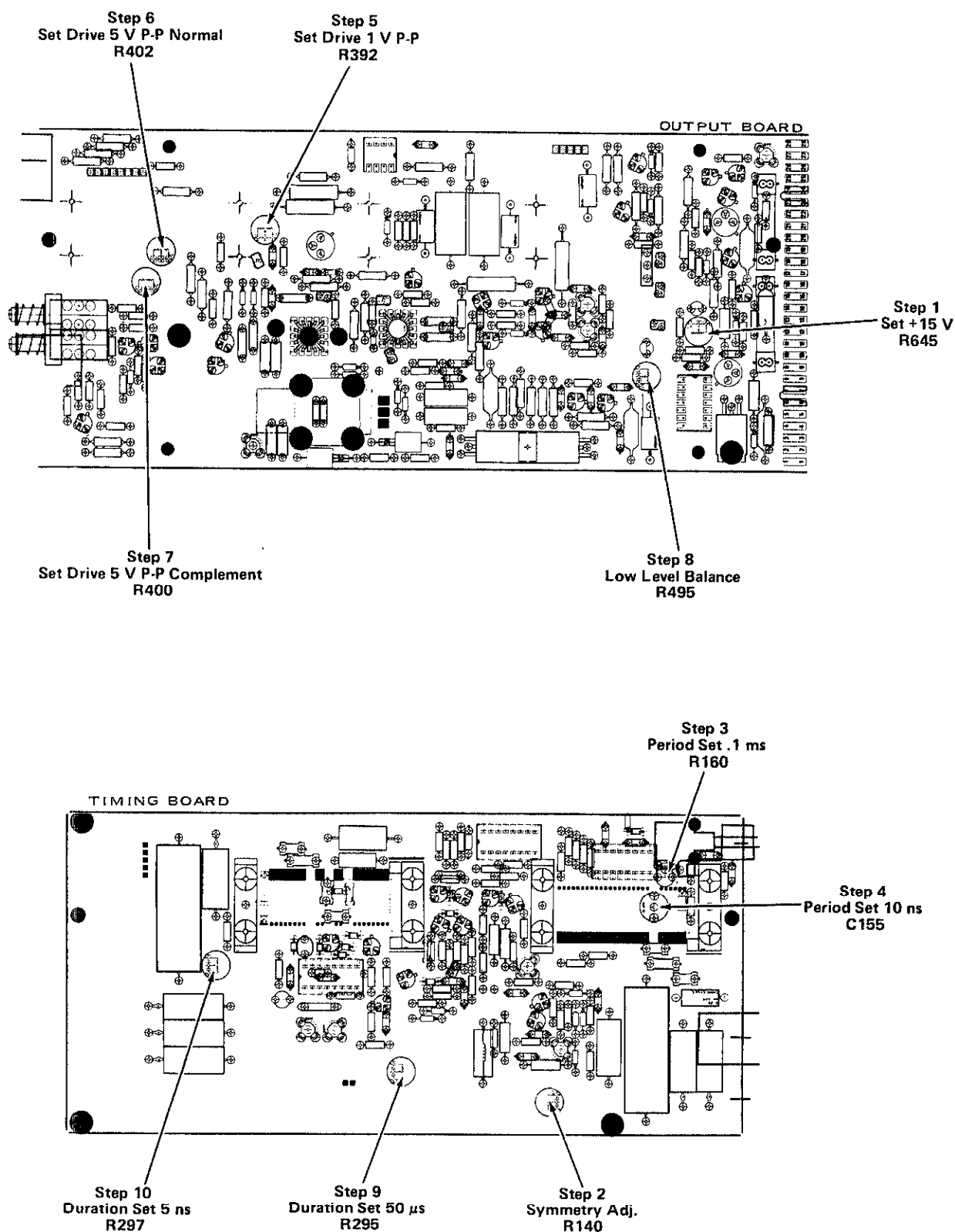
3. Adjust 0.1 ms Calibration

Connect a coaxial cable from the + TRIG OUT connector on the PG 502 through a 50 Ω termination to the input of the frequency counter. Set the PERIOD range selector to the .1 ms position. Make certain the PERIOD VARIABLE control is fully ccw. Obtain a stable counter reading. Adjust R160, Period Set .1 ms., for a reading of 10 kHz.

INTERNAL ADJUSTMENT PROCEDURE

Sht. 20F3

INTERNAL ADJUSTMENT PROCEDURE



4. Adjust

Using the
PG 502 PER
Adjust C155

5. Adjust

Connect a
panel connect
trigger input
male to GR a
GR to SMA
Connect the
to the S6. T
tion. Connect
cable. Set th
the vertical
500 mV/div).
SQ WAVE po
position. Pull
COMPLEMEN
ABLE contro
mately 40 ns
approximately
major division
P-P, for min
and best sym

6. Adjust

Using the
HIGH LEVEL
Adjust R402
aberrations o
for least aber
negative direc

Sht. 3 of 3

4. Adjust 10 ns Calibration

Using the same set up as in the previous step, set the PG 502 PERIOD range selector to the 10 ns position. Adjust C155, Period Set 10 ns, for a reading of 100 MHz.

5. Adjust 1 V Drive

Connect a coaxial cable from the + TRIG OUT front panel connector through a 5X attenuator to the external trigger input of the sampling oscilloscope. Connect a BNC male to GR adapter to the OUTPUT connector. Connect a GR to SMA male adapter to the 10X SMA attenuator. Connect the GR adapters together. Connect the attenuator to the S6. Terminate the S6 with the 50 Ω SMA termination. Connect the S6 to the 7S11 via the head extender cable. Set the sampling oscilloscope sweep at 5 ns/div and the vertical at 50 mV/div (overall deflection factor 500 mV/div). Set the PULSE DURATION control to the SQ WAVE position, and the PERIOD control to the 10 ns position. Pull the BACK TERM pushbutton, and release the COMPLEMENT pushbutton. Adjust the PERIOD VARIABLE control for a waveform with a period of approximately 40 ns. Set the OUTPUT LOW LEVEL control to approximately -1 V and the HIGH LEVEL control for one major division of amplitude. Adjust R392, Set Drive 1 V P-P, for minimum aberrations on the negative transition, and best symmetry of the pulse waveform.

7. Adjust Complement Drive

Using the same setup as in the previous step, depress the COMPLEMENT pushbutton. Set the HIGH LEVEL control for five major divisions of amplitude. Adjust R400, Set Drive 5 V P-P Complement, for minimum aberrations on the negative transition.

8. Adjust Low Level Balance

Using the same setup as in the previous step, set the vertical deflection factor to 10 mV/div (overall deflection factor 100 mV/div). Set the PULSE DURATION control in the SQ WAVE mode, and the PERIOD VARIABLE control for approximately a 40 ns Period. Set the LOW LEVEL control to 0 V. Adjust R495, Low Level Balance, for minimum shift of the low pulse level while varying the HIGH LEVEL control from +1 V to +3 V.

9. Adjust 50 μ s Duration

Connect the OUTPUT of the PG 502 through a 50 Ω coaxial cable, 10X attenuator, and 50 Ω termination to the vertical input of the real time oscilloscope. Set the PG 502 PULSE DURATION control to 50 μ s, PERIOD to .1 ms, COMPLEMENT pushbutton out, and BACK TERM in the out position. Make certain the VARIABLE controls are fully ccw. Set the oscilloscope vertical deflection factor at 50 mV/div (overall deflection factor 500 mV/div), and internally trigger the oscilloscope set for a 10 μ s/div sweep rate. Adjust R295, Duration Set 50 μ s, for a pulse duration of exactly 50 μ s.

10. Adjust 5 ns Duration

Reconnect the OUTPUT of the PG 502, through a 10X attenuator using the S1 sampling head, to the sampling oscilloscope. Set the vertical deflection factor at 50 mV/div (overall deflection factor 500 mV/div), and the horizontal time/div at 1 ns/div. Internally trigger the sampling oscilloscope. Set the PG 502 PULSE DURATION control at 5 ns, and the PERIOD control at 10 ns. Check that the VARIABLE controls are fully ccw. Adjust R297, Duration Set 5 ns, for exactly 5 divisions of pulse duration.

6. Adjust 5 V Drive

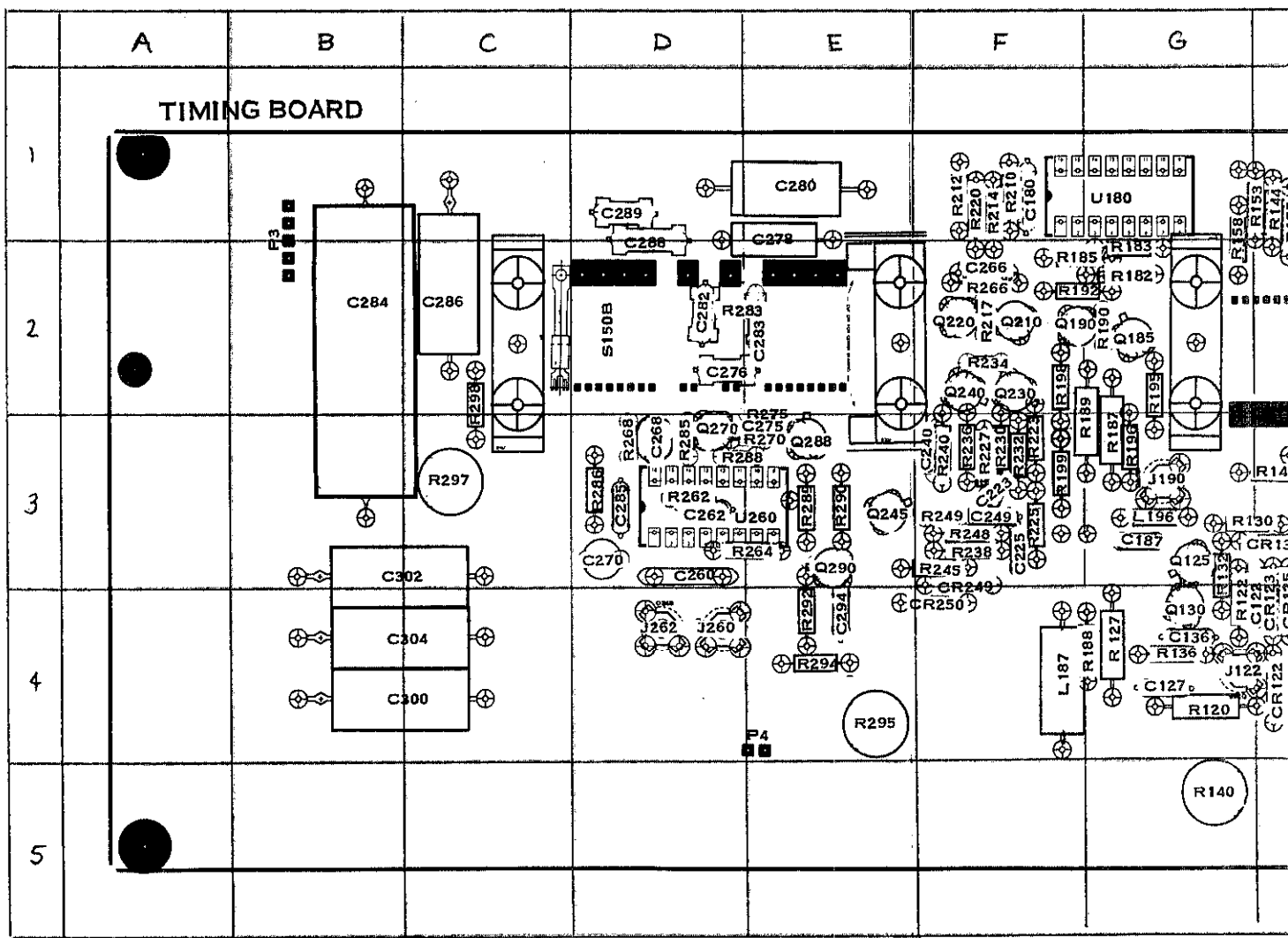
Using the same setup as in the previous step, adjust the HIGH LEVEL control for five major divisions of amplitude. Adjust R402, Set Drive 5 V P-P Normal, for minimum aberrations on the negative transition. Repeat steps 5 and 6 for least aberrations, and least change in overshoot in the negative direction in the 1 to 5 major division region.

Step 1
Set +15 V
R645

Step 4
Set 10 ns
C155

Sht. 10F2

PARTS LOCATION GRID

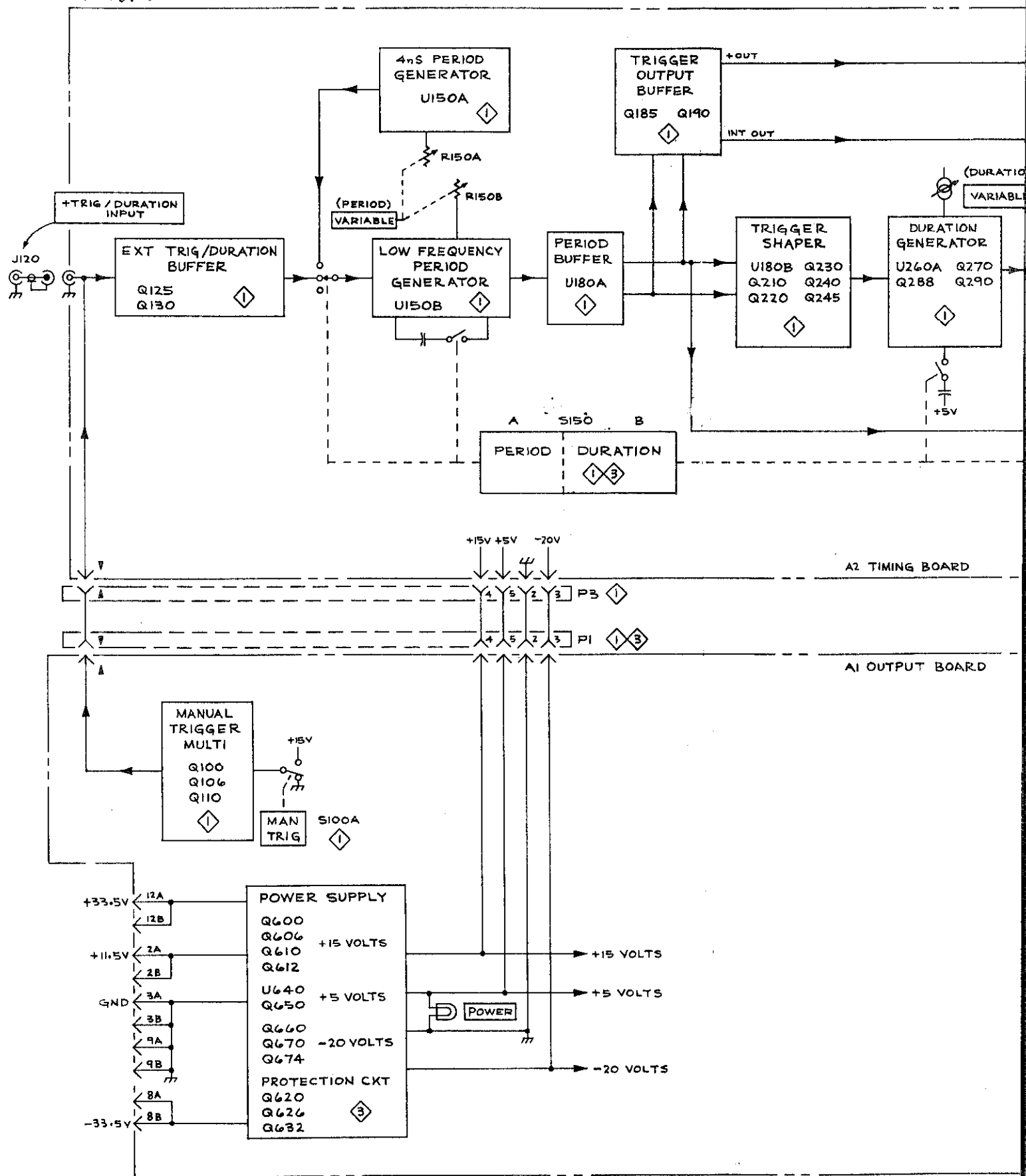


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C127	G4	C187	G3	C285	D3	J260	D4	Q270	D3	R150A	I1	R190	G2
C130	H3	C223	F3	C286	C2	J262	D4	Q288	E3	R150B	I2	R192	F2
C136	G4	C225	F3	C288	D1			Q290	E3	R153	H1	R195	G2
C140	J2	C240	F3	C289	D1	L187	F4	R120	G4	R155	H1	R196	G3
C144	H1	C249	F3	C294	E4	L196	G3	R122	G4	R158	G2	R198	F2
C150	H1	C260	D3	C300	B4			R125	H4	R160	I2	R199	F3
C151	I1	C262	D3	C302	B3	P3	B1	R127	G4	R162	I2	R210	F1
C155	I2	C266	F2	C304	B4	P4	E4	R130	G3	R164	J2	R212	F1
C156	I3	C268	D3			Q125	G3	R132	G3	R166	I2	R214	F1
C158	I3	C270	D3	CR122	H4	Q130	G4	R135	H4	R167	H1	R217	F2
C159	I3	C275	E3	CR123	H4	Q185	G2	R136	G4	R170	I2	R220	F1
C162	I3	C276	D2	CR125	H4	Q190	F2	R140	G5	R182	G2	R223	F3
C164	H4	C278	E1	CR249	F3	Q210	F2	R142	H1	R183	G2	R225	F3
C166	I4	C280	E1	CR250	F4	Q220	F2	R144	H1	R185	F2	R227	F3
C168	I4	C282	D2			Q230	F2	R146	H3	R187	G3	R230	F3
C169	I4	C283	E2	J122	G4	Q240	F2	R147	H3	R188	F4	R232	F3

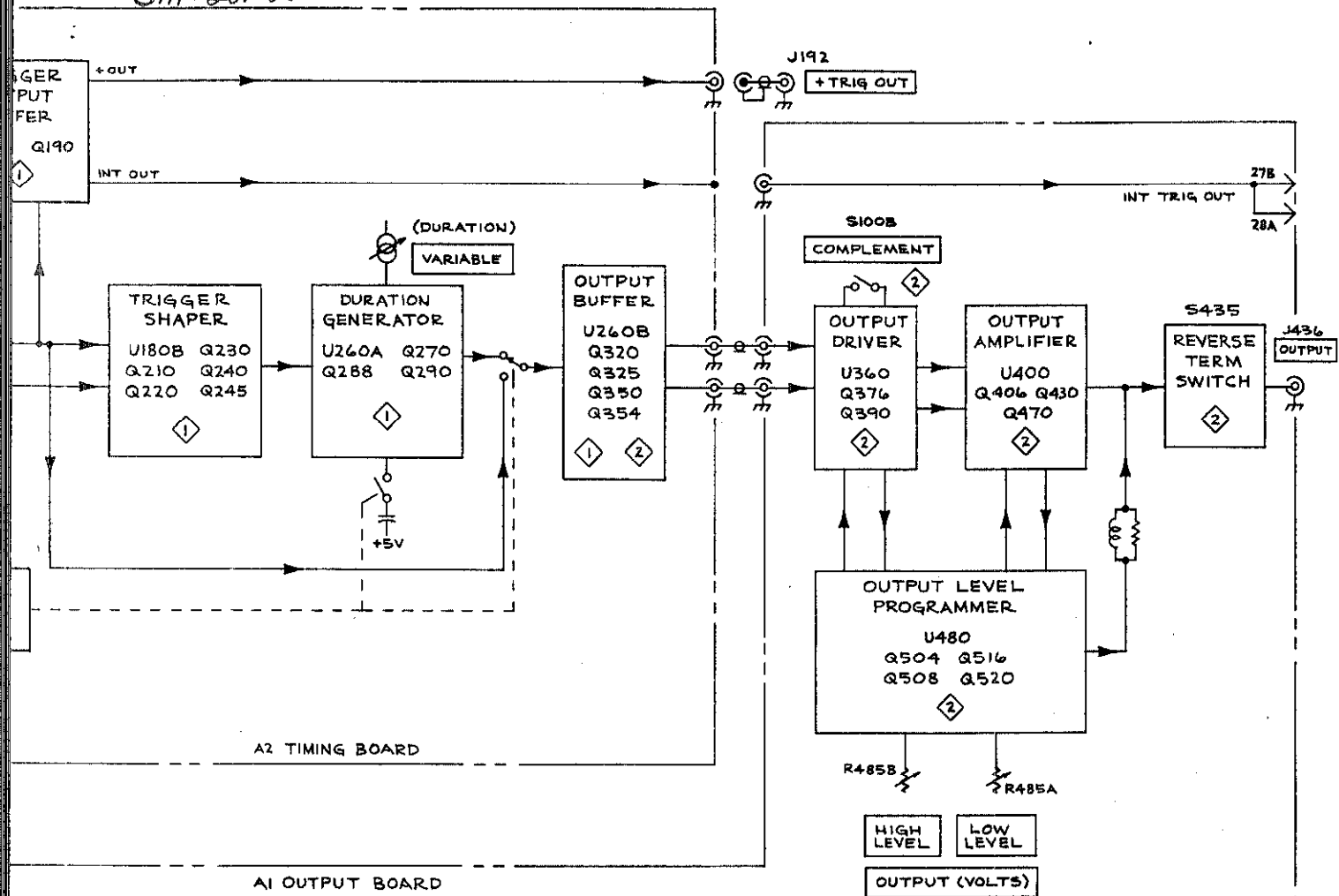
Sht. 20F2

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C187	G3	C285	D3	J260	D4	Q270	D3	R150A	I1	R190	G2	R236	F3	R292	E4
C223	F3	C286	C2	J262	D4	Q288	E3	R150B	I2	R192	F2	R238	F3	R294	E4
C225	F3	C288	D1			Q290	E3	R153	H1	R195	G2	R240	F3	R295	E4
C240	F3	C289	D1	L187	F4	R120	G4	R155	H1	R196	G3	R245	F3	R297	C3
C249	F3	C294	E4	L196	G3	R122	G4	R158	G2	R198	F2	R248	F3	R298	C2
C260	D3	C300	B4			R125	H4	R160	I2	R199	F3	R249	F3		
C262	D3	C302	B3	P3	B1	R127	G4	R162	I2	R210	F1	R262	D3	S150A	H2
C266	F2	C304	B4	P4	E4	R130	G3	R164	J2	R212	F1	R264	E3	S150B	D2
C268	D3			Q125	G3	R132	G3	R166	I2	R214	F1	R266	F2		
C270	D3	CR122	H4	Q130	G4	R135	H4	R167	H1	R217	F2	R268	D3	U150	H1
C275	E3	CR123	H4	Q185	G2	R136	G4	R170	I2	R220	F1	R270	E3	U180	G1
C276	D2	CR125	H4	Q190	F2	R140	G5	R182	G2	R223	F3	R275	E2	U260	D3
C278	E1	CR249	F3	Q210	F2	R142	H1	R183	G2	R225	F3	R283	D2		
C280	E1	CR250	F4	Q220	F2	R144	H1	R185	F2	R227	F3	R285	D3		
C282	D2			Q230	F2	R146	H3	R187	G3	R230	F3	R286	D3		
C283	E2	J122	G4	Q240	F2	R147	H3	R188	F4	R232	F3	R288	D3		

BLOCK DIAGRAM Sht. 10F2



BLOCK DIAGRAM Sht. 20F2

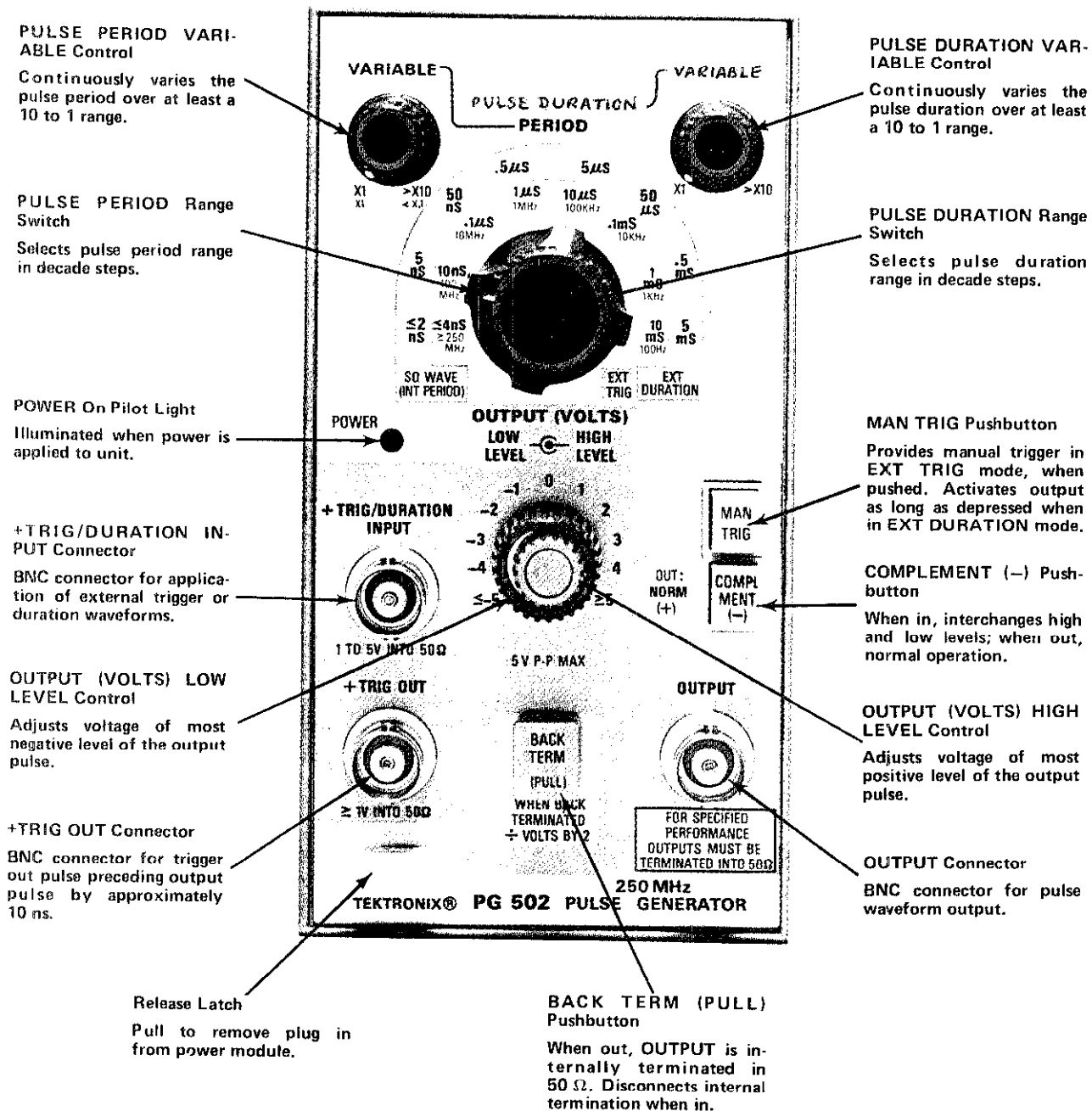


BLOCK DIAGRAM

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0773

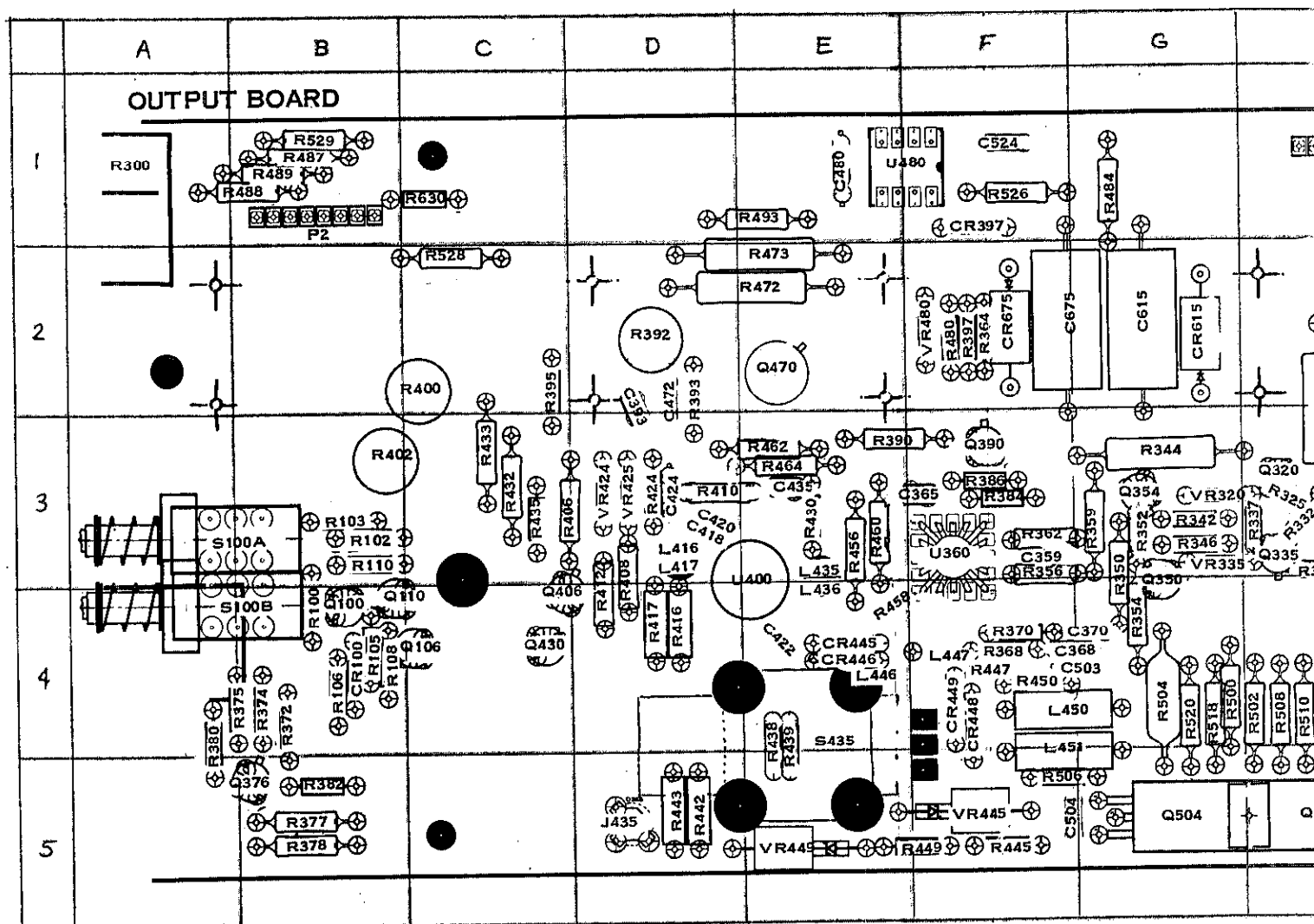


CONTROLS AND CONNECTORS



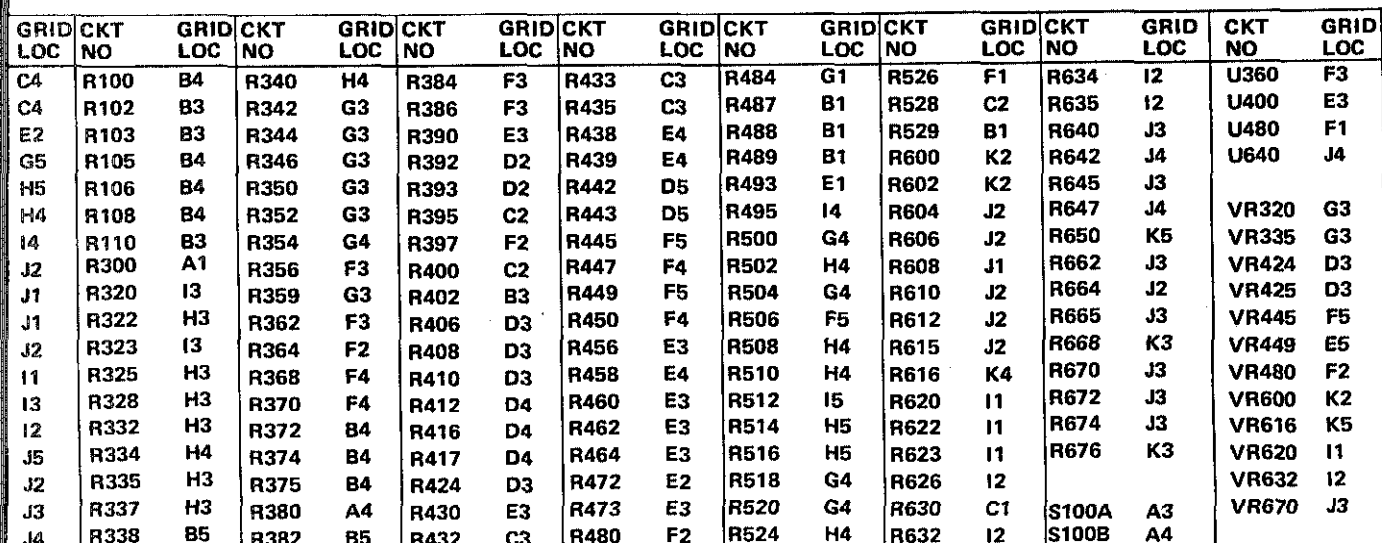
OUTPUT BOARD
Sht. 10F2

PARTS LOCATION GRID



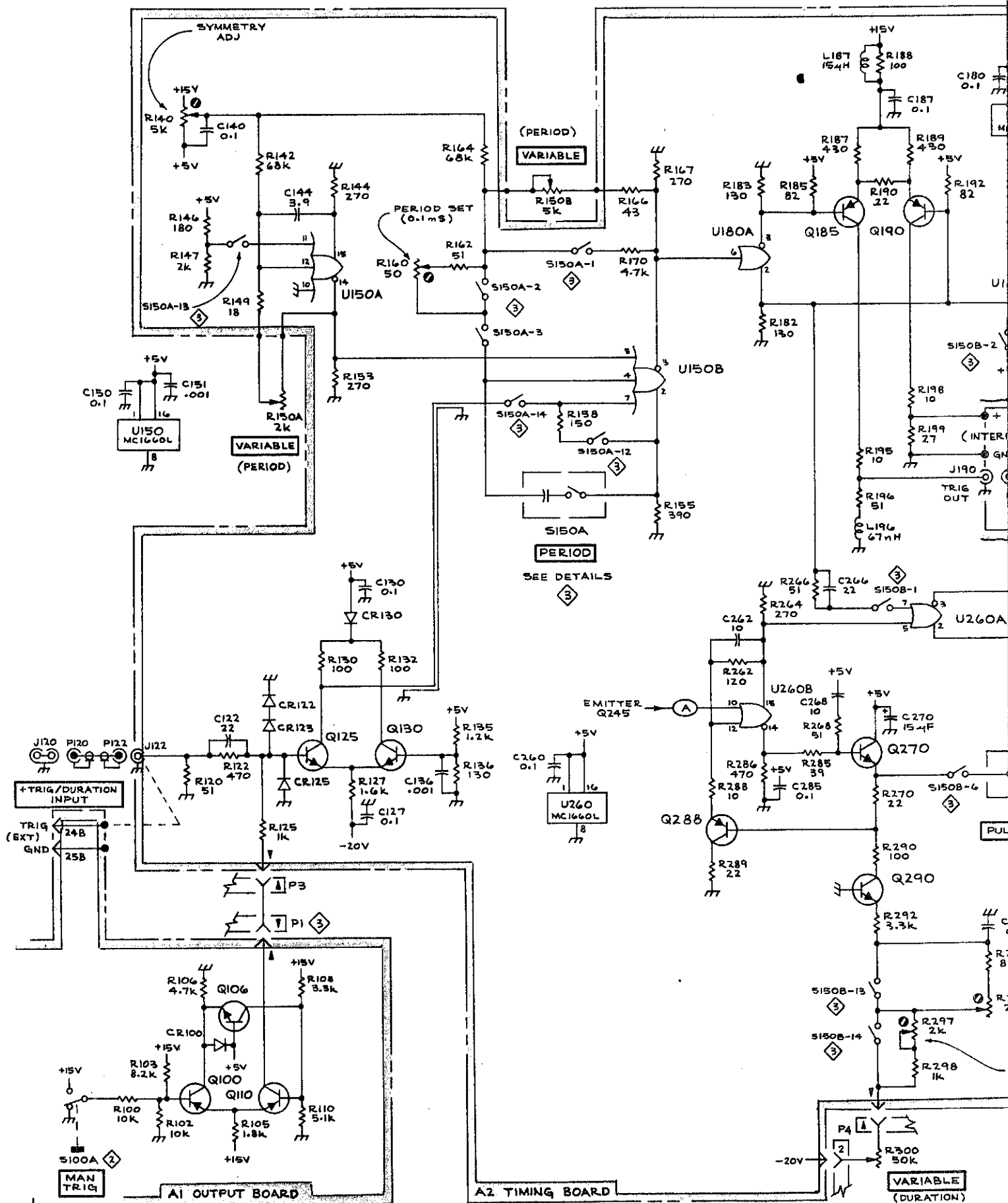
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C359	F3	C524	F1	CR448	F4	L435	E3	Q430	C4	R102	B3	R342	G3	R386	F3	R435	C3
C365	F3	C612	J2	CR449	F4	L436	E3	Q470	E2	R103	B3	R344	G3	R390	E3	R438	E4
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C370	G4	C624	I2	CR635	H2	L447	F4	Q508	H5	R106	B4	R350	G3	R393	D2	R442	D5
C393	D2	C626	I2	CR650	I5	L450	F4	Q516	H4	R108	B4	R352	G3	R395	C2	R443	D5
C418	D3	C628	I3	CR660	J3	L451	F5	Q520	I4	R110	B3	R354	G4	R397	F2	R445	F5
C420	D3	C640	J4	CR675	F2	P1	H1	Q600	J2	R300	A1	R356	F3	R400	C2	R447	F4
C422	E4	C645	J3	F600	K2	P2	B1	Q606	J1	R320	I3	R359	G3	R402	B3	R449	F5
C424	D3	C650	I4	F645	K5	Q100	B4	Q610	J1	R322	H3	R362	F3	R406	D3	R450	F4
C435	E3	C652	I3	F670	K4	Q106	C4	Q612	J2	R323	I3	R364	F2	R408	D3	R456	E3
C472	D2	C674	J4			Q110	B4	Q620	I1	R325	H3	R368	F4	R410	D3	R458	E4
C480	E1	C675	F2	J195	K1	Q320	H3	Q626	I3	R328	H3	R370	F4	R412	D4	R460	E3
C503	G4			J320	H3	Q335	H3	Q632	I2	R332	H3	R372	B4	R416	D4	R462	E3
C504	F5	CR100	B4	J340	H3	Q350	G4	Q650	J5	R334	H4	R374	B4	R417	D4	R464	E3
C511	I4	CR130	H3	J435	D5	Q354	G3	Q660	J2	R335	H3	R375	B4	R424	D3	R472	E2
C512	I5	CR397	F1			Q376	B5	Q670	J3	R337	H3	R380	A4	R430	E3	R473	E3
C516	H4	CR445	E4	L416	D3	Q390	F3	Q674	J4	R338	B5	R382	B5	R432	C3	R480	F2

ARTS LOCATION GRID



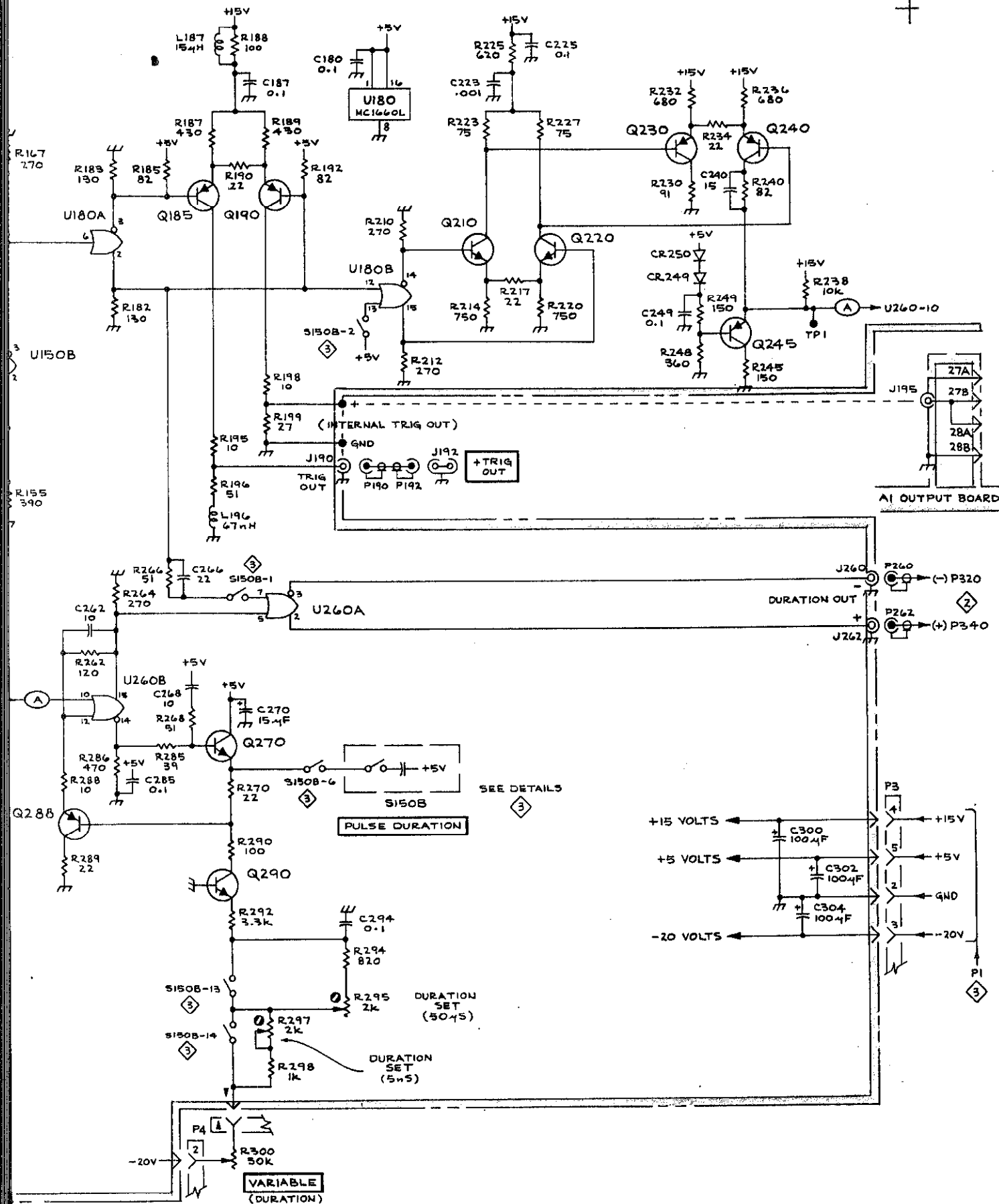
GENERATORS AND TRIGGER ①

Sht. 10F2



GENERATORS AND TRIGGER

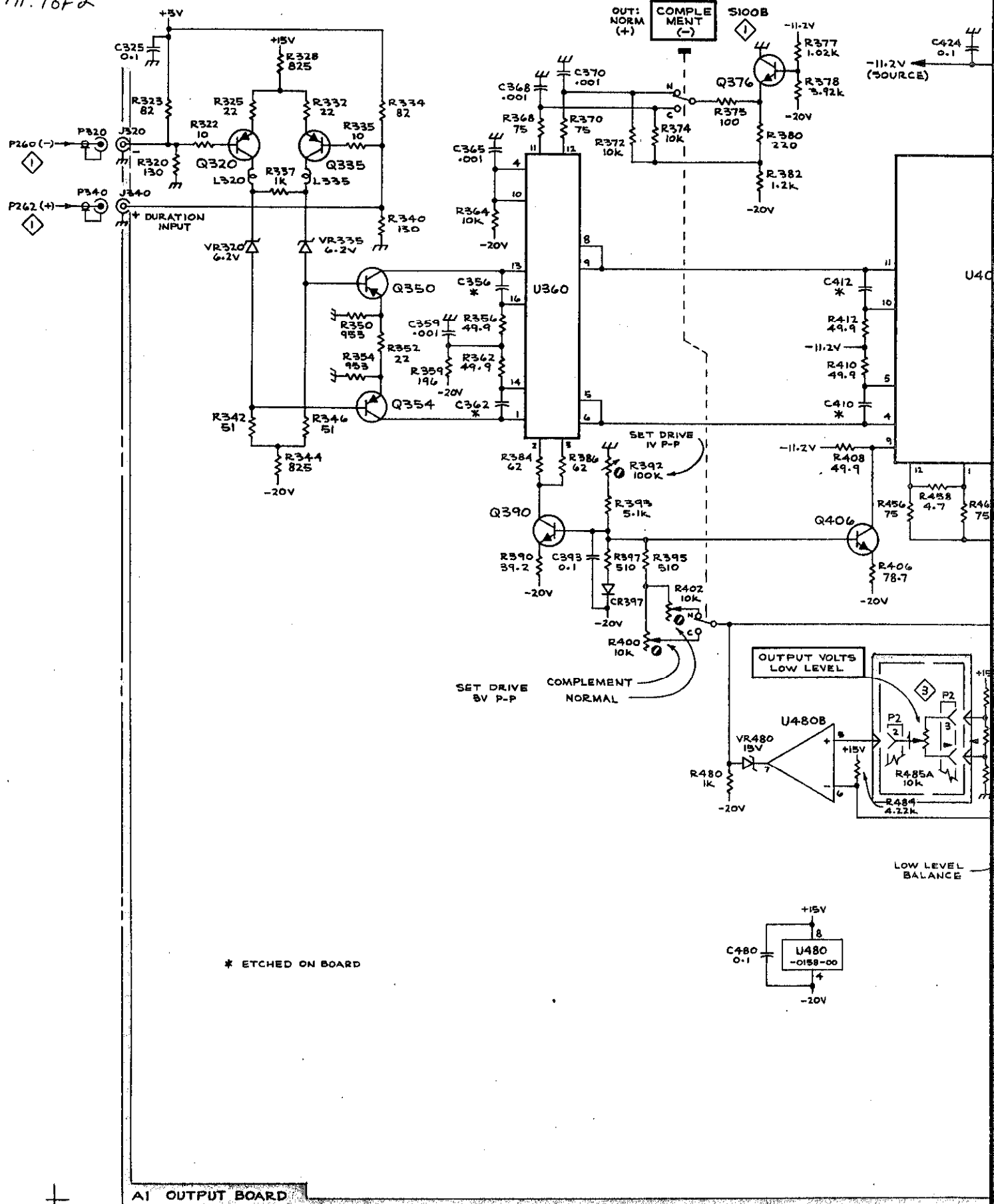
SH-20F2



GENERATORS AND TRIGGER

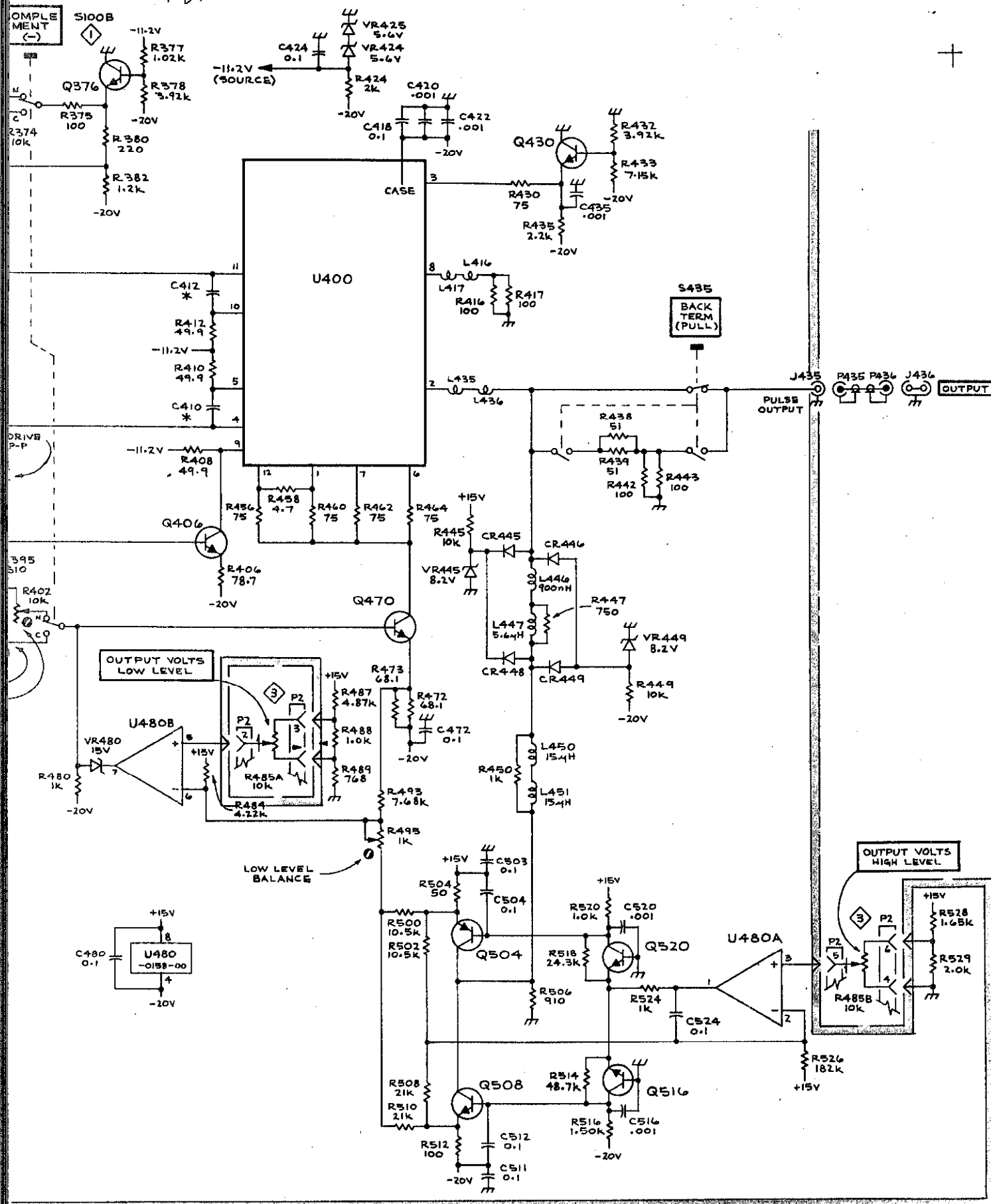
DEM 0773

OUTPUT SCHEMATIC Sht. 1 of 2



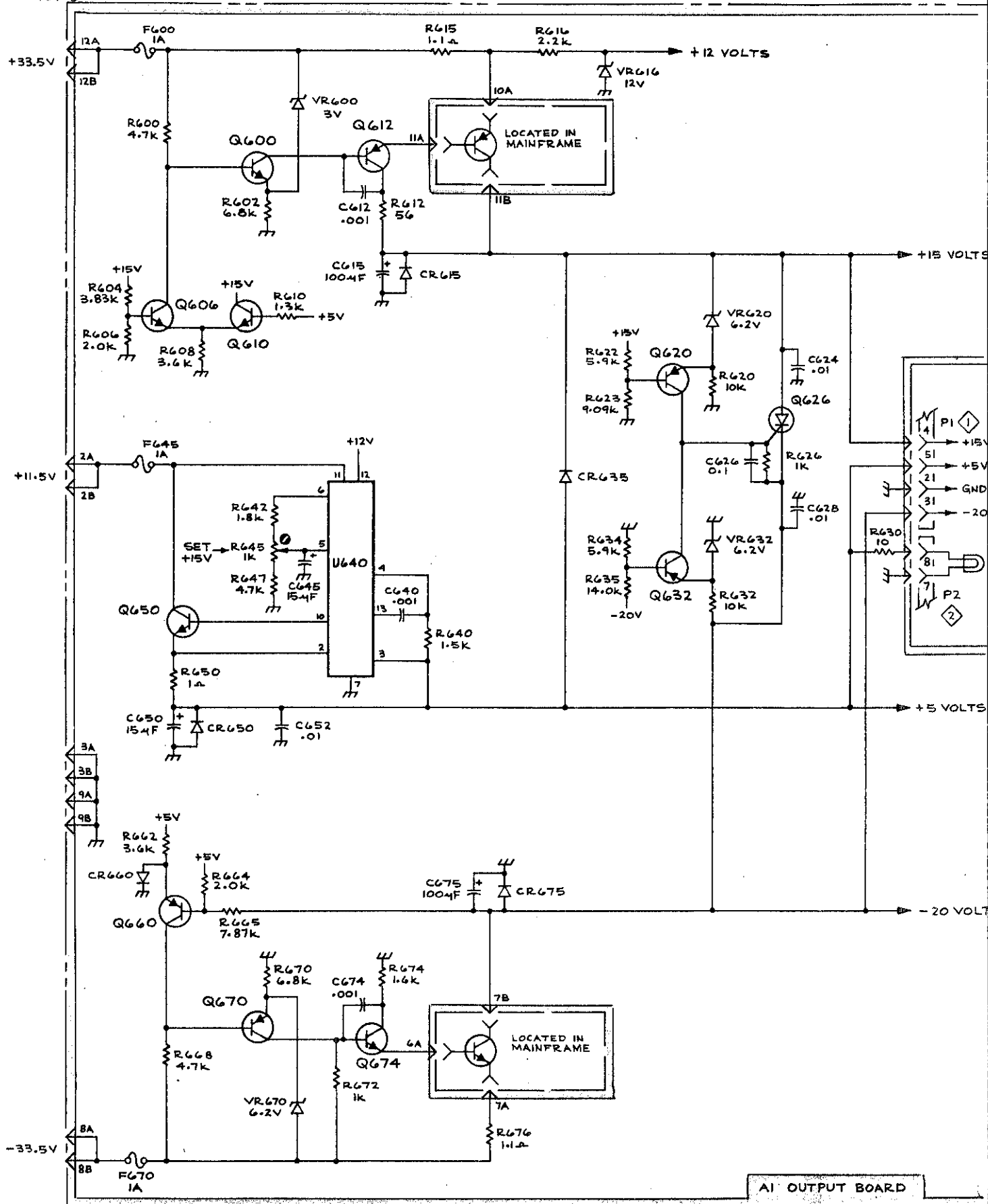
OUTPUT SCHEMATIC

Sht. 20F2



Power Supply AND SWITCH DETAILS 3

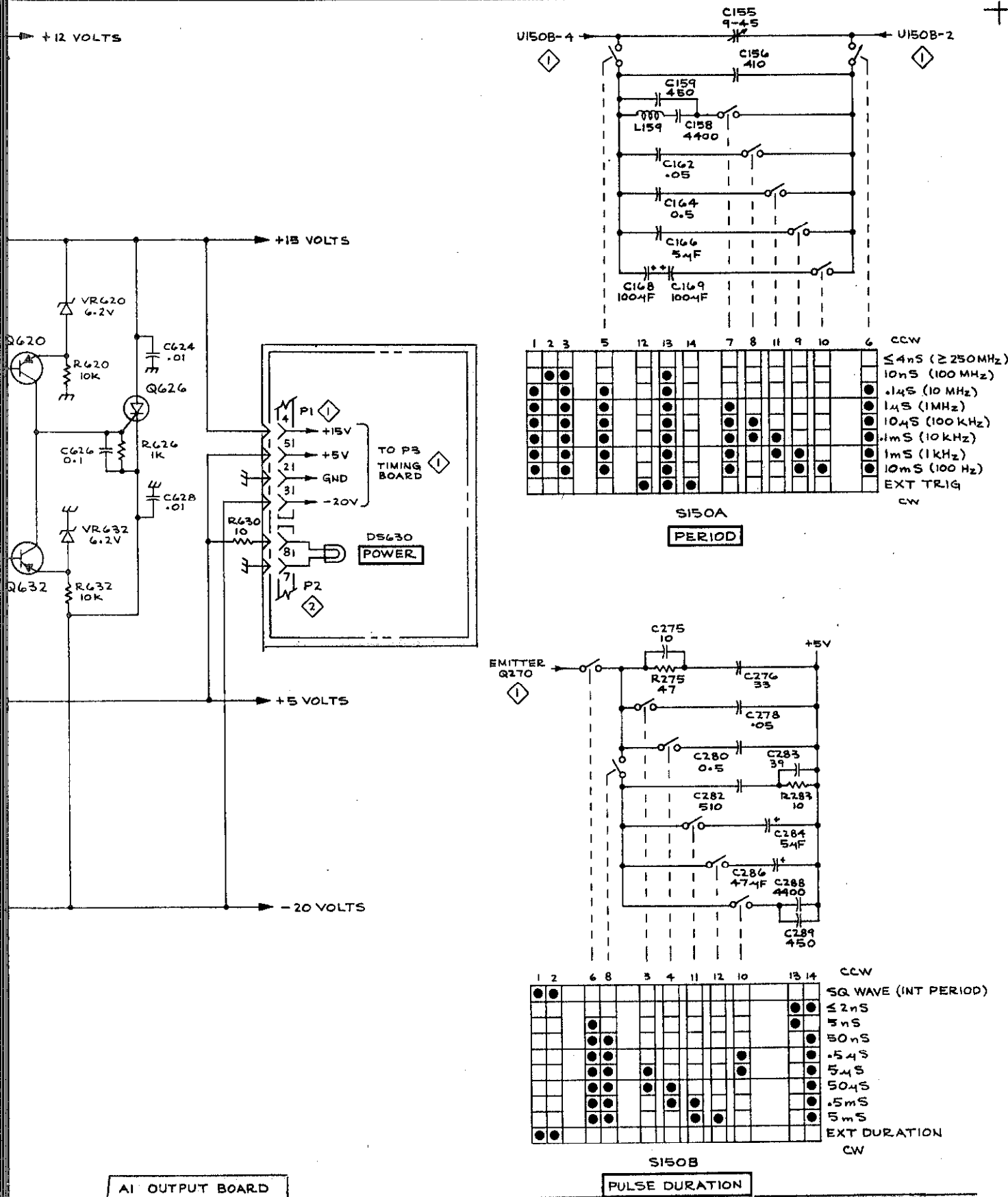
SHT-10F2



+

POWER SUPPLY AND SWITCH DETAILS 3

SH-20F2





MECHANICAL REPLACEABLE PARTS LIST

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
					<i>Assembly and/or Component</i>
					<i>Attaching parts for Assembly and/or Component</i>
				... *	
					<i>Detail Part of Assembly and/or Component</i>
					<i>Attaching parts for Detail Part</i>
				... *	
					<i>Parts of Detail Part</i>
					<i>Attaching parts for Parts of Detail Part</i>
				... *	

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY, STATE, ZIP
0000C	Gettig Engineering and Manufacturing Co.		Springmill, PA 16875
01295	Texas Instruments, Inc., Components Group	P. O. Box 5012	Dallas, TX 75222
08261	Spectra-Strip Corp.	7100 Lampson Ave.	Garden Grove, CA 92642
12327	Freeway Washer and Stamping Co.	P. O. Box 05206	Cleveland, OH 44105
22526	Berg Electronics, Inc.	Youk Expressway	New Cumberland, PA 17070
23499	Gavitt Wire and Cable, Division of Amerace Esna Corp.	455 N. Quince St.	Escondido, CA 92025
24931	Specialty Connector Co., Inc.	3560 Madison Ave.	Indianapolis, IN 46227
26365	Gries Reproducer Corp.	125 Beechwood Ave.	New Rochelle, NY 10802
42838	National Rivet and Mfg. Co.	1-21 East Jefferson St.	Waupun, WI 53963
45722	USM Corp., Parker-Kalon Fastener Div.	1 Peeray Drive	Clifton, NJ 07014
56878	Standard Pressed Steel Co.	P. O. Box 796	Jenkintown, PA 19046
70276	Allen Mfg. Co.	Box 570	Hartford, CT 06101
71785	TRW Electronic Components, Cinch Div.	1501 Morse Ave.	Elk Grove Village, IL 60007
73743	Fischer Special Mfg. Co.	446 Morgan St.	Cincinnati, OH 45206
74445	Holo-Krome Co.	31 Brook St. West	Hartford, CT 06110
78189	Illinois Tool Works, Inc. Shakeproof Division	St. Charles Road	Elgin, IL 60126
79807	Wrought Washer Mfg. Co.	2100 S. O Bay St.	Milwaukee, WI 53207
80009	Tektronix, Inc.	P. O. Box 500	Beaverton, OR 97005
83385	Central Screw Co.	2530 Crescent Dr.	Broadview, IL 60153
97464	Industrial Retaining Ring Co.	57 Cordier St.	Irvington, NJ 07111

FIGURE 1 EXPLODED

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscnt	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		2		KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00		1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	QBD
-3	366-1201-00		1		KNOB:GRAY WITH SETSCREW	80009	366-1201-00
	213-0153-00		2		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	QBD
-4	366-1202-00		1		KNOB:GRAY WITH SETSCREW	80009	366-1202-00
	213-0153-00		2		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	QBD
-5	366-1514-00		1		KNOB:GRAY WITH SETSCREW	80009	366-1514-00
	213-0048-00		1		. SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	QBD
-6	366-1517-00		1		KNOB:GRAY WITH SETSCREW	80009	366-1517-00
	213-0153-00		1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	QBD
-7	366-1489-48		1		PUSH BUTTON:--MANTRIG	80009	366-1489-48
-8	366-1489-49		1		PUSH BUTTON:--COMPLEMENT(-)	80009	366-1489-49
-9	384-1212-00		1		EXTENSION SHAFT:WITH KNOB,4.25 INCHES LONG	80009	384-1212-00
-10	426-0681-00		3		FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-11	214-1840-00		1		PIN,KNOB SECRG:	80009	214-1840-00
-12	366-1422-01		1		KNOB:LATCH	80009	366-1422-01
-13	131-1315-00		3		CONN,RCPT,ELEC:FEMALE BNC,WITH HARDWARE	24931	28JR235-1
-14	358-0378-00		1		BUSHING SLEEVE:PRESS MOUNT	80009	358-0378-00
-15	-----		1		RESISTOR,VARIABLE:(SEE R300 EPL) (ATTACHING PARTS)		
-16	210-0583-00		1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20319-402
-17	210-0940-00		1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	QBD
-18	-----		1		RESISTOR,VARIABLE:(SEE R485A/B EPL) (ATTACHING PARTS)		
-19	210-0583-00		1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20319-402
-20	210-0940-00		1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	QBD
-21	333-1784-00		1		PANEL,FRONT:	80009	333-1784-00
-22	214-1513-01		1		LCH,PLUG-IN RET: (ATTACHING PARTS)	80009	214-1513-01
-23	213-0254-00		1		SCR,TPG,THD CTG:2-56X0.25 100 DEG,FLH STL	45722	QBD
-24	200-0935-00		1		BASE,LAMPHOLDER:0.29 OD X 0.19" L,BK PLSTC	80009	200-0935-00
-25	378-0602-00		1		LENS,LIGHT:GREEN	80009	378-0602-00
-26	352-0157-00		1		LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-27	386-2695-00		1		SUBPANEL,FRONT:PLASTIC (ATTACHING PARTS)	80009	386-2695-00
-28	213-0229-00		4		SCR,TPG,THD FOR:6-20X0.375 100 DEG,FLH STL	83385	QBD
-29	337-1898-00		1		SHLD,ELECTRICAL:FRONT SUBPANEL	80009	337-1898-00
	672-0069-00		1		CKT BOARD ASSY:WITH CAM SWITCH (ATTACHING PARTS)		
-30	213-0336-00		3		SCR,TPG,THD FOR:6-32 X 1.25 INCH,PNH STL	83385	QBD
-31	361-0516-00		3		SPACER,SLEEVE:0.189 OD X 0.986" LONG,BRS	80009	361-0516-00
-32	211-0116-00		8		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	QBD
-33	-----		1		. CKT BOARD ASSY W/CAM SWITCH INCLUDES: . CKT BOARD ASSY:--TIMING(SEE A1 EPL) . CKT BOARD ASSY INCLUDES: . EXTENSION SHAFT:1 INCH LONG	80009	384-1228-00
-34	384-1228-00		1		. CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L	80009	376-0029-00
-35	376-0029-00		2		. SETSCREW:4-40 X 0.094 INCH,HEX SOC STL	70276	QBD
-36	213-0075-00		1		. RESISTOR,VARIABLE:(SEE R140 EPL) (ATTACHING PARTS)		
-37	210-0583-00		1		. NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20319-402
-38	210-0046-00		1		. WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-39	407-0579-00		1		. BRKT,RES.MTG: -----	80009	407-0579-00
-40	131-1003-00		4		. CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-41	136-0252-04		55		. SOCKET,PIN CONN:0.188 INCH LONG	22526	75060-001
-42	131-0608-00		7		. TERMINAL,PIN:0.365 INCH LONG	22526	47357
-43	131-1031-00 ¹		25		. CONTACT ASSY:CAM SWITCH,TOP (ATTACHING PARTS FOR EACH)	80009	131-1031-00
	210-0779-00		1		. RIVET,TUBULAR:0.051 OD X 0.115" LONG -----	42838	RA-29952715

¹See Maintenance Paragraph for repair information.

Mechanical Parts List—PG 502

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-44	131-0566-00		2	.	LINK,TERM.CONN:0.086 DIA X 2.375 INCH L	0000C	L-2007-1
-45	384-0923-00		1	.	EXTENSION SHAFT:5.06 INCHES LONG	80009	384-0923-00
	263-1009-00		1	.	ACTR ASSY,CAM S:DURATION (ATTACHING PARTS)	80009	263-1009-00
-46	211-0116-00		4	.	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-47	354-0391-00		1	.	ACTUATOR ASSY INCLUDES:		
-48	401-0081-02		1	.	RING,RETAINING:0.395"FREE IDX 0.025"STL	97464	3100-43-CD
-49	210-0406-00		1	.	BEARING,CAM SW:FRONT	80009	401-0081-02
-50	214-1139-02		8	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-51	214-1139-03		1	.	SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-52	214-1127-00		1	.	SPRING,FLAT:RED COLORED	80009	214-1139-03
-53	105-0510-00		2	.	ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-54	401-0115-00		1	.	DRUM,CAM SWITCH:	80009	105-0510-00
-55	376-0052-00		1	.	BEARING,CAM SW:	80009	401-0115-00
			1	.	CPLG,SHAFT,FLEX:	80009	376-0052-00
			.	.	COUPLING INCLUDES:		
	354-0251-00		1	.	RING,COUPLING:	80009	354-0251-00
	376-0049-00		1	.	CPLG,PLASTIC:	80009	376-0049-00
	354-0261-00		1	.	RING COUPLING:	80009	354-0261-00
	213-0022-00		2	.	SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
	213-0075-00		2	.	SETSCREW:4-40 X 0.094 INCH,HEX SOC STL	70276	OBD
	213-0115-00		1	.	SETSCREW:4-40 X 0.312 INCH,HEX SOC STL	56878	OBD
	263-1010-00		1	.	ACTR ASSY,CAM S:TIME/CM (ATTACHING PARTS)	80009	263-1010-00
-56	211-0116-00		4	.	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-57	354-0391-00		1	.	ACTUATOR ASSY INCLUDES:		
-58	401-0081-02		1	.	RING,RETAINING:0.395"FREE IDX 0.025"STL	97464	3100-43-CD
-59	210-0406-00		1	.	BEARING,CAM SW:FRONT	80009	401-0081-02
-60	214-1139-02		8	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-61	214-1127-00		2	.	SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-62	105-0509-00		2	.	ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-63	401-0115-00		1	.	DRUM,CAM SWITCH:	80009	105-0509-00
-64			1	.	BEARING,CAM SW:	80009	401-0115-00
-65	213-0146-00		1	.	CKT BOARD ASSY:--OUTPUT(SEE A2 EPL) (ATTACHING PARTS)		
-66	131-0608-00		13	.	SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
-67	344-0154-00		4	.	CKT BOARD ASSY INCLUDES:		
-68			1	.	TERMINAL,PIN:0.365 INCH LONG	22526	47357
			1	.	CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
			1	.	TRANSISTOR:(SEE Q650 EPL) (ATTACHING PARTS)		
-69	211-0040-00		1	.	SCREW,MACHINE:4-40 X 0.25",BDCH PLSTC	26365	921112
-70	210-0406-00		1	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-71	342-0202-00		1	.	INSULATOR,PLATE:	01295	10-21-023-106
-72	136-0252-04		44	.	SOCKET,PIN CONN:0.188 INCH LONG	22526	75060-001
-73	136-0269-00		1	.	SKT,SEMICONDE DE:14 PIN DUAL INLINE	71785	133-59-02-073
-74			2	.	TRANSISTOR:(SEE Q504/Q508 EPL) (ATTACHING PARTS)		
-75	211-0097-00		1	.	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-76	210-0406-00		1	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-77	131-1003-00		3	.	CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-78	260-1425-00		1	.	SWITCH,PUSH:DOUBLE	80009	260-1425-00
-79	361-0382-00		4	.	SPACER,PB SW:BROWN,0.275 INCH LONG	80009	361-0382-00
-80	131-1031-00 ¹		3	.	CONTACT ASSY:CAM SWITCH,TOP (ATTACHING PARTS FOR EACH)	80009	131-1031-00
	210-0779-00		1	.	RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG	42838	RA-29952715
-81			1	.	INTEGRATED CKT:(SEE U400 EPL) (ATTACHING PARTS)		
-82	210-0457-00		1	.	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-83	210-0406-00		2	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-84	214-1917-00		1	.	HEAT SINK,ELEC:TRANSISTOR	80009	214-1917-00
-85	210-0802-00		1	.	WASHER,FLAT:0.15 ID X 0.312 INCH OD	12327	OBD
-86	210-1017-00		1	.	WASHER,NONMETAL:0.281 ID X 0.875 INCH OD	80009	210-1017-00
-87	211-0071-00		1	.	SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD

¹See Maintenance Paragraph for repair information.

FIGURE 1 EXPLODED (cont.)

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-	105-0423-00		1		. ACTR ASSY, SL SW: BANDWIDTH LIMIT	80009	105-0423-00
	-----		-		. . . ACTUATOR ASSY INCLUDES:		
-88	376-0146-00		1		. . . CPLG, SHAFT, RGD: FOR 0.125 INCH DIA SHAFT	80009	376-0146-00
	213-0048-00		1		. . . SETSCREW: 4-40 X 0.125 INCH HEX SOC STL	74445	08D
-89	105-0422-00		1		. . . ACTUATOR, SL SW:	80009	105-0422-00
-90	351-0355-00		1		. . . GUIDE, SW SLIDE:	80009	351-0355-00
-91	214-1126-01		2		. . . SPRING, FLAT: GREEN COLORED	80009	214-1126-01
	214-1127-00		2		. . . ROLLER, DETENT: 0.125 DIA X 0.125 INCH L	80009	214-1127-00
-92	426-0724-04		1		FR SECT, BOTTOM:	80009	426-0724-04
-93	214-1061-00		1		SPRING, GROUND: FLAT	80009	214-1061-00
-94	426-0725-05		1		FRAME, SECT, TOP:	80009	426-0725-05
-95	210-0774-00		10		EYELET, METALLIC: 0.152 OD X 0.245 INCH L, BRS	80009	210-0774-00
-96	210-0775-00		10		EYELET, METALLIC: 0.126 OD X 0.23 INCH L, BRS	80009	210-0775-00
-97	175-0825-00		FT		WIRE, ELECTRICAL: 2 WIRE RIBBON	23499	TEK-175-0825-00
-98	175-0828-00		FT		WIRE, ELECTRICAL: 5 WIRE RIBBON	23499	TEK-175-0828-00
-99	175-0831-00		FT		WIRE, ELECTRICAL: 8 WIRE RIBBON	08261	TEK-175-0831-00
-100	131-0707-00		20		CONNECTOR TERM.: 0.48"L, 22-26 AWG WIRE	22526	47439
-101	352-0169-04		1		HOLDER, TERM. CON: 2 WIRE, YELLOW	80009	352-0169-04
-102	352-0163-01		1		HOLDER, TERM. CON: 5 WIRE, BROWN	80009	352-0163-01
	352-0163-03		1		HOLDER, TERM. CON: 5 WIRE, ORANGE	80009	352-0163-03
-103	352-0166-02		1		HOLDER, TERM. CON: 8 WIRE, RED	80009	352-0166-02

Fig. 1 Exploded
Sht. 1 of 2

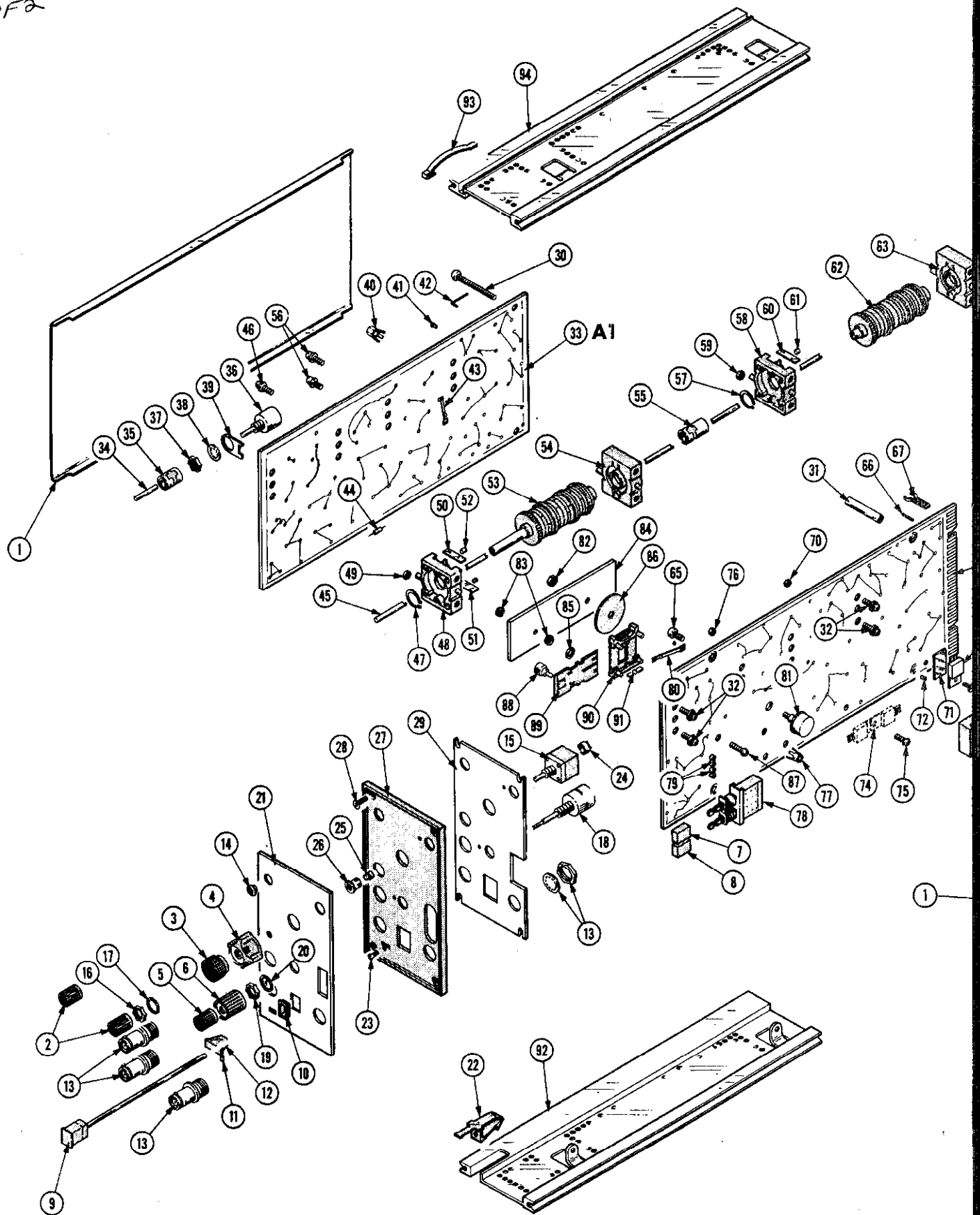
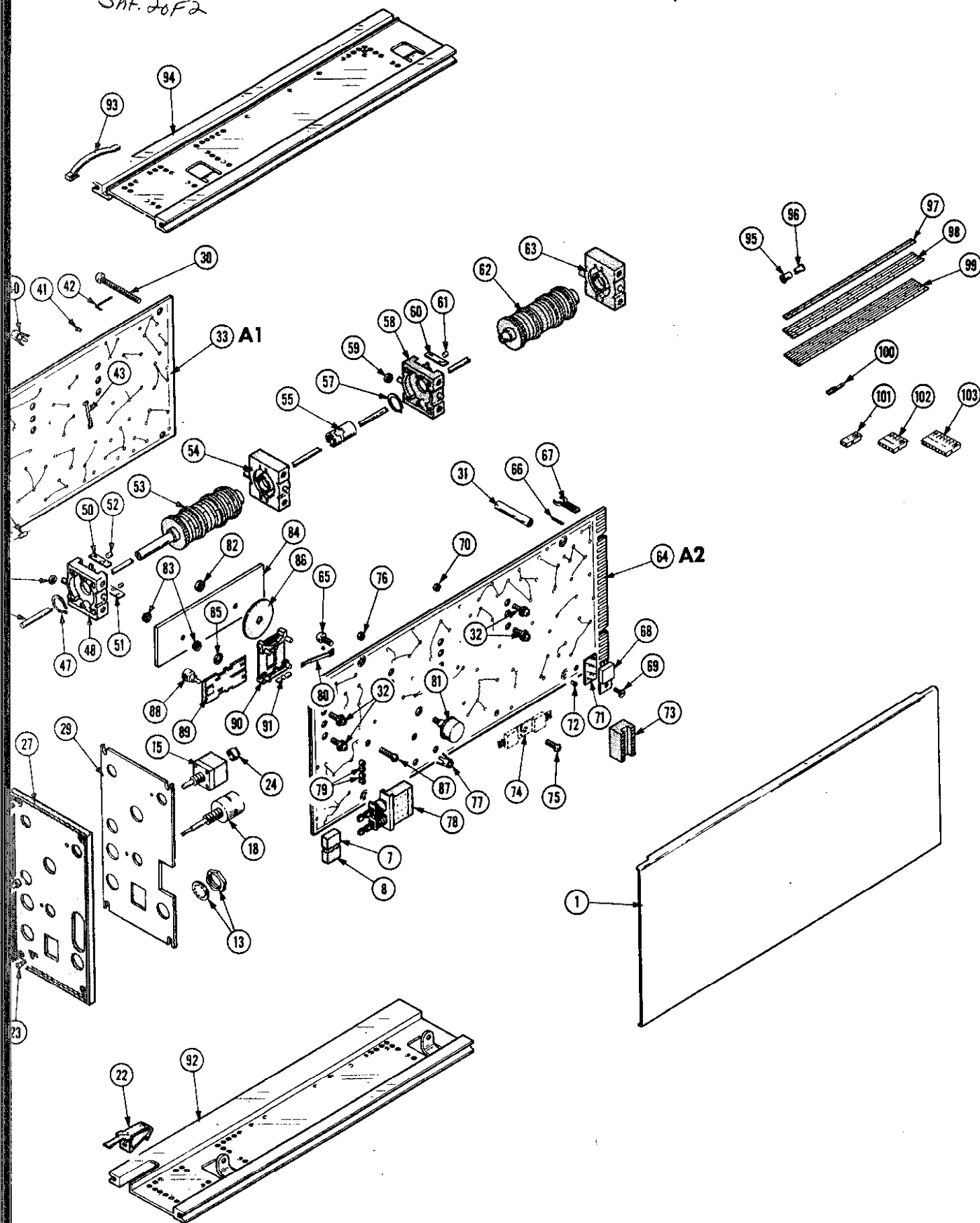


Fig. 1 Exploded
Sht. 20F2



ACCESSORIES & REPACKAGING
 + Sht. 1 of 2

ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
	012-0482-00		1						CABLE ASSY, RF:36 INCHES LONG	80009	012-0482-00
	070-1598-00		1						MANUAL TECH: SERVICE	80009	070-1598-00

Fig. & Index No.	Tektronix Part No.
2-	065-0151
-1	004-0281
-2	004-0241
-3	004-0241
-4	004-1091
-5	004-0611

ACCESSORIES & REPACKAGING

Sht. 2 of 2

REPACKAGING

Mfr Part Number

012-0482-00

070-1598-00

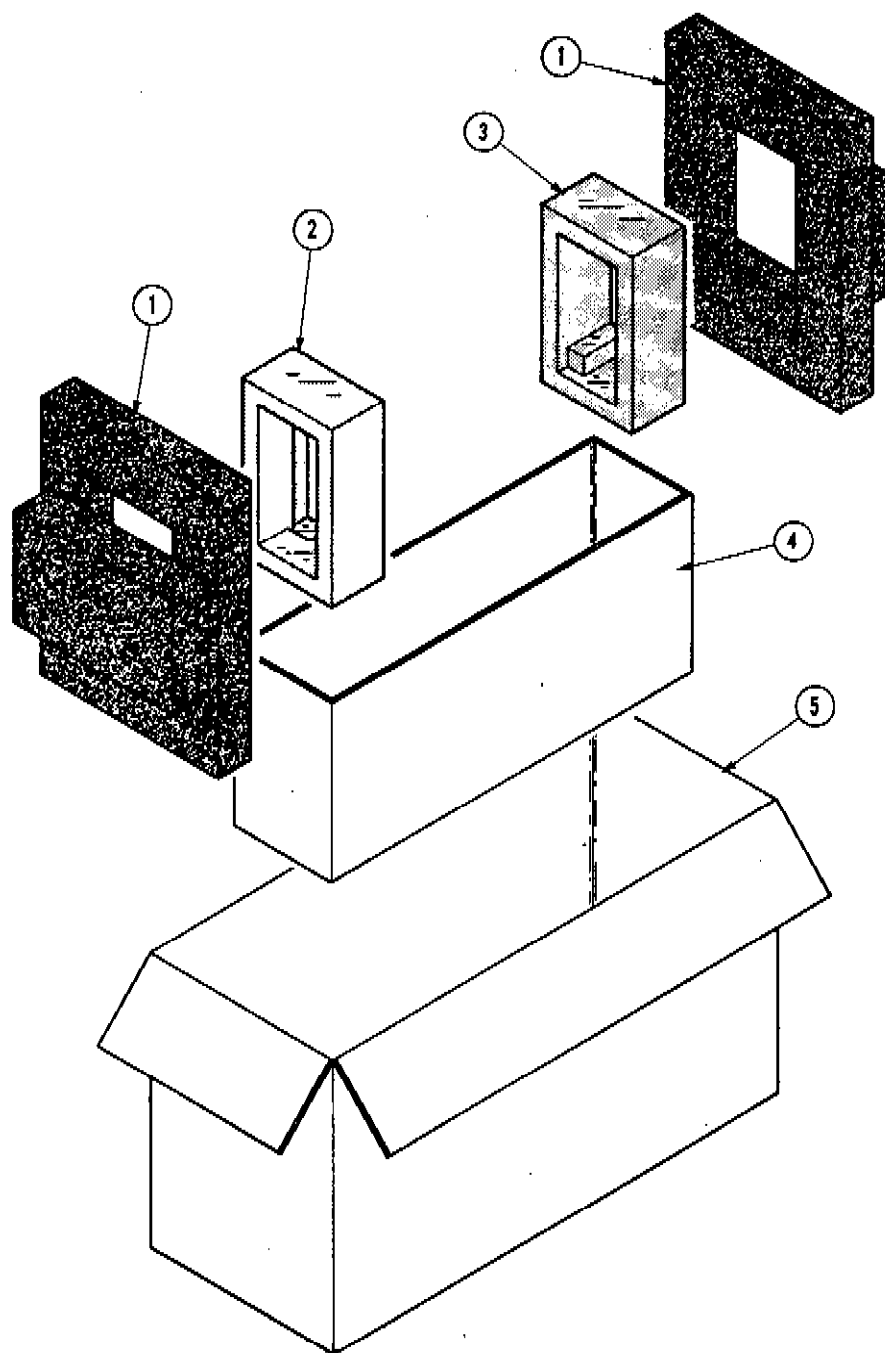


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Discont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
2-	065-0151-00			1						CARTON ASSEMBLY:	80009	065-0151-00
-1	004-0282-00			-						CARTON ASSEMBLY INCLUDES:	80009	004-0282-00
-2	004-0243-00			2						FRAME:PLASTIC FOAM	80009	004-0243-00
-3	004-0242-00			1						PAD,CUSHIONING:FRONT	80009	004-0242-00
-4	004-1093-00			1						PAD,CUSHIONING:REAR	80009	004-1093-00
-5	004-0612-00			1						PAD,CUSHIONING:13.375 X 3.25 X 5.625"	80009	004-0612-00
				1						CARTON:16.50 X 6.625 X 9.125 INCHES	80009	004-0612-00

MANUAL CHANGE INFORMATION

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

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

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

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

Q516	151-0410-00	TRANSISTOR: SILICON, PNP
R149	317-0180-00	RES., FXD, COMP: 18 ohm (nominal value) selected
R245	315-0750-00	RES., FXD, COMP: 75 ohm, 5%, 0.25 W
R286	315-0271-00	RES., FXD, COMP: 270 ohm, 5%, 0.25 W
R297	311-1560-00	RES., VAR, NONWIR: 5K ohm
R342	321-0068-00	RES., FXD, COMP: 49.9 ohm, 1%, 0.125 W
R346	321-0068-00	RES., FXD, COMP: 49.9 ohm, 1%, 0.125 W

REMOVE:

R238	315-0103-00	RES., FXD, COMP: 10K ohm, 5%, 0.25 W
R298	315-0102-00	RES., FXD, COMP: 1K ohm, 5%, 0.25 W

(R298 is replaced by a jumper (131-0566-00)).

ADD:

C245	281-0611-00	CAP, FXD, CER., 2.7 pF (nominal value) selected
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(C245 is added between the base and collector of Q245.)

C172	283-0643-00	CAP, MICA, 22 pF, 300 V
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(C172 is added between pins 2 and 4 of U150)