TEKTRONIX®

PG 508
50 MHz
PULSE GENERATOR

INSTRUCTION MANUAL

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Serial Number _____

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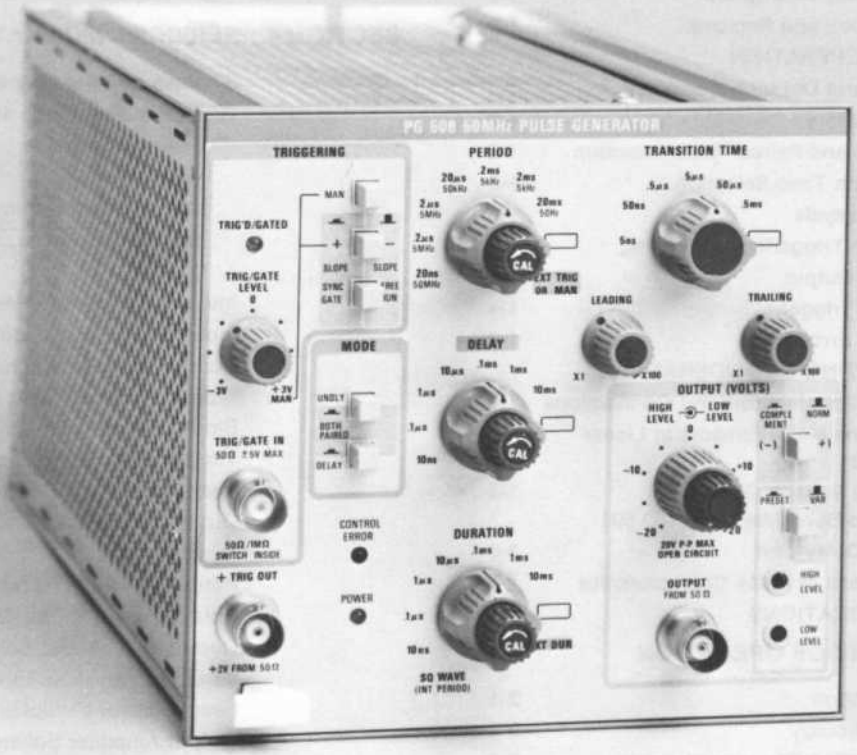

PG 508 50MHz PULSE GENERATOR
TRIGGERING
TRIG'D/GATED
TRIG/GATE LEVEL
TRIG/GATE IN
+ TRIG OUT
MODE
CONTROL ERROR
POWER
PERIOD
DELAY
DURATION
SQ WAVE
TRANSITION TIME
LEADING
TRAILING
OUTPUT (VOLTS)
HIGH LEVEL
LOW LEVEL
OUTPUT

OPERATING INSTRUCTIONS

Instrument Description

The PG 508 is a 50 MHz general purpose full function pulse generator usable in all TM 500-series power modules except the TM 501. It is compatible with MOS and other general purpose circuitry. Important features of the instrument include independent period and duration controls with a control error light, independent pulse top and bottom level controls, variable leading and trailing transition time adjustments, and fully adjustable pulse delay capabilities. Front panel controls and connectors provide a trigger or synchronous gate input with level and slope controls, square wave output and complementary pulse output for high duty factors. Delayed and paired pulse and manual trigger or gate capabilities are also provided. All inputs and outputs are internally terminated in 50 Ω except the TRIG/GATE input which is internally selectable for either 50 Ω or 1 MΩ, 20 pF input impedance. Special positions on PERIOD, DURATION, DELAY, and TRANSITION controls permit customized control ranges.

The front panel is color coded for easy reference to controls and their associated functions. Green indicates triggering functions and blue indicates mode functions.

Installation and Removal

The PG 508 is calibrated and ready for use when received. It operates in any two compartments of the TM 500-series power modules. See the power module instruction manual for line voltage requirements and power module operation. Fig. 1-1 shows the installation and removal procedure. Make certain the power module is **off** when inserting or removing the PG 508. Check that the PG 508 is fully inserted in the power module. Pull the power switch on the power module. The POWER light on the PG 508 should now be on. Refer to the Controls and Connectors foldout page in Section 4 of this manual for a complete description of the front panel controls and connectors.

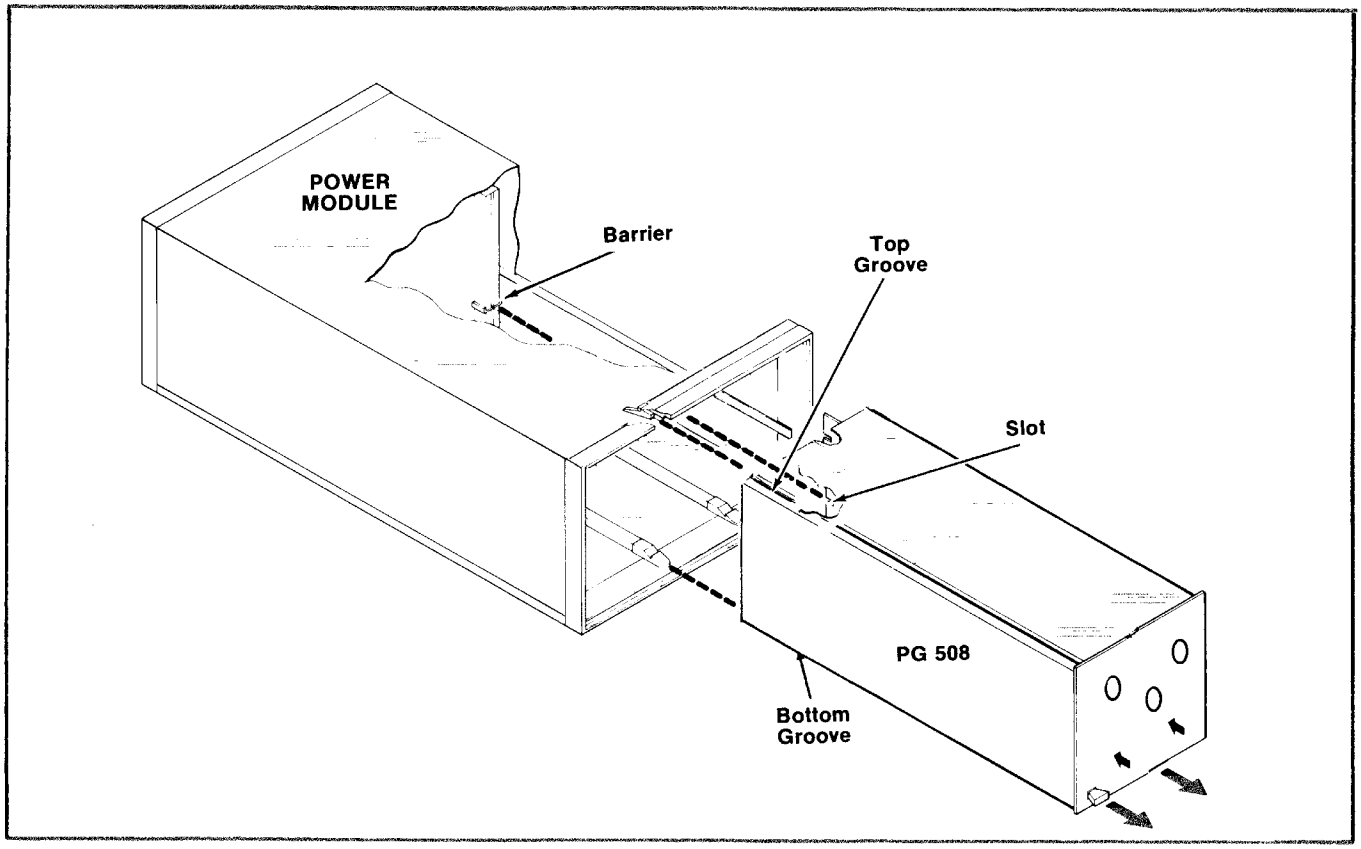


Fig. 1-1. PG 508 installation and Removal.

BASIC OPERATION

Period and Duration Selection

The period generator operates, in all modes except EXT TRIG or MAN, at a rate set by the PERIOD range switch and variable control. The duration of the output pulse is set by the DURATION range switch and variable control. When the DURATION control is set for a time greater than the PERIOD, the CONTROL ERROR lamp will light. When the DURATION control is set to the SQ WAVE position, the duration time is determined internally at approximately 50% of the period time.

The custom range positions on the PERIOD and DURATION controls permit user-selected period and duration times. To determine the approximate capacitor value for the desired period, multiply the period time in seconds by 5×10^{-3}. The result is the value of the capacitor in Farads. For example, a 50 ms period times 5×10^{-3} equals 250×10^{-6} or 250 μF. This capacitor must be non-polarized and have at least a 6 V rating. Solder this capacitor in the position shown in Fig. 1-2.

To determine the capacitor value for the duration time desired, multiply the duration time by 1×10^{-2}. For example a 50 ms duration time requires 50 ms times 1×10^{-2} or a 500 μF capacitor. If a polarized capacitor is used, observe the correct polarity. Use at least a 6 V rated capacitor. Connect this capacitor as shown in Fig. 1-2.

Duty Factors

Duty factors greater than those specified are obtainable on several ranges. When the duty factor is increased to the point that internal circuitry prevents completion of the pulse waveform, the CONTROL ERROR light will flash. To further increase the duty factor, switch to the complement mode. Set the DURATION control for a pulse width equal to the desired pulse off time and push the front panel COMPLEMENT (—) pushbutton.

Delayed and Paired Pulse Selection

In the pulse delay mode, the output pulse is delayed from the +TRIG OUT signal by the DELAY time selected plus a specified fixed delay. In the PAIRED mode of operation, the delay controls the time between the leading edges of the paired pulses. To use this feature push the DELAY button and trigger the external device from the +TRIG OUT jack. Set the DELAY control for the desired delay time from trigger to pulse leading edge. Use the variable control labeled CAL for time adjustments between steps or to increase the delay times beyond the steps.

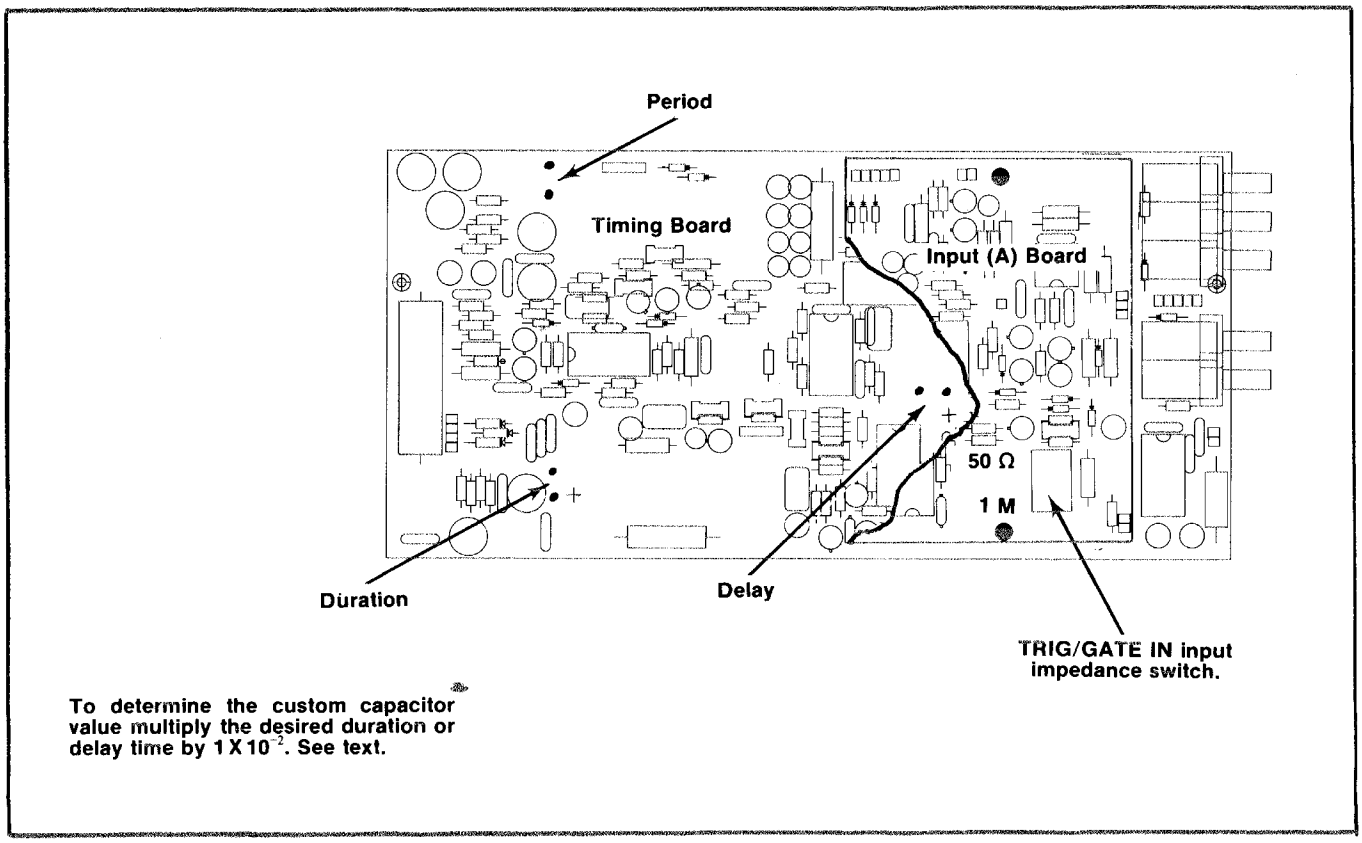


Fig. 1-2. Locations of period, delay and duration custom timing capacitors and TRIG/GATE IN input impedance switch. Remove the Input board to gain access to the delay pads.

Paired pulses are obtained by pushing both the DELAY and UNDLY buttons. An initial pulse now occurs at external trigger time with the second or paired pulse delayed by the selected delay time. The CONTROL ERROR light illuminates if the delay is too short or long for a valid pulse train. A custom delay position is provided on the DELAY switch. To determine the value of the capacitor required, multiply the desired delay time in seconds by 1 X 10^{-2}. For example, a 50 ms delay time requires a 500 μF capacitor (50 ms times 1 X 10^{-2}). Use either a polarized or non-polarized capacitor with a rating of at least 6 V. If a polarized capacitor is used, observe the polarity markings. Remove the input board and connect the capacitor as shown in Fig. 1-2.

Transition Time Selection

The leading and trailing times of the pulses may be varied by using the TRANSITION TIME control and the LEADING and TRAILING variable controls. Select the desired transition time range with the TRANSITION TIME control and vary the leading and trailing times independently with the LEADING and TRAILING controls.

A custom range position is also provided on the TRANSITION TIME control. To select the correct capacitor (in Farads) for this range, multiply the desired transition time (in seconds) measured from 10% to 90% points, by 4.4 X 10^{-3}. For example, a desired transition time of 50 ms requires a capaciator of 220 μF. Connect the capacitor as shown in Fig. 1-3. Use a capacitor with at least a 10 V rating and observe polarity requirements.

When the transition times become large compared with the duration or period times and the pulse does not reach full amplitude, the CONTROL ERROR light will flash indicating improper control settings.

Output Levels

The output amplitude and offset are selected by independent pulse LOW LEVEL and HIGH LEVEL controls. Use the front panel voltage calibration marks for an open circuit load and divide the values by two when the PG 508 is operating into a 50 Ω load. The OUTPUT (VOLTS) controls are interlocked to prevent setting the HIGH LEVEL more negative than the LOW LEVEL. It is also impossible to set the controls for more than about 20 V peak to peak output amplitude into an open circuit or 10 V 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 base line reference level. The flexibility of this method is useful in certain applications such as logic testing. Either the high or low level can be varied without disturbing the other.

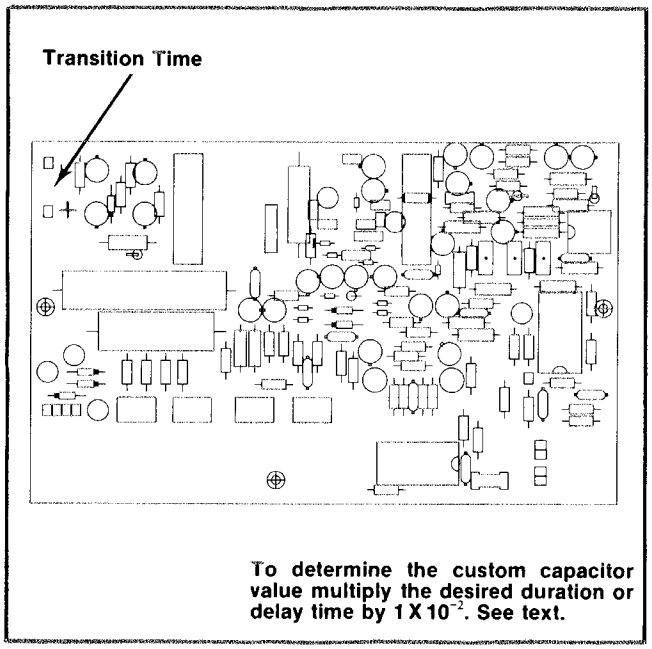


Fig. 1-3. Location tor transition custom timing capacitor.

The pulse high and low levels can be preset. Push the PRESET button and adjust the HIGH LEVEL and the LOW LEVEL potentiometers with a screwdriver for the desired output levels.

External Triggering and Gating

To change the TRIG/GATE IN input impedance remove the plug-in from the mainframe. Remove the left side cover. Set the slide switch, located on the Input board and labeled Input Impedance, to either the 50 Ω or the 1 MΩ position. In the 1 MΩ position the shunt capacitance is approximately 20 pF. A standard oscilloscope probe can be used to acquire the triggering signal from the external circuitry. If a compensated probe is used, calibrate the probe on the input of a 1 MΩ 20 pF oscilloscope first. A 10X probe allows triggering directly from high impedance sources such as MOS digital circuitry with an effective TRIG/GATE LEVEL range of ±30 V.

For external gating select the desired period and duration. Press the SYNC GATE pushbutton. Select the desired trigger slope with the + or − SLOPE button. The OUTPUT now consists of pulses, described by the front panel controls, whenever the TRIG/GATE IN input exceeds the TRIG/GATE LEVEL control setting.

To externally trigger the PG 508, connect the triggering signal to the TRIG/GATE IN connector. Select the slope on which triggering is desired with the + or − SLOPE button. Place the PERIOD switch in the EXT TRIG OR MAN position. Now adjust the TRIG/GATE LEVEL control for the desired triggering level. The output waveform commences about 48 ns after the triggering signal.

For external DURATION place the DURATION control in the EXT DUR position, and the PERIOD control in the EXT TRIG OR MAN position. The period and duration of the output waveform are now controlled by the triggering waveform. This is an extremely useful mode of operation for translating logic levels, etc. If the PERIOD is set for internal operation and the DURATION for external, the CONTROL ERROR light illuminates indicating an illegal mode of operation.

The TRIG'D/GATED indicator light functions as a TRIG/GATE level indicator. When the +SLOPE is selected and the external input level exceeds the threshold set by the TRIG/GATE LEVEL control, the light is on continuously. For input voltages below the threshold the light is continuously off. When the input transits through the threshold the light flashes. When the −SLOPE is selected the light behaves as for +SLOPE selection. However, the polarities are reversed.

The TRIG'D/GATED indicator light may be used as a logic level indicator for troubleshooting logic circuitry. Set the TRIG/GATE LEVEL control to a voltage equal to the midrange value of the logic voltage swing. If an attenuator probe is used for signal pickup, remember to consider the attenuation factor when setting the TRIG/GATE LEVEL voltage.

Trigger Output

The signal appearing at the connector is an approximate square wave. The leading edge (positive-going) precedes the output pulse by a specified fixed delay plus the delay as set by the DELAY control. In paired pulse operation, the leading edge precedes the first pulse by the fixed delay. The second pulse then appears after the set delay. A complement square wave (negative-going leading edge) is also available at the front panel by moving a connector on the timing circuit board. See the illustration on the Rear Interface Connector Assignments at the rear of this manual for the location of this connector.

Manual Trigger

To use this feature place the PERIOD switch in the EXT TRIG OR MAN position. Set the TRIG/GATE LEVEL control fully clockwise. If the +SLOPE is selected, the manual trigger will occur when the MAN button is depressed. If the −SLOPE is selected, the trigger occurs when the button is released. The manual trigger causes one output pulse, or a set of paired pulses if the DELAY and UNDLY buttons are depressed.

Control Error Light

The CONTROL ERROR light helps to solve setup problems by indicating most control errors. A steady glow indicates static control setting errors while a flashing light indicates dynamic errors. In either case, the control settings do not correctly indicate the output. Check the control settings for compatibility. See Table 1-1. Dynamic functions monitored are period, delay, duration and transition time.

OPERATING CONSIDERATIONS

Output Terminations and Connections

The PG 508 operates as a voltage source in series with an internal 50 Ω impedance. Maximum pulse fidelity is obtained when the output operates into an external 50 Ω impedance. The output circuitry of the PG 508 is fully protected against any voltage transients when operating into passive loads.

Table 1-1 lists static control settings that illuminate the CONTROL ERROR light and their corresponding operating modes. Some of these modes may be useful.

If the load has a dc voltage across it, connect a blocking capacitor in series with the OUTPUT connector and the load. Make certain the time constant of the capacitor and load is large enough to maintain pulse top flatness.

TABLE 1-1

Control Settings	Operation
EXT TRIG OR MAN and SYNC GATE	External Trigger Mode
EXT DUR and Internal Period	Square Wave Mode
EXT TRIG OR MAN and SQ WAVE (INT PERIOD)	External Duration Mode
SQ WAVE (INT PERIOD) and SYNC GATE	Truncated square wave when gate ends
SQ WAVE (INT PERIOD) and DELAY	No delay
EXT DUR and DELAY	No delay

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 508, 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 systems, determine the actual risetime of the device under test by using the following formula:

$$R_t = \sqrt{R^2_1 + R^2_2 + R^2_3 \ldots\ldots}$$

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.

External Voltage Control

The high and low level output voltages can be controlled externally through pins 22B and A at the rear interface connector. Fig. 1-4 shows the equivalent circuit.

Connections must be made from pad K to pad L and pad M to pad N located as shown on the adjustment location illustration in the fold out pages at the rear of this manual. Use ordinary hookup wire of the proper length. Solder the wire to the pads. Also note the location of the Ext Hi and Ext Lo potentiometers on the output board.

To use this feature, set the front panel controls as follows: depress the PRESET button (PRESET), place the PERIOD switch in the EXT TRIG OR MAN position, the DURATION in EXT DUR and the NORM COMPLEMENT switch in the NORM position (out). Use a screwdriver to center the Ext Hi and the preset HIGH LEVEL controls. Supply a voltage to the external high input (pin 22B on the rear interface connector) equal to the lowest external input voltage desired (maximum 20 V).

Now adjust the front panel preset HIGH LEVEL control for an OUTPUT voltage equal to the minimum desired output voltage. It may be necessary to adjust the preset LOW LEVEL control as the OUTPUT voltage is limited to 20 V peak to peak open circuit. The high level OUTPUT voltage is clamped by the low level OUTPUT voltage if this range is exceeded. Now apply a voltage equal to the highest external control voltage desired to the same rear interface connector (pin 22B). Adjust the Ext Hi potentiometer until the highest desired output voltage is obtained. It may be necessary to adjust the preset LOW LEVEL control to obtain the desired output. The high level OUTPUT voltage cannot go below the low level OUTPUT voltage due to the level control voltage clamps. The Ext Hi and the preset HIGH LEVEL controls interact. It may be necessary to repeat the above procedure several times until the desired results are obtained.

Now push the NORM COMPLEMENT switch (COMPLEMENT). Center the Ext Lo and preset LOW LEVEL potentiometers. Supply a voltage to pin 22A of the rear interface connector equal to the lowest external control voltage desired. Adjust the preset LOW LEVEL control for an OUTPUT voltage equal to the lowest OUTPUT voltage desired. Change this voltage to the highest desired external control voltage. Adjust the Ext Lo potentiometer for the highest OUTPUT voltage desired. As these adjustments interact, readjust the preset LOW LEVEL and the Ext Lo potentiometers for the desired results. Do not readjust the preset HIGH LEVEL or the Ext Hi potentiometers. The OUTPUT voltages now vary linearly and independently with the external control voltage.

Counted Burst Using the DD 501 Digital Delay Unit

This application permits preselecting the number of output pulses from the PG 508. The event is initiated by an externally applied signal or pulse, 5 ns or longer. The time duration of this signal or pulse has no effect on the output from the PG 508.

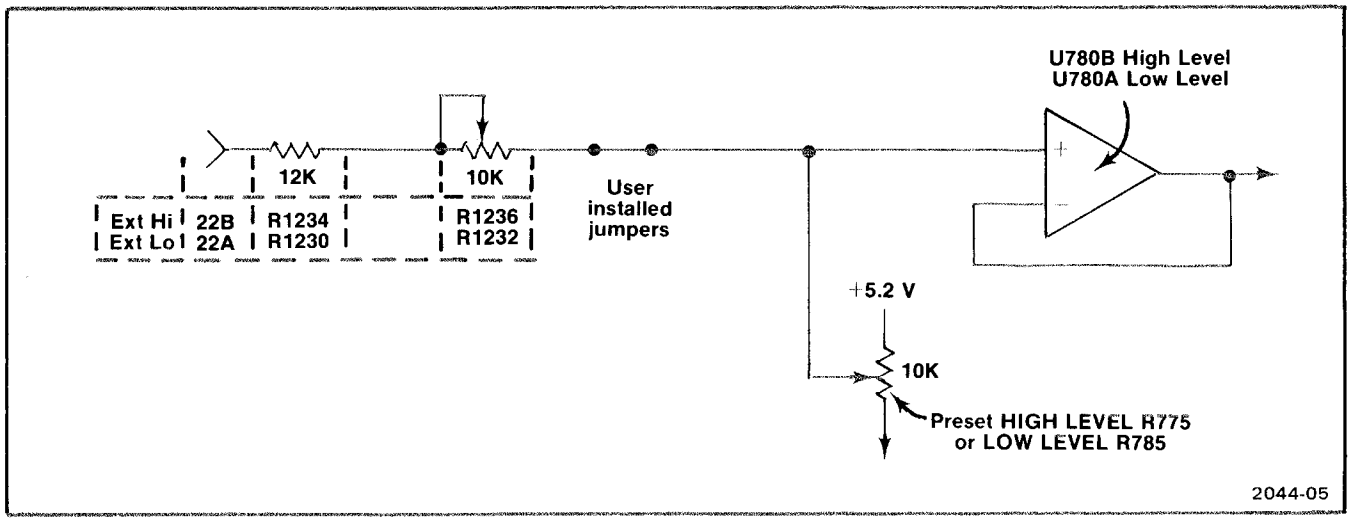


Fig. 1-4. Equivalent circuit of external input for output voltage control.

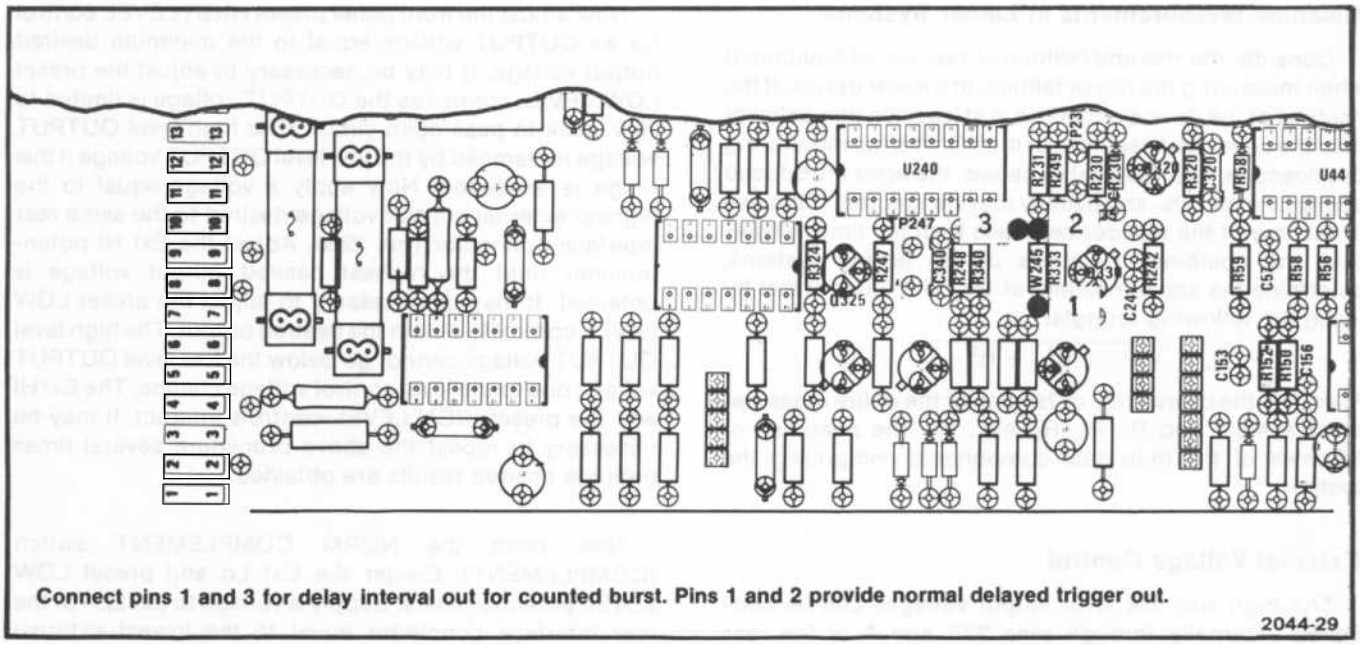


Fig. 1-5. Location of trigger jumpers in DD 501 for selecting trigger or delay interval output.

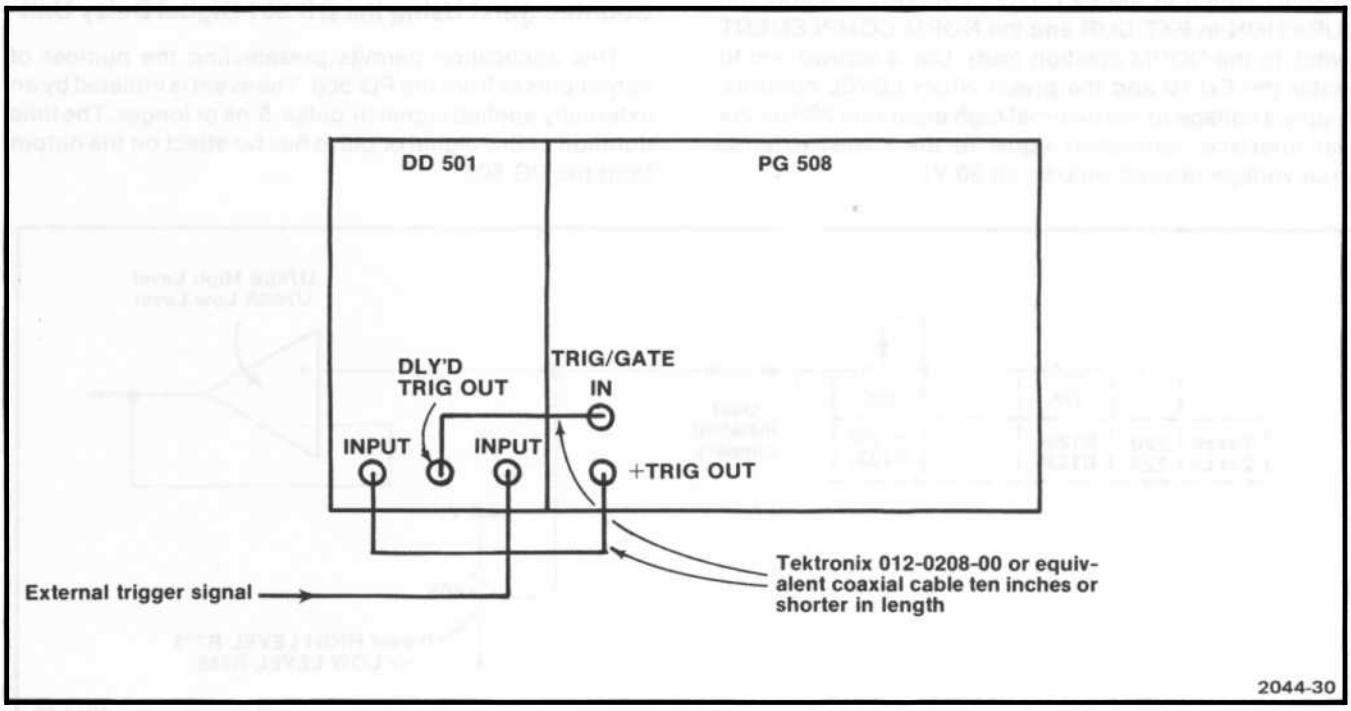


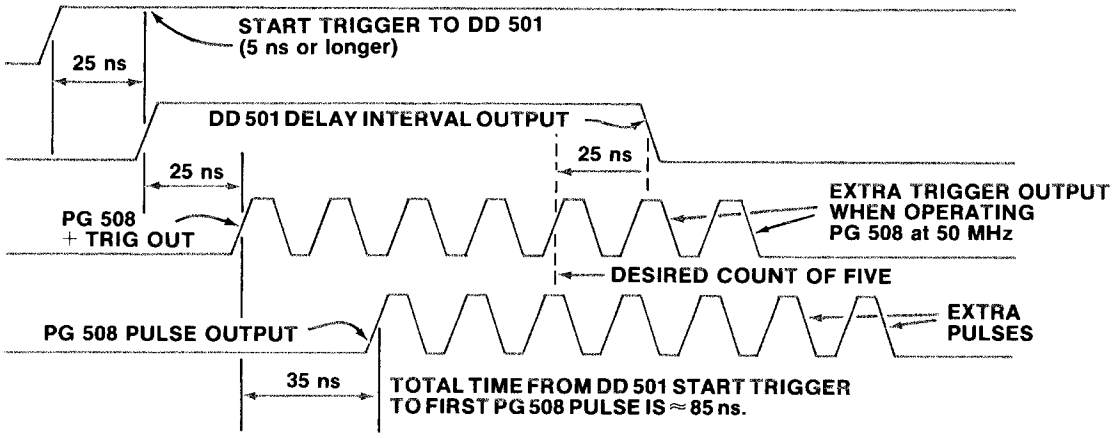
Fig. 1-6. PG 508-DD 501 interconnections for counted burst operation.

To use this feature, place the DD 501 in the delay interval mode of operation by moving the wire strap as shown in Fig. 1-5 or changing connections, depending on the DD 501 available. Connect the PG 508 and the DD 501 as shown in Fig. 1-6. Use ten inch (Tektronix Part Number 012-0208-00) or shorter cables for interconnecting the two units to reduce delays.

Make certain the PG 508 TRIG/GATE IN input impedance is set for 50 Ω. (See External Triggering and Gating discussion and Fig. 1-2.) Set the controls of the PG 508 for the desired output waveform with the PG 508 in FREE RUN. Do not use the SQ WAVE mode. Place the PG 508 in the + SLOPE, SYNC GATE mode and set the TRIG/GATE LEVEL control at the 2 o'clock position. Select EVENTS + SLOPE, START + SLOPE and place the EVENTS and START LEVEL controls at the 2 o'clock position on the DD 501. The three TRIG'D lights on the DD 501 and the TRIG'D/GATED light on the PG 508 will be off until the DD 501 is triggered. Upon receipt of a trigger, all lights will illuminate. If not, check the setup and slightly adjust the LEVEL controls as necessary.

Set the EVENTS DELAY COUNT on the DD 501 for one less than the desired number of counts up to PG 508 repetition rates of about 20 MHz. See below for further information. If necessary, a single trigger may be obtained by rotating the DD 501 START LEVEL control through the 0 position, with no external trigger applied. A single trigger may also be obtained by using the TEKTRONIX manual (One Shot) Trigger Generator, Tektronix Part Number 016-0597-00. All other DD 501 and PG 508 operating controls function normally.

Due to propagation delays in the PG 508, DD 501 and the interconnecting cables, one or more pulses in addition to the desired number are generated when the PG 508 repetition rates are set between 20 MHz and 50 MHz. These extra pulses are consistant for any given frequency irrespective of the desired EVENTS DELAY COUNT setting. To determine the number of extra pulses for a given PG 508 period, set the PG 508 and the DD 501 controls as previously described. Now adjust the PG 508 TRIG/GATE LEVEL or the DD 501 EVENTS LEVEL for the same number of extra pulses at DD 501 EVENTS DELAY COUNT setting of zero and nine.



At PG 508 repetition rates below about 20 MHz the extra pulse count is one. From about 20 MHz to 50 MHz the worst case extra pulse count is two. The above conditions are true only with ten inch or shorter interconnecting cables.

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Fig. 1-7. Typical propagation delays using PG 508 with DD 501 in counted burst mode at 50 MHz repetition rate.

Definitions of Pulse Characteristics

The following is a glossary of common pulse characteristics used in this manual. They are illustrated in Fig. 1-8.

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

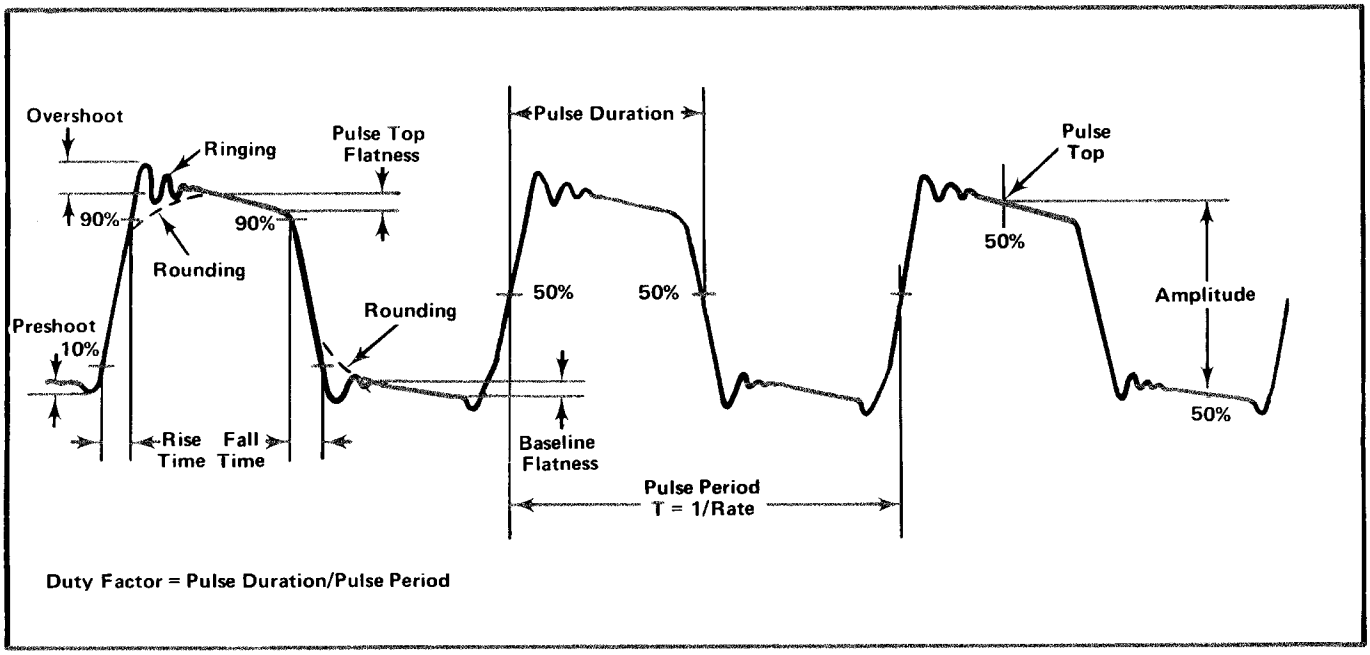


Fig. 1-8. Pulse characteristics.

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

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

Ringing. Periodic aberrations that dampen in time, following the overshoot.

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

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

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

SPECIFICATIONS

PERIOD:

Range:	≤20 ns to ≥200 ms in seven decade steps plus variable, with overlap on all ranges. Periods longer than 200 ms can be obtained in custom range position.
Jitter:	<0.1% +50 ps.

DELAY: (Time between leading transitions in the paired pulse mode)

Range:	≤10 ns to ≥100 ms in seven decade steps plus variable, with overlap on all ranges. Delays longer than 100 ms can be obtained in custom range position.
Duty Factor:	Delays to at least 70% of pulse periods for periods of 0.2 μs or greater, decreasing to at least 50% for a 20 ns period.
Jitter:	≤0.1% to +50 ps.

DURATION

Range:	≤10 ns to ≥100 ms in seven decade steps plus variable, with overlap on all ranges. Durations longer than 100 ms can be obtained in custom range position. An additional position provides durations of approximately 50% of the period setting for square wave output.
Duty Factor:	Pulse durations to at least 70% of pulse periods for periods of ≥0.2 μs, decreasing to at least 50% for a 20 ns period.
Jitter:	≤0.1% +50 ps.

PULSE OUTPUT:

Transition Times:	Independently adjustable leading and trailing transition times from ≤5 ns typical (≤7 ns at some offset and amplitude levels) to ≥50 ms, measured from the 10% point to the 90% point, in six decade steps plus variable. Variable controls with 100:1 range (50:1 on 5 ns) provide overlap on all ranges. Transition times longer than 50 ms are obtainable in the custom range position.
Transition Linearity:	Deviation from straight line ≤5% between the 10% and 90% point for transition times greater than 10 ns.
Amplitude:	Pulse high and low levels independently adjustable over a ±20 V range from a 50 Ω low reactance source. Maximum pulse amplitude into a 50 Ω load is ≥10 V peak to peak; minimum is ≤0.5 V peak to peak. Maximum pulse amplitude into an open circuit is ≥20 V peak to peak; minimum is ≤1.0 V peak to peak. The preset level controls are adjustable over the same ranges.
Aberrations:	≤5%, +50 mV into a 50 Ω load for pulse levels between ±5 V. May increase to ≤10%, +50 mV for pulse levels outside this range.

TRIGGER OUTPUT:

Amplitude:	≥+2 V from 50 Ω.

Source Impedance: 50 Ω.

Duty Cycle:

Internal Triggering: ≈50%.

External Triggering: Determined by duty cycle of triggering signal.

TRIGGER/GATE INPUT:

Sensitivity: 80 mV peak to peak to ⩾10 MHz; 250 mV peak to peak to 50 MHz at 50 Ω input impedance.

Input Impedance: Internally selected, 50 Ω or 1 MΩ paralleled by ≈20 pF.

Maximum Input: ±5 V peak into 50 Ω, ±20 V peak into 1 MΩ.

Minimum Input Pulse Width: 10 ns.

Trigger Level:

Polarity: Front panel selectable, + or − slope.

Range: ±3 V.

TRIG'D GATED LIGHT:

Flashing: Input triggered at greater than approximately a 10 Hz repetition rate or following the input signal at slower repetition rates.

On: (Logic True) TRIG/GATE IN input potential above TRIG/GATE LEVEL setting with + SLOPE selected or below TRIG/GATE LEVEL setting with − SLOPE selected.

Off: (Logic False) TRIG/GATE IN input potential below TRIG/GATE LEVEL with + SLOPE selected or above TRIG/GATE LEVEL with − SLOPE selected.

Synchronous Gate: Rate generator starts synchronously with external gating signal and completes the last output pulse.

PULSE DELAY MODES:

Undelayed, delayed and paired. Paired pulse mode limited to 25 MHz. Minimum pulse separation governed by duration duty factor specification.

FIXED DELAYS:

Trigger Out to Pulse Out: ≈23 ns.

Gate Input to Trigger Out: ≈25 ns.

CONTROL ERROR LIGHT:

Steady On: Indicates invalid operating mode. Output is undefined.

Flashing: Timing control settings selected do not properly define the output pulse because valid limits have been exceeded.

Steady Off: Indicates valid operation for most control settings.

POWER REQUIREMENT:

Nominal: 40 Watts

Maximum: 45 Watts

POWER DISSIPATION:

Nominal: 25 Watts

Maximum: 28 Watts

WEIGHT: 3.5 lbs.

THEORY OF OPERATION

Introduction

Refer to the block diagram and the schematics in the foldout pages at the rear of this manual as well as the following discussion to understand the operation of the PG 508.

Input Circuitry

This circuitry processes the external trigger or gating signal providing triggering waveforms for the period circuit. The 50 Ω input impedance for this circuitry is provided by R12, switched in or out by internal switch S12. When R12 is out of the circuit, the input impedance is 1 M Ω, obtained by R14 and R16. Diodes CR16 and CR17 are protective diodes. The proper voltage at the drain of Q20 is set by VR20. The source voltage of Q20 is set by VR22. Impedance transformation, with no voltage shift, is obtained by source follower Q20. Constant current for Q20 is supplied by Q22. A differential comparator is formed by Q25 and Q26. This comparator compares the trigger or gate input level with the level set by the front panel TRIG/GATE control. Constant current for this comparator is provided by Q30. Level control voltage for the differential comparator is provided by operational amplifier U40. The output, pin 6, swings over a range of ±3 V. The voltage at TP36 is the triggering level voltage, as set by the TRIG/GATE LEVEL control. If the triggering or gating voltage at the base of Q25 is more positive that TP36, then Q26 is conducting and Q25 is off. This places the collector of Q26 more positive than the collector of Q25. When the gating or triggering waveform level drops below TP36, Q25 conducts and Q26 turns off.

This switching waveform is applied to the bases of U60A and U60B, operating as a differential pair. The collector of U60A drives U60C in a cascode mode of operation. The collector of U60C drives the base of U60D which, as an emitter follower, drives the input of U70B. This gate operates as a dual input Schmitt trigger shaper. When the emitter of U60D goes to about 4.2 V above ground, pin 7 of U70B goes high. When the emitter of U60D drops to about 3.8 V, pin 7 of U70B drops to its low level. The inverting output terminal, pin 6, is always in the opposite state from pin 7. Positive feedback for this portion of the Schmitt is provided by R72. If the unit is manually triggered, pin 10 of U70B is momentarily connected to +5 V. Pin 10 of U70B, along with R75 and R76 now acts as a Schmitt shaper for the manual trigger. This action holds the output, pin 7, high and the inverting output, pin 6, low as long as the MAN button is depressed.

When the plus slope is selected for triggering or gating, +5 V is applied to pin 4 of U70A. This gate is now inhibited and the signal passes through U70C. As the outputs of U70A and C are connected together, a high on either output overrides the low. Pin 13 of U70C is low as long as the anodes of CR82 and CR84 are low, which occurs when the logic circuitry has enabled the input circuitry. When the control logic is set to disable the input circuitry, the anodes of these diodes are raised to +5 V which disables gates U70A and U70C.

Pin 12 of U70C now shifts between the high and low state corresponding with the input gate or trigger. The ouput from U70C, pin 14, is passed to the period circuitry. A high at the output of U70C turns the period circuitry off and a low starts the period generator.

TRIG'D/GATED Light Circuitry

Transistors Q100, Q102, Q110 and their associated components compose the circuitry that operates the front panel TRIG'D/GATE light emitting diode. The pair Q100 and Q102 form a modified astable multivibrator, while Q110 operates as a voltage source. When the output of U70A or U70C is high (period generator off) or the logic circuitry has inhibited the input circuitry, the base of Q100 is high. This causes the base of Q102 to be low through R106. The collector of Q102 is now high and the light emitting diode is off. When the base of Q100 goes low, the base of Q102 goes high, the collector goes low and the light emitting diode illuminates. The light emitting diode circuitry follows the triggering gate up to about a 5 Hz rate, i.e., about 100 ms on and 100 ms off. At faster gating frequencies, C106 inhibits the changing states of this circuitry at about the 5 Hz rate.

Triggered Mode

In the triggered mode of operation S200-2 is closed. This places a high on pin 10 of U140B locking pin 7 high and pin 6 low irrespective of the level on pin 11. This disables the period generator. Pin 15 of U140C now follows pin 4 of U140A in coincidence with the input triggering signal. Pin 14 of U140C drives Q244 and pin 15 drives Q240. The output from the collector of Q240 is in phase with the trigger or gate input signal providing the trigger output, and the phase of the waveform at the collector of Q244 is inverted.

Period Generator

This circuitry generates the internal period timing waveform. In this mode, U140B operates as an astable multivibrator. When either input of U140B is high, pin 7 is high and pin 6 is low. The switched timing capacitances are connected from pin 7 to pin 11. These capacitors are switched by the period range switch. The period variable control, R190, varies the resistance in the negative feedback loop.

To start the period cycle, assume pin 7 of U140B goes high and pin 6 low. This positive step, at pin 7, is coupled through the period timing capacitor to pin 11. As the timing capacitor discharges through the resistances connected from pin 11 to pin 6, the voltage at pin 11 decays at a rate determined by the timing capacitor and these resistances. When the switching level (approximately 4 V) is reached, pin 7 goes low and pin 6 goes high. The negative step, at pin 7, is coupled through the timing capacitor, and appears at pin 11. The capacitor now charges through the resistances until the switching level is reached, and the period cycle repeats. The symmetry adjustment compensates for the bias current through pin 11.

When the PERIOD switch is in any position other than EXT TRIG (MAN), switch S200-2 is opened. This lowers pin 10 of U140B and permits the period generator to operate during the external gate on time. During the time of the external gating signal pins 4 and 2 of U140A are low. Pin 3 is high. As transistors Q150 and Q160 form a comparator, with their bases connected to pins 3 and 1 of U140A respectively, the collector of Q150 is low causing the emitter of Q175 to be low, as well as pin 11 of U140B. This allows the period generator to operate. During the gated off time this action reverses. Pin 11 of U140B rises and inhibits the period generator.

Resistor R170 and R165 adjust the lock up voltage at pin 11 of U140B so that, at turn on, the first period generated is identical in time with subsequent periods. Resistor R165 is switched into the circuit only on the 20 ns range. Components R177 and C177 form a time constant to help compensate for first period error.

Delay Generator

This circuitry provides the delay for delayed or paired pulse operation. As the signal from the period generator of the external trigger input goes from high to low at pin 7 of U270B, pin 3 goes high. This causes pin 5 of U270A to go high and pin 2 low. Pin 13 of U270D and pin 9 of U300B go low. Pin 15 of U270D goes high but pin 10 of U300B does not follow until about 10 ns later, due to the delaying action of R275 and C275. When pin 9 of U300B goes low pin 6 goes high, assuming pin 11 is already low. Pin 6 stays high until pin 10 goes high as described above. This action provides the delay generator with about a 10 ns trigger pulse under all input conditions.

The positive-going trigger pulse, at pin 5 of U300A, causes pin 3 to go low and pin 2 high. Positive feedback through R300 and C300 causes pin 4 to go high. The low at the base of Q320 turns Q320 off. The emitter of Q320 goes negative at a rate determined by the timing capacitor and current source Q342, with its variable emitter resistances. As the emitter of Q320 goes negative, it pulls the base of Q294 negative which lowers pin 4 of U300A. When pin 4 reaches the switching threshold (≈4.0 V) pin 2 goes low and pin 3 high. The timing capacitor is now discharged through Q320. The monostable delay generator is now reset for the next trigger pulse. Transistor Q290 provides a constant load for the power supplies irrespective of the current flowing through Q294.

Components R304, R306 and C304 provide a delay line for the CONTROL ERROR light. The ouput from the delay generator is connected to pin 13 of U300C. Pin 15 of U300C is high during the delay time and pin 14 low. Gates U360B and D provide a positive-going trigger at pin 15 of U360D when the delay time ends. Gates U360A and C provide a positive-going trigger at pin 14 when the delay time starts. As the delay time starts, pin 4 of U360A goes low as does pin 11 of U360C. Pin 10 of U360C is low as the anode of CR378 is grounded through the UNDLY switch. The low at pin 11 of U360C allows pin 14 to go high. Pin 14 stays high until the propagation time through gate U360A and the delaying action of R364 and C366 allow the high generated in U360A, from pin 2, to reset U360C through pin 10. This causes pin 14 to return to its low state. The width of the output trigger pulse is about 6 ns.

To obtain the delayed trigger, the anode of CR378 is connected to +5 V disabling gate U360C. The anode of CR382 is grounded through the DLY switch. Gates U360B and U360D now operate in exactly the same manner as U360A and C. A positive trigger pulse appears on pin 15 of U360D when the delay time ends (pin 6 of U360B goes from high to low). In the paired pulse mode both gates operate. Gate U360C provides a positive-going trigger at the start of the delay time and U360D a positive trigger at the end of the delay time.

Duration Generator

This circuitry generates the duration times. Gate U400B accepts the delayed or undelayed positive triggers from the delay generator. The result is a positive-going pulse at pin 5 or U400A. This triggers the duration generator which operates in the same manner as the delay generator. Refer to the discussion under the heading Delay Generator for a description of the duration generator operation. Gate U400C is an output buffer. Pin

12 goes high during the pulse duration time and if pin 13 is low, pin 15 goes high and pin 14 low. Pin 13 controls U400C in the square wave and external duration modes.

Duration and Delay Control Error Light Circuitry

This circuitry illuminates the CONTROL ERROR light when the duration or delay times are greater than the periods of their respective triggers. The positive pulse from the duration generator is fed into the D input, pin 10, of U480A. The clock enable line is low. If the duration time is set so that a trigger pulse (connected to the clock in) for the next duration pulse occurs before the output of the duration generator goes low, the high on the D input, pin 10 of U480A, is transferred to the output, pin 1. This high is connected to the set input, pin 5, of U480B which causes the output, pin 2, of U480B to go high illuminating the error light. When the output, pin 2, of U480B goes high, the inputs to U480A and B are disabled through the clock enable line preventing further trigger inputs until both flip flops are reset. When the output, pin 2, of U480B goes and stays high, C487 starts to charge to the voltage on pin 2, through R490. This takes approximately 100 ms. When the reset inputs to U480A and B, pins 13 and 4, reach the high level (about 4.0 V) U480A and B are reset and C487 discharges through R490. When these reset inputs return to the low level both flip flops are ready to accept triggers and the error cycle is ready to repeat. If the delay time is set for a time greater than the period of the delay triggers, the high on pin 7 of U480B transfers to pin 2 directly, and the light is illuminated. Reset takes place in the same manner as described above. Also connected to this circuitry is a line from the transition time board which also lights the CONTROL ERROR light.

The CONTROL ERROR light is also illuminated for certain improper control settings. Fig. 2-1 shows a simplified schematic for the CONTROL ERROR indicator logic and control settings causing illumination.

Variable Transition Time Circuitry

This circuitry controls the output transition times. Resistors R534 and R536 provide equivalent 50 Ω termination impedance for the normal (positive-going) input from the duration generator. Also, R520 and R522 provide an identical termination impedance for the complement input (negative-going) from the duration generator. These inputs drive the bases of Q525 and Q530. When the input from the duration generator is high and the complement is low, the collector of Q530 drops from ground to about −1/2 V. This turns Q565 on and Q560 off. The adjustable constant current through Q545, to +15 V, is now passed through R578, from the −15 V supply. Transistor Q560 is turned off as its base is connected to ground. Zener diodes VR620 and VR630 lower the voltage from the bases of Q565 and Q560 to the bases of Q625 and Q630 by about 7.5 V. Transistor Q625 is therefore off and Q630 is conducting. Current flows from −15 V through an adjustable current source Q635 and then through Q630 to charge the particular capacitor determined by the transition time selected. As the capacitor charges through a constant current source, the junction of CR584 and CR600 goes negative at a linear rate until the diode CR600 turns on. This diode serves as the negative clamp. The voltage at the anode of CR600 is set by R615 through Q608 and Q600. The voltage at the junction of CR584 and CR600 remains low for the pulse duration.

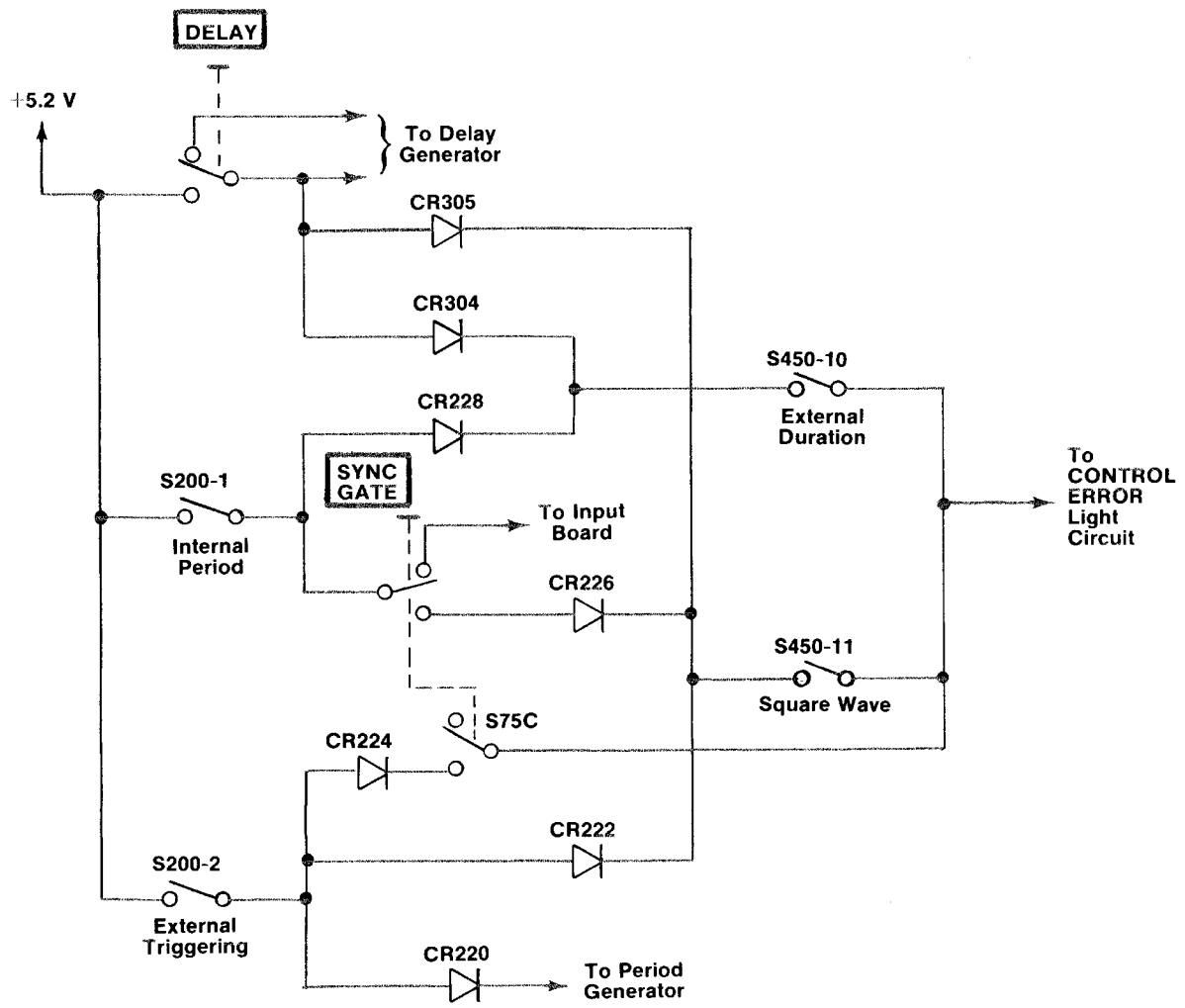
At the end of the pulse duration time, the collector of Q530 goes positive. This action turns Q565 off and Q560 on. Current from the +15 V supply flows through constant current source Q545, then through Q560 raising the junction of CR584 and CR600 at a linear rate determined by the capacitor value and the current available. The junction of CR584 and CR600 goes positive until CR584 turns on. The voltage at the cathode of CR584 is set by R570 through Q575 and Q580. Transistor Q625 is turned on, and Q630 off, passing current from constant current source Q635 through Q625, CR604, and R604 to ground. The leading and trailing transition times are varied independently by varying the amount of current passing through constant current source transistors Q635 and Q545.

The output waveform at the junction of CR584 and CR600 passes to the gate of fet Q680. This fet serves as a source follower for driving Q685 and Q690. These transistors compose a linear differential amplifier. The clamp levels for diodes CR584 and CR600 are set so that Q685 and Q690 are slightly overdriven. This serves to remove any ringing or other signal irregularities at the top and bottom of the waveform. Operational amplifier U665 provides, along with Q660, constant current for Q685 and Q690.

Transition Time Control Error Light Circuitry

This circuitry illuminates the control error light when the leading transition time is greater than the pulse duration time, or when the trailing transition time is greater than the pulse off time. The inverted signal from the leading and trailing generator appears at the base of Q704 through fet follower Q700. A differential amplifier is formed by Q704 and Q706. The output is taken from the collector of Q706. Transistors Q704 and Q706 are overdriven to reduce the window of comparision. During the pulse on time, the base of Q704 is negative with respect to ground. This action causes the collector of Q706 to also go negative, driving the base of Q715, an emitter follower negative. The emitter of Q715 is connected to pins 7 and 10, the D input of flip flops U720A and B.

The waveforms driving the transition time circuitry are also applied to gates U740A and B. Pin 6 of U740B is high during pulse time while pin 4 of U740A is low. The purpose of the four gates in U740 is to delay the signal ap-



Switches are closed when controls are in the labeled position.

The CONTROL ERROR light illuminates when the unit is set to operate under the following conditions:

Delay and Square Wave
Delay and External Duration
Internal Period and External Duration
Internal Period, Synchronous Gate and Square Wave
External Trigger and Square Wave
External Trigger and Synchronous Gate

Fig. 2-1. Simplified schematic for CONTROL ERROR indicator logic with control settings causing illumination.

proximately the same amount as the circuitry in the variable transition time generator. The positive-going waveform from pin 14 of U740C is fed through pin 6 to the clock input, pin 6, of flip flop U720A. The negative-going output from pin 15 is fed to the clock input pin 11, of flip flop U720B. Flip flop U720A senses the pulse trailing timing error and U720B, the pulse leading timing error. If the leading time from the output of the variable transition time generator is slow enough so that the D input of U720B has not dropped below approximately the 50% point, when the waveform at the clock input of flip flop U720B (waveform driving the transition time board) goes positive (end of pulse), the high on D input, pin 10, transfers to the output, pin 15, and the CONTROL ERROR lamp is lit.

When pin 15, of flip flop U720B goes high, C734 starts to charge through R728. When the voltage at pin 13 of U720B and pin 5 of U720A reaches the high level (≈4.0 V), both flip flops are reset to their initial conditions and the CONTROL ERROR light goes out. If the trailing time of the

pulse is slow enough so that the D input of flip flop U720A has not reached the high level when the pulse at the clock terminal (pin 6) of flip flop U720A goes high (leading portion of the next pulse driving the transition circuitry) the 0 terminal, pin 3, of flip flop U720A goes high. This high is connected to the set terminal, pin 12, of U720B causing the 1 terminal of U720B to go high illuminating the CONTROL ERROR light. The on time and reset for this error indicating mode now proceeds as previously described.

Level Control Multiplier

This circuitry provides independent top and bottom level control of the output pulse by controlling the amplitude and offset of the drive signal to the linear output amplifier. Also included is circuitry to accomplish the normal complement function and the preset function. Control voltage clamps to ensure the output amplifier is not over driven are also provided.

Amplitude control of the signal occurs in the analog multiplier, U850. The pulse signal provides the X input, and the level control voltages provide the Y input. The X·Y product of these inputs is converted to a drive current for the output amplifier.

Input and complement pulses from the variable transition time generator are applied to the bases of Q825 and Q840. These transistors form a differential amplifier, supplied by constant current source U800B and Q820. A positive-going signal at the base of Q825, with the complementary (negative-going) signal at the base of Q840 causes the signal current at pin 11 of the multiplier to go negative and the signal current at pin 12 to go positive. When the pulse polarity reverses, at the bases of Q825 and Q840, the signal current also reverses polarity at pins 11 and 12. The difference between the currents at pins 11 and 12 corresponds to the X signal input for the multiplier.

The total current flowing from pins 2 and 3 of U850 is essentially equal to the current required by the constant current source, U895A and Q900. However, the difference in currents between these pins corresponds to the Y input signal for the multiplier.

The amplitude difference of these currents is controlled by U895B. This is a dc differential amplifier which amplifies the difference between the high & low level control voltages to produce the Y input signal. Gain adjustment for the Y input signal is provided by R885.

The high and low level control voltages are determined by their respective front panel controls, R770B and R770A. If the preset function is selected, the preset high and preset low potentiometers, R775 and R785, provide the control voltages. These voltages are buffered by unity gain amplifiers U780A and U780B. Both control voltages range between 0 and +5.2 V. When the control voltages are equal, the Y input is zero and the multiplier signal output (X·Y) equals zero. A difference of +2.6 V between the high and low level control voltages corresponds to maximum output amplitude from the pulse generator.

The normal complement switch inverts the level control voltage inputs to differential amplifier U895B. However, since the difference between the voltages is unchanged, the control voltage input signal has constant amplitude, but reverses polarity. This complements the pulse generator output. The normal complement balance adjustment, R910, ensures that the Y multiplier input responds equally to changes in either the high or low level control voltages.

The signal current at pins 5 and 6 of U850 is the pulse signal. Since Q845, in conjunction with U800B, provides a constant current sink, the current through R954, from the emitter of common base stage Q954, also contains signal current variations. The current driver for the output amplifier is Q954. The signal currents into pins 8 and 9 of U850 also contain the pulse signal. However constant current sink R847, and common base stage Q950 are included only as a balancing thermal load for the multiplier.

To obtain independent control of the output pulse high and low levels, the control voltages are averaged by resistor network R914, R915, R918 and R920. High and Low tracking potentimeters, R915 and R920, are adjustable to provide minimum interaction between pulse levels. The dc voltage from this network, along with the voltage from the offset adjustment R925, is summed and inverted by U930A. U930B proves further gain and level shifting and, in conjunction with Q945, serves as a level controlled offset generator. A dc current source to the collector of Q954 is provided by Q945. The collector of Q954 is the virtual ground input to the output amplifier.

When the high and low level control potentiometers are both at midrange (+2.6 V zero output) Q945 sources all the quiescent bias current required by Q954, which is approximately 15 mA. Therefore, there is no current drive to the output amplifier through R975 or R1055. If the high level control is turned fully cw (maximum output), the low level control voltage remains at +2.6 V. The high level control voltage increases to +5.2 V. This causes the voltage output of U930A to decrease, causing the offset generator U930B and Q945 to source approximately 20 mA. This is an increase of 5 mA. This difference in control voltage settings also causes maximum difference in the control voltage input signal to the multiplier. This action also causes 10 mA peak to peak signal current variations in the collector current of Q954. Since the signal current

variations and dc offset currents are summed at the collectors of Q945 and Q954, the output pulse high level changes to maximum voltage and the low level remains at 0 V.

It follows that any positive increase in either the high or low level control voltages causes an increase in the dc offset current. A decrease in either control voltage causes a decrease in offset current. However, signal current variations respond only to differences between these control voltages. The larger the voltage difference, the larger the signal current amplitude into the output amplifier.

Since the dynamic range of the pulse generator output is + or − 20 V, and the maximum amplitude is only 20 V peak to peak, clamping circuits are provided to prevent the difference between the high and low level control voltages from exceeding +2.6 V, which corresponds to maximum output. A clamping circuit also prevents the high level from becoming less than the low level control voltage.

The level control unity gain amplifiers U780A and U780B contain a precision diode clamp composed of CR782, CR790, R780, and R782. Since the feedback for U780A is taken from the cathode of CR790, the voltage at the junction of CR782 and CR790 is equal to the low level control voltage plus one diode drop (CR790). If the high level attempts to decrease below the low level or attempts to increase above the high level control voltage, CR782 conducts clamping the high level at the low level voltage. Current limiting for U780B, during clamping, is provided by R780.

U800A is also configured as a precision clamping circuit. The output at pin 1 is equal to the low level control voltage plus 2.6 V plus one diode drop. Therefore, if the high level voltage attempts to exceed the low level plus 2.6 volts, or the low level is decreased more than 2.6 V below the high level, CR805 conducts and the high level is clamped at the low level control voltage plus 2.6 volts. The low level control always overrides the high level control. Current limiting for U780B, during clamping, is provided by R780.

Output Amplifier

The positive and negative dc voltages for this amplifier are provided by dual power supplies which track the high and low level control voltages. These tracking supplies ensure that the positive potential is at least 6 V above the output pulse high level and the negative potential is at least 6 volts below the output pulse low level. This arrangement enables the pulse generator to provide a 40 V dynamic range, with a 20 V peak to peak maximum output pulse, while maintaining minimum power dissipation and voltage requirements for the amplifier transistors. The range of the positive tracking supply is +6 to +26 V, with a −6 to −26 V range for the negative supply.

The output circuit functions as a linear current driven operational amplifier with a closed loop transresistance gain of 2 V/mA. Negative feedback through R1042 to the input node (collectors of Q945 and Q954) causes a virtural ground at the input. A 10 mA peak to peak input signal creates a 20 V peak to peak output pulse (open circuit).

Since the output amplifier is a complementary circuit, only the operation of one side will be explained.

For a positive-going output pulse, current is driven into the input node. This action causes an increase in base current to Q975 which decreases the base drive to Q980. A cascode circuit is formed by Q980 and Q990, with R985 and L980 serving as a constant current source to the common collector-emitter connection. Therefore, when the base drive to Q980 is decreased, the current in Q990 increases. (The constant current source supplies approximately 60 mA which, with no signal, is equally divided between Q980 and Q990.) Another constant current source, Q1000, causes a 2.0 V drop across R1002. The emitter follower, Q995, buffers this potential and provides a voltage source for the base of the cascode transistor, Q990. An increasing current through Q990 increases the base current from the output parallel emitter followers, Q1010 and Q1015. The emitters of these transistors drive the output positive through a network of resistors and capacitors. Components R1020, R1024, and C1024, in this network, are adjustable to provide an internal resistive 50 Ω termination for the output. Network C1048 and R1048, with potentiometer R1050, provides transient response peaking for the amplifier.

Equivalent biasing for the complementary output emitter followers is provided by CR990, R990, and CR992. With zero output, the quiescent current in each output follower is approximately 20 mA. The output potential is available at the rear interface connector, pin 25A, for monitoring the output amplitude.

Power Supply

The +11.5 Vdc from the mainframe provides the raw supply voltage for the series regulated +5.2 Vdc supply. The precision voltage regulator, U1210, includes a temperature compensated voltage reference supply at pin 6. The +5.2 V potentiometer, R1210, with the voltage divider R1209 and R1211 provides the reference input to the non-inverting input, pin 5. The output voltage is applied to the inverting input, pin 4, through R1217. Sensing differences in the two input potentials, the regulator amplifier provides base current drive from pin 10

to the mainframe transistor used as the series pass element, until the inverting and non-inverting inputs are approximately equal. At this condition, the series pass transistor drops the voltage from the raw supply until the output is +5.2 V. Current limiting is provided by R1215. When the current from the supply exceeds approximately 1.1 A, the regulator provides no further base drive current to the series pass element and current limiting occurs.

The +33.5 Vdc from the mainframe is the raw supply for the regulated +15 Vdc. The 3-terminal voltage regulator, U1205, performs the entire regulating function. Current limiting occurs within U1205.

The −33.5 Vdc from the mainframe is the raw supply for the regulated −15 Vdc. As in the +15 Vdc supply a 3-terminal voltage regulator, U1335, provides the regulating function. However, due to additional load considerations, the raw supply is pre-regulated to decrease power dissipated by the integrated circuit. A shunt current path to the load is furnished by VR1330 and R1330. The zener voltage is also used to maintain base drive to the series pass mainframe transistor. This transistor is used as a pre-regulator to drop the voltage across U1335 to approximately 3.6 V. Current limiting is also provided by the regulator, U1335.

The dual tracking supplies provide the positive and negative voltages required by the output amplifier. The voltage at the base of Q1255 varies from 0 V to +5.2 V depending on the setting of the HIGH LEVEL control. When the voltage at the base of Q1255 varies from 0 V to +2.6 V, the voltage at the collector of the series pass transistor is +6 V. As the voltage at the base of Q1255 varies from +2.6 V to +5.2 V, the voltage at the collector of the series pass transistor varies from +6 V to +26 V.

Transistor Q1255 and Q1270 form a differential comparator. The voltage at the base of Q1270 is referenced between the +5.2 V supply, ground and the output voltage. As the HIGH LEVEL control is moved in the positive direction, the collector of Q1255 goes negative. This increases current flow through Q1280 and therefore the series pass transistor in the mainframe which raises the + tracking supply voltage to the output amplifier. Feedback to the differential comparator is provided by R1275. Transistor Q1265 prevents the +V tracking supply from going lower than about +6 V. The base of Q1265 is set at about 2.6 V. When the base of Q1255 goes more negative than about 2.6 V, Q1265 comes into conduction holding the common emitter circuit at one diode drop from the base of Q1265. If the base of Q1255 is lowered further, Q1255 looses control of the circuit and the supply voltage remains at the level determined by Q1265, +6 V.

Current limiters for this circuit are Q1285, Q1290 and Q1300. A differential comparator is formed by Q1285 and Q1290. If the load on the +V supply exceeds the maximum current allowed for the voltage supplied, the voltage drop across R1282 becomes great enough that Q1285 comes into conduction. This action increases conduction in Q1270 reducing the current flow in Q1255. Finally, the conduction through the series pass transistor is limited to a safe value. The current through Q1300 is determined by the actual supply output voltage. Therefore, the current limit varies proportionally with the supply voltage. In most overload conditions, the supply folds back to minimum current. Diode CR1310 conducts should the +V supply go more negative than ground.

The −V supply operates in the same manner as the +V supply. Only the polarities are reversed. Transistors Q1355 and Q1370 are the basic comparator transistors. The base of Q1355 varies between 0 V and +5.2 V. The −V output is prevented from going more positive than about −6 V by Q1365. The series pass transistor is driven by Q1380. The comparator transistors for the current limiting circuitry are Q1385 and Q1395. The current source for the current comparator is Q1400. Diode CR1410 prevents the −V output from going more positive than ground.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01002	GENERAL ELECTRIC COMPANY, INDUSTRIAL AND POWER CAPACITOR PRODUCTS DEPARTMENT	JOHN STREET	HUDSON FALLS, NY 12839
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01282	PARKER STEARNS AND CO., INC.	300 SHEFFIELD AVENUE	BROOKLYN, NY 11207
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
53184	XCITON CORPORATION	5 HEMLOCK STREET	LATHAM, NY 12110
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
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 FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
79727	C-W INDUSTRIES	550 DAVISVILLE RD.,P O BOX 96	WARMINISTER, PA 18974
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET P O BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-4273-00	B010100	B020244	CKT BOARD ASSY:INPUT	80009	670-4273-00
A1	670-4273-01	B020245		CKT BOARD ASSY:INPUT	80009	670-4273-01
A2	670-4274-00	B010100	B020244	CKT BOARD ASSY:TIMING	80009	670-4274-00
A2	670-4274-01	B020245	B029999	CKT BOARD ASSY:TIMING	80009	670-4274-01
A2	670-4274-02	B030000		CKT BOARD ASSY:TIMING	80009	670-4274-02
A3	670-4275-00	B010100	B020244	CKT BOARD ASSY:TRANSITION TIMING	80009	670-4275-00
A3	670-4275-01	B020245	B029999	CKT BOARD ASSY:TRANSITION TIMING	80009	670-4275-01
A3	670-4275-02	B030000		CKT BOARD ASSY:TRANSITION TIMING	80009	670-4275-02
A4	670-4276-00	B010100	B020698	CKT BOARD ASSY:OUTPUT	80009	670-4276-00
A4	670-4276-01	B020699		CKT BOARD ASSY:OUTPUT	80009	670-4276-01
A5	670-4272-00			CKT BOARD ASSY:AUXILIARY	80009	670-4272-00
C14	281-0518-00			CAP.,FXD,CER DI:47PF,+/-9.4PF,500V	72982	301-000U2J0470M
C36	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C40	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C55	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C70	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C76	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C104	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C106	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C110	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C140	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C142	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C154	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C170	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C171	281-0540-00	B010100	B010124X	CAP.,FXD,CER DI:51PF,5%,500V	72982	301-000U2J0510J
C172	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C177	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16.8D0
C180	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C200	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C201	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C202	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C203	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C205	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C206	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C207	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C208	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C210	285-0576-00			CAP.,FXD,PLSTC:1UF,10%,100V	56289	410P10591
C212	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P10451
C214	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
C216	283-0645-00			CAP.,FXD,MICA D:790PF,1%,100V	00853	D151E791F0
C218	281-0540-00			CAP.,FXD,CER DI:51PF,5%,500V	72982	301-000U2J0510J
C244	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C260	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C270	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C275	283-0636-00	B010100	B010124	CAP.,FXD,MICA D:36PF,1.4%,100V	00853	D155F360G0
C275	283-0634-00	B010125		CAP.,FXD,MICA D:65PF,1%,100V	00853	D151E650F0
C277	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C279	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C296	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C300	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C304	283-0634-00	B010100	B020244X	CAP.,FXD,MICA D:65PF,1%,100V	00853	D151E650F0
C317	281-0516-00			CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	301-000U2J0390K

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C325	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C326	283-0677-00			CAP.,FXD,MICA D:82PF,1%,500V	00853	D155E820F0
C328	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C330	285-1049-00			CAP.,FXD,PLSTC:0.01UF,1%,200V	14752	230B1C103F
C332	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P10451
C334	285-0576-00			CAP.,FXD,PLSTC:1UF,10%,100V	56289	410P10591
C336	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C338	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C346	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C360	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C366	283-0635-00	B010100	B010124	CAP.,FXD,MICA D:51PF,1%,100V	00853	D151E510F0
C366	283-0634-00	B010125		CAP.,FXD,MICA D:65PF,1%,100V	00853	D151E650F0
C375	283-0635-00	B010100	B010124	CAP.,FXD,MICA D:51PF,1%,100V	00853	D151E510F0
C375	283-0634-00	B010125		CAP.,FXD,MICA D:65PF,1%,100V	00853	D151E650F0
C378	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C382	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C385	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C386	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C389	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C400	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C415	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C418	283-0634-00	B010100	B020244X	CAP.,FXD,MICA D:65PF,1%,100V	00853	D151E650F0
C432	281-0516-00	B010100	B010124	CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	301-000U2J0390K
C432	281-0509-00	B010125	B020244	CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C432	281-0516-00	B020245	B029999	CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	301-000U2J0390K
C432	281-0504-00	B030000		CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C433	283-0111-00	XB010125		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C435	283-0634-00			CAP.,FXD,MICA D:65PF,1%,100V	00853	D151E650F0
C436	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C438	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C439	281-0513-00			CAP.,FXD,CER DI:27PF,+/-5.4PF,500V	72982	301-000P2G0270M
C442	285-1049-00			CAP.,FXD,PLSTC:0.01UF,1%,200V	14752	230B1C103F
C444	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P10451
C446	285-0576-00			CAP.,FXD,PLSTC:1UF,10%,100V	56289	410P10591
C448	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C450	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C460	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C462	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C480	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C485	283-0111-00	B010100	B010169X	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C487	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C493	283-0000-00	XB010170	B029999X	CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C500	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C502	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C503	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C505	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C532	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C544	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C555	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C563	281-0653-00			CAP.,FXD,CER DI:3.3PF,30%,200V	72982	374000M7J339F
C569	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C580	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C581	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C586	285-0934-00			CAP.,FXD,PLSTC:2.2UF,10%,200V	56289	430P238
C588	285-0633-00			CAP.,FXD,PLSTC:0.22UF,20%,100V	56289	410P22491
C590	285-0566-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	56289	410P22392
C592	283-0694-00			CAP.,FXD,MICA D:2240PF,0.5%,300V	00853	D193F2241E0
C594	283-0625-00			CAP.,FXD,MICA D:220PF,1%,500V	00853	D105F221F0
C596	281-0544-00			CAP.,FXD,CER DI:5.6PF,10%,500V	72982	301-000C0H0569D
C600	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C601	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C622	281-0653-00			CAP.,FXD,CER DI:3.3PF,30%,200V	72982	374000M7J339F
C630	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C643	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C647	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C662	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C665	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C675	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C680	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C682	283-0648-00			CAP.,FXD,MICA D:10PF,5%,100V	00853	D151C100D0
C697	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-518-Z5D0102J
C701	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C708	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C720	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C724	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C734	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C735	283-0024-00	XB030000		CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C736	283-0000-00	XB020245	B029999X	CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C740	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8121N083Z5U0104Z
C744	281-0187-00	XB030000		CAP.,VAR,PLSTC:4-40PF,250V	80031	2810D00440QN02F0
C749	283-0648-00	B010100	B029999	CAP.,FXD,MICA D:10PF,5%,100V	00853	D151C100D0
C749	281-0187-00	B030000		CAP.,VAR,PLSTC:4-40PF,250V	80031	2810D00440QN02F0
C780	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C800	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C814	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C820	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C834	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C836	283-0187-00			CAP.,FXD,CER DI:0.047UF,10%,400V	72982	8131N401X5R0473K
C840	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C850	283-0752-00	B010100	B020698	CAP.,FXD,MICA D:345PF,1%,500V	00853	D155E3450F0
C850	283-0638-00	B020699		CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C850	----- -----			* NOMINAL INSTALLED,TEST SELECTED AS A SET		
C852	283-0752-00	B010100	B020698	CAP.,FXD,MICA D:345PF,1%,500V	00853	D155E3450F0
C852	283-0638-00	B020699		CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C852	----- -----			* NOMINAL INSTALLED,TEST SELECTED AS A SET		
C854	283-0752-00	B010100	B020698	CAP.,FXD,MICA D:345PF,1%,500V	00853	D155E3450F0
C854	283-0638-00	B020699		CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C854	----- -----			* NOMINAL INSTALLED,TEST SELECTED AS A SET		
C856	283-0752-00	B010100	B020698	CAP.,FXD,MICA D:345PF,1%,500V	00853	D155E3450F0
C856	283-0638-00	B020699		CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C856	----- -----			* NOMINAL INSTALLED,TEST SELECTED AS A SET		
C860	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C863	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C879	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C880	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C895	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C930	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C938	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C958	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C962	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C964	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C966	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C975	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C985	290-0573-00			CAP.,FXD,ELCTLT:2.7UF,20%,50V	56289	196D275X0050JA1
C989	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C992	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C997	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C1017	283-0669-00			CAP.,FXD,MICA D:360PF,1%,500V	00853	D155F361F0
C1024	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	72982	538-011 D9-35
C1048	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
C1055	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C1065	290-0573-00			CAP.,FXD,ELCTLT:2.7UF,20%,50V	56289	196D275X0050JA1
C1072	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C1075	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C1077	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C1097	290-0573-00			CAP.,FXD,ELCTLT:2.7UF,20%,50V	56289	196D275X0050JA1
C1202	290-0633-00			CAP.,FXD,ELCTLT:2400UF,+75-10%,30V	56289	39D360
C1205	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C1207	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C1211	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1217	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1219	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C1220	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1240	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C1242	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C1244	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C1246	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1248	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1250	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1259	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C1280	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C1307	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C1308	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C1310	290-0117-00			CAP.,FXD,ELCTLT:50UF,+75-10%,50V	56289	30D506G050DD9
C1327	290-0633-00			CAP.,FXD,ELCTLT:2400UF,+75-10%,30V	56289	39D360
C1335	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C1337	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C1340	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1342	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1344	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1359	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C1380	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C1407	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C1408	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C1410	290-0117-00			CAP.,FXD,ELCTLT:50UF,+75-10%,50V	56289	30D506G050DD9
CR16	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR17	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR25	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR26	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR80	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR82	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR84	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR86	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR145	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR147	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR220	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR222	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR224	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR226	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR228	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR296	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR304	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR305	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR378	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR382	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR493	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR495	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR584	152-0536-00			SEMICOND DEVICE:SILICON,HOT CARRIER,4V	04713	MBD101
CR600	152-0536-00			SEMICOND DEVICE:SILICON,HOT CARRIER,4V	04713	MBD101
CR604	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR782	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR790	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR792	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR794	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR805	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR876	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR885	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR958	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR990	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR991	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR1200	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR1202	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1207	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1219	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1225	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR1240	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1242	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1244	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1246	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1248	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1250	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1272	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR1282	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1283	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1306	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR1310	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1325	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR1327	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1337	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1340	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1342	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1344	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR1372	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR1382	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1383	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1406	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	80009	152-0141-02
CR1410	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
DL480	119-0755-00	B010100	B020244X	DELAY LINE,ELEC:4.75NS,50 OHMS	80009	119-0755-00
DS110	150-1029-00			LAMP,LED:2.0V,GREEN	53184	XC209G
DS500	150-1031-00			LAMP,LED:RED,650NM,40MA MAX	53184	XC209R
DS1250	150-1029-00			LAMP,LED:2.0V,GREEN	53184	XC209G
J10	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	13511	31-279
J12	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J90	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J140	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J254	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J255	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	13511	31-279
J260	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J305	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J450	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J452	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J480	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J481	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J485	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J520	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J522	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J1024	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J1025	131-1315-00			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR235-1
J1200	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
J1201	131-1003-00			CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
L240	276-0569-00			CORE,TOROID:	80009	276-0569-00
L507	108-0114-00	B010100	B029999X	COIL,RF:6UH	80009	108-0114-00
L507	----- -----			* ABOVE S/N B030000 REPLACED WITH A #22		
	----- -----			* WIRE STRAP		
L980	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
L1060	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR682	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
Q20	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	80009	151-1042-00
Q22						
Q25	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q26	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q30	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q100	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q102	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q110	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q150	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q160	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q175	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q178	151-0221-00	XB010125		TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q240	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q244	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q290	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00

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Q294	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q320	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q342	151-0225-00			TRANSISTOR:SILICON,NPN	80009	151-0225-00
Q406	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q410	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q435	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q460	151-0225-00			TRANSISTOR:SILICON,NPN	80009	151-0225-00
Q525	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q530	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q545	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q550	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q560	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q565	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q575	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q580	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q600	151-0302-00			TRANSISTOR:SILICON,NPN	80009	151-0302-00
Q608	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q625	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q630	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q635	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q640	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q660	151-0282-00			TRANSISTOR:SILICON,NPN	80009	151-0282-00
Q675 Q680	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	80009	151-1042-00
Q685	151-0282-00			TRANSISTOR:SILICON,NPN	80009	151-0282-00
Q690	151-0282-00			TRANSISTOR:SILICON,NPN	80009	151-0282-00
Q700 Q701	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	80009	151-1042-00
Q704	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q706	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q715	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q820	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q825	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q840	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q845	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q900	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q945	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q950	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q954	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q975	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS6927	80009	151-0438-00
Q980	151-0211-00			TRANSISTOR:SILICON,NPN	01282	2N3866
Q990	151-0285-00			TRANSISTOR:SILICON,PNP	80009	151-0285-00
Q995	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q1000	151-0302-00			TRANSISTOR:SILICON,NPN	80009	151-0302-00
Q1010	151-0411-00			TRANSISTOR:SILICON,NPN	80009	151-0411-00
Q1015	151-0411-00			TRANSISTOR:SILICON,NPN	80009	151-0411-00
Q1055	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q1060	151-0285-00			TRANSISTOR:SILICON,PNP	80009	151-0285-00
Q1070	151-0211-00			TRANSISTOR:SILICON,NPN	01282	2N3866
Q1075	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q1080	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q1090	151-0450-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N5583	80009	151-0450-00
Q1095	151-0450-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N5583	80009	151-0450-00

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Q1255	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q1265	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q1270	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q1280	151-0463-00			TRANSISTOR:SILICON,PNP	03508	D41E7
Q1285	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1295	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1300	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1355	151-0453-00			TRANSISTOR:SILICON,PNP	80009	151-0453-00
Q1365	151-0453-00			TRANSISTOR:SILICON,PNP	80009	151-0453-00
Q1370	151-0453-00			TRANSISTOR:SILICON,PNP	80009	151-0453-00
Q1380	151-0439-00			TRANSISTOR:SILICON,NPN	80009	151-0439-00
Q1385	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1395	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1400	151-0453-00			TRANSISTOR:SILICON,PNP	80009	151-0453-00
R12	301-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.50W	01121	EB5105
R14	315-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R16	315-0914-00			RES.,FXD,CMPSN:910K OHM,5%,0.25W	01121	CB9145
R20	301-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.50W	01121	EB4715
R22	301-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.50W	01121	EB4715
R25	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R28	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R30	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R32	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R33	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R36	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R38	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R40	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	91637	MFF1816G13701F
R42	321-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.125W	91637	MFF1816G24901F
R43	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R45	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	MFF1816G10201F
R48	311-1484-00			RES.,VAR,NONWIR:PNL,2.5K OHM,1W	01121	11M110
R52	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R53	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R55	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R56	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R57	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R60	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R62	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R64	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R66	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R70	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R72	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R73	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R75	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R76	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R78	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R90	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R92	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R95	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R100	301-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.50W	01121	EB1525
R102	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R104	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R106	321-0297-00	B010100	B020244	RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F

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R106	321-0322-00	B020245		RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R110	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R112	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	91637	MFF1816G17800F
R113	321-0255-00	B010100	B020244	RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R113	321-0269-00	B020245		RES.,FXD,FILM:6.19K OHM,1%,0.125W	91637	MFF1816G61900F
R140	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R142	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R145	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R147	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R150	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R152	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R154	301-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.50W	01121	EB1325
R156	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R160	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R162	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R165	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91A R2500
R167	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R169	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R170	311-1560-00			RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A R5K
R171	315-0430-00	B010100	B010124X	RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R172	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R175	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R177	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R178	315-0271-00	XB010125		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R180	311-1560-00			RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A R5K
R182	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R185	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R186	311-1567-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-89-0
R190	311-1832-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	01121	14M395
R192	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R194	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R195	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91-88-0
R214	307-0113-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
R218	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R219	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R224	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R230	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R232	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R234	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R240	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R242	301-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.50W	01121	EB4315
R244	301-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.50W	01121	EB4315
R248	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R249	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R252	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R253	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R270	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R272	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R274	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R275	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R280	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R284	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R290	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715

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R292	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R294	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R296	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R300	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R304	315-0430-00	B010100	B020244X	RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R306	315-0151-00	B010100	B020244X	RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R310	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R312	315-0271-00	B010100	B020244X	RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R315	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R317	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R320	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R325	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R328	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R342	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R346	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R348	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R350	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R352	311-1562-00	B010100	B029999	RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A R2K
R352	311-1560-00	B030000		RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A R5K
R354	315-0124-00	B010100	B020244	RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R354	315-0124-00	B020245	B029999	RES.,FXD,CMPSN:120K OHM,(NOM VALUE),SEL	01121	CB1245
R354	315-0184-00	B030000		RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R355	311-1834-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	01121	73M4G040L503A
R360	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R362	315-0471-00	B010100	B020244	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R362	315-0471-00	B020245		RES.,FXD,CMPSN:470 OHM,(NOM VALUE),SEL	01121	CB4715
R364	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R366	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R368	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R370	315-0471-00	B010100	B020244	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R370	315-0471-00	B020245		RES.,FXD,CMPSN:470 OHM,(NOM VALUE),SEL	01121	CB4715
R372	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R375	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R380	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R400	315-0471-00	B010100	B010124	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R400	315-0271-00	B010125		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R402	315-0471-00	B010100	B010124	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R402	315-0271-00	B010125		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R406	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R408	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R410	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R412	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R415	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R420	315-0430-00	B010100	B020244X	RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R422	315-0151-00	B010100	B020244X	RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R425	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R426	315-0271-00	B010100	B020244X	RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R430	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R432	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R436	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R439	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R455	315-0220-00	B010100	B020244X	RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R456	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015

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R460	315-0202-00	B010100	B020244	RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R460	315-0162-00	B020245		RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R465	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91A R2500
R462	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R467	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R470	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A R2K
R473	315-0124-00	B010100	B020244	RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R473	315-0124-00	B020245	B029999	RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R473	315-0184-00	B030000		RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R475	311-1834-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	01121	73M4G040L503A
R482	315-0102-00	XB010125	B020244	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R482	315-0820-00	B020245		RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R483	315-0820-00	XB030000		RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R484	315-0131-00	XB020245		RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R485	315-0102-00	B010100	B029999	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R485	315-0131-00	B030000		RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R487	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R490	315-0152-00	B010100	B020244	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R490	315-0751-00	B020245		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R492	315-0102-00	XB010125	B020244	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R492	315-0820-00	B020245		RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R493	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R494	315-0131-00	XB020245		RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R495	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R500	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R520	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R522	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R525	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R527	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R528	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R530	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R534	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R536	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R538	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R540	311-1833-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	01121	73A1G040L503A
R542	311-1248-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	73138	72X-23-0-501K
R544	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R545	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R547	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R550	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R552	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R554	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R555	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R560	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R563	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R565	317-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.125W	01121	BB2205
R569	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R570	311-1237-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3386X-T07-102
R571	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R575	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R578	301-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.50W	01121	EB4715
R585	317-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.125W	01121	BB1505
R586	317-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.125W	01121	BB1505

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R600	315-0221-00	XB010125		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R604	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R608	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R614	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R615	311-1237-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3386X-T07-102
R616	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R620	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R622	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R625	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R630	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R631	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R635	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R637	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R640	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R643	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R644	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R647	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R648	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R650	311-1248-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	73138	72X-23-0-501K
R655	311-1833-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	01121	73A1G040L503A
R660	321-0173-00			RES.,FXD,FILM:619 OHM,1%,0.125W	91637	MFF1816G619R0F
R662	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R667	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R668	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	91637	MFF1816G84500F
R670	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R671	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	91637	MFF1816G84500F
R678	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R682	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R685	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R687	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R690	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R692	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R695	321-0199-00			RES.,FXD,FILM:1.15K OHM,1%,0.125W	91637	MFF1816G11500F
R697	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R698	321-0153-00			RES.,FXD,FILM:383 OHM,1%,0.125W	91637	MFF1816G383R0F
R700	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R702	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R704	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R706	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R708	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R710	321-0153-00			RES.,FXD,FILM:383 OHM,1%,0.125W	91637	MFF1816G383R0F
R712	321-0199-00			RES.,FXD,FILM:1.15K OHM,1%,0.125W	91637	MFF1816G11500F
R715	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R722	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R724	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R728	315-0152-00	B010100	B020244	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R728	315-0751-00	B020245		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R730	315-0561-00	B010100	B029999X	RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R732	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R734	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R742	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R743	315-0680-00	XB030000		RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R744	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015

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R748	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R749	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R750	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R770A,B	311-1162-00			RES.,VAR,NONWIR:2 X 10K OHM,10%,1W	12697	381-CM39691
R775	311-1245-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	72-28-0
R777	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R778	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R780	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R782	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R785	311-1245-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	72-28-0
R787	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R788	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R790	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R794	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R796	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R798	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R800	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R802	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R804	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R810	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R811	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R814	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R815	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R817	321-0182-00			RES.,FXD,FILM:768 OHM,1%,0.125W	91637	MFF1816G768R0F
R820	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R825	321-0107-00			RES.,FXD,FILM:127 OHM,1%,0.125W	91637	MFF1816G127R0F
R827	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R830	321-0142-00			RES.,FXD,FILM:294 OHM,1%,0.125W	91637	MFF1816G294R0F
R832	321-0142-00			RES.,FXD,FILM:294 OHM,1%,0.125W	91637	MFF1816G294R0F
R834	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R836	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R840	321-0107-00			RES.,FXD,FILM:127 OHM,1%,0.125W	91637	MFF1816G127R0F
R842	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R845	322-0119-00			RES.,FXD,FILM:169 OHM,1%,0.25W	91637	MFF1421G169R0F
R847	323-0145-00			RES.,FXD,FILM:316 OHM,1%,0.50W	91637	MFF1226G316R0F
R850	321-0114-00	B010100	B020698	RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R850	321-0121-00	B020699		RES.,FXD,FILM:178 OHM,1%,0.125W	91637	MFF1816G178R0F
R850	----- -----			* NOMINAL VALUE,TEST SELECTED AS A SET		
R852	321-0114-00	B010100	B020698	RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R852	321-0121-00	B020699		RES.,FXD,FILM:178 OHM,1%,0.125W	91637	MFF1816G178R0F
R852	----- -----			* NOMINAL VALUE,TEST SELECTED AS A SET		
R854	321-0114-00	B010100	B020698	RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R854	321-0121-00	B020699		RES.,FXD,FILM:178 OHM,1%,0.125W	91637	MFF1816G178R0F
R854	----- -----			* NOMINAL VALUE,TEST SELECTED AS A SET		
R856	321-0114-00	B010100	B020698	RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R856	321-0121-00	B020699		RES.,FXD,FILM:178 OHM,1%,0.125W	91637	MFF1816G178R0F
R856	----- -----			* NOMINAL VALUE,TEST SELECTED AS A SET		
R860	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R861	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R863	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R865	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R866	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R868	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225

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R869	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R875	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R876	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R878	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R883	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R885	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91-88-0
R887	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R888	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R892	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R893	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R895	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R897	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R898	323-0133-00			RES.,FXD,FILM:237 OHM,1%,0.50W	75042	CECT0-2370F
R900	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R904	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	91637	MFF1816G20500F
R905	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R908	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	91637	MFF1816G20500F
R910	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A R2K
R911	321-0322-00			RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R914	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R915	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R918	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R920	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R924	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R925	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R930	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R932	321-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.125W	91637	MFF1816G95300F
R934	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R936	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R938	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R942	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R944	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R945	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R947	323-0157-00			RES.,FXD,FILM:422 OHM,1%,0.50W	91637	MFF1226G422R0F
R950	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R954	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R956	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R958	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R975	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R977	315-0160-00			RES.,FXD,CMPSN:16 OHM,5%,0.25W	01121	CB1605
R978	301-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.50W	01121	EB7515
R982	321-0001-00			RES.,FXD,FILM:10 OHM,1%,0.125W	75042	CEAT0-10R00F
R985	322-0051-00			RES.,FXD,FILM:33.2 OHM,1%,0.25W	75042	CEBT0-33R20F
R990	307-0110-00			RES.,FXD,CMPSN:3 OHM,5%,0.25W	01121	CB30G5
R992	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R995	301-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R1000	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R1002	321-0136-00			RES.,FXD,FILM:255 OHM,1%,0.125W	91637	MFF1816G255R0F
R1005	315-0430-00			RES.,FXD,CMPSN:43 OHM,(NOM VALUE),SEL	01121	CB4305
R1014	307-0114-00			RES.,FXD,CMPSN:6.2 OHM,5%,0.25W	01121	CB62G5
R1017	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R1018	307-0114-00			RES.,FXD,CMPSN:6.2 OHM,5%,0.25W	01121	CB62G5
R1019	301-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.50W	01121	EB1325

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R1020	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R1021	303-0391-00			RES.,FXD,CMPSN:390 OHM,5%,1W	01121	GB3915
R1024	311-1567-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-89-0
R1026	305-0470-00			RES.,FXD,CMPSN:47 OHM,5%,2W	01121	HB4705
R1027	305-0470-00			RES.,FXD,CMPSN:47 OHM,5%,2W	01121	HB4705
R1028	303-0100-00			RES.,FXD,CMPSN:10 OHM,5%,1W	01121	GB1005
R1029	303-0100-00			RES.,FXD,CMPSN:10 OHM,5%,1W	01121	GB1005
R1030	305-0470-00			RES.,FXD,CMPSN:47 OHM,5%,2W	01121	HB4705
R1031	305-0470-00			RES.,FXD,CMPSN:47 OHM,5%,2W	01121	HB4705
R1032	303-0100-00			RES.,FXD,CMPSN:10 OHM,5%,1W	01121	GB1005
R1033	303-0100-00			RES.,FXD,CMPSN:10 OHM,5%,1W	01121	GB1005
R1035	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R1040	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1042	322-0222-00			RES.,FXD,FILM:2K OHM,1%,0.25W	75042	CEBT0-2001F
R1044	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1048	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R1050	311-1568-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	73138	91A R50
R1055	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1057	315-0160-00			RES.,FXD,CMPSN:16 OHM,5%,0.25W	01121	CB1605
R1058	301-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.50W	01121	EB7515
R1062	321-0001-00			RES.,FXD,FILM:10 OHM,1%,0.125W	75042	CEAT0-10R00F
R1065	322-0051-00			RES.,FXD,FILM:33.2 OHM,1%,0.25W	75042	CEBT0-33R20F
R1072	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1075	301-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R1080	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R1082	321-0136-00			RES.,FXD,FILM:255 OHM,1%,0.125W	91637	MFF1816G255R0F
R1085	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1094	307-0114-00			RES.,FXD,CMPSN:6.2 OHM,5%,0.25W	01121	CB62G5
R1098	307-0114-00			RES.,FXD,CMPSN:6.2 OHM,5%,0.25W	01121	CB62G5
R1202	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1205	308-0179-00			RES.,FXD,WW:5 OHM,5%,5W	91637	RS5-D5R000J
R1209	321-0209-00			RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
R1210	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A R2K
R1211	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	91637	MFF1816G56200F
R1215	308-0245-00			RES.,FXD,WW:0.6 OHM,5%,2W	91637	CW-2B30.60HM 5%
R1217	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R1230	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1232	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R1234	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1236	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R1250	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R1255	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R1257	315-0752-00	B010100	B010149	RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1257	315-0512-00	B010150		RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R1259	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1260	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1265	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	MFF1816G35700F
R1266	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	MFF1816G35700F
R1270	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1272	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
R1273	321-0254-00			RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
R1275	321-0296-00			RES.,FXD,FILM:11.8K OHM,1%,0.125W	91637	MFF1816G11801F
R1276	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1280	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1282	308-0767-00			RES.,FXD,WW:1.1 OHM,5%,1W	75042	BW20-1R100J
R1285	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1287	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1290	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1295	301-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.50W	01121	EB1525
R1297	321-0124-00			RES.,FXD,FILM:191 OHM,1%,0.125W	91637	MFF1816G191R0F
R1298	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1300	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R1302	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	MFF1816G24301F
R1305	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	MFF1816G10201F
R1306	321-0211-00			RES.,FXD,FILM:1.54K OHM,1%,0.125W	91637	MFF1816G15400F
R1310	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1327	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1330	305-0471-00			RES.,FXD,CMPSN:470 OHM,5%,2W	01121	HB4715
R1355	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R1357	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R1359	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1360	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1365	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	MFF1816G35700F
R1366	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	MFF1816G35700F
R1370	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1372	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	91637	MFF1816G28000F
R1373	321-0278-00			RES.,FXD,FILM:7.68K OHM,1%,0.125W	91637	MFF1816G76800F
R1375	321-0303-00			RES.,FXD,FILM:14K OHM,1%,0.125W	91637	MFF1816G14001F
R1376	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1380	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1382	308-0767-00			RES.,FXD,WW:1.1 OHM,5%,1W	75042	BW20-1R100J
R1385	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1387	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1390	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1395	301-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.50W	01121	EB1525
R1397	321-0124-00			RES.,FXD,FILM:191 OHM,1%,0.125W	91637	MFF1816G191R0F
R1398	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1400	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R1402	321-0321-00			RES.,FXD,FILM:21.5K OHM,1%,0.125W	91637	MFF1816G21501F
R1405	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R1406	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R1410	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
S12	260-0723-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
S75A-C	260-1723-00			SWITCH,PUSH:3 BUTTON,2 POLE	80009	260-1723-00
S200	263-1142-00			SW CAM ACTR AS:PERIOD	80009	263-1142-00
S330A,B	263-1141-00			SW CAM ACTR AS:DELAY	80009	263-1141-00
S380A,B	260-1801-00			SWITCH,PUSH:DPDT,2 BUTTON	80009	260-1801-00
S450	263-1144-00			SW CAM ACTR AS:DURATION	80009	263-1144-00
S590	263-1143-00			SW CAM ACTR AS:RANGE	80009	263-1143-00
S785	260-1453-00			SWITCH,PUSH:1 BUTTON	80009	260-1453-00
S865	260-1453-00			SWITCH,PUSH:1 BUTTON	80009	260-1453-00
U40	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U60	156-0197-00			MICROCIRCUIT,LI:5 TRANSISTOR ARRAY	80009	156-0197-00
U70	156-0182-00			MICROCIRCUIT,DI:TRIPLE 2-3-2 INPUT GATE	80009	156-0182-00
U140	156-0182-00			MICROCIRCUIT,DI:TRIPLE 2-3-2 INPUT GATE	80009	156-0182-00
U270	156-0205-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0205-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U300	156-0182-00			MICROCIRCUIT,DI:TRIPLE 2-3-2 INPUT GATE	80009	156-0182-00
U360	156-0205-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0205-00
U400	156-0182-00			MICROCIRCUIT,DI:TRIPLE 2-3-2 INPUT GATE	80009	156-0182-00
U480	156-0230-00	B010100	B029999	MICROCIRCUIT,DI:DUAL D MA-SLAVE FLIP-FLOP	80009	156-0230-00
U480	156-0880-00	B030000		MICROCIRCUIT,DI:DUAL D MASTER SLAVE FF	80009	156-0880-00
U665	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U720	156-0230-00	B010100	B029999	MICROCIRCUIT,DI:DUAL D MA-SLAVE FLIP-FLOP	80009	156-0230-00
U720	156-0880-00	B030000		MICROCIRCUIT,DI:DUAL D MASTER SLAVE FF	80009	156-0880-00
U740	156-0205-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0205-00
U780	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U800	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U850	155-0078-10			MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER,SEL	80009	155-0078-10
U895	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U930	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U1205	156-0312-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR,15V,1A	27014	LM340T-15
U1210	156-0071-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	80009	156-0071-00
U1335	156-0527-00			MICROCIRCUIT,LI:NEG VOLTAGE REGULATOR,15V	80009	156-0527-00
VR20	152-0127-00			SEMICOND DEVICE:ZENER,0.4W,7.5V,5%	80009	152-0127-00
VR22	152-0127-00			SEMICOND DEVICE:ZENER,0.4W,7.5V,5%	80009	152-0127-00
VR65	152-0217-00			SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	80009	152-0217-00
VR172	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0279-00
VR620 VR630	153-0063-00			SEMICOND DVC SE:MATCHED,50MV AT 10 MA	80009	153-0063-00
VR944	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0279-00
VR975	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	80009	152-0149-00
VR1000	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	07910	1N4372A
VR1080	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	07910	1N4372A
VR1257	152-0280-00	XB010150		SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR1330	152-0395-00			SEMICOND DEVICE:ZENER,0.4W,4.3V,5%	04713	1N749A
W306	131-0566-00	XB020245		LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
W422	131-0566-00	XB020245		LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
W455	131-0566-00	XB020245		LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1

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 (μF).

Resistors = Ohms (Ω).

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

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

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

Abbreviations are based on ANSI Y1.1-1972.

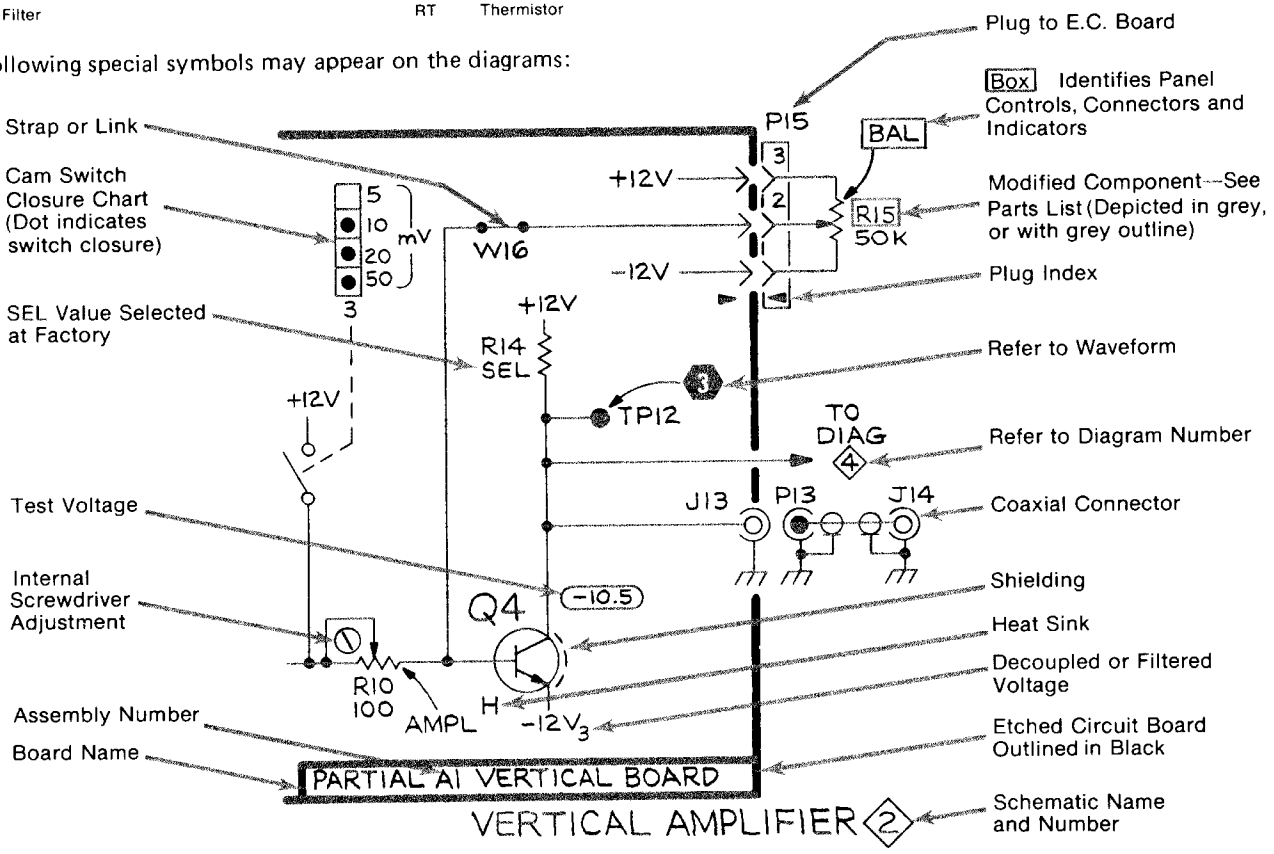
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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

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

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

The following special symbols may appear on the diagrams:



GENERAL MAINTENANCE AND ADJUSTMENTS

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 manuals for complete maintenance information. For replacement of cam switch contacts, cam switch repair kits are available from Tektronix. To obtain the kits, contact your local Tektronix Field Office or representative.

If trouble exists in the output amplifier, remove the + and − tracking power supply jumpers located as shown in the adjustment location illustration. This completely isolates the tracking power supplies from the output circuitry.

Circuit Board Removal

To remove the output circuit board and gain access to the components on the variable transition timing board, first remove the four screws on the plug-in rear panel and remove the panel. Next remove the TRANSITION TIME knob. Disconnect the coaxial cable plugs and unplug all the wires connected to the output or transition time boards. Finally, remove the four screws holding the output board to the plug-in frame and remove the two boards by sliding toward the rear of the plug-in until the TRANSITION TIME shaft clears the front panel hole. Now lift the boards and remove them from the mainframe. To remove the input board remove the wires and cables to the input board and the two screws holding the board to the chassis. To remove the timing board, first remove the rear panel, as explained above. Then remove the PERIOD, DELAY, and DURATION knobs from their shafts. Disconnect all wires and cables leading to the timing board. Remove the four screws holding the timing board to the spacers. Slide the timing board toward the rear of the plug-in until the shafts clear the front panel and lift the board out.

Test Equipment

For complete calibration of the PG 508, the following equipment is recommended:

Power module with four compartments or more, TEKTRONIX TM 504.

Digital voltmeter with ranges greater than ±26 V, TEKTRONIX DM 502 or equivalent (requires a TM 500-series power module).

Digital counter capable of frequencies to 51 MHz, TEKTRONIX DC 504 (requires a TM 500-series power module).

5 kHz to 500 kHz square-wave generator with variable frequency control and external triggering capabilities, TEKTRONIX PG 501 (requires a TM 500-series power module).

Complete oscilloscope system, sampling and real time, capable of faithful reproduction to at least 500 MHz. TEKTRONIX 5440 mainframe, 5A45 real time vertical amplifier, 5B42 real time delaying sweep plug-in, and 5S14N sampler plug-in suggested.

Two flexible plug-in extender cables, Tektronix Part No. 067-0645-02.

50 Ω 42 inch coaxial cable with bnc connectors, Tektronix Part No. 012-0057-01, or equivalent.

50 Ω termination, bnc connectors, Tektronix Part No. 011-0049-01, or equivalent.

50 Ω10X attenuator, bnc connectors, Tektronix Part No. 011-0059-02, or equivalent.

Bnc female to dual banana adapter, Tektronix Part No. 103-0090-00.

General

For easy access to all adjustments, calibrate the PG 508 using the extender cables. Make certain the cables and plug-in are properly connected; top of each end of extender cable to top of power module and to top of plug-in. Adjustments are located on the output board (right side of instrument), period board (left side and top) and transition board (through the bottom of the instrument). Make adjustments at an ambient temperature between +20° C and +30° C. Recommended recalibration interval is 2000 hours of operation or six months, whichever occurs first.

Output Voltage Control Knob Check or Adjustment

To check or reset the OUTPUT (VOLTS) control knobs, use the following procedure. Connect an oscilloscope to the PG 508 OUTPUT connector. Set the DURATION control to the SQ WAVE position, and the PERIOD control at the 2 ms position. Set the HIGH LEVEL knob for an output level of about +5 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 about −5 V, and the HIGH LEVEL for 0 V on the oscilloscope. If the HIGH LEVEL knob does not point to 0, loosen the setscrew and readjust.

1. Adjust 5.2 V Supply

Connect the + lead from the DVM to the point labeled +5.2 V in the illustration and the − lead to ground. Adjust R1210, 5.2, for a reading of +5.2 V.

2. Adjust 2 μs Period

Connect the coaxial cable to the +TRIG OUT connector. Connect the 50 Ω termination to the other end of the cable and connect the termination to the counter input. Set the counter to read 500 kHz. Set the PERIOD control to the 2 μs position. Make certain the CAL knob is fully ccw. Adjust R186, Per, for a frequency of 500 kHz.

3. Adjust Symmetry

Maintain the PERIOD as in the previous step and the CAL knob fully clockwise. Connect the +TRIG OUT through the coaxial cable and termination to the vertical amplifier input of the oscilloscope. Set the oscilloscope sweep rate so that one-half cycle of the waveform is displayed over most of the graticule. While switching from + slope to − slope on the oscilloscope triggering, adjust R180, Sym, so that the waveform transitions occur at exactly the same point on the oscilloscope graticule.

4. Adjust 20 ns Period

Connect the + TRIG OUT through a coaxial cable and termination to the counter set to read 50 MHz. Make certain the CAL knob is in the fully ccw position. Change the PERIOD to the 20 ns position. Now adjust R195, 20 ns Per, for a reading of 50 MHz.

5. Adjust 1st Period 2 μs

Set the PERIOD to 2 μs and the DURATION to SQ WAVE. Turn the PERIOD CAL control fully cw. Push the correct buttons for SYNC GATE and + SLOPE operation. Connect the + TRIG OUT from the PG 508 to the vertical amplifier of the oscilloscope. Connect the trigger output from the square-wave generator to the external trigger input of the oscilloscope real time base. Connect the output from the square-wave generator to the TRIG/GATE IN connector of the PG 508. Set the square-wave generator for a 5 kHz square wave. Adjust the TRIG/GATE LEVEL control of the PG 508 for gated operation. The TRIG'D/GATED light will flash when the unit is properly triggered. Set the oscilloscope sweep speed at 50 μs and trigger the time base externally from the square-wave generator. Now adjust the square-wave generator variable frequency control for a gated burst of about ten cycles from the + TRIG OUT connector on the PG 508. Set the delayed sweep rate for the time base at 5 μs and switch the time base to the delayed sweep. Using the delay time multiplier dial, compare the period of the first and fourth cycles in the burst. Adjust R170 1 Per for a first period length matching the fourth period length.

6. Adjust 1st Period 20 ns.

Change the PERIOD to 20 ns. Turn the PERIOD CAL control fully cw. Set the square-wave frequency to 500 kHz. Install the sampling plug-in and connect the + TRIG OUT through the coaxial cable and termination to the sampling plug-in input. Connect the square-wave generator trigger output to the external trigger input of the sampling unit. Set the delayed sweep time to 0.5 μs (main sweep time 0.5 μs) and adjust the frequency variable control on the square-wave generator for a burst of about ten cycles. Now switch the delayed sweep time to 50 ns. Use the delay time multiplier to compare the periods of the first and fourth cycles in the burst measured at the 50% points. If necessary, adjust R165, 20 ns 1 Per for a first period length matching the fourth period length.

7. Adjust 1 μs Duration

Change the DURATION switch to 1 μs. Make certain the variable control is fully ccw. Change the PERIOD to 2 μs and make certain the variable control is fully ccw. Connect the OUTPUT to the sampling unit's vertical input and the + TRIG OUT to the sampling unit's external trigger input. Make certain the TRANSITION TIME is in the 5 ns position and the LEADING and TRAILING controls are fully ccw. Push the MODE button placing the PG 508 in the UNDLY mode; all other pushbuttons out. Set the sweep rate at 0.2 μs. Set the OUTPUT LOW and HIGH LEVEL controls for a convenient vertical deflection of the oscilloscope trace. Now adjust R470, Dur 1 μs, for a pulse duration (on time) of exactly five horizontal divisions. Leave all connections as they are for the next step.

8. Adjust 10 ns Duration

Using the same setup as in the previous step, change the PERIOD to 20 ns and the DURATION to 10 ns. Set the period variable (CAL) knob about 45° from the fully ccw position. Change the sweep rate to 2 ns per division. Now adjust R465, Dur 10 ns, for a duration of 10 ns measured at the 50% points on the waveform.

9. Adjust Delay

Set the PERIOD to 2 μs and the DURATION to .1 μs. Make certain the CAL controls are fully ccw. Set the DELAY to 1 μs. Change the sweep rate to 0.2 μs per division. Leave all other controls as in the previous step. Note the time position of the pulse on the oscilloscope. Now push the MODE DELAY button and adjust R352, Del, for a pulse delayed exactly 1 μs (five divisions) from the previous pulse.

10. Adjust Bottom Level Clamp

Connect the 10X attenuator between the coaxial cable from the OUTPUT connector and the sampling oscilloscope input so that a 10 V p-p signal can conveniently be displayed, on the oscilloscope. Set the OUTPUT (VOLTS) HIGH and LOW LEVEL controls for a display of + and −5 V (maximum output). Set the PERIOD to 2 μs and the DURATION to 1 μs. Set the TRANSITION TIME to 5 ns and turn the LEADING and TRAILING variable controls fully cw. Leave the other controls as in the previous step. Set the oscilloscope for a 0.2 μs sweep rate. Adjust R570, Bot Lvl Clamp, until the transition from the bottom of the waveform to the leading transition portion of the waveform is linear. Improper setting of this adjustment causes either a fast step at the start of the leading transition or a time extension of the transition start.

11. Adjust Top Level Clamp

Leave all controls as in the previous step. Adjust R615, Top Lvl Clamp until the transition from the top of the waveform to the trailing transition is linear. Improper setting of this adjustment causes either a fast fall at the start of the trailing transition or a time extension of the transition start.

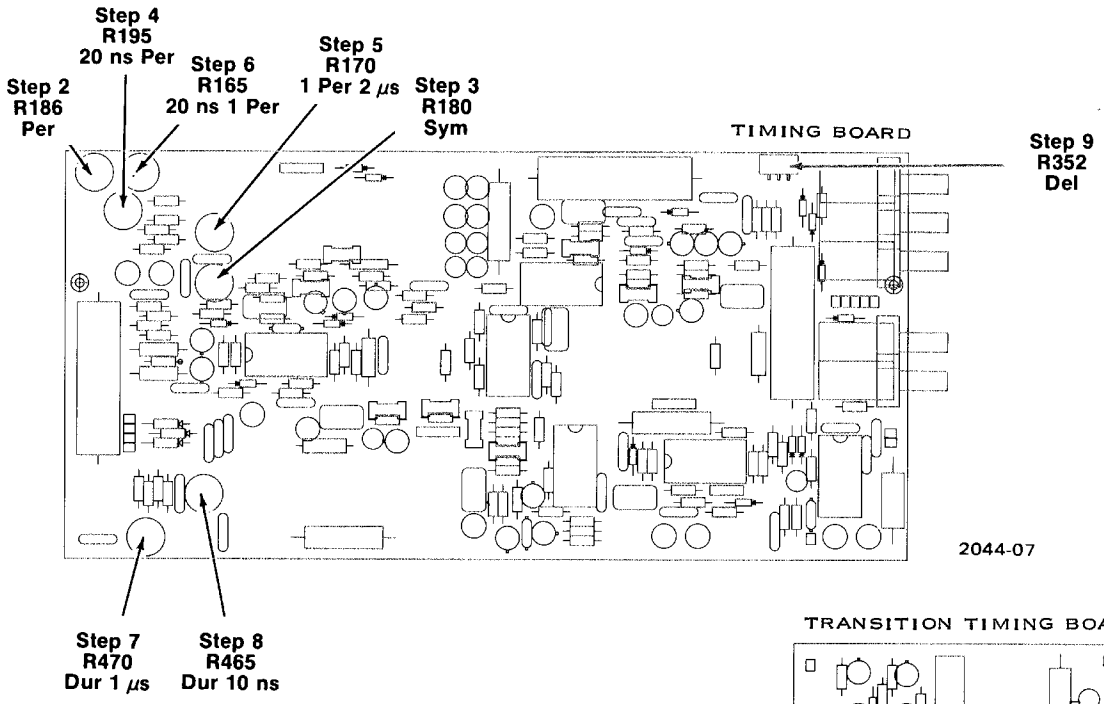
12. Adjust Leading Transition Time

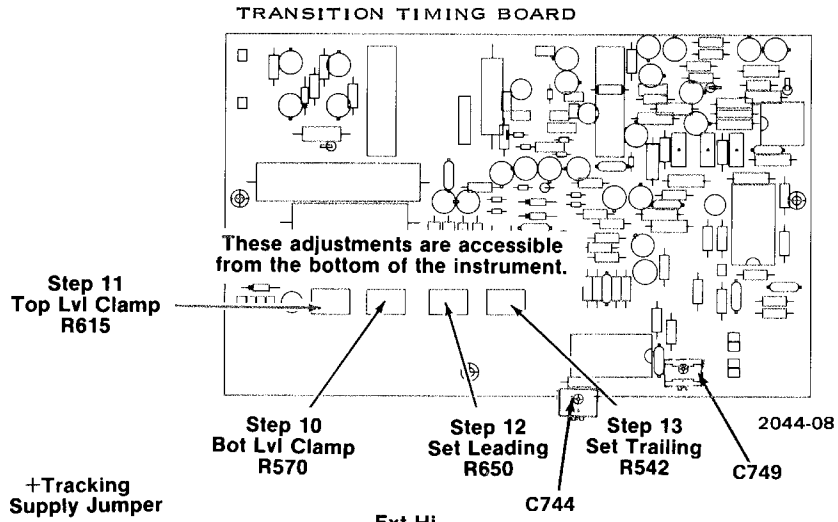
Turn the LEADING and TRAILING controls fully ccw. Change the TRANSITION TIME to 0.5 μs and the oscilloscope sweep speed to 0.1 μs. Leave all other controls as in the previous step. Adjust the oscilloscope sweep so that the leading waveform transition is visible on the crt. Adjust R650, Set Leading, for a leading transition time of 0.5 μs measured from the 10% to the 90% points of the waveform transition.

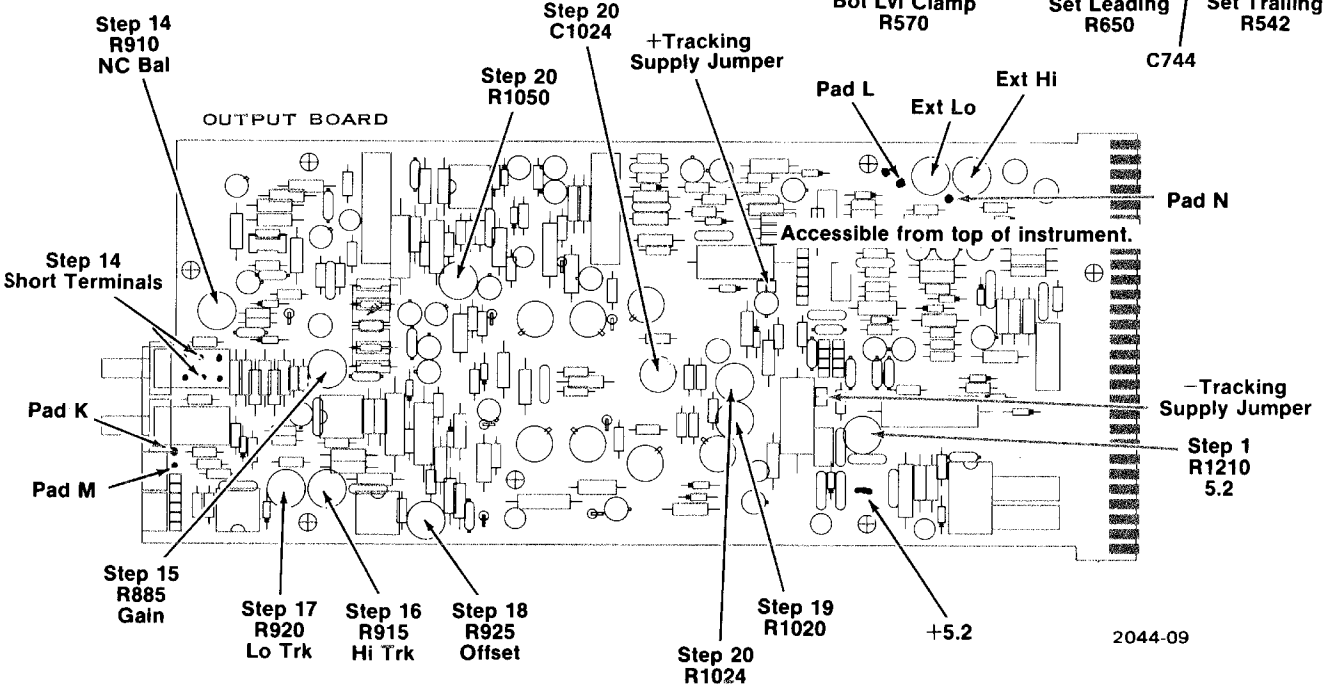
13. Adjust Trailing Transition Time

Adjust the oscilloscope sweep so that the trailing transition is visible on the crt. Adjust R542, Set Trailing, for a trailing transition time of 0.5 μs measured from the 10% to the 90% portion of the transition time.

INTERNAL ADJUSTMENT PROCEDURE







14. Adjust Normal Complement Balance

Change the oscilloscope sweep speed to 0.5 μs. Set the OUTPUT (VOLTS) HIGH and LOW level controls to their 0 position and set the NORM/COMPLEMENT button out. Short the center terminals of the NORM/COMPLEMENT switch as shown in the illustration. Increase the vertical gain of the oscilloscope by a factor of 10. Now adjust R910, N/C Bal, for equal high and low level output voltages (no signal). Remove the short from the switch terminals.

15. Adjust Gain

Using the voltmeter connected to the bottom center terminal of the NORM/COMPLEMENT switch and ground, adjust the OUTPUT (VOLTS) LOW LEVEL control for 1.33 V dc. Now connect the voltmeter to the top center pin of the NORM/COMPLEMENT switch and, without moving the LOW LEVEL control, set the OUTPUT (volts) HIGH LEVEL control for 3.87 V dc. Adjust R885, Gain, for a peak to peak output amplitude of 10 V into 50 Ω.

16. Adjust High Level Tracking

While observing the waveform low level on the oscilloscope, vary the HIGH LEVEL from 0 V amplitude to maximum amplitude (10 V) and adjust R915, Hi Trk, for minimum shift.

17. Adjust Low Level Tracking

Observe the waveform high level on the oscilloscope and vary the LOW LEVEL control from 0 V to maximum amplitude. Adjust R920, Lo Trk, for minimum shift.

18. Adjust Offset

Connect the voltmeter to the bottom center pin of the NORM/COMPLEMENT switch. Connect the negative lead to ground. Set the LOW LEVEL control for a voltmeter reading of 2.600. Now adjust R925, Offset, until the waveform low level is at 0 V on the oscilloscope.

19. Adjust Output Impedance

Set the Period at EXT TRIG OR MAN and the DURATION at EXT DUR. Make certain the TRIG/GATE LEVEL control is turned clockwise enough so the TRIG'D/GATED light is lit. Connect the OUTPUT of the PG 508 to the digital voltmeter through a coaxial cable and bnc female to dual banana adapter. Adjust the HIGH LEVEL for a reading of 10.0 V on the voltmeter. Connect a 50 Ω termination between the coaxial cable and adapter. Adjust R1020 for a reading of 5.0 V on the voltmeter.

20. Adjust Output Amplifier

Connect the OUTPUT terminal of the PG 508 through a coaxial cable and 10X attenuator to the input of the sampling oscilloscope. Set the sampling oscilloscope sweep speed at 20 ns per division. Set the DURATION at .1 μs, PERIOD at .2 μs and the TRANSITION TIME at 5 ns. Obtain a free running undelayed output waveform. Adjust the OUTPUT (VOLTS) HIGH LEVEL and LOW LEVEL controls for a 10 V peak to peak output waveform centered around 0 V. Adjust R1050, C1024 and R1024 for the fastest risetime and least aberrations on the trailing transition and corner of the pulse.

21. Adjust Control Error Light

Connect the OUTPUT terminal of the PG 508 through a coaxial cable and 50 ohm termination to the input of the real time oscilloscope. Set the oscilloscope for a vertical sensitivity of 1 V with dc coupling and for a 10 ns sweep rate. Set DURATION at 10 ns, PERIOD at 20 ns, TRANSITION TIME at 5 ns, TRAILING and LEADING controls fully ccw, MODE UNDLY button in and MODE DELAY button out. Set all TRIGGERING buttons to out position, NORM/COMPLEMENT button out and PRESET/VAR button out. Adjust the OUTPUT (VOLTS) HIGH LEVEL and LOW LEVEL controls for a display of +2.5 divisions and −2.5 divisions centered around 0 V. Adjust LEADING control cw to where the top of the waveform is decreased in amplitude by 10% (0.5 division). Adjust C749 for a flashing indication of the CONTROL ERROR light.

NOTE

If the CONTROL ERROR light does not flash, adjust LEADING control cw to where the top of waveform is decreased by 5% more (0.25 division); then adjust C749 again for a flashing indication. If the light still cannot be made to flash with adjustment of C749, continue adjusting the LEADING control cw in intervals of a 5% decrease until adjustment of C749 results in a flashing indication of the CONTROL ERROR light (do not exceed a 50% decrease in waveform amplitude).

Readjust C749 to a point where the CONTROL ERROR light is just extinguished. Return LEADING control to its fully ccw position. Adjust TRAILING control cw to where the bottom of the displayed waveform is decreased in amplitude by 10% (0.5 division). Adjust C744 for a flashing indication of the CONTROL ERROR light.

NOTE

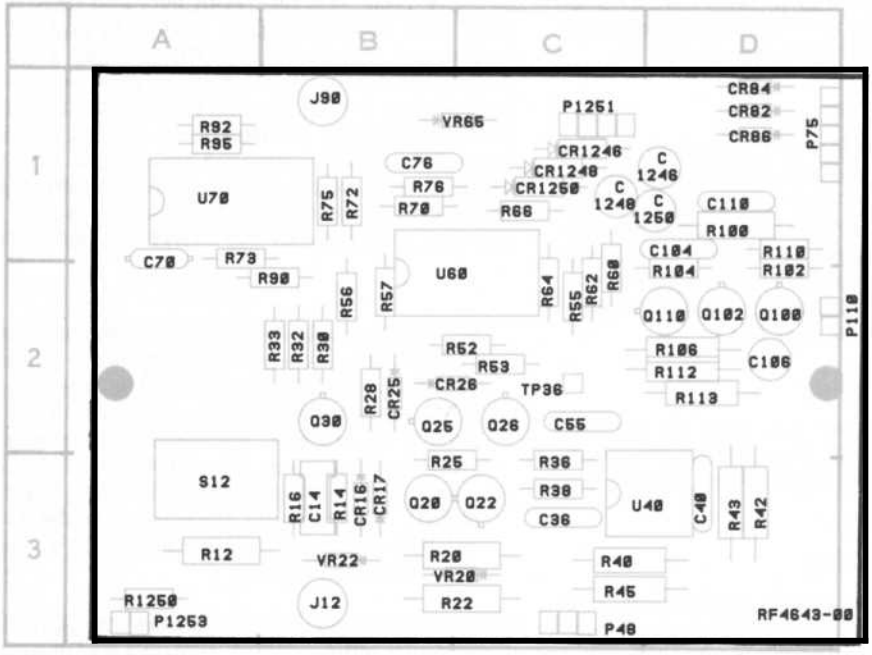
If the CONTROL ERROR light does not flash, adjust TRAILING control cw to where the bottom of waveform is decreased by 5% more (0.25 division); then adjust C744 again for a flashing indication. If the light still cannot be made to flash with adjustment of C744, continue adjusting the TRAILING control cw in intervals of a 5% decrease until adjustment of C744 results in a flashing indication of the CONTROL ERROR light (do not exceed a 50% decrease in waveform amplitude).

Readjust C744 to a point where the CONTROL ERROR light is just extinguished. Return TRAILING control to its fully ccw position.

Go back to steps 3, 7, and 8 and perform the adjustments in these steps, if necessary, for optimum performance.

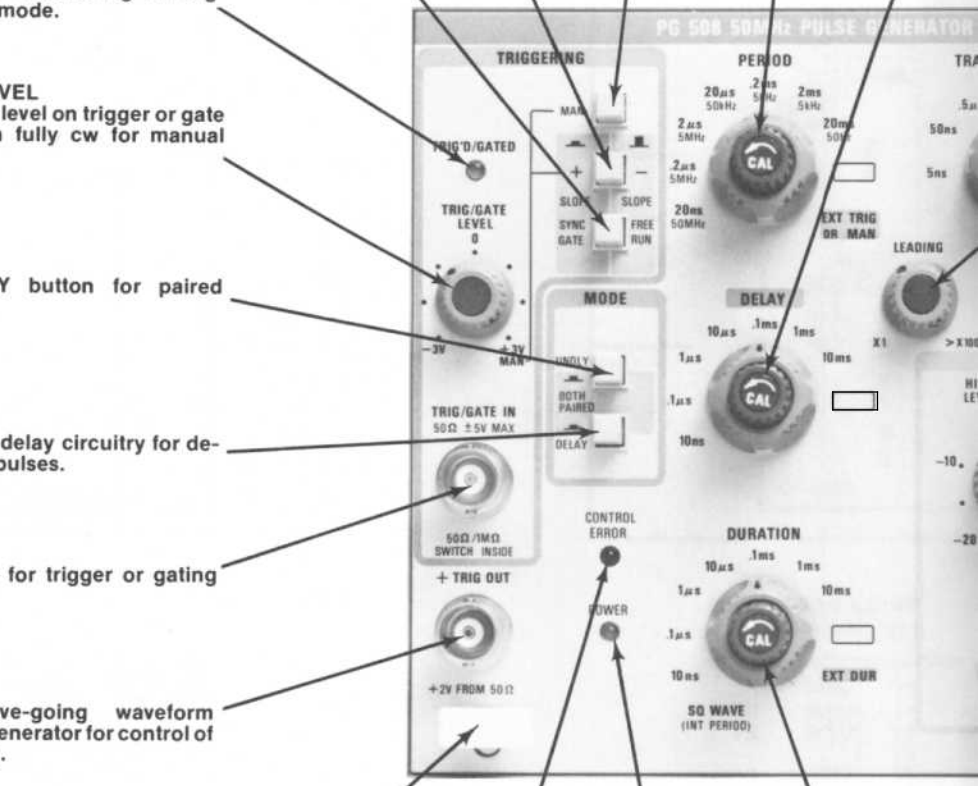
PARTS LOCATION GRID

INPUT BOARD (A1)



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C14	B3	P12	B3	R32	B2	R102	D2
C36	C3	P48	C3	R33	B2	R104	D2
C40	D3	P75	D1	R36	C3	R106	D2
C55	C2	P90	B1	R38	C3	R110	D1
C70	A2	P110	D2	R40	C3	R112	D2
C76	B1	P1248	A3	R42	D3	R113	D2
C104	D1	P1251	C1	R43	D3	R1250	A3
C106	D2	P1253	A3	R45	C3		
C110	D1			R52	C2	S12	A3
C1246	D1	Q20	B3	R53	C2		
C1248	C1	Q22	C3	R55	C2	TP36	C2
C1250	D1	Q25	B2	R56	B2		
		Q26	C2	R57	B2	U40	D3
CR16	B3	Q30	B2	R60	C2	U60	C2
CR17	B3	Q100	D2	R62	C2	U70	A1
CR25	B2	Q102	D2	R64	C2		
CR26	B2	Q110	D2	R66	C1	VR20	C3
CR82	D1			R70	B1	VR22	B3
CR84	D1	R12	A3	R72	B1	VR65	C1
CR86	D1	R14	B3	R73	A1		
CR1246	C1	R16	B3	R75	B1		
CR1248	C1	R20	C3	R76	B1		
CR1250	C1	R22	C3	R90	B2		
		R25	B3	R92	A1		
J12	B3	R28	B2	R95	A1		
J90	B1	R30	B2	R100	D1		

CONTROLS AND CON



MAN
Push for manual trigger or gate.

Push for trigger or gate start on + slope; out for − slope start.

PERIOD
Selects pulse period time.

Button in for gated operation, out for free run.

DELAY
Selects delay time

TRIG'D/GATED
Indicates when functioning in triggered or gated mode.

TRIG/GATE LEVEL
Selects starting level on trigger or gate waveform. Turn fully cw for manual trigger.

UNDLY
Push with DLY button for paired pulses.

DELAY
Push to actuate delay circuitry for delayed or paired pulses.

TRIG/GATE IN
Input connector for trigger or gating signals.

+ TRIG OUT
Supplies positive-going waveform from the period generator for control of external circuitry.

LATCH
Pull to remove plug-in.

CONTROL ERROR
Indicates improper control settings.

POWER
Indicates when power is applied.

DURATION
Selects pulse duration

OUT
Puls

AND CONNECTORS

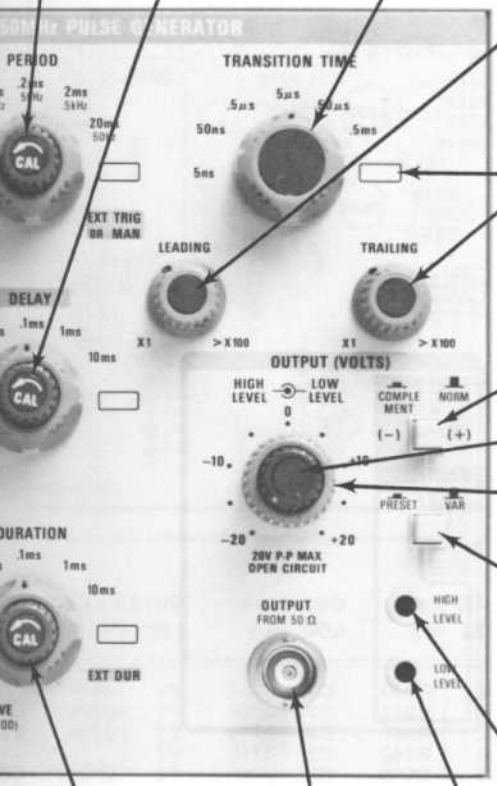
er or gate.

TRANSITION TIME
Selects transition times measured from the 10% to the 90% points.

OD
s pulse period time.

LEADING
Varies the leading transition time from X1 to >X100.

DELAY
Selects delay time.



TRAILING
Varies the trailing transition time from X1 to >X100.

CUSTOM TIMING POSITION

Button out selects normal pulse, button in complement pulse.

OUTPUT (VOLTS) HIGH LEVEL
Controls the pulse high level.

OUTPUT (VOLTS) LOW LEVEL
Controls the pulse low level.

Button out selects OUTPUT HIGH and LOW LEVEL controls for output amplitude; button in selects preset LEVEL controls.

OUTPUT
Pulse output bnc connector.

HIGH LEVEL
Control for preset high level.

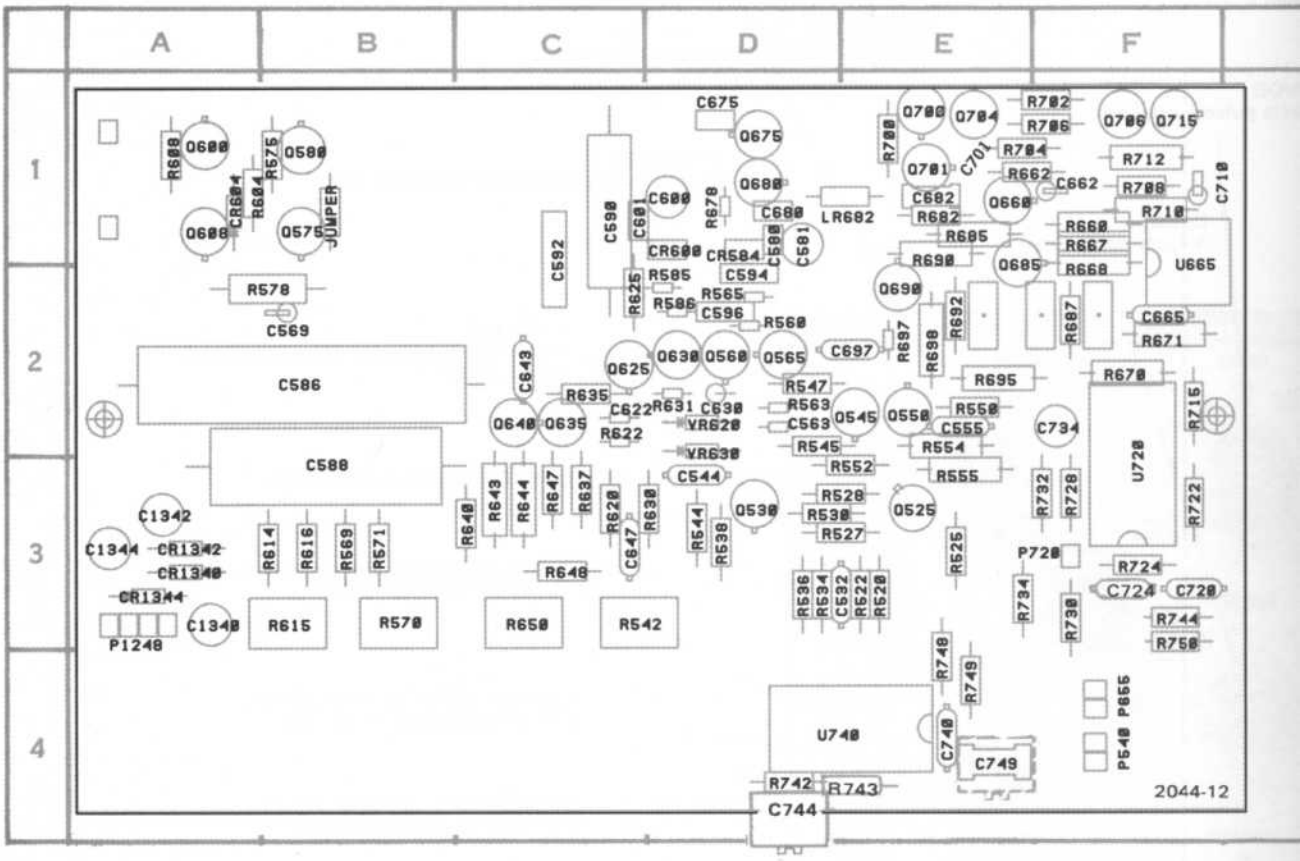
DURATION
Selects pulse duration time.

LOW LEVEL
Control for preset low level.

er is applied.

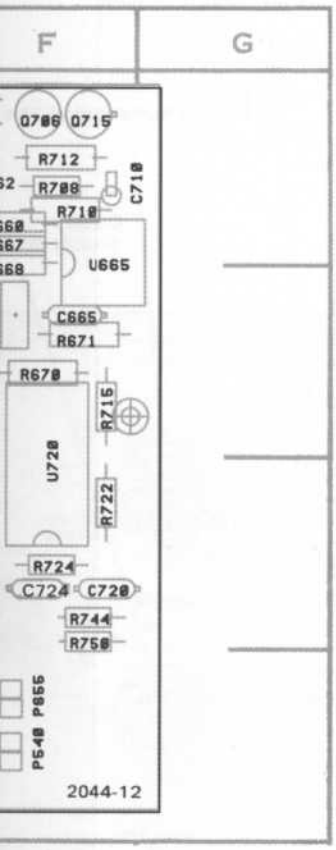
PARTS LOCATION GRID

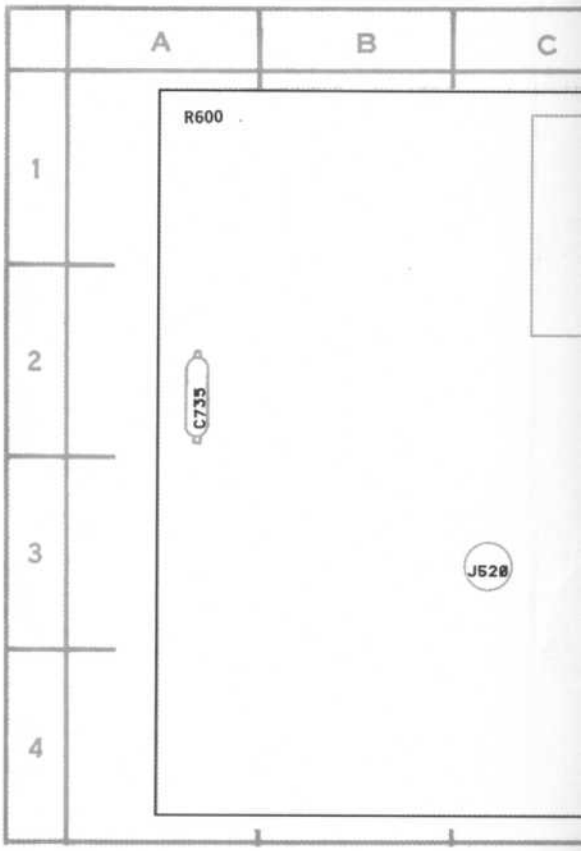
TRANSITION TIMING BOARD (A3)



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C532	D3	C682	E1	LR682	D1	Q700	E1	R560	D2	R643	C3	R706	F1	U665	F2
C544	D3	C697	E2			Q701	E1	R563	D2	R644	C3	R708	F1	U720	F2
C555	E2	C701	E1			Q704	E1	R565	D2	R647	C3	R710	F1	U740	E4
C563	D2	C708	F1	P248	A3	Q706	F1	R569	B3	R648	C3	R712	F1		
C569	B2	C720	F3	P540	F4	Q715	F1	R570	B3	R650	C3	R715	F2	VR620	C2
C580	D1	C724	F3	P655	F4			R571	B3	R660	F1	R722	F3	VR630	C2
C581	D1	C734	F2			R520	E3	R575	B1	R662	E1	R724	F3		
C586	B2	C735*†	A2			R522	E3	R578	A2	R667	F1	R728	F3		
C588	B3					R525	E3	R585	D2	R668	F1	R730†	F3		
C590	C1	C740	E4	Q525	E3	R527	D3	R586	D2	R670	F2	R732	F3		
C592	C1			Q530	D3	R528	D3	R600*†	A1	R671	F2	R734	E3		
C594	D2	C744†	D4	Q545	E2	R530	D3	R604	A1	R678	D1	R742	E4		
C596	D2	C749†	E4	Q550	E2	R534	D3	R608	A1	R682	E1	R743†	D4		
C600	D1	C1340	A3	Q560	D2	R536	D3	R614	B3	R685	E1	R744	F3		
C601	D1	C1342	A3	Q565	D2	R538	D3	R615	B3	R687	F2	R748	E4		
C622	C2	C1344	A3	Q575	B1	R542	C3	R616	B3	R690	E1	R749	E4		
C630	D2			Q580	B1	R544	D3	R620	C3	R692	E2	R750	F3		
C643	C2			Q600	A1	R545	D2	R622	C2	R695	E2				
C647	C3	CR584	D1	Q608	A1	R547	D2	R625	C2	R697	E2				
C662	F1	CR600	D1	Q625	C2	R550	E2	R630	C3	R698	E2				
C665	F2	CR604	A1	Q630	D2	R552	E3	R631	D2	R700	E1	S590	D1		
C675	D1	CR1340	A3	Q635	C2	R554	E2	R635	C2	R702	F1				
C680	D1	CR1342	A3	Q640	C2	R555	E3	R637	C3	R704	E1				
		CR1344	A3	Q660	E1			R640	C3						
				Q675	D1										
				Q680	D1										
				Q685	E1										
				Q690	E2										
		J520*	C3												
		J522*	D3												

(BACKSIDE) TRANSITION TIMING BOARD (A3)



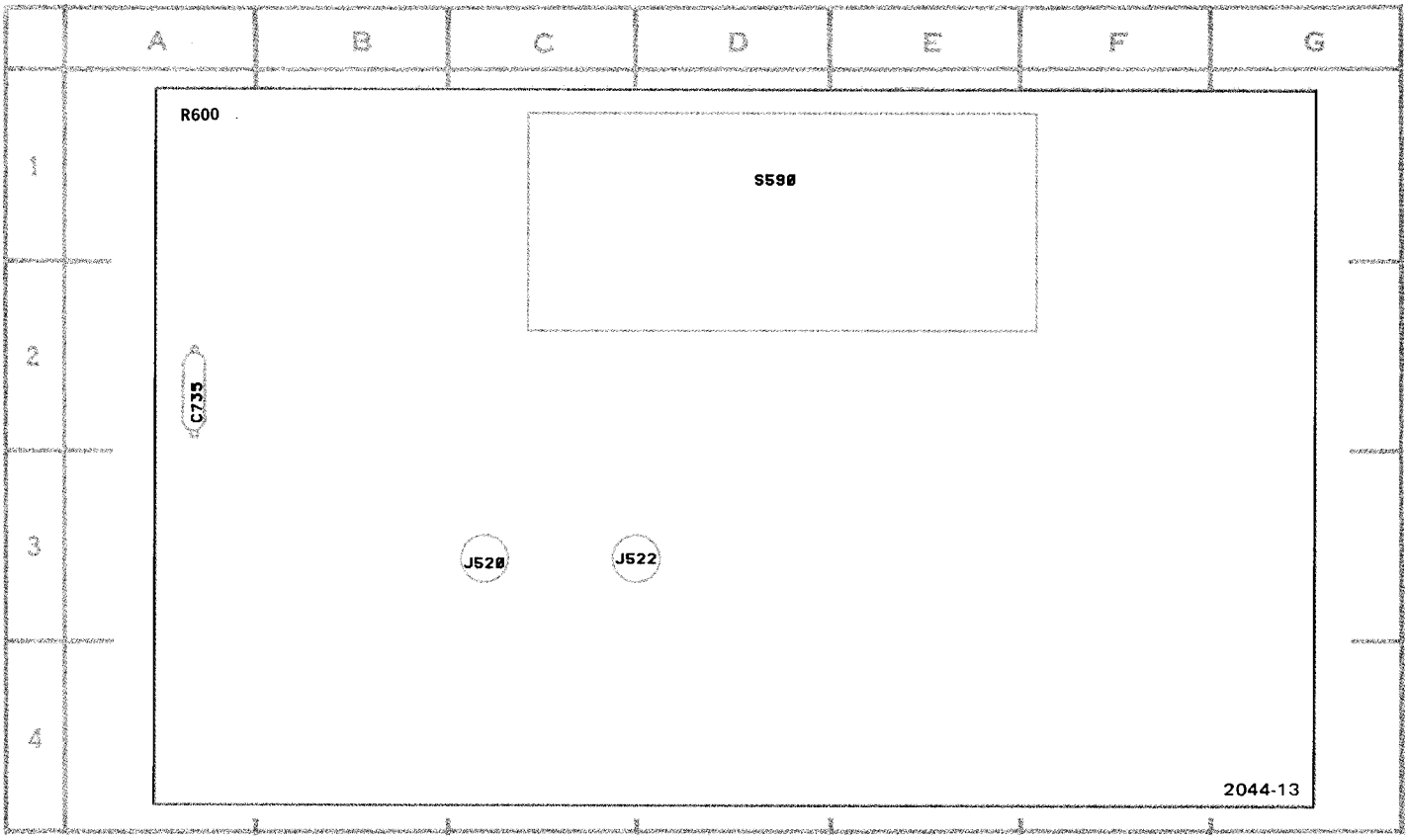


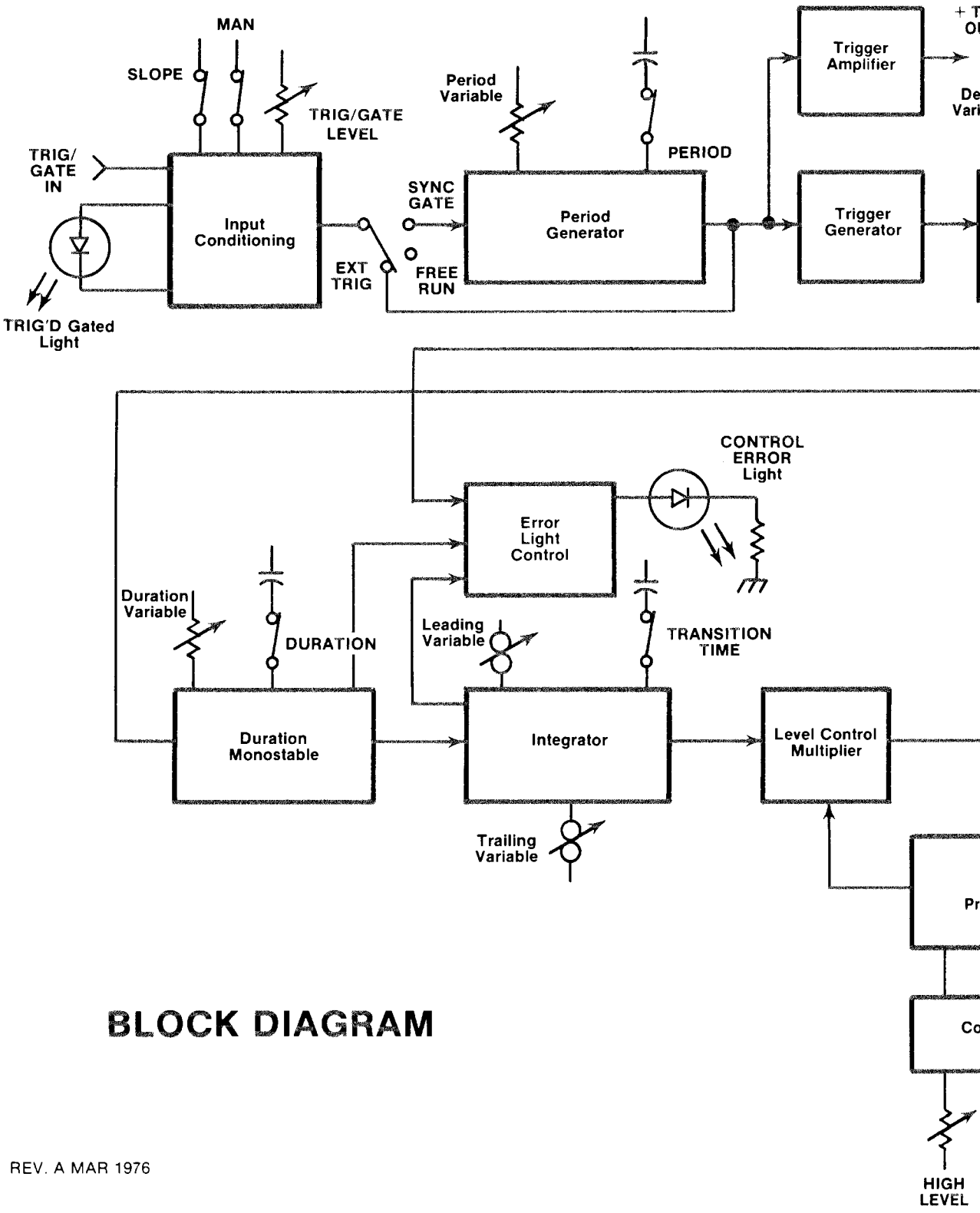
GRID LOC	CKT NO	GRID LOC
F1	U665	F2
F1	U720	F2
F1	U740	E4
F1		
F2	VR620	C2
F3	VR630	C2
F3		
F3		
F3		
F3		
E3		
E4		
D4		
F3		
E4		
E4		
F3		
D1		

†See Parts List for serial number ranges.

*On back of board.

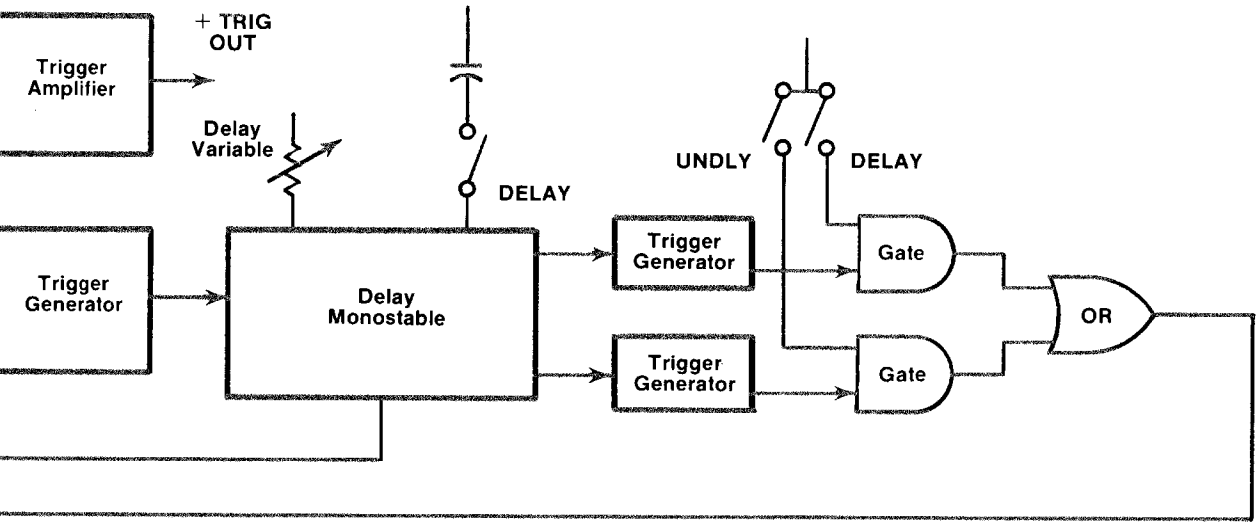
(BACKSIDE) TRANSITION TIMING BOARD (A3)

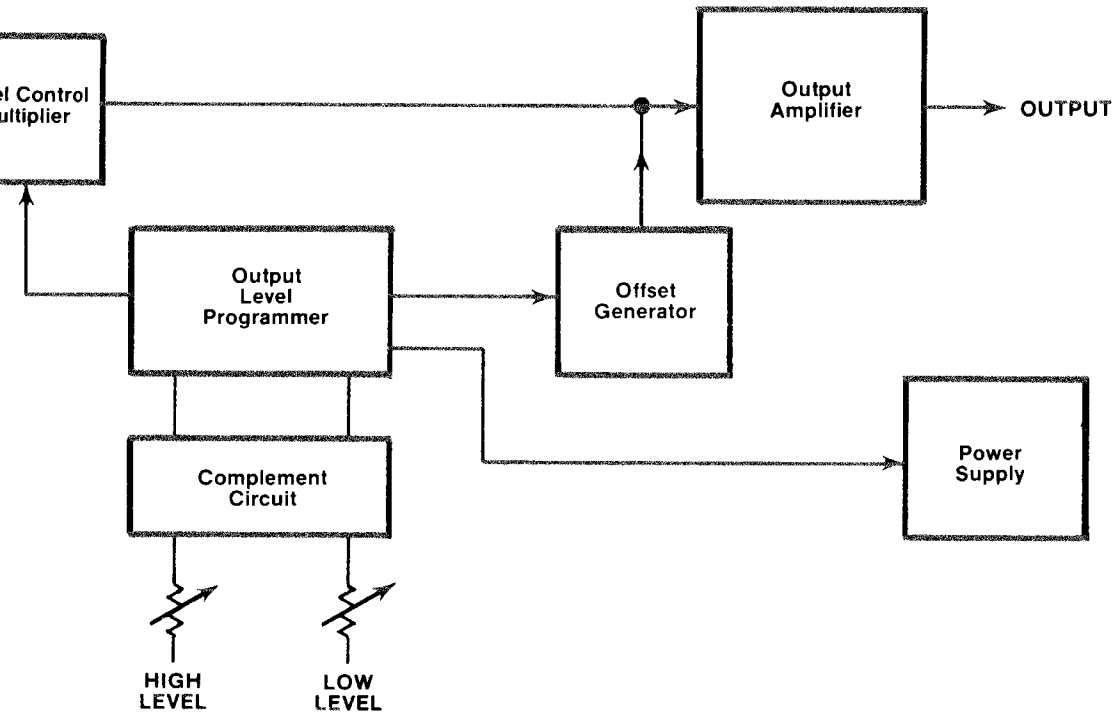




BLOCK DIAGRAM

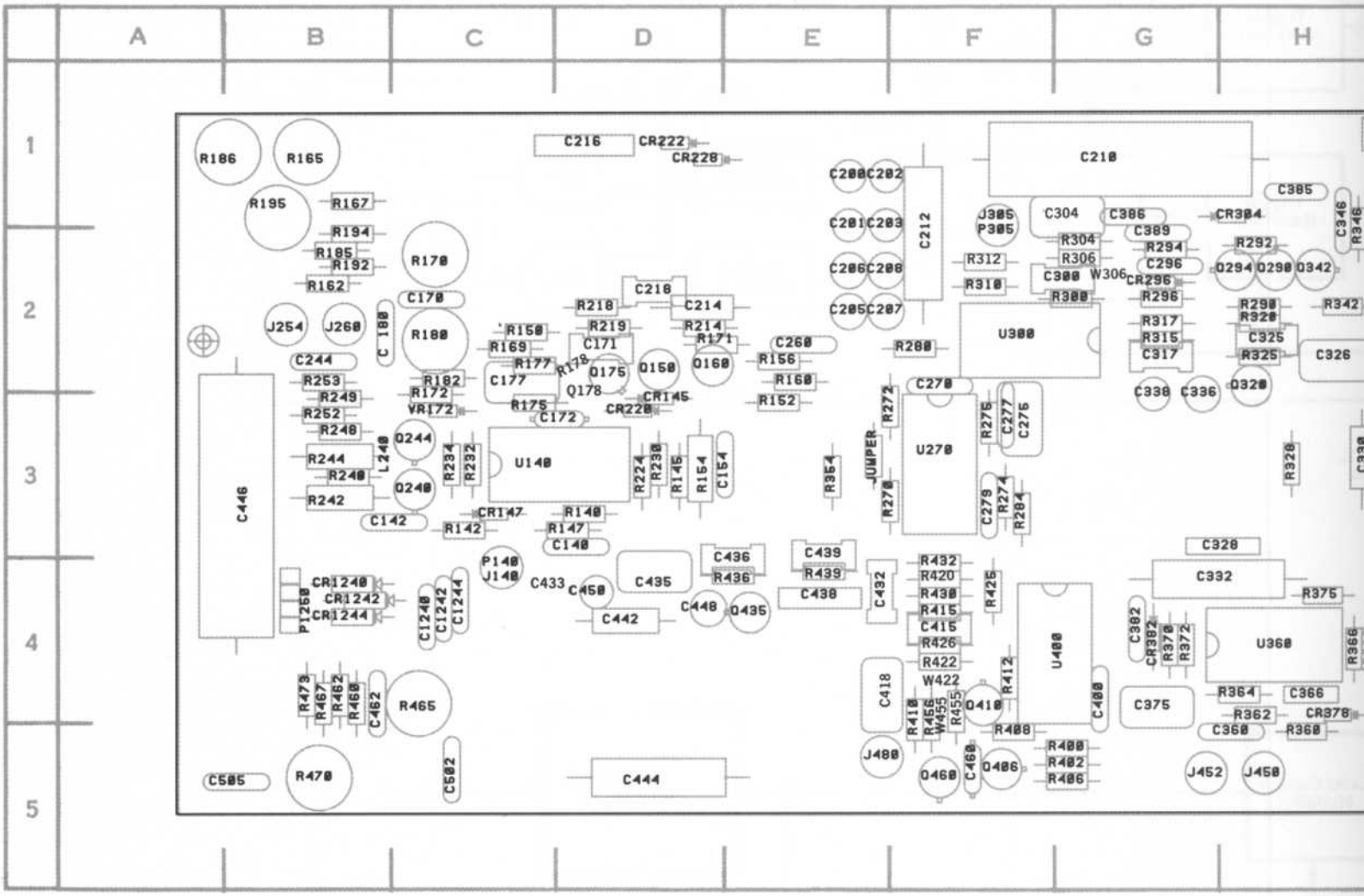
REV. A MAR 1976


+ TRIG OUT
Trigger Amplifier
Delay Variable
DELAY
UNDLY
DELAY
Trigger Generator
Delay Monostable
Trigger Generator
Gate
OR
Trigger Generator
Gate

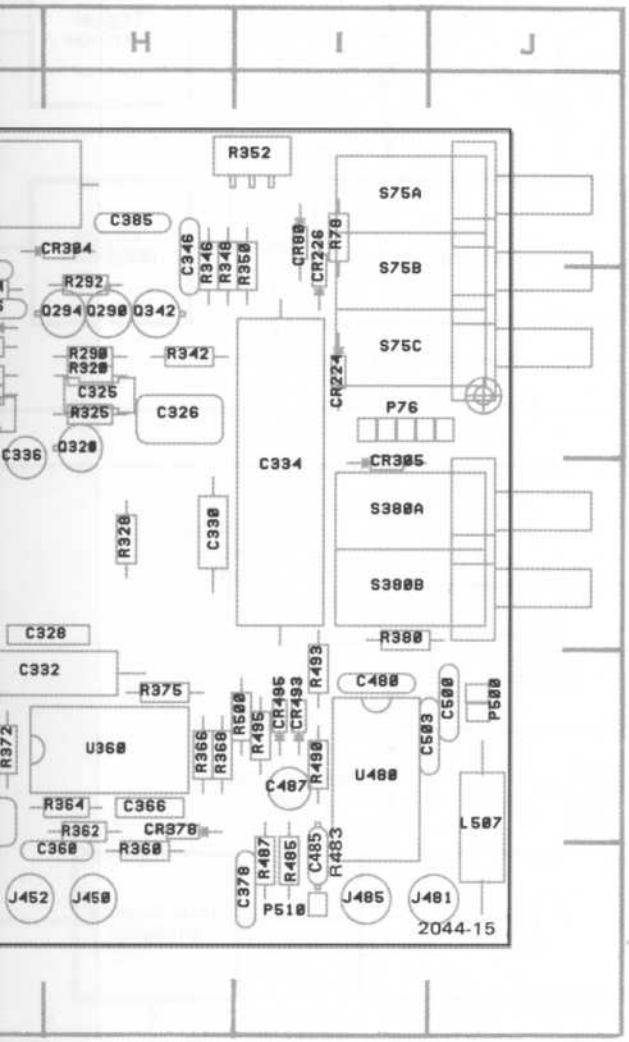

Output Amplifier
OUTPUT
Output Level Programmer
Offset Generator
Power Supply
Complement Circuit
HIGH LEVEL
LOW LEVEL

PARTS LOCATION GRID

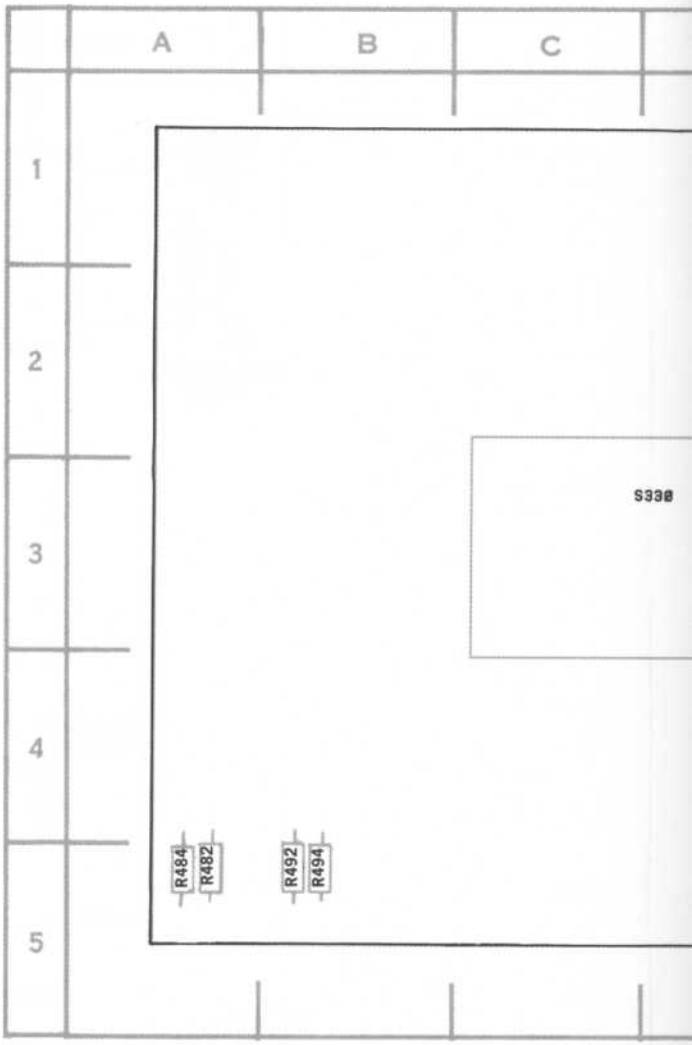
TIMING BOARD (A2)



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	C N
C140	D3	C218	D2	C360	H5	C450	D4	CR296	G2	L240	B3	Q406	F5	R171	D2	R242	B3	R
C142	B3	C244	B2	C366	H4	C460	F5	CR304	H1	L507†	J4	Q410	F4	R172	C3	R244	B3	R
C154	D3	C260	E2	C375	G4	C462	B4	CR305	I2			Q435	E4	R175	C3	R248	B3	R
C170	C2	C270	F2	C378	I5	C480	I4	CR378	H4	P76	I2	Q460	F5	R177	C2	R249	B3	R
C171†	D2	C275	F3	C382	G4	C485†	I5	CR382	G4	P140	C4			R178†	D2	R252	B3	R
C172	C3	C277	F3	C385	H1	C487	I4	CR493	I4	P305	F1	R78	I1	R180	C2	R253	B2	R
C177	C2	C279	F3	C386	G1	C493*†	I4	CR495	I4	P500	J4	R140	D3	R182	C2	R270	E3	R
C180	B2	C296	G2	C389	G1	C500	J4	CR1240	B4	P510	I5	R142	C3	R185	B2	R272	E3	R
C200	E1	C300	G2	C400	G4	C502	C5	CR1242	B4	P1245*	I4	R145	D3	R186	A1	R274	F3	R
C201	E1	C304†	G1	C415	F4	C503	J4	CR1244	B4	P1250	B4	R147	D3	R190*	I1	R275	F3	R
C202	E1	C317	G2	C418†	E4	C505	B5					R150	C2	R192	B2	R280	F2	R
C203	E1	C325	H2	C432†	E4	C1240	C4	J140	C4	Q150	B2	R152	E3	R194	B2	R284	F3	R
C205	E2	C326	H2	C433†	C4	C1242	C4	J254	B2	Q160	B2	R154	D3	R195	B1	R290	H2	R
C206	E2	C328	H3	C435	D4	C1244	C4	J260	B2	Q175	B2	R156	E2	R214	D2	R292	H2	R
C207	E2	C330	H3	C436	D3			J305	F1	Q178†	D3	R160	E2	R218	D2	R294	G2	R
C208	E2	C332	G4	C438	E4	CR145	D3	J450	H5	Q240	C3	R162	B2	R219	D2	R296	G2	R
C210	G1	C334	I2	C439	E3	CR147	C3	J452	G5	Q244	C3	R165	B1	R224	D3	R300	G2	R
C212	F1	C336	G2	C442	D4	CR220	D3	J480	E5	Q290	H2	R167	B1	R230	D3	R304†	G2	R
C214	D2	C338	G2	C444	D5	CR222	D1	J481	J5	Q294	H2	R169	C2	R232	C3	R306†	G2	R
C216	D1	C346	H1	C446	A3	CR224	I2	J485	I5	Q320	H2	R170	C2	R234	C3	R310	F2	R
				C448	D4	CR226	I1			Q342	H2			R240	B3			
						CR228	D1											



(BACKSIDE) TIMING BOARD (A2)

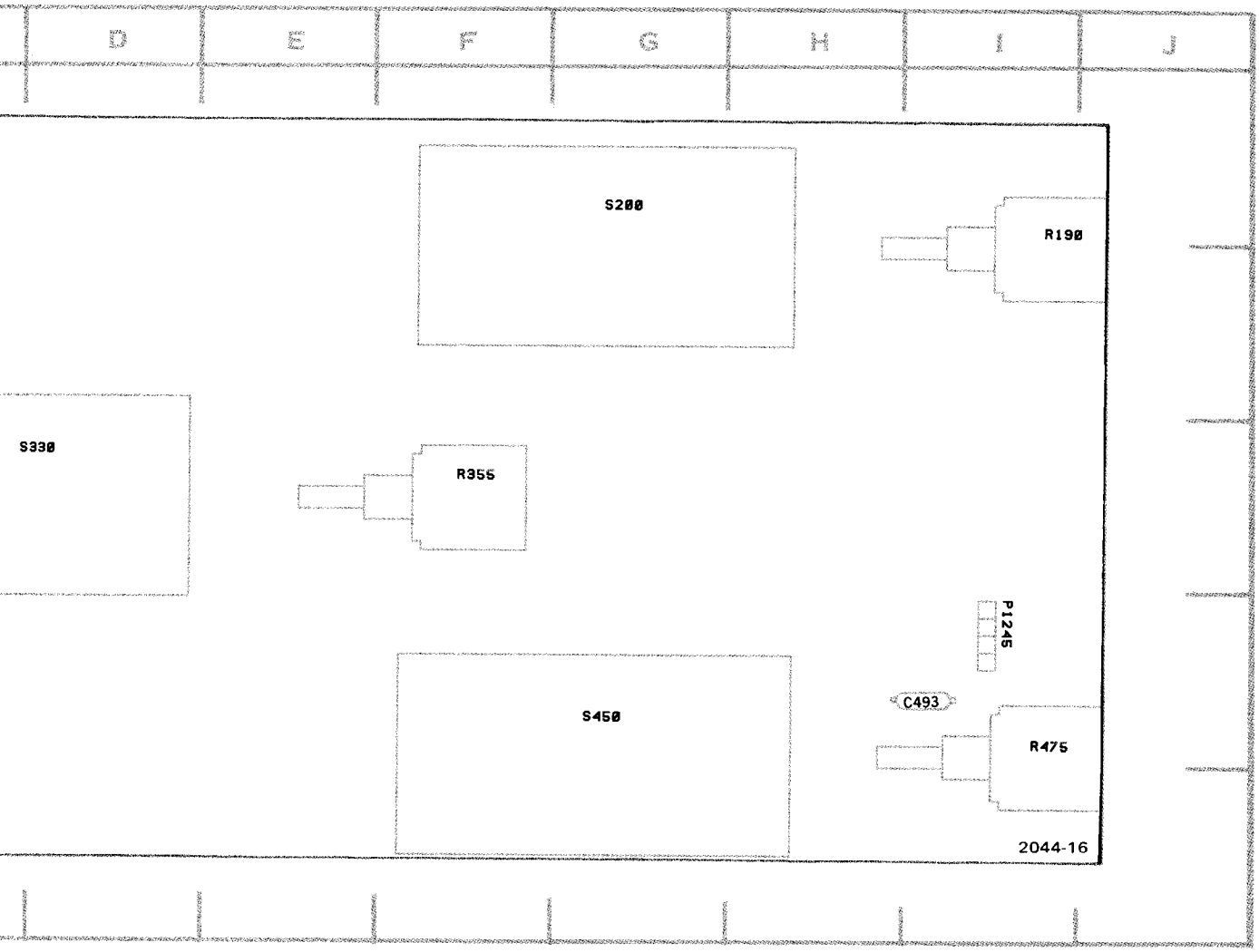


CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
R242	B3	R312†	F2	R375	H4	R462	B4	U140	C3
R244	B3	R315	G2	R380	I3	R465	C4	U270	F3
R248	B3	R317	G2	R400	G5	R467	B4	U300	F2
R249	B3	R320	H2	R402	G5	R470	B5	U360	H4
R252	B3	R325	H2	R406	G5	R473†	B4	U400	F4
R253	B2	R328	H3	R408	F5	R475*	I4	U480	I4
R270	E3	R342	H2	R410	F4	R482††	I4		
R272	E3	R346	H1	R412	F4	R483†	I5		
R274	F3	R348	H1	R415	F4	R484*†	A5	VR172	C3
R275	F3	R350	I1	R420†	F4	R485	I5		
R280	F2	R352†	I1	R422†	F4	R487	I5		
R284	F3	R354†	E3	R425	F4	R490	I4	W306†	G2
R290	H2	R355*	F3	R426†	F4	R492††	J4	W422†	F4
R292	H2	R360	H5	R430	F4	R493	I4	W455†	F4
R294	G2	R362	H4	R432	F4	R494*†	B5		
R296	G2	R364	H4	R436	E4	R495	I4		
R300	G2	R366	H4	R439	E4	R500	I4		
R304†	G2	R368	H4	R455†	F4	S75	I1		
R306†	G2	R370	G4	R456	F4	S200*	G1		
R310	F2	R372	G4	R460	B4	S330*	C3		
						S380	I3		
						S450*	G4		

*On back of board

†See Parts List for serial number ranges.

††R482 & R492 moved to back of board effective SN B020245.


D
E
F
G
H
I
J
S200
R190
S330
R355
P1245
C493
S450
R475
2044-16

Using the Rear Interface Connectors

See the accompanying chart for rear interface connector assignments. For other functions not detailed here the small auxiliary board (E) has numerous connectors available. Use the connections to make custom inputs or outputs to the PG 508 through the Power Module.

Amplitude Monitor

These pins (25A) are connected to the OUTPUT terminal through a 27 k resistor and ground (26A). To use this function place the PERIOD control in the EXT TRIG OR MAN position and connect an accurate voltmeter to these terminals. Now adjust the TRIG/GATE LEVEL control cw for the high steady state output voltage and ccw for the low steady state output voltage. In this manner the output pulse amplitude levels may be precisely monitored.

External Level Control Inputs

See the discussion under the heading External Voltage Control in Section 1 of this manual for use of these terminals.

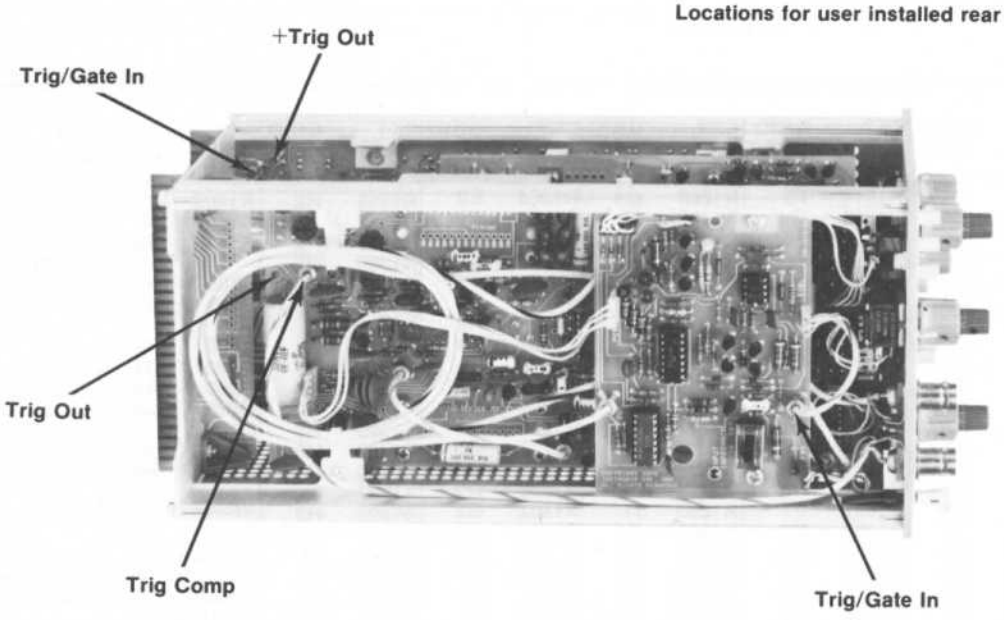
Trig/Gate Input

These assignments provide rear interface input capabilities for the front panel TRIG/GATE IN input. The signal lead (24B) must be user installed but the ground (25B) is factory wired. To make the proper connections remove the cable extending from the TRIG/GATE IN connector to the input board by pulling the end from the socket on the board. Install a twelve inch cable with the proper connectors, Tektronix Part No. 175-1827-00, from the connector on the input circuit board labeled Trig/Gate In to the other connector on the output board labeled Trig/Gate In as shown in the illustration.

Trigger Output

The hot or signal lead (28B) must be user installed while the ground (27B) is factory wired. To route this function through the rear interface connector remove the plug on the timing circuit board connected to the cable from the + TRIG OUT front panel connector. This plug is shown on the illustration and is labeled Trig Out. Connect a six inch cable with the proper connectors, Tektronix Part No. 175-1824-00, from the connector labeled Trig Out in the illustration to the connector on the output board labeled + Trig Out in the illustration. To obtain the complement trigger out signal connect the coaxial cable to the connector labeled Trig Comp in the illustration. The normal trigger output may be used simultaneously with the complement, through the rear connector, without disturbing the operation of either.

Locations for user installed rear interface connections.



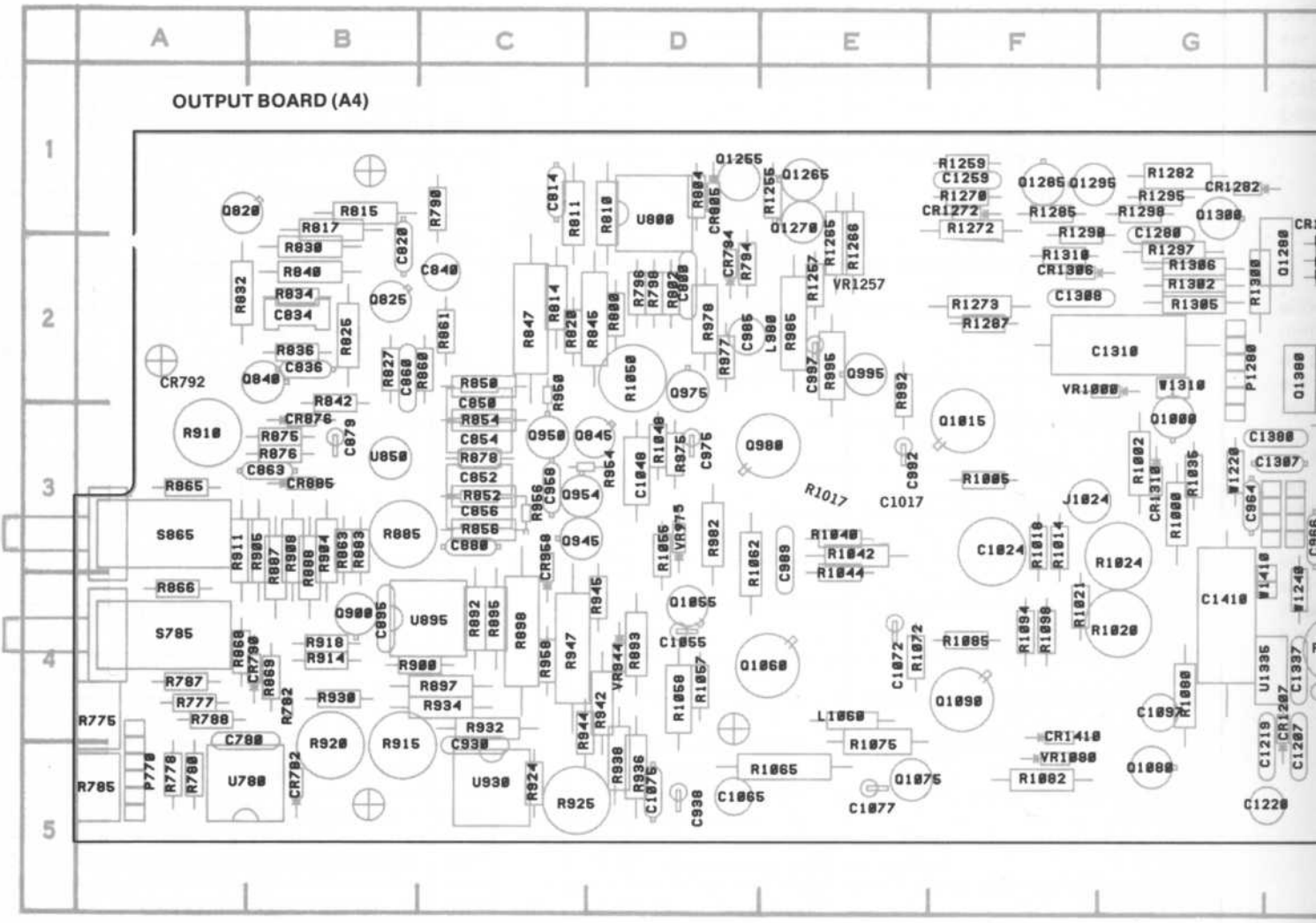
REAR INTERFACE CONNECTOR ASSIGNMENTS

Remarks	Recommended Loads	Output or Input	Pin B		Pin A	Output or Input	Recommended Loads	Remarks
Factory Wired		Trigger Out Common	28		28			
Factory Wired	50 Ω	Trigger Out	27		27			
			26		26	Amplitude Monitor Ground		Factory Wired
Factory Wired		Trig/Gate Input Common	25	Barrier Slot	25	Amplitude Monitor	>1 MΩ	Factory Wired
User installed		Trig/Gate Input	24		24			
			23		23			
Factory Wired		External High Level Control Input	22		22	External Low Level Control Input		Factory Wired
			21		21			
			20		20			
			19		19			
			18		18			
			17		17			
			16		16			
			15		15			
			14		14			
		25 V ac winding	*13		*13	25 V ac 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	10		**10	Emitter lead of pnp series-pass		
		±33.5 V common return	*9	TM 500 Barrier Slot	*9	±33.5 V common return		
		−33.5 V filtered dc	*8		*8	−33.5 V common return		
		Collector lead of npn series-pass	**7		**7	Emitter lead of npn series-pass		
		No connection	6		**6	Base lead of npn series-pass		
		17.5 V ac winding	*5		*5	17.6 V ac 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 V ac winding	*1		*1	25 V ac 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 508. Those connections marked with a double asterisk (**) are the only connections used on the E board.

PARTS LOCATION GRID



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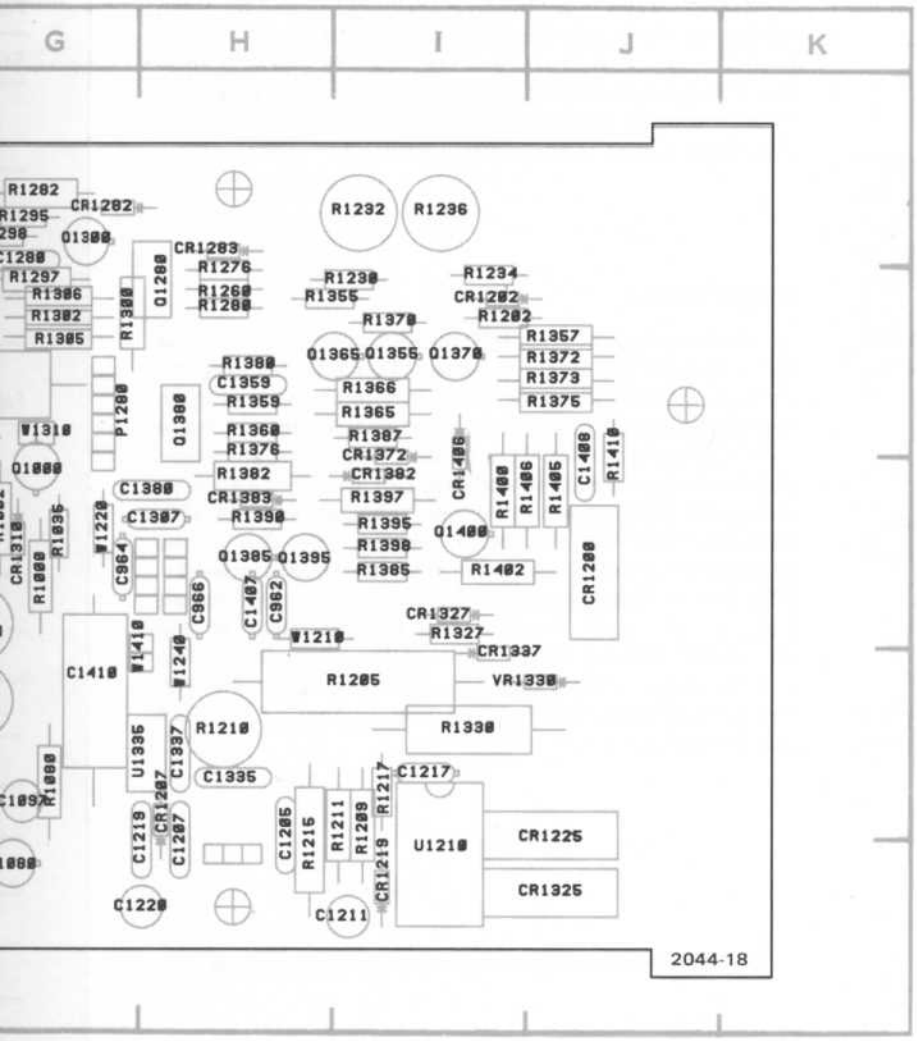
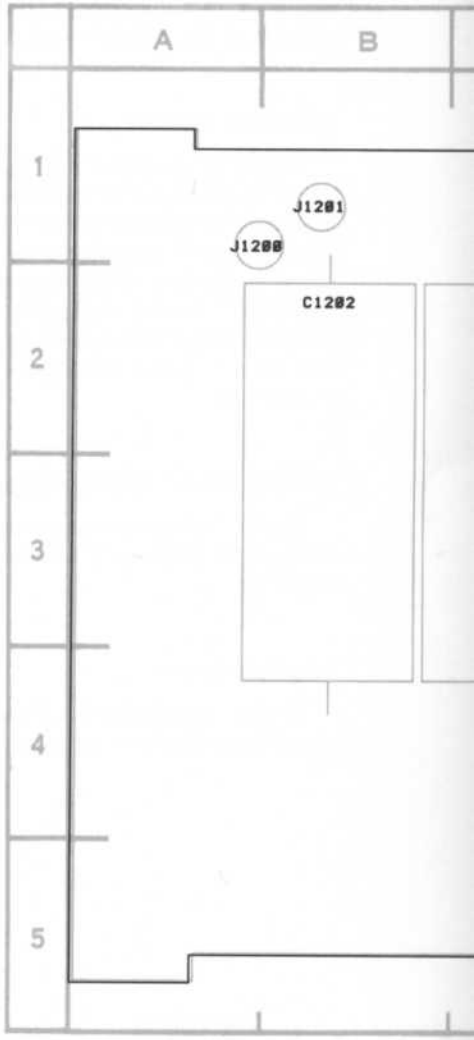
C780	A5	C962	H3	C1211	I5	CR782	B5	CR1382	I3	Q845	D3	Q1270	E1	R790	C1	R845	D2
C800	D2	C964	G3	C1217	I4	CR790	B4	CR1383	H3	Q900	B4	Q1280	H2	R794	D2	R847	C2
C814	C1	C966	H3	C1219	H5	CR792†	A2	CR1406	I2	Q945	C3	Q1285	F1	R796	D2	R850	C2
C820	B2	C975	D3	C1220	H5	CR794	D2	CR1410	F4	Q950	C3	Q1295	F1	R798	D2	R852	C3
C825	A2	C985	D2	C1259	F1	CR805	D1			Q954	C3	Q1300	G1	R800	D2	R854	C3
C832	A2	C987	E3			CR876	B3	J1024	F3	Q975	D2	Q1355	I2	R802	D2	R856	C3
C834	B2	C988	E4	C1280	G1	CR885	B3	J1200★	A1	Q980	F3	Q1365	I2	R804	D1	R860	C2
C836	B2	C989	E3	C1307	H3	CR958	C3	J1201★	B1	Q990★	F3	Q1370	I2	R810	D1	R861	C2
C840	C2	C992	E3	C1308	F2	CR1200	J3			Q995	E2	Q1380	H2	R811	C1	R863	B3
C850	C2	C997	E2	C1310	G2	CR1202★	B2	L980	E2	Q1000	G3	Q1385	H3	R814	C2	R865	A3
C852	C3	C1017†	E3	C1327★	C2	CR1207	H4	L1060	E4	Q1010★	E3	Q1395	H3	R815	B1	R866	A4
C854	C3	C1024	F3	C1335	H4	CR1215	J4			Q1015	F3	Q1400	I3	R817	B1	R868	A4
C856	C3	C1048	D3	C1337	H4	CR1219	I5	P770	A5	Q1055	D4			R820	C2	R869	B4
C860	B2	C1055	D4	C1359	H2	CR1225	J5	P1205	H5	Q1060	D4	R775	A4	R825	B2	R875	B3
C863	B3	C1065	D5			CR1272	F1	P1246★	D3	Q1070★	F4	R777	A4	R827	B2	R876	B3
C879	B3	C1072	E4	C1380	H3	CR1282	G1	P1247★	D3	Q1075	E5	R778	A5	R830	B2	R878	C3
C880	C3	C1075	D5	C1407	H3	CR1283	H1	P1280	G2	Q1080	G5	R780	A5	R832	A2	R883	B3
C895	B4	C1077	E5	C1408	J3	CR1306	F2			Q1090	F4	R782	B4	R834	B2	R885	B3
C930	C5	C1097	G4	C1410	G4	CR1310	G3	Q820	A1	Q1095★	E4	R785	A5	R836	B2	R887	B3
C938	D5	C1202★	B2			CR1325	J5	Q825	B2	Q1255	D1	R787	A4	R840	B2	R888	B3
C958	C3	C1205	H5			CR1327★	I3	Q840	B2	Q1265	E1	R788	A4	R842	B3	R892	C4
		C1207	H5			CR1337	I4										
						CR1372	I3										

GRID

(BACKSIDE) OUTPUT BOARD (A4)





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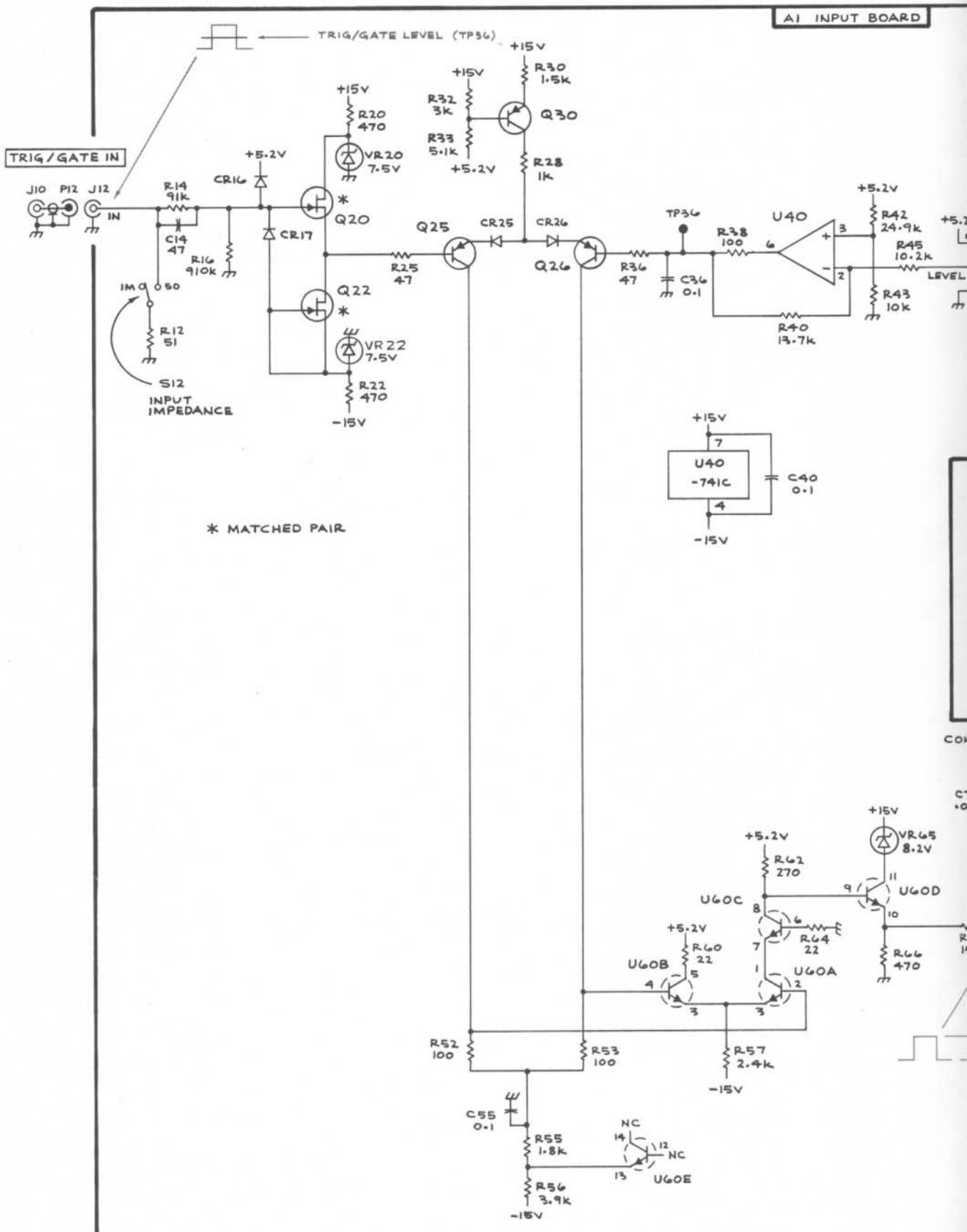
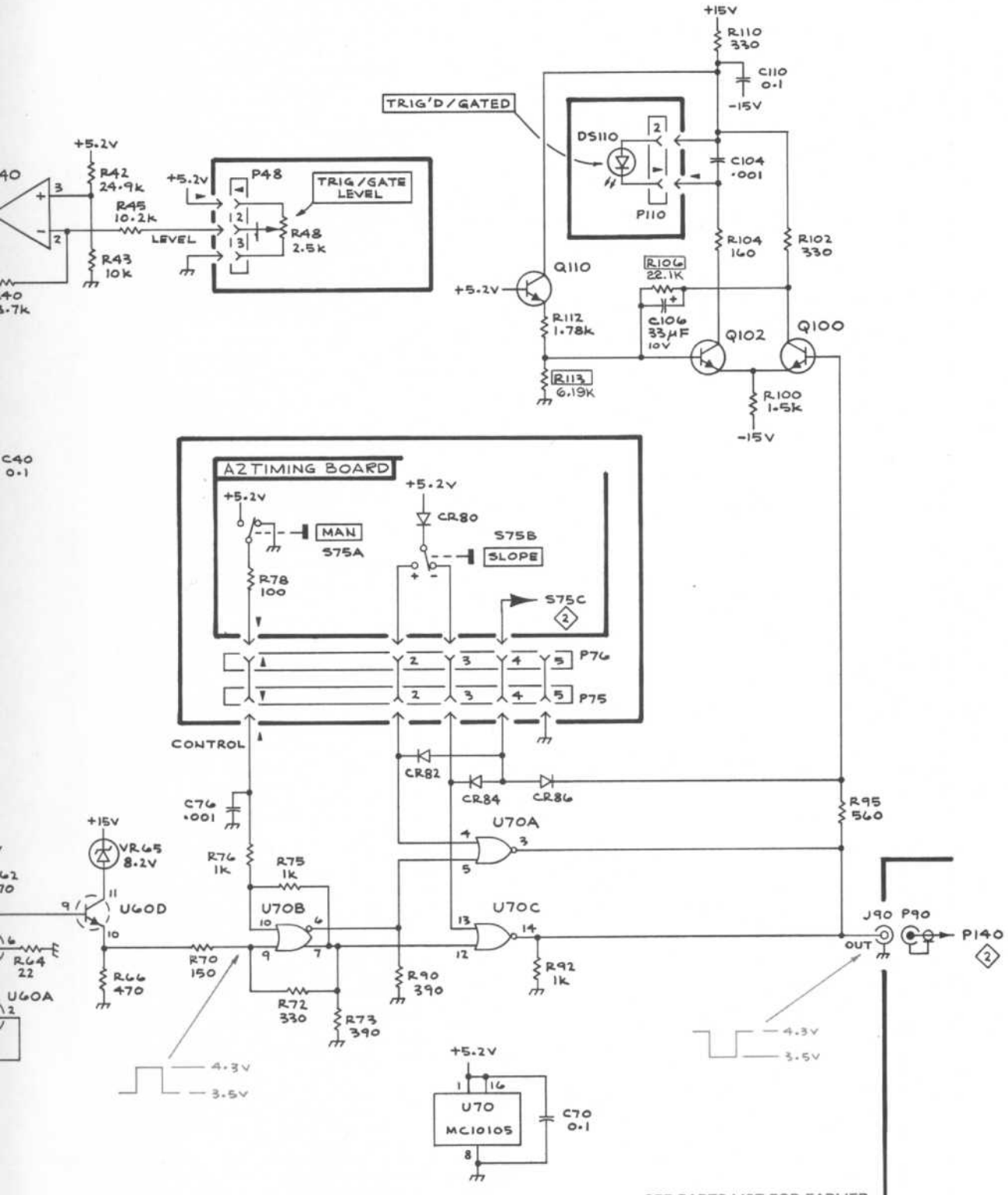
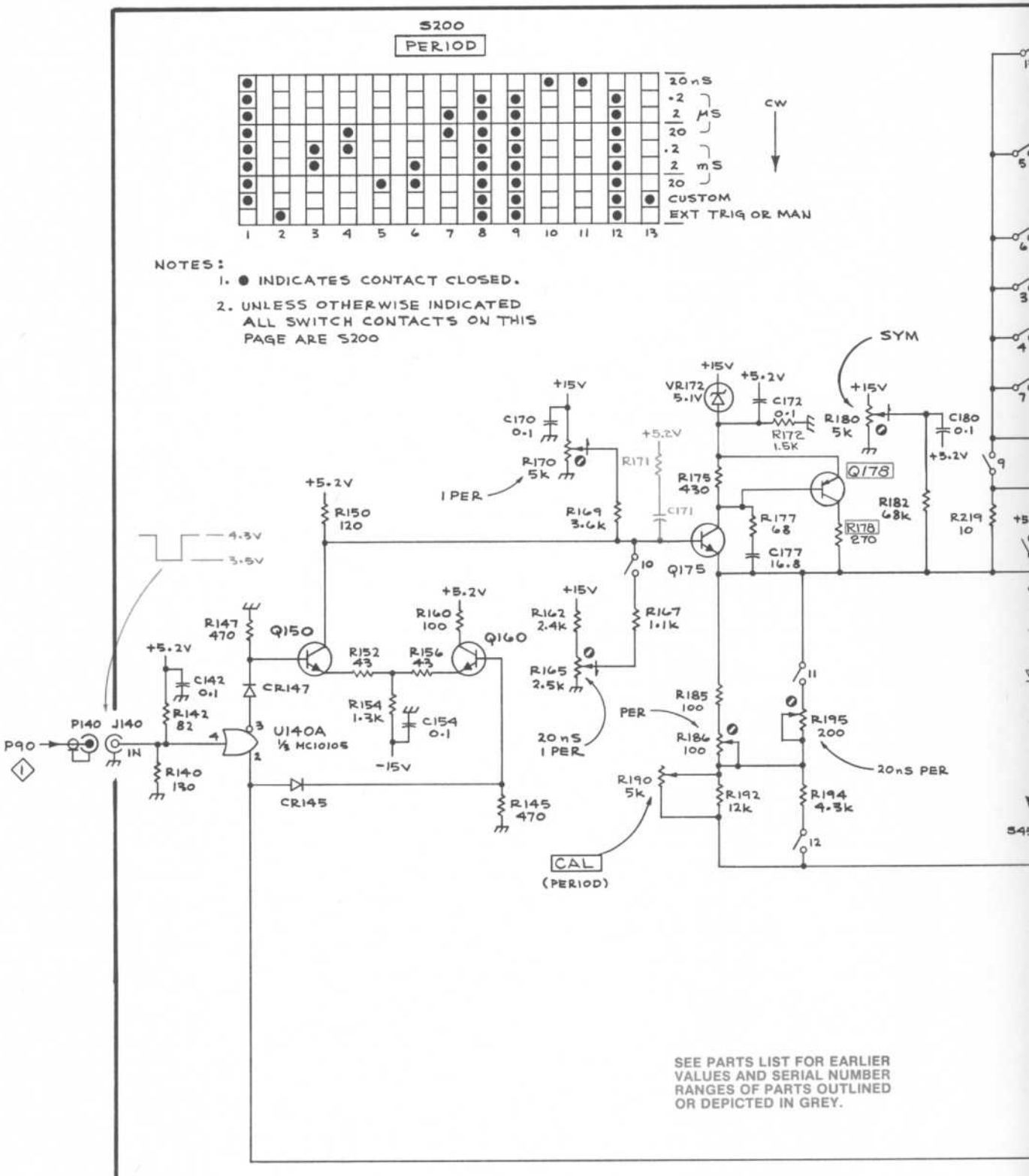
C1	R845	D2	R893	D4	R942	D4	R1018	F3	R1080	G4	R1266	E2	R1355	H2	R1405	J3	W1210	H3			
D2	R847	C2	R895	C4	R944	C4	R1020	G4	R1082	F5	R1270	F1	R1357	J2	R1406	I3	W1220	G3			
D2	R850	C2	R897	C4	R945	D4	R1021	F4	R1085	F4	R1272	F1	R1359	H2	R1410	J3	W1240	H4			
D2	R852	C3	R898	C4	R947	C4	R1024	G3	R1094	F4	R1273	F2	R1360	H2			W1310	G2			
D2	R854	C3	R900	C4	R950	C2	R1028*	F4	R1098	F4			R1365	I2	S785	A4	W1410	G4			
D2	R856	C3	R904	B3	R954	D3	R1029*	F3	R1202	I2	R1276	H2	R1366	I2	S865	A3					
D1	R860	C2	R905	B3	R956	C3	R1032*	F4	R1205	I4	R1280	H2	R1370	I2							
D1	R861	C2	R908	B3	R958	C4	R1033*	F3	R1209	I4	R1282	G1	R1372	J2	U780	B5					
C1	R863	B3	R910	A3	R975	D3	R1035	G3	R1210	H4	R1285	F1	R1373	J2	U800	D1					
C2	R865	A3	R911	A3	R977	D2	R1040	E3	R1211	I4	R1287	F2	R1375	J2	U850	B3					
B1	R866	A4	R914	B4	R978	D2	R1042	E3	R1215	H5	R1290	F2	R1376	H2	U895	C4					
B1	R868	A4	R915	B4	R982	D3	R1044	E4	R1217	I5	R1295	G1	R1380	H2	U930	C5					
C2	R869	B4	R918	B4	R985	E2	R1048	D3	R1230	I2	R1297	G2	R1382	H3	U1210	I5					
B2	R875	B3	R920	B4	R987	E3	R1050	D2	R1232	I1	R1298	G1	R1385	I3	U1335	H4					
B2	R876	B3	R924	C5	R988	E4	R1055	D3	R1234	I2	R1300	G2	R1387	I2							
B2	R878	C3	R925	C5	R992	E2	R1057	D4	R1236	I1	R1302	G2	R1390	H3	VR944	D4					
A2	R883	B3	R930	B3	R995	E2	R1058	D4	R1255	E1	R1305	G2	R1395	I3	VR975	D3					
B2	R885	B3	R932	C4	R1000	G3	R1062	D3	R1257	E2	R1306	G2	R1397	I3	VR1000	F2					
B2	R887	B3	R934	C4	R1002	G3	R1065	E5	R1259	F1	R1310	F2	R1398	I3	VR1080	F5	†See Parts List for serial number ranges.				
B2	R888	B3	R936	D5	R1005	F3	R1072	E4	R1260	H2	R1327	I3	R1400	I3	VR1257†	E2					
B3	R892	C4	R938	D5	R1014	F3	R1075	E5	R1265	E2	R1330	I4	R1402	I3	VR1330	J4					
					R1017†	E3											*On back of board.				



REV.B, APR 1978
2044-20



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



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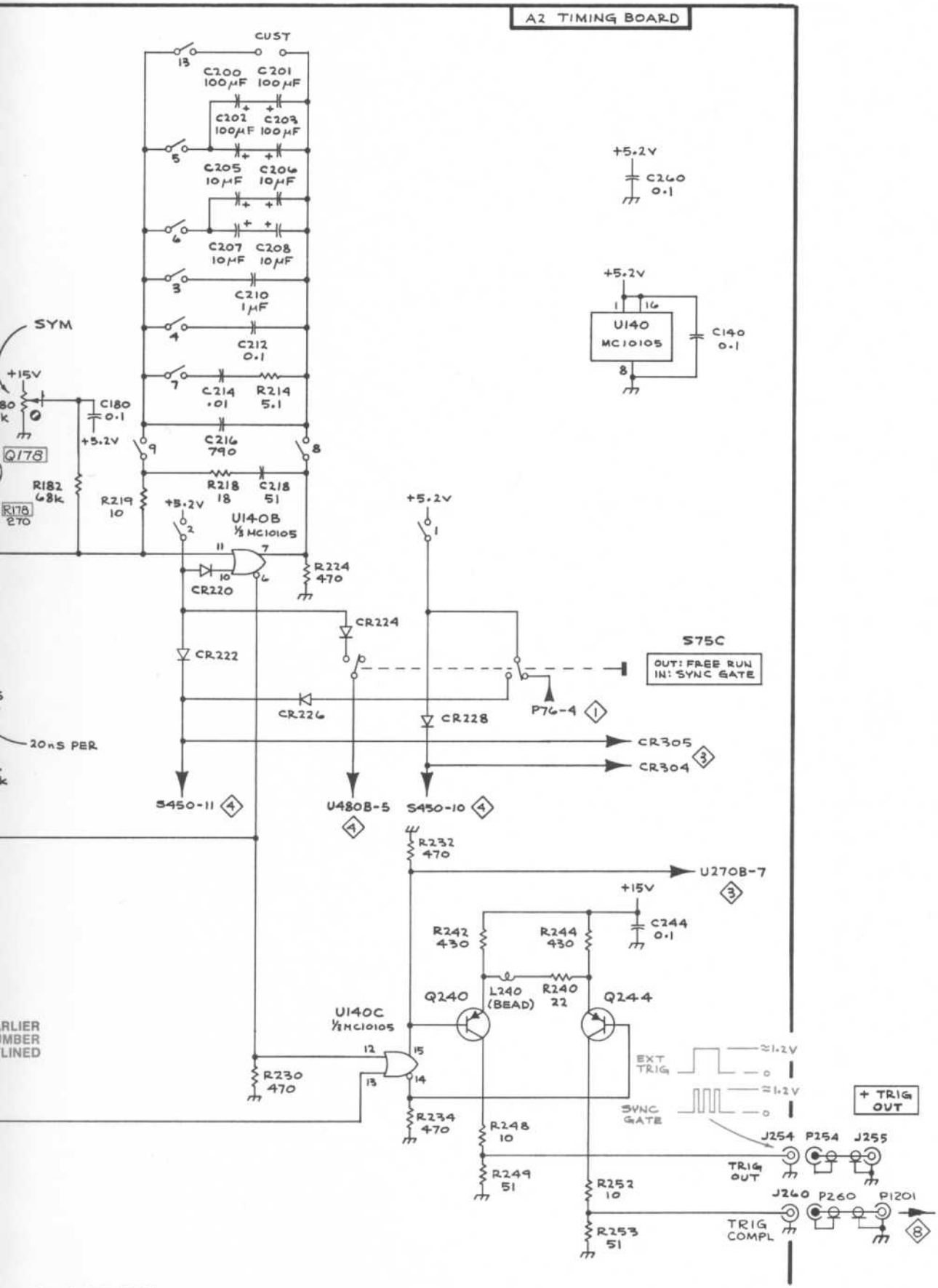
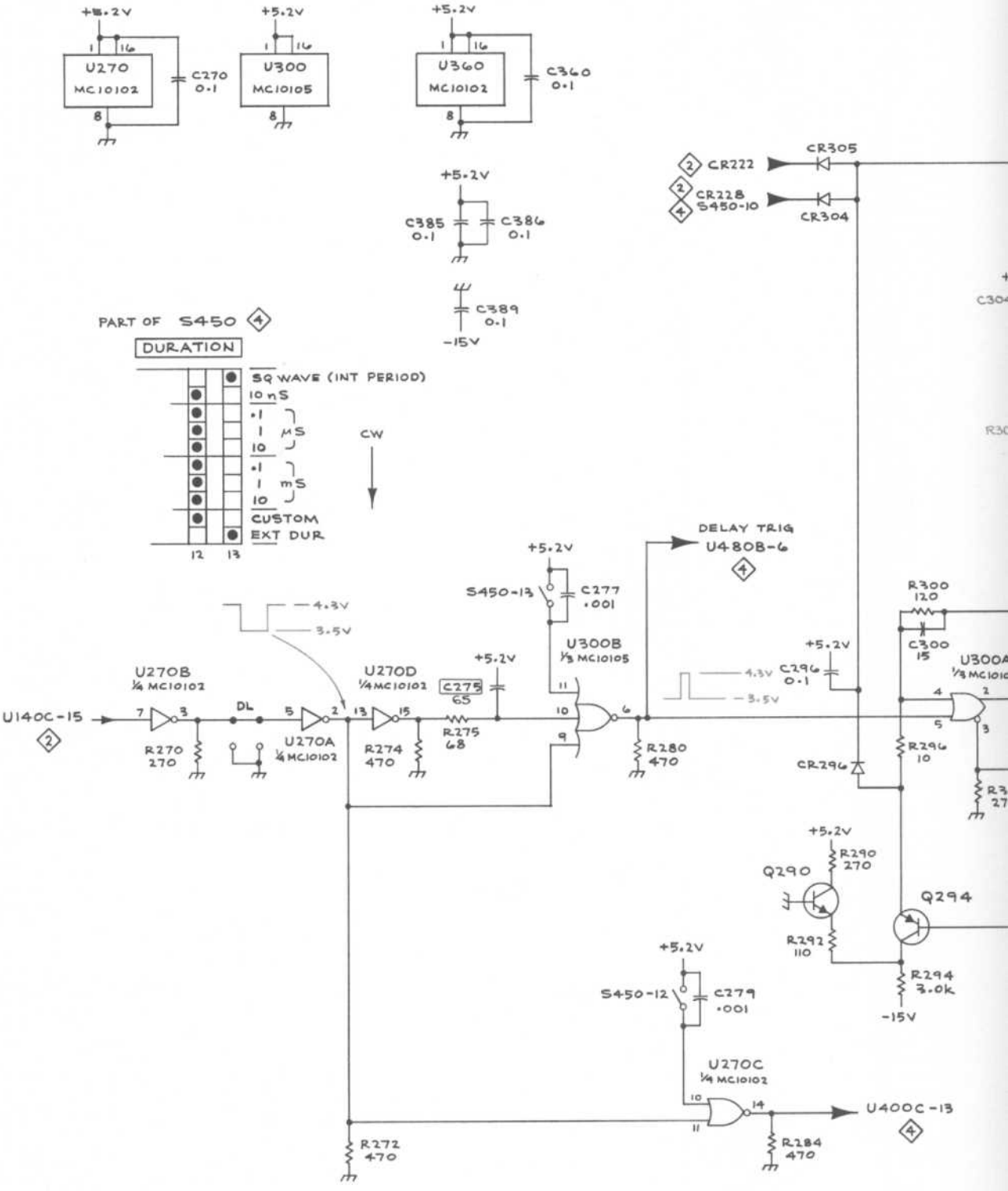
2044-21

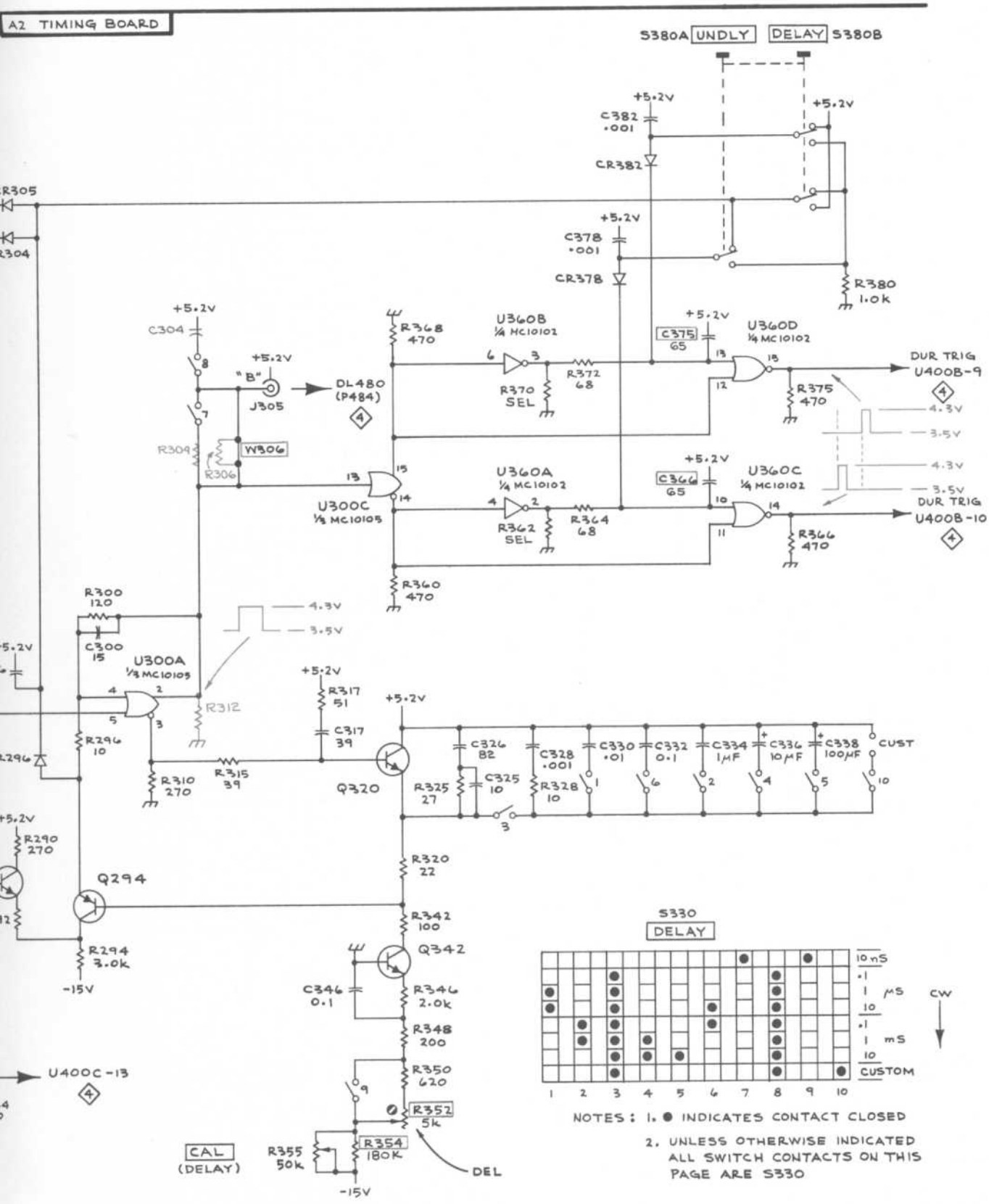


REV.B, APR, 1978
2044-21

PERIOD GENERATOR ◇2 DEH 1175

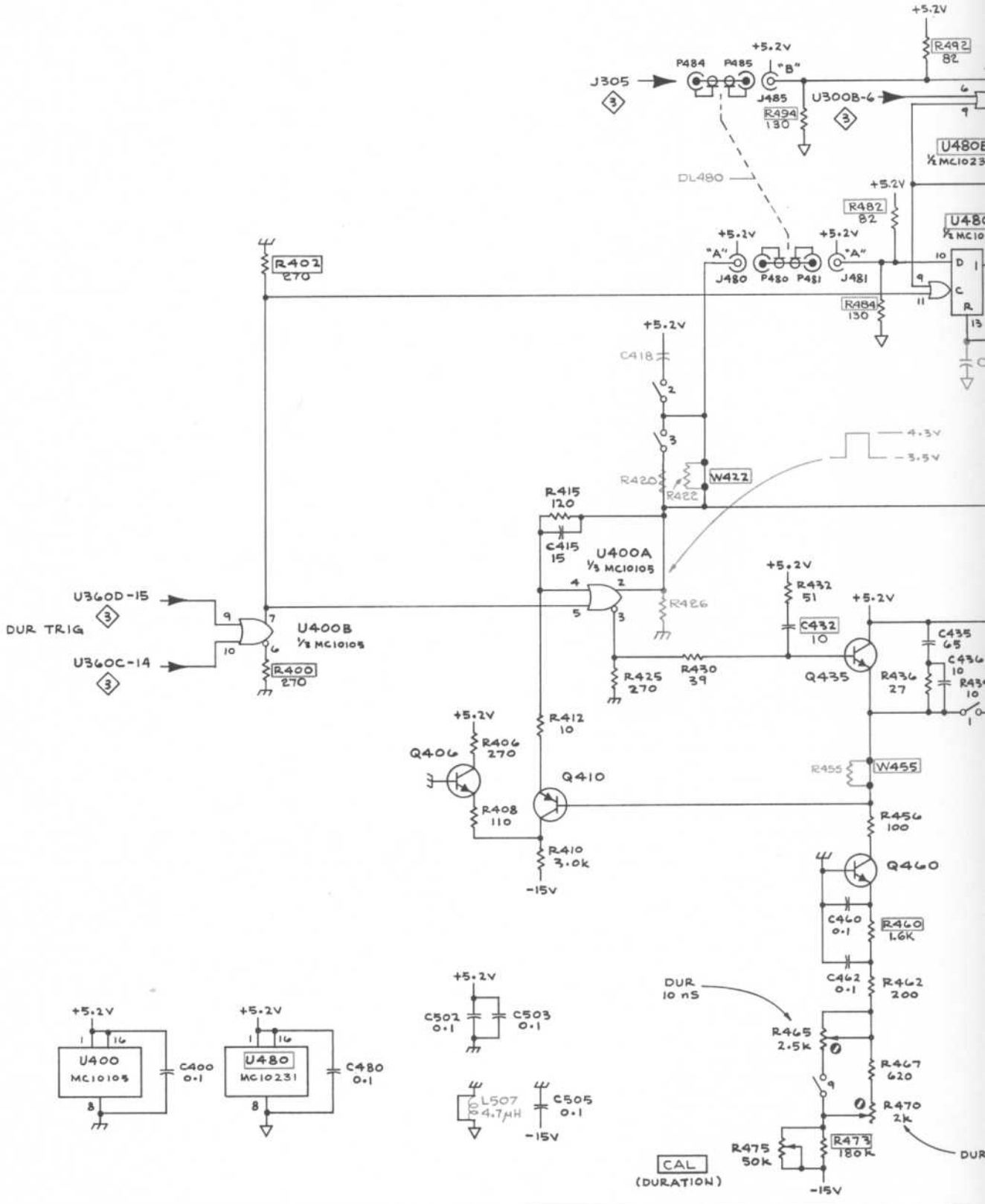


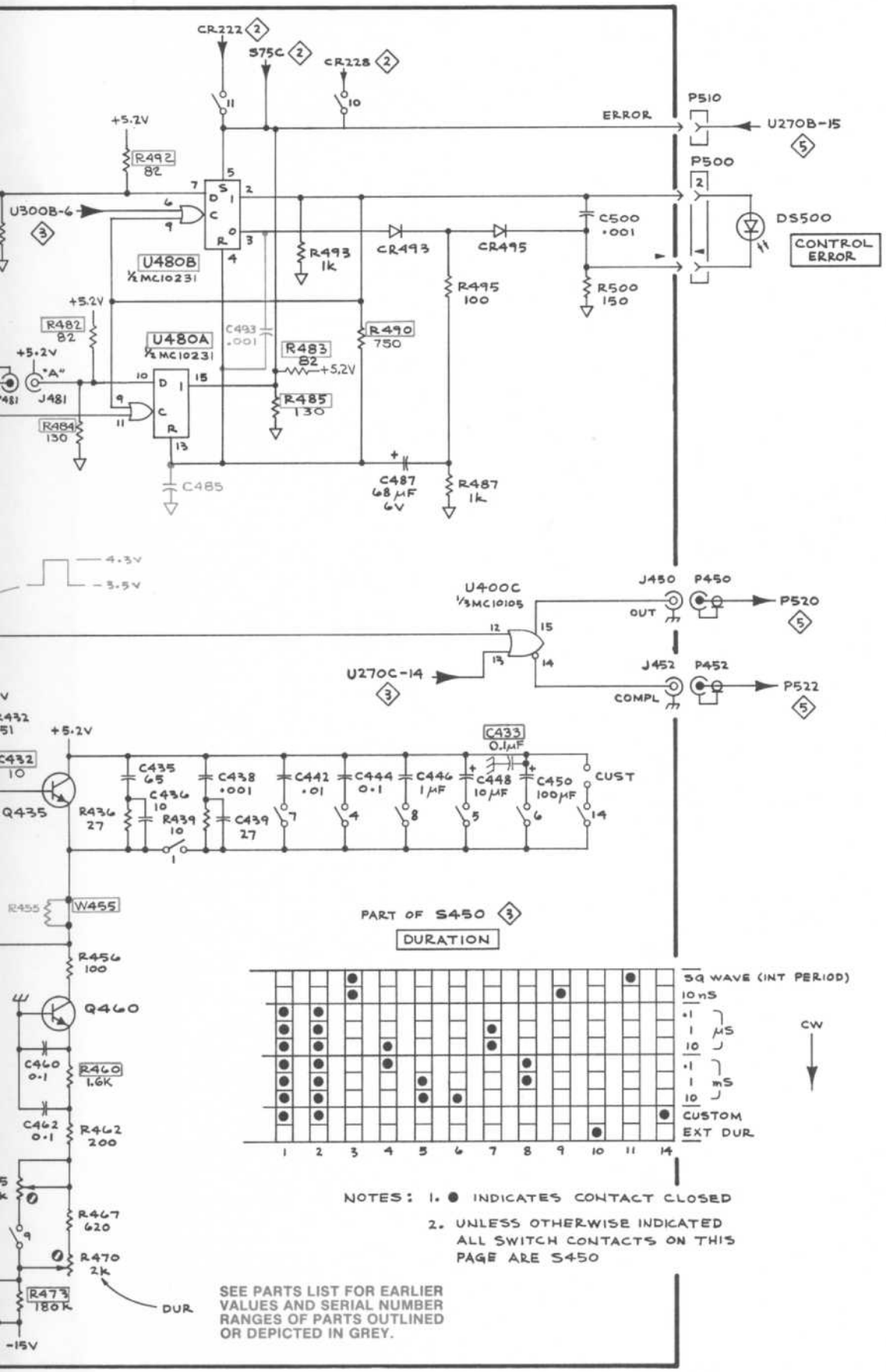
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.



NOTES: 1. ● INDICATES CONTACT CLOSED

2. UNLESS OTHERWISE INDICATED ALL SWITCH CONTACTS ON THIS PAGE ARE S330


+5.2V
R492 82
J305
P484
P485
"B"
J485
R494 130
U300B-6
U480B
DL480
R482 82
"A"
J480
P480
P481
J481
R484 130
R402 270
C418
4.3V
3.5V
R420
R422
W422
R415 120
C415 15
U400A
1/3 MC10105
U360D-15
DUR TRIG
U360C-14
U400B
1/3 MC10105
R400 270
R426
R432 51
C432 10
C435 65
C436 10
R436 27
Q435
R425 270
R430 39
R412 10
Q406
R406 270
Q410
R408 110
R410 3.0k
-15V
R455
W455
R456 100
Q460
C460 0.1
R460 1.6K
C462 0.1
R462 200
DUR 10 nS
R465 2.5k
R467 620
R470 2k
R475 50k
R473 180K
CAL
(DURATION)
U400 MC10105
C400 0.1
U480 MC10231
C480 0.1
C502 0.1
C503 0.1
L507 4.7μH
C505 0.1



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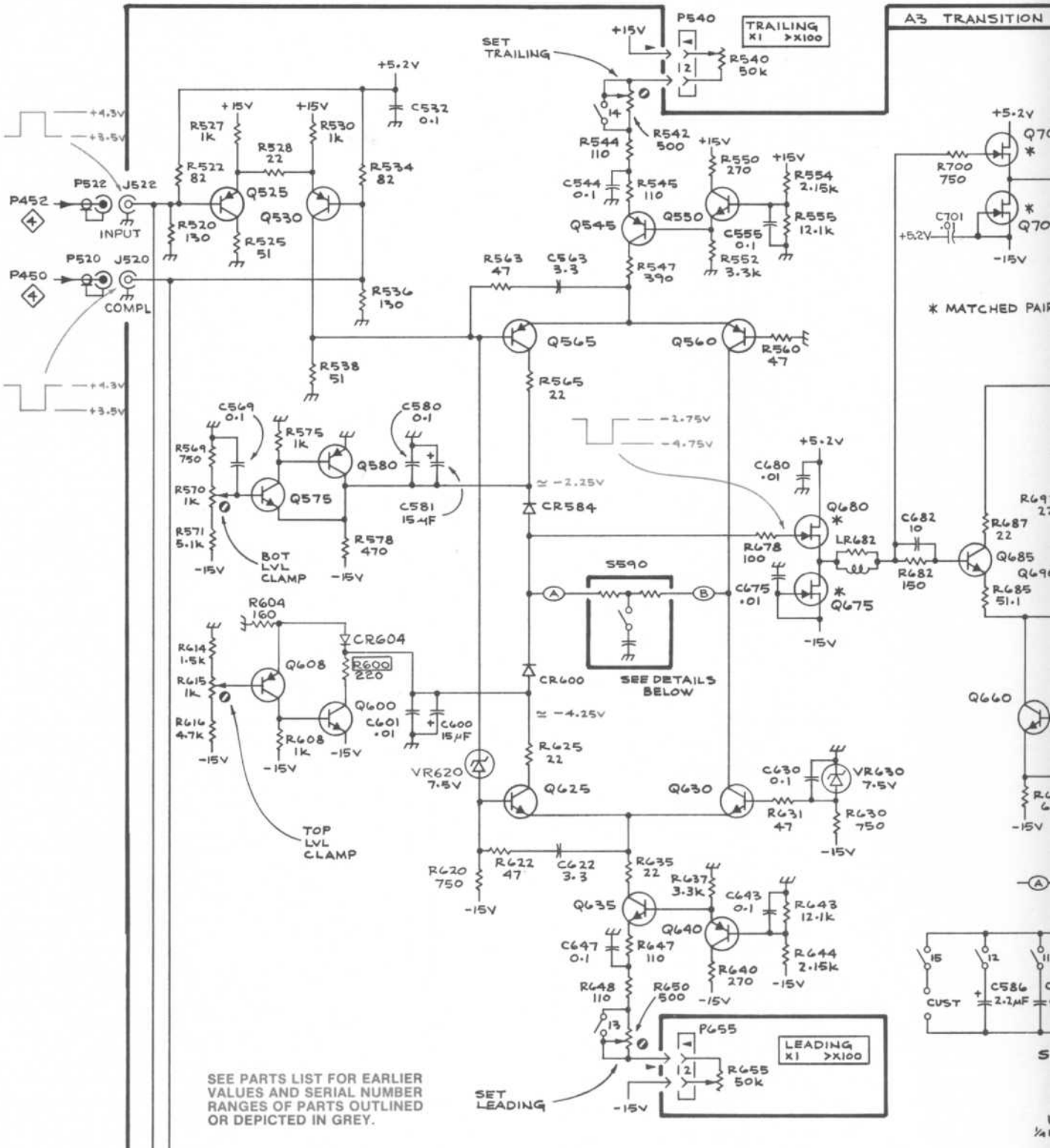
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

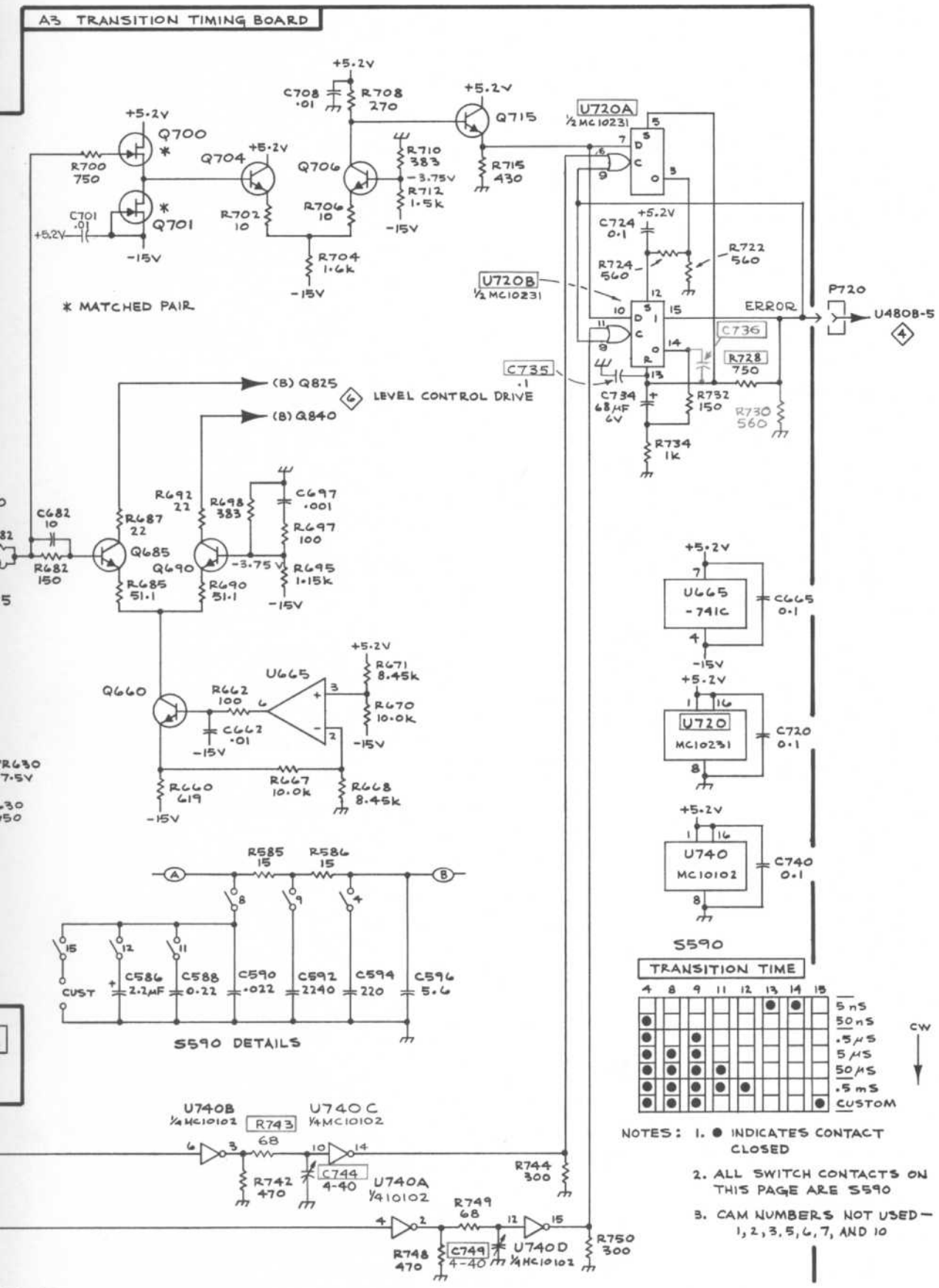
978

DURATION GENERATOR 4

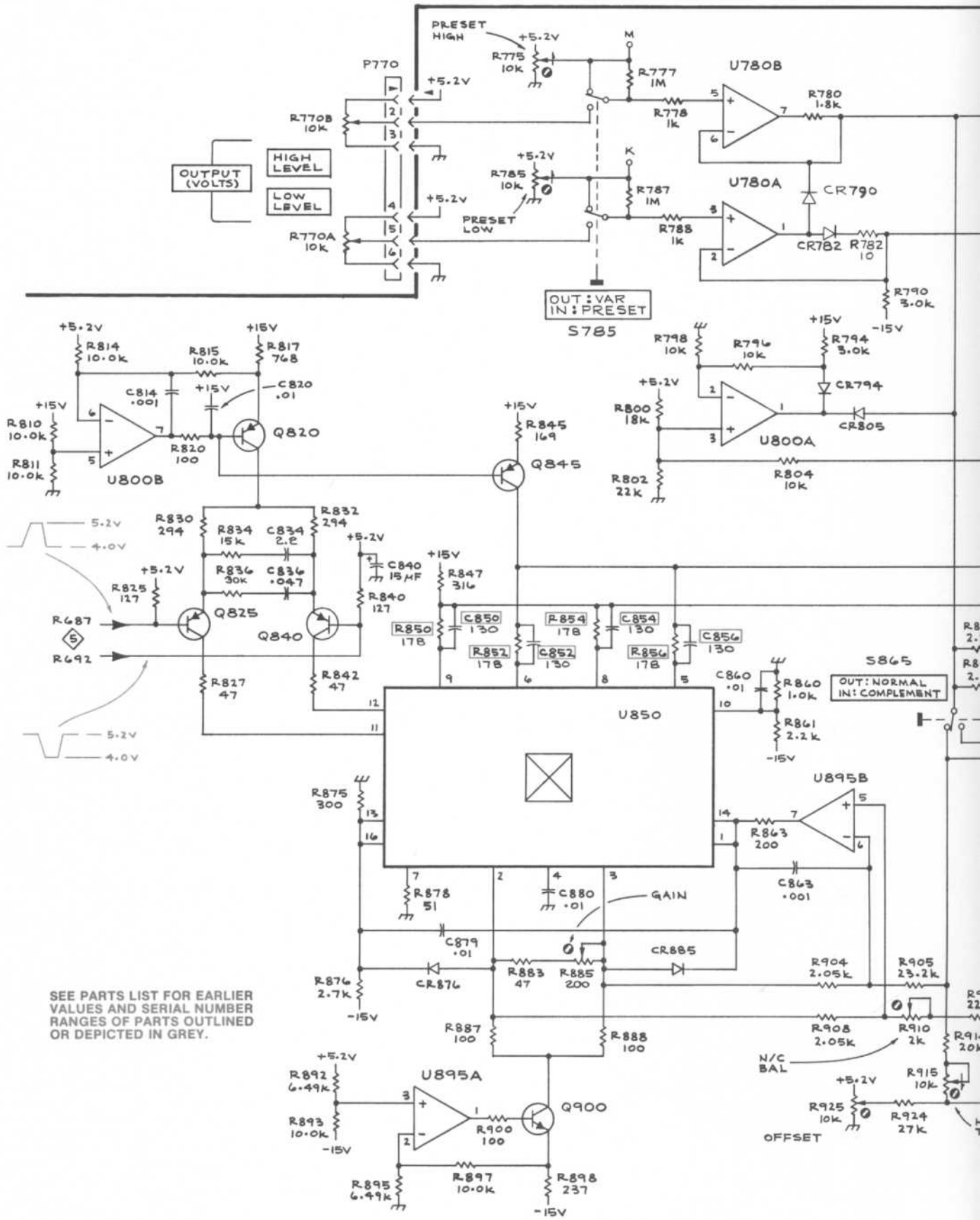
DEH 1175



REV.C, APR, 1978
2044-24

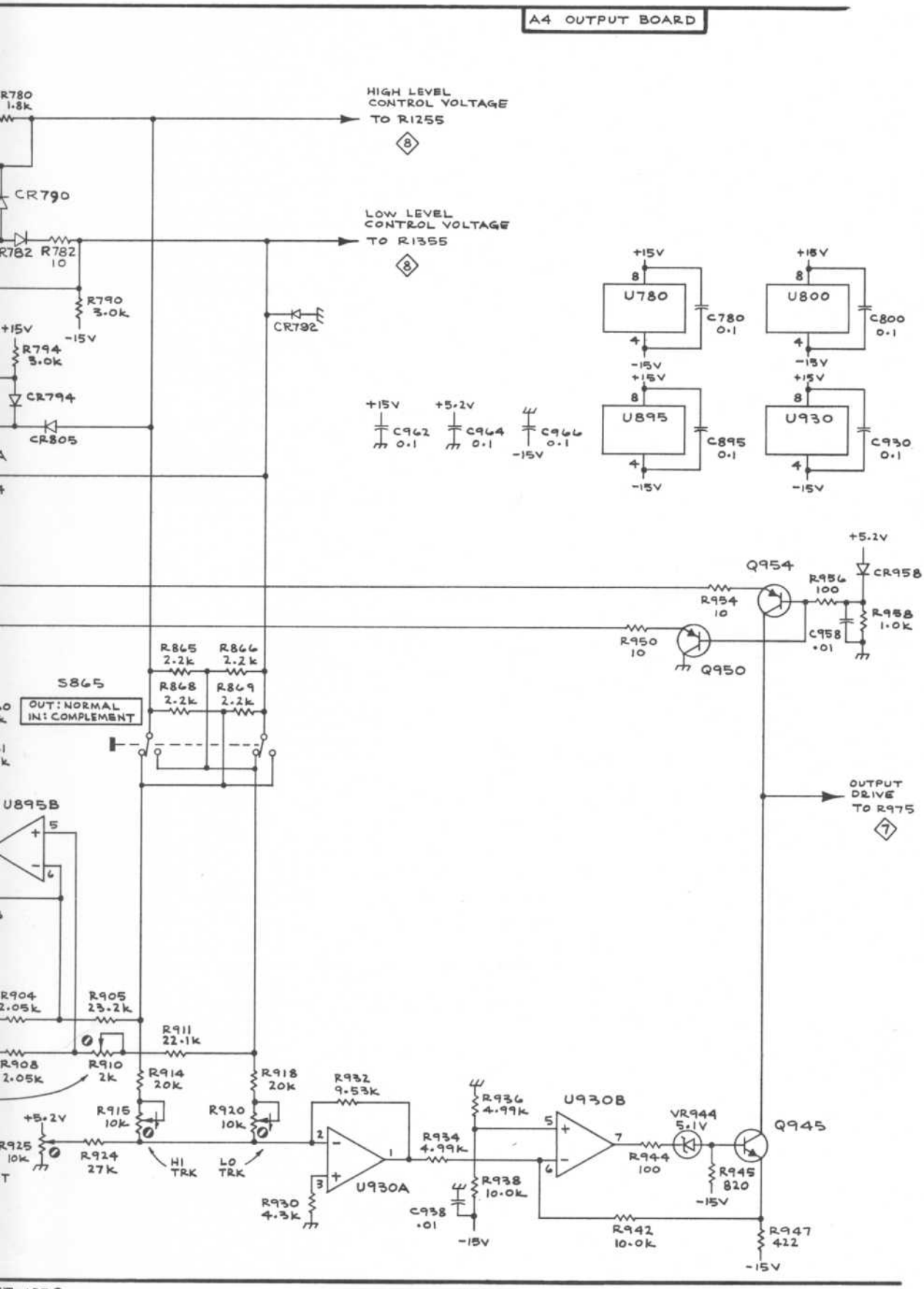


VARIABLE TRANSITION TIME GENERATOR ⑤ DEH 1175

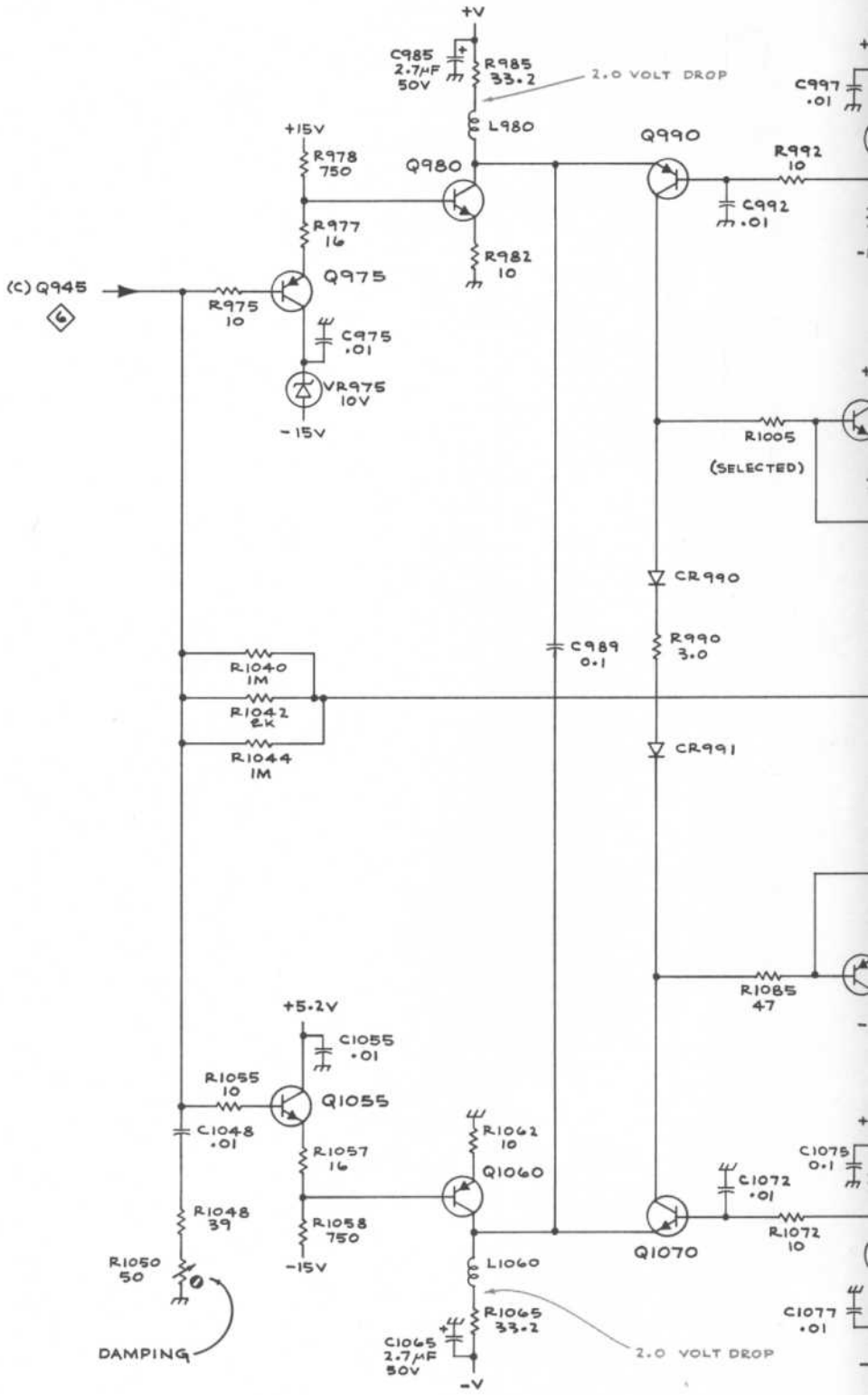


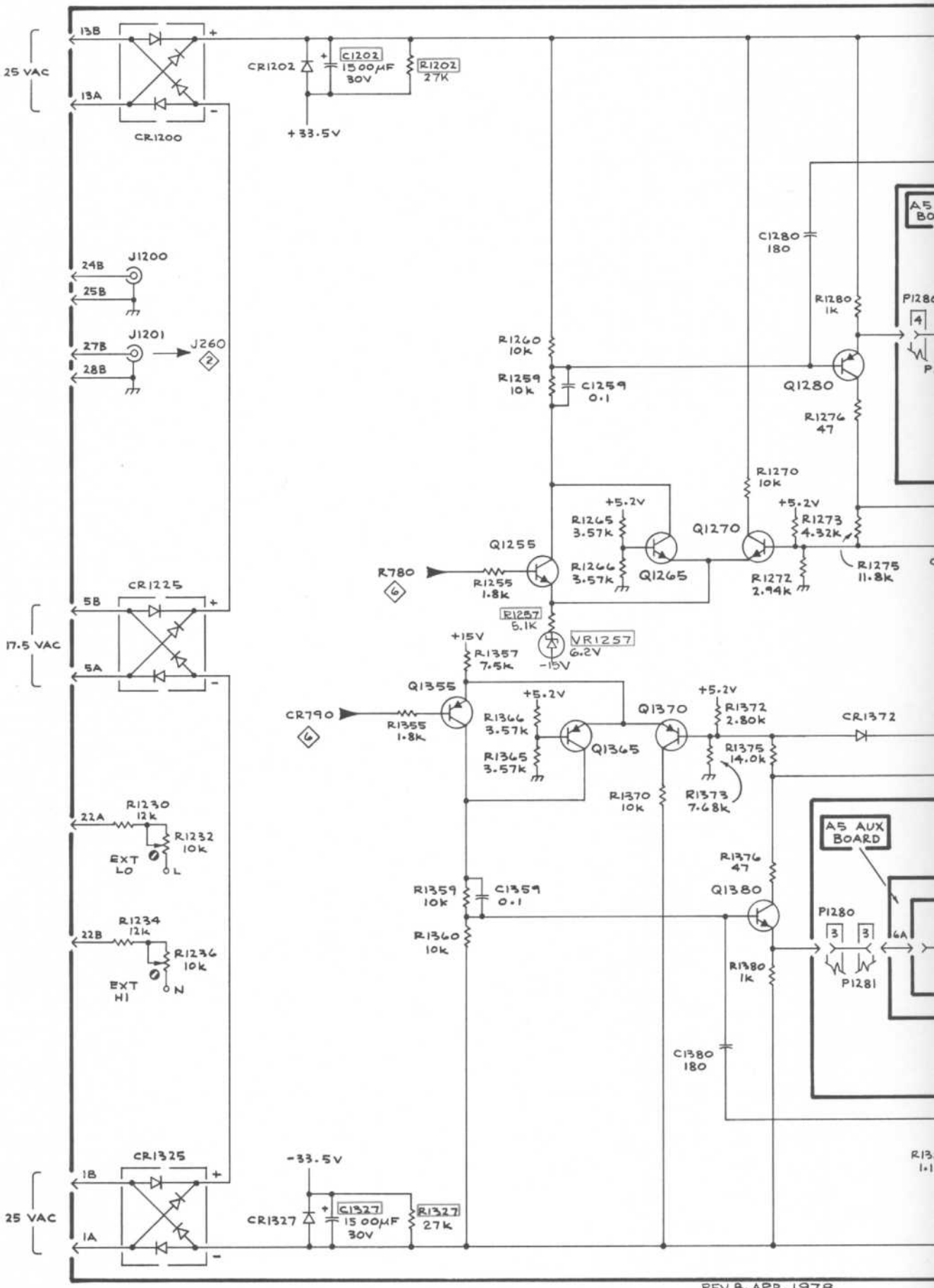
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

REV.C, APR, 1978
2044-25



LEVEL CONTROL MULTIPLIER ⟨6⟩ DEH 1175


+V
C985 2.7μF 50V
R985 33.2
2.0 VOLT DROP
L980
+15V
R978 750
Q980
Q990
R992 10
C992 .01
R977 16
R982 10
(C) Q945
R975 10
Q975
C975 .01
VR975 10V
-15V
R1005
(SELECTED)
CR990
C989 0.1
R990 3.0
R1040 1M
R1042 2K
R1044 1M
CR991
R1085 47
+5.2V
C1055 .01
R1055 10
Q1055
C1048 .01
R1057 16
R1062 10
Q1060
C1075 0.1
C1072 .01
R1048 39
R1058 750
R1072 10
Q1070
R1050 50
L1060
DAMPING
R1065 33.2
C1077 .01
C1065 2.7μF 50V
2.0 VOLT DROP
-V



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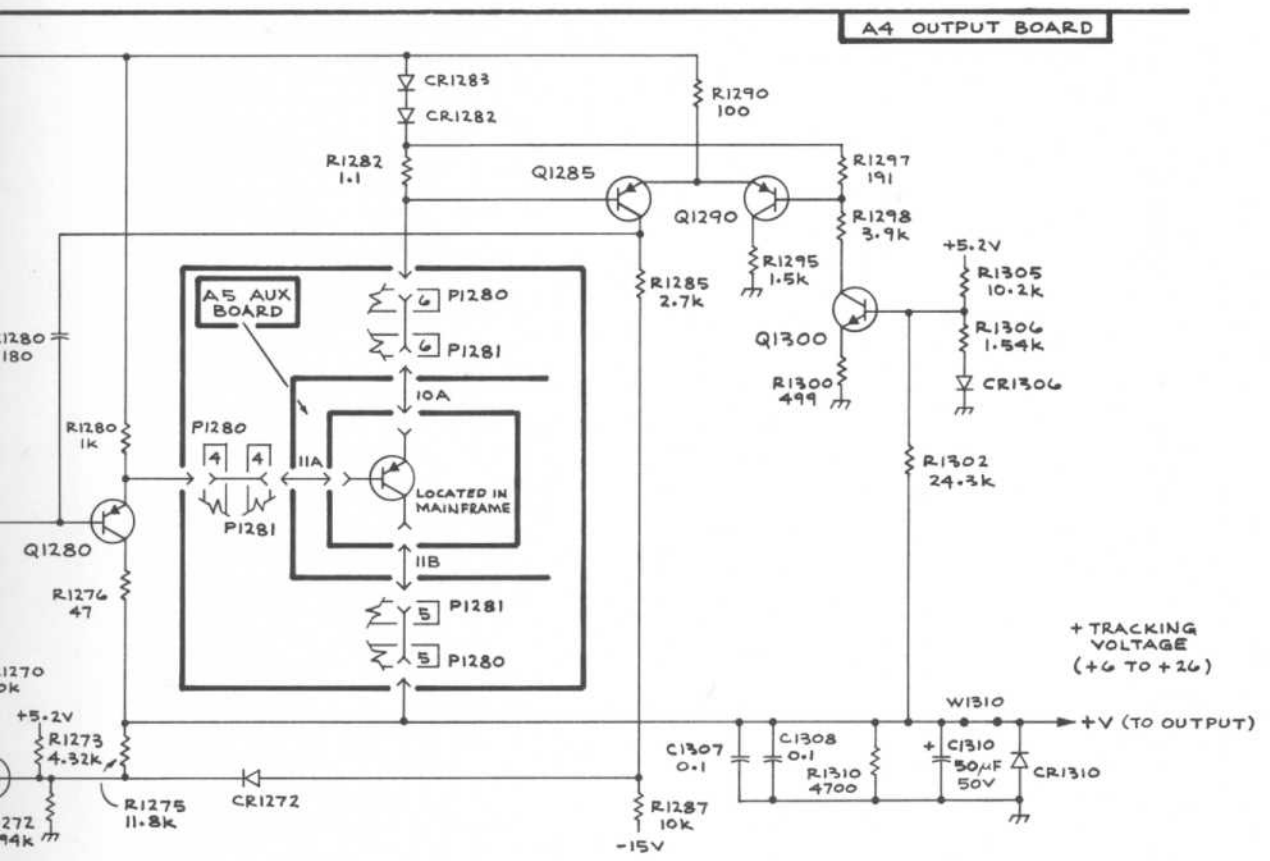
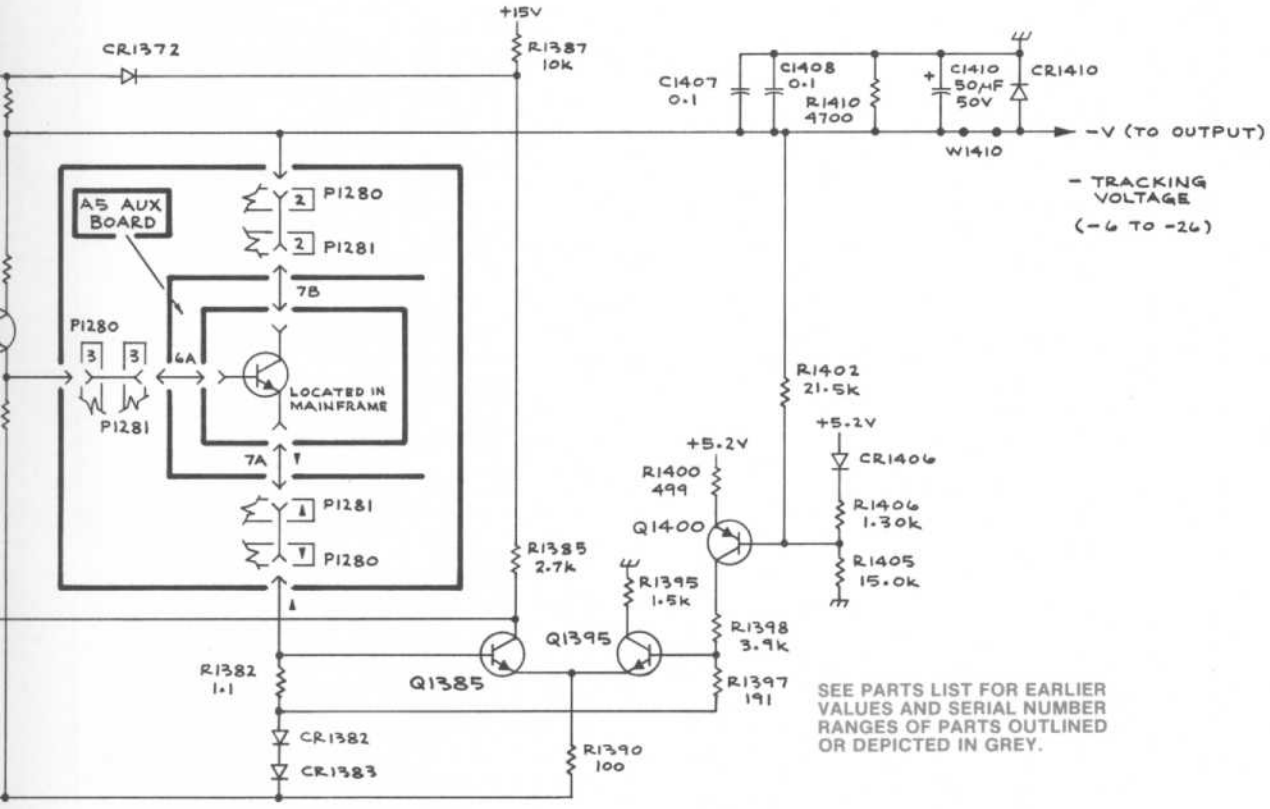
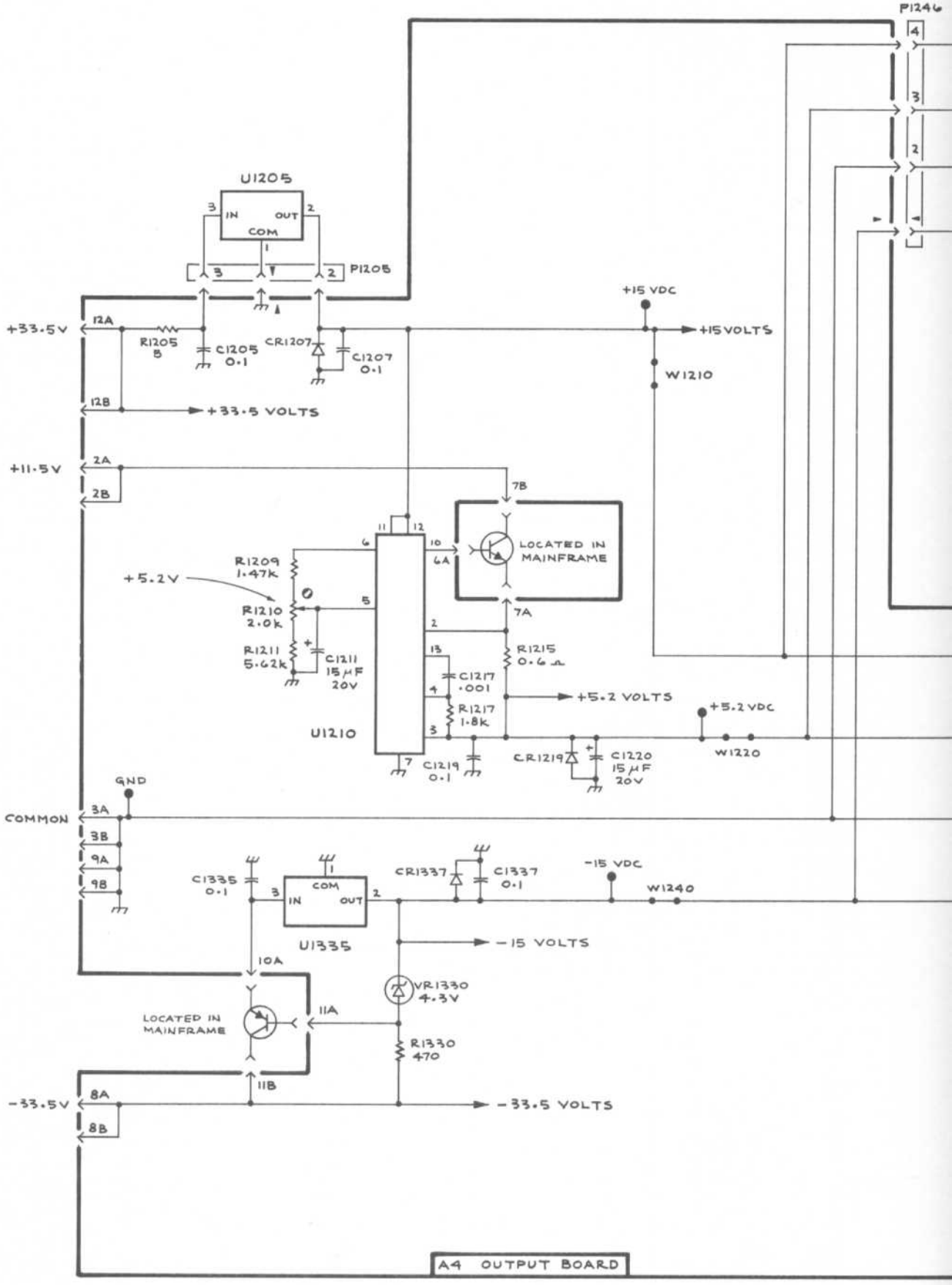
2044-27





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



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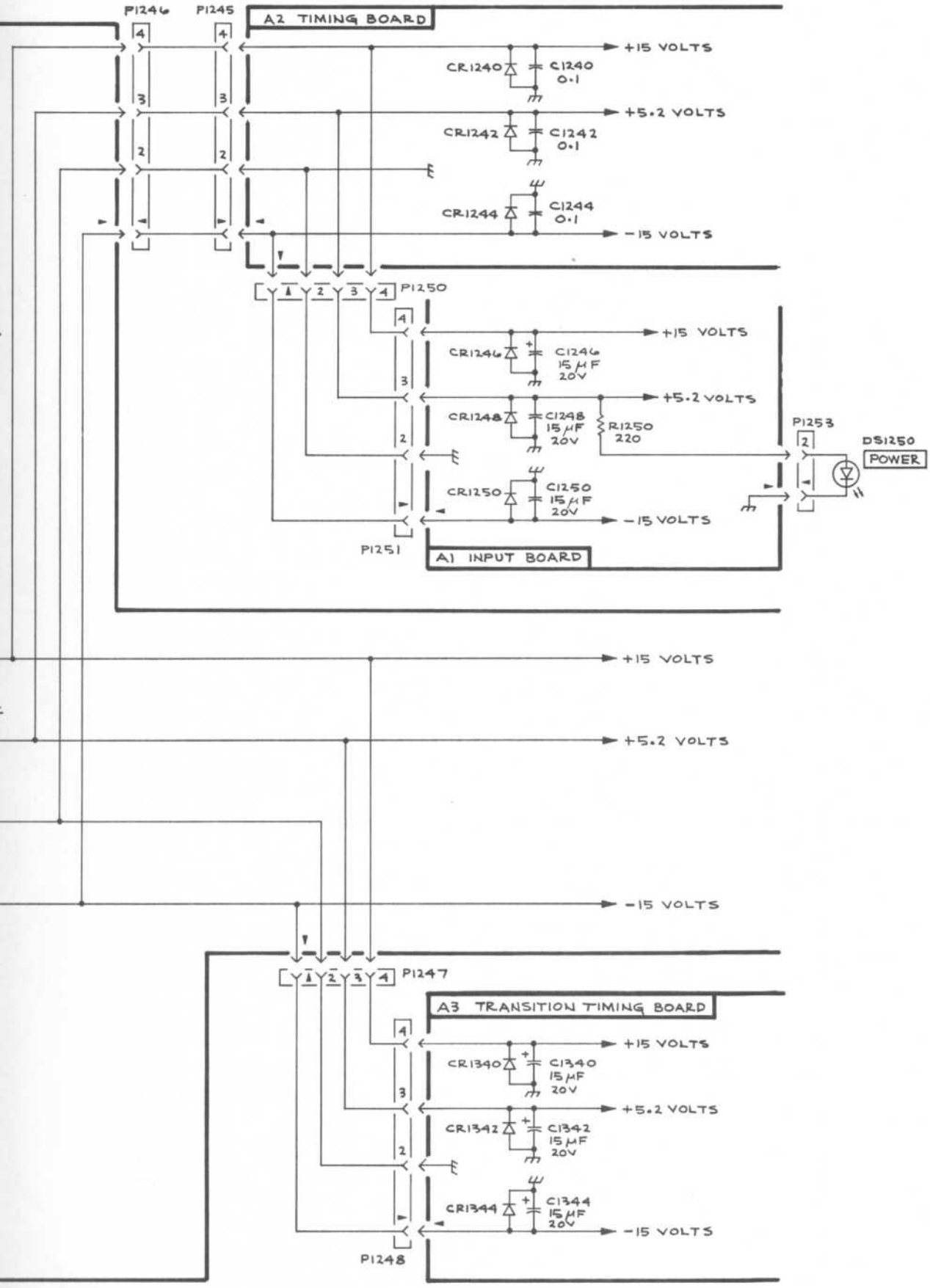


Power Supply ◈9 DEH 1075

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 *Name & Description*

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
13103	THERMALLOY COMPANY, INC.	2021 W VALLEY VIEW LANE P O BOX 34829	DALLAS, TEXAS 75234
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
26365	GRIES REPRODUCER CO., DIV. OF COATS AND CLARK, INC.	125 BEECHWOOD AVE.	NEW ROCHELLE, NY 10802
42838	NATIONAL RIVET AND MFG. CO.	1-21 EAST JEFFERSON ST.	WAUPUN, WI 53963
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
59730	THOMAS AND BETTS COMPANY	36 BUTLER ST.	ELIZABETH, NJ 07207
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78471	TILLEY MFG. CO.	900 INDUSTRIAL RD.	SAN CARLOS, CA 94070
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
82647	TEXAS INSTRUMENTS, INC., CONTROL PRODUCTS DIV.	34 FOREST ST.	ATTLEBORO, MA 02703
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
87308	N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101

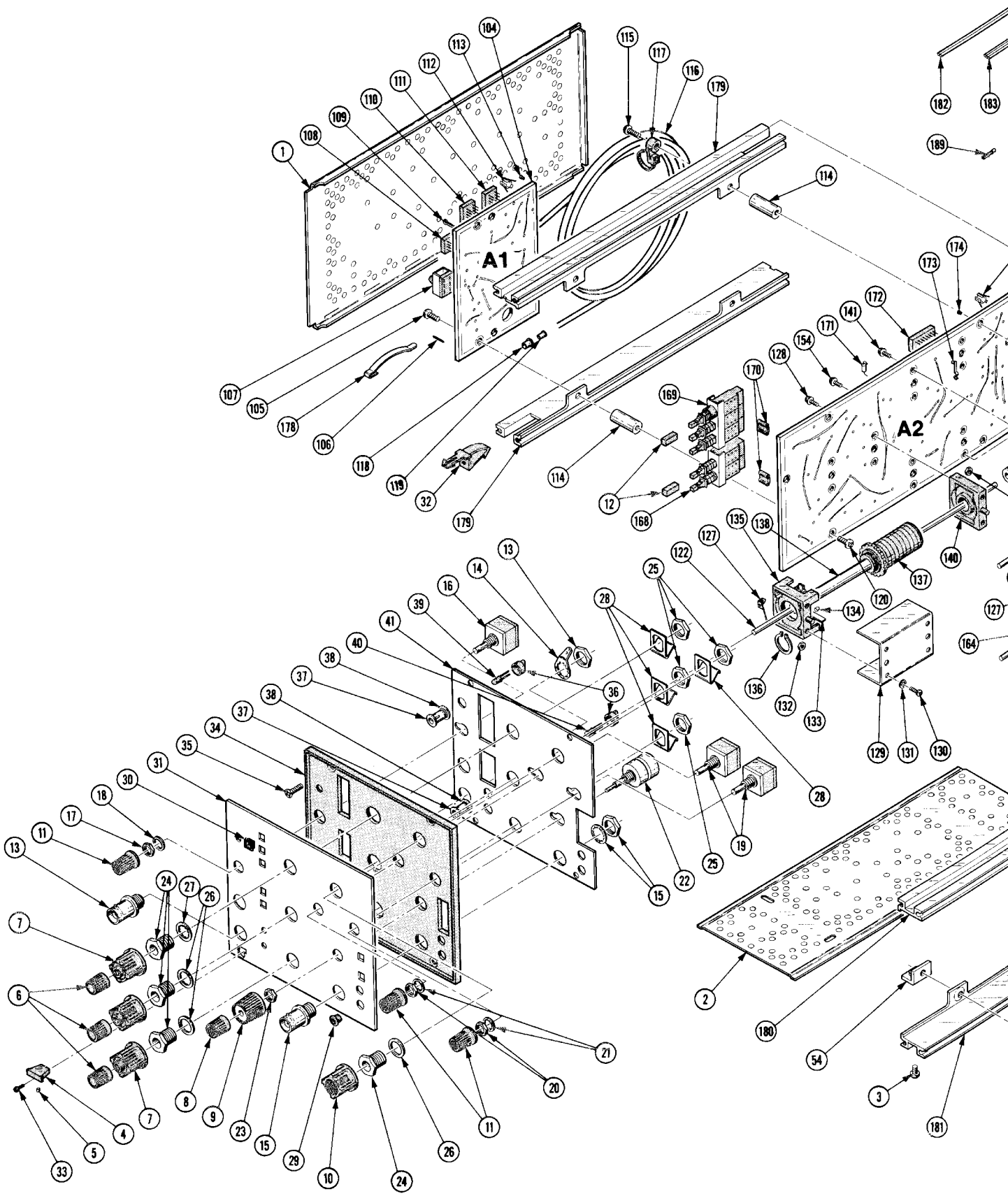
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	337-1399-04			2		SHIELD,ELEC:SIDE	80009	337-1399-04
-2	200-1837-00	B010100	B021213	2		COVER,PLUG-IN:TOP AND BOTTOM	80009	200-1837-00
	200-1837-01	B021214		2		COVER,PLUG-IN:TOP & BOTTOM	80009	200-1837-01
						(ATTACHING PARTS)		
-3	211-0503-00			2		SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-4	366-1520-02	B010100	B021102	1		KNOB:GRAY	80009	366-1520-02
	366-1690-00	B021103		1		KNOB,LATCH:	80009	366-1690-00
						(ATTACHING PARTS)		
-5	214-1840-00	B010100	B021102X	1		PIN,KNOB SECRG:0.094 OD X 0.120 INCH LONG	80009	214-1840-00
						- - - * - - -		
-6	366-1464-01			3		KNOB:GRAY	80009	366-1464-01
	----- -----			-		. EACH KNOB INCLUDES:		
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-7	366-1170-03			3		KNOB:GRAY,0.25 ID X 0.706 OD,0.6H	80009	366-1170-03
	----- -----			-		. EACH KNOB INCLUDES:		
	213-0153-00			2		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-8	366-1514-01			1		KNOB:GRAY,0.81 ID X 0.392 OD,0.466 H	80009	366-1514-01
	213-0048-00			1		. SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-9	366-1517-01			1		KNOB:GRAY,0.126 IDX 0.588 OD,0.6H	80009	366-1517-01
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-10	366-1190-02			1		KNOB:0.252 ID X0.706 OD,0.6H	80009	366-1190-02
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-11	366-0494-05			3		KNOB:GRAY,0.127 IDX 0.5 OD,0.531H	80009	366-0494-05
	----- -----			-		. EACH KNOB INCLUDES:		
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-12	366-1559-00			7		PUSH BUTTON:GRAY	80009	366-1559-00
-13	131-0955-00			2		CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	13511	31-279
-14	210-0255-00			2		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
-15	131-1315-00			1		CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR235-1
-16	----- -----			1		RESISTOR,VAR:(SEE R48 EPL)		
						(ATTACHING PARTS)		
-17	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-18	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-19	----- -----			1		RESISTOR,VAR:(SEE R540 AND R655 EPL)		
						(ATTACHING PARTS FOR EACH)		
-20	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-21	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-22	----- -----			1		RESISTOR,VAR:(SEE R770A AND B EPL)		
						(ATTACHING PARTS)		
-23	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
						- - - * - - -		
-24	358-0029-00			4		BSHG,MACH.THD:HEX,0.375-32 X 0.438"LONG	80009	358-0029-00
						(ATTACHING PARTS)		
-25	210-0413-00			4		NUT,PLAIN,HEX.:0.375-32 X 0.50 INCH,STL	73743	3145-402
-26	210-0978-00			3		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
-27	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
						- - - * - - -		
-28	344-0195-01			4		CLIP,ELECTRICAL:CAM SHAFT	80009	344-0195-01
-29	358-0378-00			2		BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00
-30	426-1072-00			7		FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-31	333-2106-00			1		PANEL,FRONT:	80009	333-2106-00
-32	214-1513-01	B010100	B021102	1		LCH,PLUG-IN RET:	80009	214-1513-01
	105-0719-00	B021103		1		LATCH,RETAINING:PLUG-IN	80009	105-0719-00
						(ATTACHING PARTS)		
-33	213-0113-00			1		SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	93907	OBD
						- - - * - - -		
	105-0718-00	XB021103	B032369	1		BAR,LATCH RLSE:	80009	105-0718-00
	105-0718-01	B032370		1		BAR,LATCH RLSE:	80009	105-0718-01
-34	386-3468-00	B010100	B021213	1		SUBPANEL,FRONT:	80009	386-3468-00

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-	386-3468-01	B021214		1		SUBPANEL,FRONT:	80009	386-3468-01
						(ATTACHING PARTS)		
-35	213-0229-00	B010100	B021213	4		SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL	93907	OBD
	213-0227-00	B021214		8		SCR,TPG,THD FOR:6-32 X 0.50 DEG,FLH ST	83385	OBD
						- - - * - - -		
-36	200-0935-00			3		BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-37	352-0157-00			3		LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-38	210-1258-00			3		WASHER,FLAT:0.265 ID X 0.375 OD INCH AL	86928	5712-71-32
-39	----- -----			2		LAMP,LED:(SEE DS110 AND DS1250 EPL)		
-40	----- -----			1		LAMP,LED:(SEE DS500 EPL)		
-41	337-2273-00	B010100	B021213	1		SHIELD,ELEC:REAR SUBPANEL	80009	337-2273-00
	337-2273-01	B021214		1		SHIELD,ELEC:REAR SUBPANEL	80009	337-2273-01
-42	----- -----			1		CKT BOARD ASSY:AUXILLARY(SEE A5 EPL)		
-43	131-0608-00			6		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-44	351-0449-00			2		GUIDE,CKT BOARD:	80009	351-0449-00
						(ATTACHING PARTS FOR EACH)		
-45	211-0062-00			2		SCREW,MACHINE:2-56 X 0.312 INCH,RDH STL	83385	OBD
-46	210-0405-00			2		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
-47	210-0053-00			2		WASHER,LOCK:INTL,0.092 ID X 0.175"OD,STL	83385	OBD
						- - - * - - -		
-48	255-0334-00			FT		PLASTIC CHANNEL:	11897	122-37-2500
-49	334-2208-00			1		MARKER,IDENT:WARNING	80009	334-2208-00
-50	386-3356-00	B010100	B021213	1		PANEL,REAR:	80009	386-3356-00
	333-2380-00	B021214		1		PANEL,REAR:	80009	333-2380-00
						(ATTACHING PARTS)		
-51	213-0192-00			6		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
						- - - * - - -		
-52	----- -----			1		CKT BOARD ASSY:MAIN(SEE A4 EPL)		
						(ATTACHING PARTS)		
-53	211-0510-00			4		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
-54	407-1693-00			4		BRACKET,COVER:TOP AND BOTTOM	80009	407-1693-00
-55	211-0244-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-56	211-0558-00			1		SCREW,MACHINE:6-32 X 0.250 BDGH,NYL,SLOT	26365	921-1150-0014
-57	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-58	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-59	----- -----			1		. MICROCIRCUIT,DI:(SEE U1205 EPL)		
-60	----- -----			1		. SWITCH,PUSH:(SEE S785 AND S865 EPL)		
-61	361-0385-00			4		. SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
-62	136-0514-00			4		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	82647	C93-08-18
-63	214-1291-00			4		. HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H	05820	207-AB
-64	342-0324-00			8		. INSULATOR,DISC:TO-5 TRANSISTOR	13103	7717-5N-BLUE
-65	214-1254-00			4		. HEAT SINK,ELEC:0.422 H X 1.240 INCH OD	05820	209-AB
-66	131-1003-00			3		. CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
-67	136-0252-04			21		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-68	131-0608-00			27		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-69	136-0269-02			1		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C95140
-70	214-0579-00			4		. TERM.,TEST PT:BRS CD PL	80009	214-0579-00
-71	131-0566-00			3		. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
-72	131-0993-00			2		. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
-73	343-0149-00			2		. CLAMP,LOOP:NYLON	80009	343-0149-00
-74	214-1967-00			1		. HEAT SINK,DIODE:FINGER TYPE	13103	6107B-14
						(ATTACHING PARTS)		
-75	211-0008-00			1		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-76	210-0586-00			1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-77	----- -----			1		. MICROCIRCUIT,LI:(SEE U1335 EPL)		
-78	131-0595-00			3		. CONTACT,ELEC:1.37 INCH LONG	22526	47355
-79	352-0161-02			1		. CONN BODY,PL,EL:3 WIRE RED	80009	352-0161-02
-80	131-0707-00			3		. CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-81	385-0016-00			1		SPACER,POST:1.0 L W/6-32 THD THRU,NYLON	80009	385-0016-00
						(ATTACHING PARTS)		
-82	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		

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-	672-0558-00			1		CKT BOARD ASSY:MAIN W/CAM SW	80009	672-0558-00
	131-0963-00			1		. CONTACT,ELEC:GROUNDING	80009	131-0963-00
	----- -----			1		. ACTR ASSY CAM S:RANGE(SEE S590 EPL)		
						(ATTACHING PARTS)		
-83	211-0244-00			4		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
	----- -----			-		. . ACTUATOR ASSEMBLY INCLUDES:		
-84	131-0963-00			1		. . CONTACT,ELEC:GROUNDING	80009	131-0963-00
-85	210-0406-00			2		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-86	214-1139-02			1		. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02
	214-1139-03			1		. . SPRING,FLAT:RED COLORED	80009	214-1139-03
-87	214-1752-00			2		. . ROLLER,DETENT:	80009	214-1752-00
-88	401-0180-00			1		. . BEARING,CAM SW:FRONT	80009	401-0180-00
						(ATTACHING PARTS)		
-89	354-0390-00			1		. . RING,RETAINING:0.338 ID X 0.025" THK,STL	79136	5100-37MD
-90	105-0709-00			1		. . ACTUATOR,CAM SW:RANGE	80009	105-0709-00
-91	384-0878-02			1		. . SHAFT,CAM SW:	80009	384-0878-02
-92	210-0406-00			4		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-93	401-0178-00			1		. . BEARING,CAM SW:CENTER/REAR	80009	401-0178-00
-94	----- -----			1		. CKT BOARD ASSY:RISE AND FALL(SEE A3 EPL)		
-95	131-1003-00			2		. . CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
-96	136-0514-00			1		. . SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	82647	C93-08-18
-97	136-0263-04			3		. . SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-98	131-0566-00			1		. . LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
-99	131-1031-00			8		. . CONTACT ASSY,EL:CAM SWITCH,TOP	80009	131-1031-00
-100	210-0779-00			8		. . RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG	42838	RA-29952715
-101	136-0260-02			2		. . SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
-102	131-0608-00			9		. . TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-103	136-0252-04			6		. . SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-104	----- -----			1		CKT BOARD ASSY:INPUT(SEE A1 EPL)		
						- - - * - - -		
-105	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						(ATTACHING PARTS)		
	----- -----			-		. CKT BOARD ASSEMBLY INCLUDES:		
-106	131-0608-00			16		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-107	----- -----			1		. SWITCH,SLIDE:(SEE S12 EPL)		
-108	136-0514-00			1		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	82647	C93-08-18
-109	214-0579-00			1		. TERM.,TEST PT:BRS CD PL	80009	214-0579-00
-110	136-0269-02			1		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C95140
-111	136-0260-02			1		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
-112	131-1003-00			2		. CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
-113	136-0252-04			2		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-114	385-0160-00			4		SPACER,POST:0.812 L W/6-32 THD THRU,AL	80009	385-0160-00
						(ATTACHING PARTS)		
-115	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
-116	----- -----	B010100	B020244	1		DELAY LINE:(SEE DL480 EPL)		
-117	346-0121-00	B010100	B020244	2		. STRAP,ELEC COMP:TIE DOWN,5.0 LONG	59730	T4-34M
-118	210-0775-00	B010100	B020244	4		. EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
-119	210-0774-00	B010100	B020244	4		. EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00
	175-1825-00	B020245		2		CABLE ASSY,RF:50 OHM COAX,8.0 LONG	80009	175-1825-00
	----- -----			-		. EACH CABLE ASSY INCLUDES:		
	210-0775-00	B020245		1		. EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
	210-0774-00	B020245		1		. EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00
	672-0557-00			1		CKT BOARD ASSY:TIMING W/CAM SW	80009	672-0557-00
						(ATTACHING PARTS)		
-120	211-0504-00			4		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-121	384-1415-00			2		. EXTENSION SHAFT:8.905 L X 0.125 DIA,AL,CRM	80009	384-1415-00
-122	384-1416-00			1		. EXTENSION SHAFT:5.58 L X 0.125 DIA,AL,CRM	80009	384-1416-00
-123	376-0051-01			3		. CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-01
	213-0048-00			4		. . SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-124	------ ------			1		. RESISTOR,VAR:(SEE R190 EPL)		
-125	------ ------			2		. RESISTOR,VAR:(SEE R355 AND R475 EPL)		
-126	361-0515-00			3		. SPACER,SWITCH:PLASTIC	80009	361-0515-00
-127	131-0963-00			3		. CONTACT,ELEC:GROUNDING	80009	131-0963-00
	------ ------			1		. ACTR ASSY CAM S:(SEE S200 EPL)		
						(ATTACHING PARTS)		
-128	211-0244-00			4		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
	----- -----			-		. . ACTR ASSY INCLUDES:		
-129	200-1935-00			1		. . COVER,CAM SW:1.85 L X 0.876 H,AL	80009	200-1935-00
						(ATTACHING PARTS)		
-130	211-0008-00			4		. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-131	210-0004-00			4		. . WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
	131-0963-00			1		. . CONTACT,ELEC:GROUNDING	80009	131-0963-00
-132	210-0406-00			2		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-133	214-1139-02			1		. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02
	214-1139-03			1		. . SPRING,FLAT:RED COLORED	80009	214-1139-03
-134	214-1752-00			2		. . ROLLER,DETENT:	80009	214-1752-00
-135	401-0180-00			1		. . BEARING,CAM SW:FRONT	80009	401-0180-00
						(ATTACHING PARTS)		
-136	354-0390-00			1		. . RING,RETAINING:0.338 ID X 0.025" THK,STL	79136	5100-37MD
						- - - * - - -		
-137	105-0710-00			1		. . ACTUATOR,SWITCH:CAM SWITCH	80009	105-0710-00
-138	384-0878-10			1		. . SHAFT,CAM SW:OUTER CONCENTRIC,W/DRIVER	80009	384-0878-10
-139	210-0406-00			4		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-140	401-0178-01			1		. . BEARING,CAM SW:CENTER/REAR	80009	401-0178-01
	263-1141-00			1		. SW CAM ACTR AS:DELAY	80009	263-1141-00
						(ATTACHING PARTS)		
-141	211-0244-00			4		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
	----- -----			-		. . ACTR ASSY INCLUDES:		
-142	200-1934-00			1		. . COVER,CAM SW:1.55 L X 0.876 H,AL	80009	200-1934-00
						(ATTACHING PARTS)		
-143	211-0008-00			4		. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-144	211-0004-00			4		. . SCREW,MACHINE:3-48 X 0.125,PNH,STL	83385	OBD
						- - - * - - -		
	131-0963-00			1		. . CONTACT,ELEC:GROUNDING	80009	131-0963-00
-145	210-0406-00			2		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-146	214-1139-02			1		. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02
	214-1139-03			1		. . SPRING,FLAT:RED COLORED	80009	214-1139-03
-147	214-1752-00			2		. . ROLLER,DETENT:	80009	214-1752-00
-148	401-0180-00			1		. . BEARING,CAM SW:FRONT	80009	401-0180-00
						(ATTACHING PARTS)		
-149	354-0390-00			1		. . RING,RETAINING:0.338 ID X 0.025" THK,STL	79136	5100-37MD
						- - - * - - -		
-150	105-0708-00			1		. . ACTUATOR,SWITCH:CAM SWITCH	80009	105-0708-00
-151	384-0878-00			1		. . SHAFT,CAM SW:W/DRIVER	80009	384-0878-00
-152	210-0406-00			4		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-153	401-0178-01			1		. . BEARING,CAM SW:CENTER/REAR	80009	401-0178-01
	------ ------			1		. ACTR ASSY,CAM S:(SEE S450 EPL)		
						(ATTACHING PARTS)		
-154	211-0244-00			4		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
	----- -----			-		. . ACTR ASSY INCLUDES:		
-155	200-1936-00			1		. . COVER,CAM SW:1.95 L X 0.876 H,AL	80009	200-1936-00
						(ATTACHING PARTS)		
-156	211-0008-00			4		. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-157	210-0004-00			4		. . WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
	131-0963-00			1		. . CONTACT,ELEC:GROUNDING	80009	131-0963-00
-158	210-0406-00			2		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-159	214-1139-02			1		. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02

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-	214-1139-03			1		. . SPRING,FLAT:RED COLORED	80009	214-1139-03
-160	214-1752-00			2		. . ROLLER,DETENT:	80009	214-1752-00
-161	401-0180-00			1		. . BEARING,CAM SW:FRONT	80009	401-0180-00
						(ATTACHING PARTS)		
-162	354-0390-00			1		. . RING,RETAINING:0.338 ID X 0.025" THK,STL	79136	5100-37MD
						- - - * - - -		
-163	105-0711-00			1		. . ACTUATOR,SWITCH:CAM SWITCH	80009	105-0711-00
-164	384-0878-11			1		. . SHAFT,CAM SW:OUTER CNCTRC,W/DRIVER	80009	384-0878-11
-165	210-0406-00			4		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-166	401-0178-01			1		. . BEARING,CAM SW:CENTER/REAR	80009	401-0178-01
-167	----- -----			1		. CKT BOARD ASSY:TIMING(SEE A2 EPL)		
-168	----- -----			1		. . SWITCH,PUSH:(SEE S380A,B EPL)		
-169	----- -----			1		. . SWITCH,PUSH:(SEE S380A,B,C EPL)		
-170	361-0382-00			8		. . SPACER,PB SW:BROWN,0.275 INCH LONG	80009	361-0382-00
-171	131-0566-00	B010100	B020244	1		. . LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
	131-0566-00	B020245		4		. . LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
-172	136-0260-02			6		. . SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
-173	131-0604-00			37		. . CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-174	136-0252-04			9		. . SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-175	131-1003-00			9		. . CONNECTOR BODY,:CKT BD MT,2 PRONG	80009	131-1003-00
-176	131-0827-00			4		. . CONTACT,ELEC:0.55 INCH LONG	22526	47349
-177	131-0608-00			8		. . TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-178	214-1061-00			1		SPRING,GROUND:FLAT	80009	214-1061-00
	386-3657-00	XB021113		2		SUPPORT,PLUG-IN:	80009	386-3657-00
-179	426-1245-00	B010100	B021223	2		FR SECT,PLUG-IN:LEFT SIDE,TOP AND BOTTOM	80009	426-1245-00
	426-1245-00	B021224		1		FR SECT,PLUG-IN:LEFT SIDE,TOP AND BOTTOM	80009	426-1245-00
	426-1245-01	B021224		1		FR SECT,PLUG-IN:TOP LEFT	80009	426-1245-01
-180	426-1246-00			1		FR SECT,PLUG-IN:RIGHT SIDE,TOP AND BOTTOM	80009	426-1246-00
-181	426-1246-01			1		FR SECT,PLUG-IN:RIGHT SIDE,TOP AND BOTTOM	80009	426-1246-01
-182	175-0825-00			FT		WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-183	175-0826-00			FT		WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-184	175-0827-00			FT		WIRE,ELECTRICAL:4 WIRE RIBBON	08261	SS-0426-710610C
-185	175-0828-00			FT		WIRE,ELECTRICAL:5 WIRE RIBBON	08261	OBD
-186	175-0829-00			FT		WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
-187	210-0775-00			1		EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
-188	210-0774-00			1		EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00
-189	131-0707-00			81		CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-190	352-0171-01			2		CONN BODY,PL,EL:1 WIRE BROWN	80009	352-0171-01
-191	352-0169-00			1		CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
	352-0169-02			2		CONN BODY,PL,EL:2 WIRE RED	80009	352-0169-00
	352-0169-03			1		CONN BODY,PL,EL:2 WIRE ORANGE	80009	352-0169-03
-192	352-0161-04			1		CONN BODY,PL,EL:3 WIRE YELLOW	80009	352-0161-04
-193	352-0162-04			4		CONN BODY,PL,EL:4 WIRE YELLOW	80009	352-0162-04
	352-0162-05			2		CONN BODY,PL,EL:4 WIRE GREEN	80009	352-0162-05
-194	352-0163-05			2		CONN BODY,PL,EL:5 WIRE GREEN	80009	352-0163-05
-195	352-0164-06			3		CONN BODY,PL,EL:6 WIRE BLUE	80009	352-0164-06


A1
A2

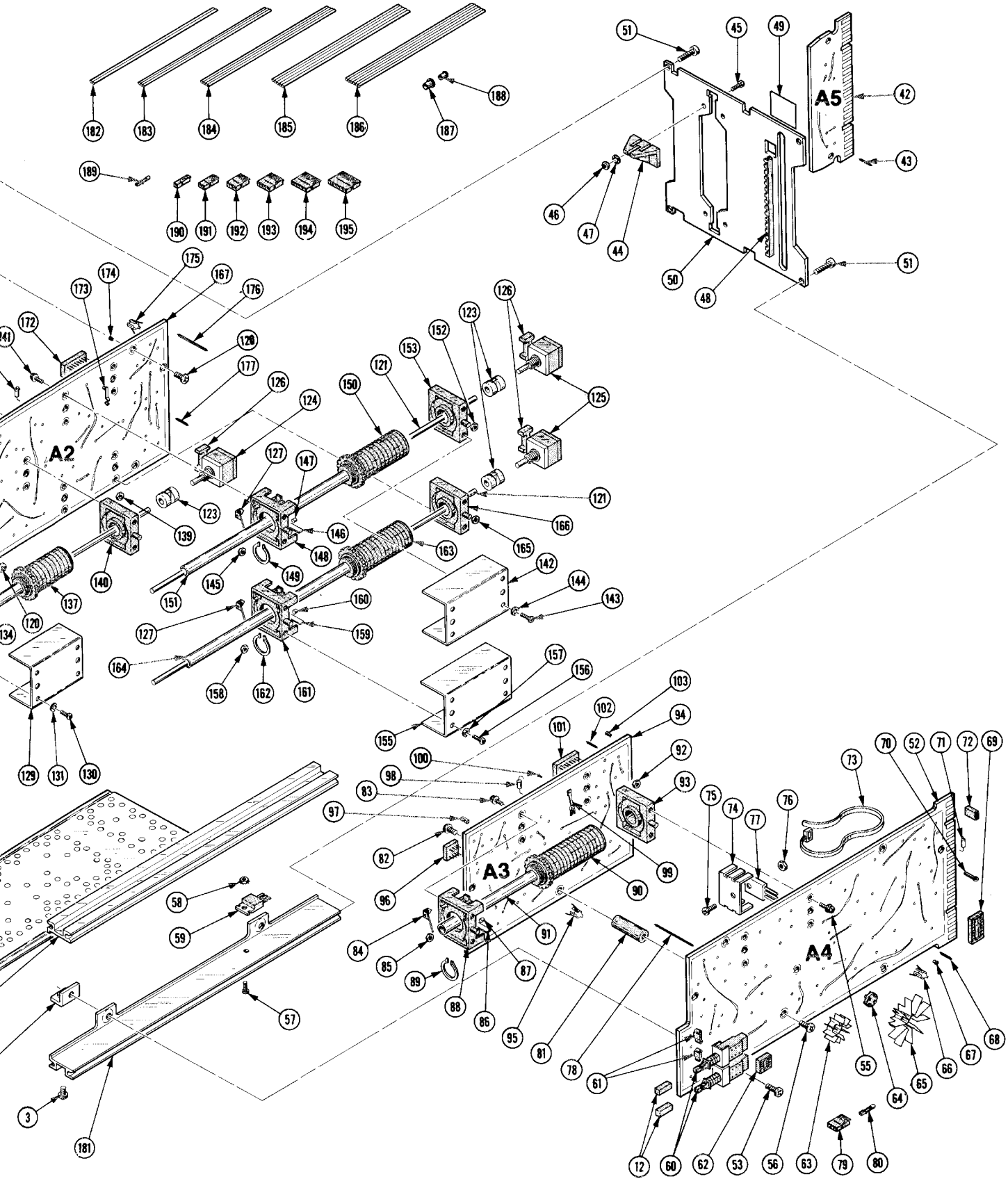

A2
A3
A4
A5

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-	070-2044-00			1		MANUAL,TECH:INSTRUCTION	80009	070-2044-00

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. 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 following this page, your manual is correct as printed.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

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

Comparison of Main Characteristics

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

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

Tektronix®
COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: 9-13-79 Change Reference: M30603

Product: PG 508 EFF SN B043259 Manual Part No.: 070-2044-00

DESCRIPTION

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

A2	670-4274-03	CKT BOARD ASSY:TIMING
A4	670-4276-02	CKT BOARD ASSY:OUTPUT
C432	281-0167-00	CAP.,VAR,CER DI:9-45PF,200V
C1202	290-0786-00	CAP.,FXD,ELCTLT:1500UF,+50-10%,75V
C1207	283-0080-00	CAP.,FXD,CER DI:0.022UF,+80-20%,25V
C1219	283-0080-00	CAP.,FXD,CER DI:0.022UF,+80-20%,25V
C1327	290-0786-00	CAP.,FXD,ELCTLT:1500UF,+50-10%,75V
C1335	283-0080-00	CAP.,FXD,CER DI:0.022UF,+80-20%,25V
C1337	283-0080-00	CAP.,FXD,CER DI:0.022UF,+80-20%,25V
L240	276-0569-00	CORE,TOROID:TEST SELECTED AS NEEDED
Q435	151-0427-00	TRANSISTOR:SILICON,NPN
R462	315-0391-00	RES.,FXD,CMPSN:390 OHM,5%,0.25W
R467	315-0391-00	RES.,FXD,CMPSN:390 OHM,5%,0.25W
R1202	315-0273-00	RES.,FXD,CMPSN:27K OHM,5%,0.25W
R1327	315-0273-00	RES.,FXD,CMPSN:27K OHM,5%,0.25W
ADD:		
C778	283-0204-00	CAP.,FXD,CER DI:0.01UF,20%,50V
C782	283-0177-00	CAP.,FXD,CER DI:1UF,+80-20%,25V
C788	283-0204-00	CAP.,FXD,CER DI:0.01UF,20%,50V
C945	283-0024-00	CAP.,FXD,CER DI:0.1UF,+80-20%,50V
R434	317-0100-00	RES.,FXD.,CMPSN:10 OHM,5%,0.125W
R1214	301-0101-00	RES.,FXD.,CMPSN:100 OHM,5%,0.50W

Foldout page "Internal Adjustment Procedure", Step 8. Adjust 10 ns Duration

Change the last sentence to read:

Adjust R465 (Dur 10 ns) for a duration of 10 ns measured at the waveform 50% points. For serial number B043259 and above: Rotate R465 (Dur 10 ns) to mid-range; adjust C432 for a duration 10% above 10 ns. Adjust R465 for a duration of 10 ns measured at the waveform 50% points.

DESCRIPTION

SCHEMATIC CHANGES

DIAGRAM <4> DURATION GENERATOR - Partial

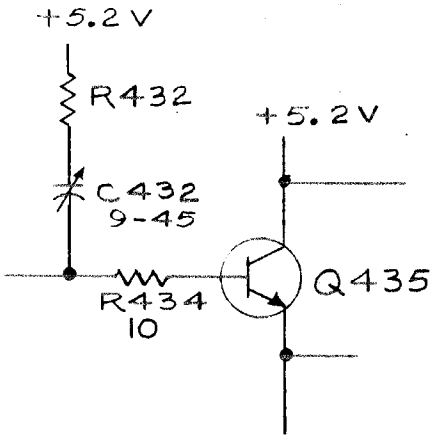


DIAGRAM <9> POWER SUPPLY - Partial

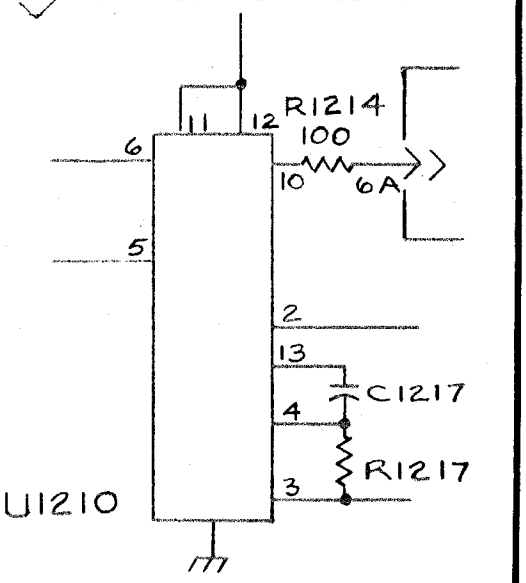
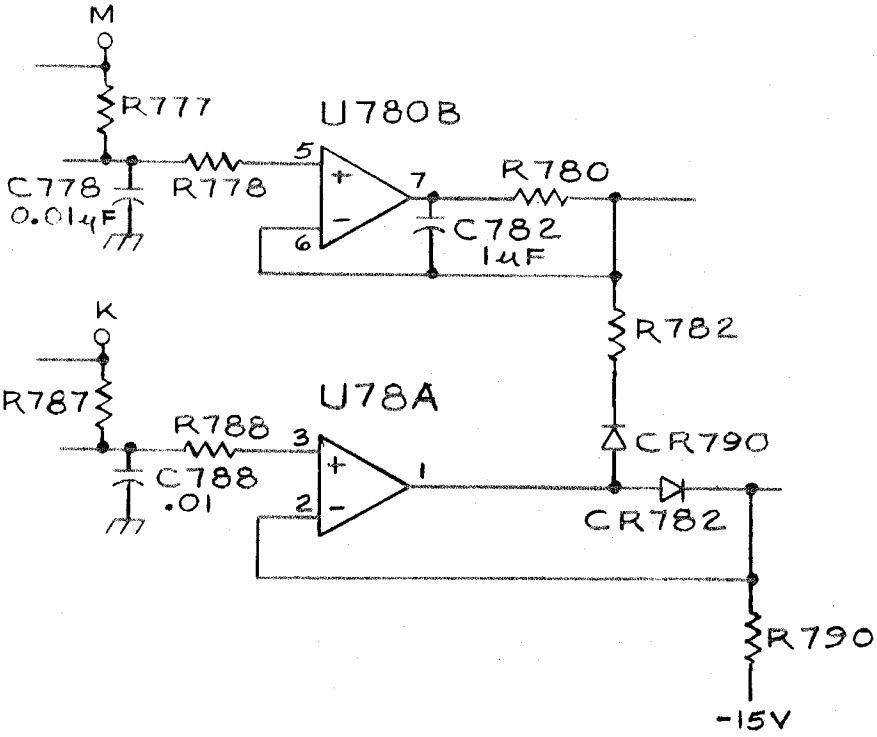
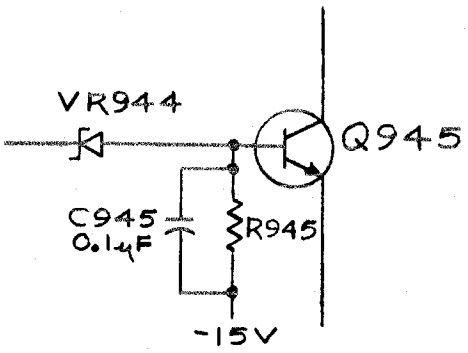


DIAGRAM <6> LEVEL CONTROL MULTIPLIER - Partial





Nachfolgend ist das Service-Manual abgebildet, welches die US-Army für dieses Gerät herausgegeben hat.

Möglicherweise sind hier zusätzliche Informationen verfügbar.

TM 11-6625-2980-14

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR PULSE GENERATOR AN/USM-359A

(NSN 6625-01-077-4620)

(TEKTRONIX MODEL PG 508 WITH TM 503)

HEADQUARTERS, DEPARTMENT OF THE ARMY

27 MARCH 1981

SAFETY SUMMARY

This manual contains safety information which the user must follow to ensure safe operation of this instrument. WARNING information is intended to protect the operator; CAUTION information is intended to protect the instrument. The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument.

Warning statements precede potentially dangerous procedures throughout this manual. The instructions contained in the warnings must be followed. The following warning statements are found in this manual.

WARNING

Use a proper power source. This instrument is designed to operate from a power source with its neutral at or near ground potential with a separate safety-earth conductor. It is not intended for operation from two phases of a multi-phase system, or across the legs of a single-phase, three-wire system.

WARNING

Avoid live circuits. Dangerous voltages exist at several points throughout this instrument. When the instrument is operated with the cover removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect power before cleaning the instrument or replacing parts.

WARNING

Avoid contact with chemicals. Handle silicone grease with care. Avoid getting silicon-in grease in eyes. Wash hands thoroughly after use.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flames; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact wit h skin should be avoided. When necessary,-use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a-physician immediately.

WARNING

Compressed air is dangerous and can cause serious bodily harm if protective means or methods are not observed to prevent a chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 p.s.i.f. and then only with effective chip guarding and personnel protective equipment. Do not use compressed air to dry parts when Trichlorotrifloroethane has been used.

CAUTION

Avoid power surge damage. Do not remove or install plug-in unit while power is on as damage may occur to circuitry.

TECHNICAL MANUAL

No. 11-6625-2980-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 27 March 1981

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR GENERATOR, PULSE AN/USM-359A (TEKTRONIX MODEL PG 508 WITH TM 503) (NSN 6625-01-077-4620)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, New Jersey 07703.

This manual is an authentication of the manufacturer's commercial literature which, through usage, has been found to cover the data required to operate and maintain this equipment. Since the manual was not prepared in accordance with military specifications, the format has not been structured to consider levels of maintenance.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

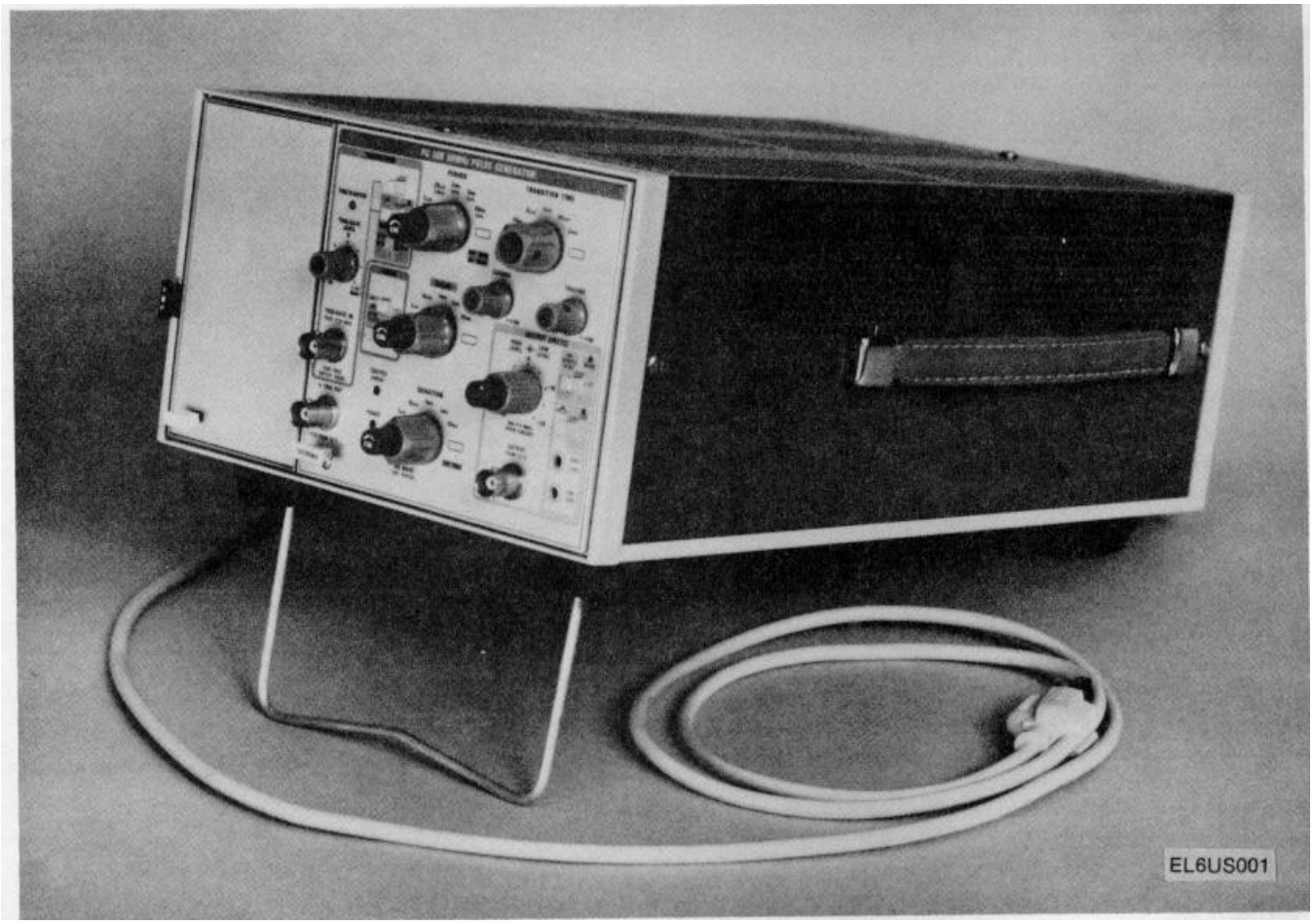


Figure 1-0 . Pulse generator AN/USM-359A

SECTION O

INTRODUCTION

Scope

This manual describes Pulse Generator AN/USM-359A and provides instructions for operation and maintenance. Throughout this manual, the SG-1178/USM-359A is referred to as Tektronix Model PG 508 and PP-7578/USM 359A is referred to as TM 503.

Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are New editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

Maintenance Forms, Records, and Reports

Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management system (Army).

b. Report of Item and Packaging Discrepancies. Fill out and forward SF 364 [Report of Discrepancy (ROD)] as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINS4355.73/AFR 400-54/MCO 4430.3E.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/ NA.VSUPI NST 4610.33B/AFR 75**-**18/MCO P4610.19C and DLAR 4500.15**.**

Reporting Equipment Improvement Recommendations (EIR)

If your AN/USM-359A needs improvement, let us know**.** Send us an EIR**.** You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN**:** DRSEL-ME-MO, Fort Monmouth, New **Jersey** 07703. We'll send you a reply.

Administrative Storage

To prepare the equipment for administrative storage, ascertain its operability and reliability. In addition, use the proper packing materials.

Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

OPERATING INSTRUCTIONS

Instrument Description

The PG 508 is a 50 MHz general purpose full function pulse generator usable in all TM 500-series power modules except the TM 501. It is compatible with MOS and other general purpose circuitry. Important features of the instrument include independent period and duration controls with a control error light, independent pulse top and bottom level controls, variable leading and trailing transition time adjustments, and fully adjustable pulse delay capabilities. Front panel controls and connectors provide a trigger or synchronous gate input with level and slope controls, square wave output and complementary pulse output for high duty factors. Delayed and paired pulse and manual trigger or gate capabilities are also provided. All inputs and outputs are internally terminated in 50 n except the TRIG/GATE input which is internally selectable for either 50 n or 1 Mn, 20 pF input impedance. Special positions on PERIOD, DURATION, DELAY, and TRANSITION controls permit customized control ranges.

The front panel is color coded for easy reference to controls and their associated functions. Green indicates triggering functions and blue indicates mode functions.

Installation and Removal

The PG 508 is calibrated and ready for use when received. It operates in any two compartments of the TM 500-series power modules. See Appendix A for line voltage requirements and power module operation. Fig. 1-1 shows the installation and removal procedure. Make certain the power module is off when inserting or removing the PG 508. Check that the PG 508 is fully inserted in the power module. Pull the power switch on the power module. The POWER light on the PG 508 should now be on. Refer to the Controls and Connectors foldout page in Section 4 of this manual for a complete description of the front panel controls and connectors.

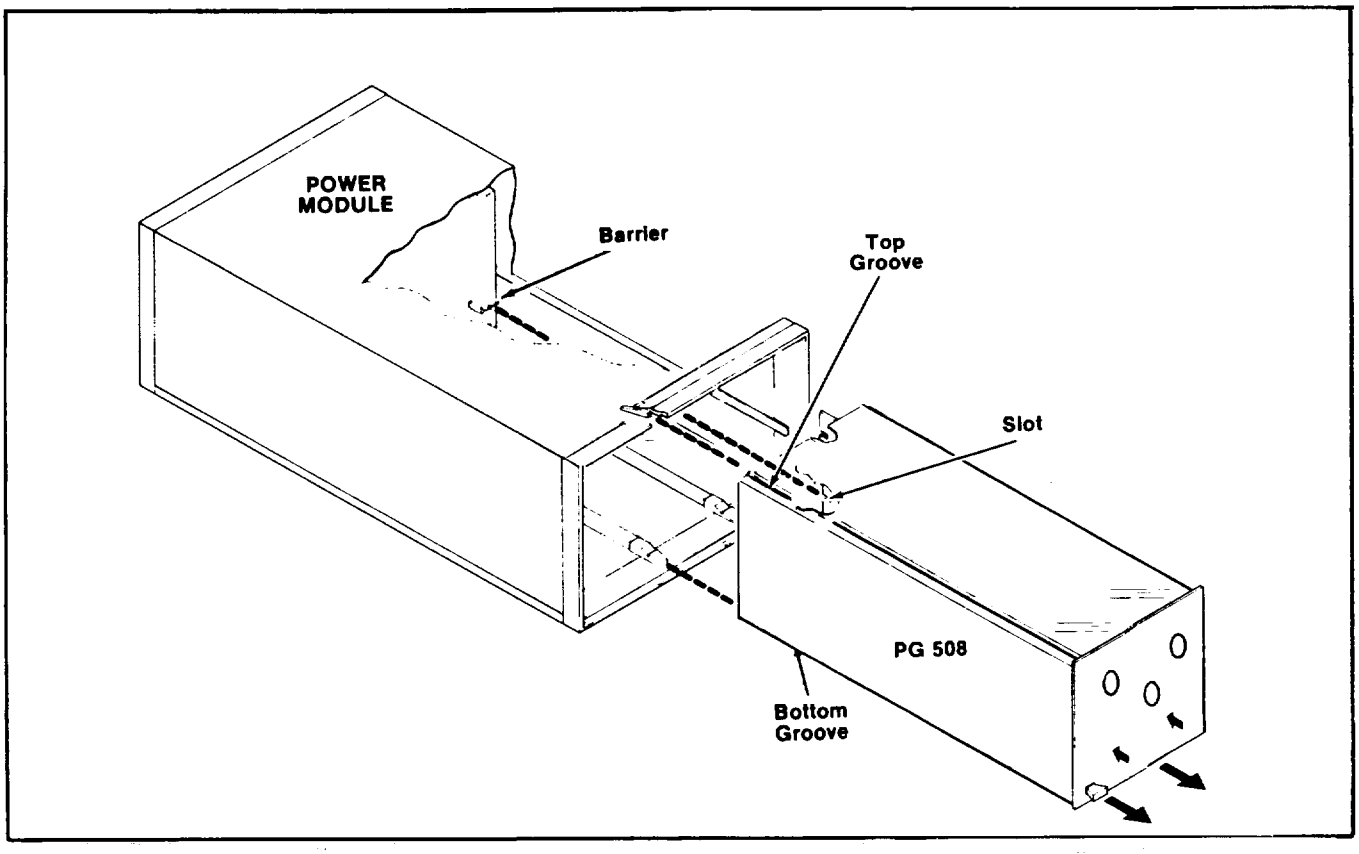


Fig. 1-1. PG 508 installation and removal.

BASIC OPERATION

Period and Duration Selection

The period generator operates, in all modes except EXT TRIG or MAN, at a rate set by the PERIOD range switch and variable control. The duration of the output pulse is set by the DURATION range switch and variable control. When the DURATION control is set for a time greater than the PERIOD, the CONTROL ERROR lamp will light. When the DURATION control is set to the SQ WAVE position, the duration time is determined internally at approximately 50% of the period time.

The custom range positions on the PERIOD and DURATION controls permit user-selected period and duration times. To determine the approximate capacitor value for the desired period, multiply the period time in seconds by 5 X $10^{-3.}$ The result is the value of the capacitor in Farads. For example, a 50 ms period times 5 X 10-3 equals 250 X 10- or 250 HF. This capacitor must be non-polarized and have at least a 6 V rating. Solder this capacitor in the position shown in Fig. 1-2.

To determine the capacitor value for the duration time desired, multiply the duration time by 1 X $10^{-2.}$ For example a 50 ms duration time requires 50 ms times 1 X 10^{-2} or a 500pF capacitor. If a polarized capacitor is used, observe the correct polarity. Use at least a 6 V rated capacitor. Connect this capacitor as shown in Fig. 1-2.

Duty Factors

Duty factors greater than those specified are obtainable on several ranges. When the duty factor is increased to the point that internal circuitry prevents completion of the pulse waveform, the CONTROL ERROR light will flash. To further increase the duty factor, switch to the complement mode. Set the DURATION control for a pulse width equal to the desired pulse off time and push the front panel COMPLEMENT (-) pushbutton.

Delayed and Paired Pulse Selection

In the pulse delay mode, the output pulse is delayed from the +TRIG OUT signal by the DELAY time selected plus a specified fixed delay. In the PAIRED mode of operation, the delay controls the time between the leading edges of the paired pulses. To use this feature push the DELAY button and trigger the external device from the +TRIG OUT jack. Set the DELAY control for the desired delay time from trigger to pulse leading edge. Use the variable control labeled CAL for time adjustments between steps or to increase the delay times beyond the steps.

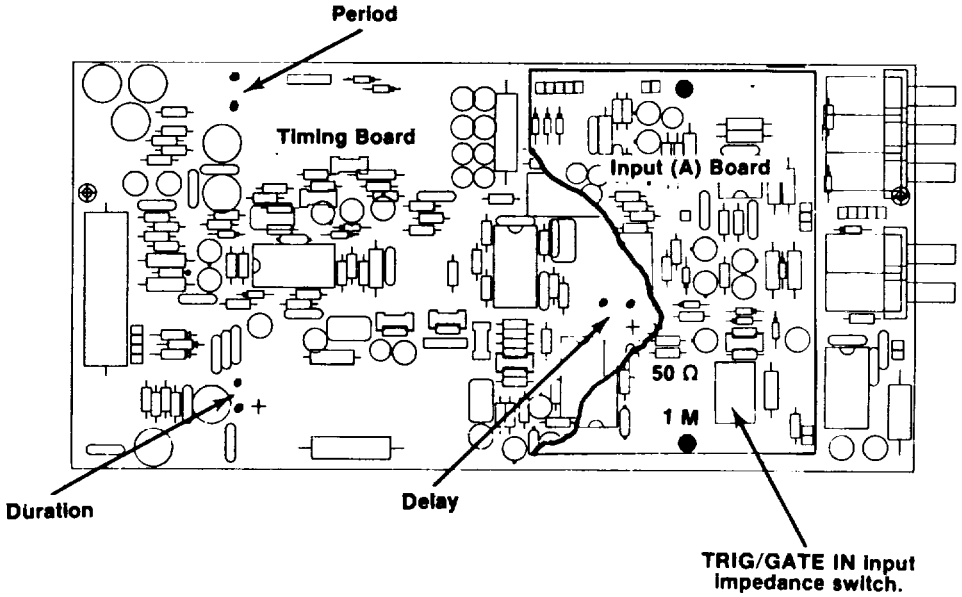


Fig. 1-2. Locations of period, delay and duration custom timing capacitors and TRIG/GATE IN input impedance switch. Remove the Input board to gain access to the delay pads.

Paired pulses are obtained by pushing both the DELAY and UNDLY buttons. An initial pulse now occurs at external trigger time with the second or paired pulse delayed by the selected delay time. The CONTROL ERROR light illuminates if the delay is too short or long for a valid pulse train. A custom delay position is provided on the DELAY switch. To determine the value of the capacitor required, multiply the desired delay time in seconds by 1 X 10-*2.* For example, a 50 ms delay time requires a 500 Pf capacitor (50 ms times 1 X 10-2). Use either a polarized or non-polarized capacitor with a rating of at least 6 V. If a polarized capacitor is used, observe the polarity markings. Remove the input board and connect the capacitor as shown in Fig. 1-2.

Transition Time Selection

The leading and trailing times of the pulses may be varied by using the TRANSITION TIME control and the LEADING and TRAILING variable controls. Select the desired transition time range with the TRANSITION TIME control and vary the leading and trailing times independently with the LEADING and TRAILING controls.

A custom range position is also provided on the TRANSITION TIME control. To select the correct capacitor (in Farads) for this range, multiply the desired transition time (in seconds) measured from 10% to 90% points, by 4.4 X 10-'. For example, a desired transition time of 50 ms requires a capacitor of 220 HF. Connect the capacitor as shown in Fig. 1-3. Use a capacitor with at least a 10 V rating and observe polarity requirements.

When the transition times become large compared with the duration or period times and the pulse does not reach full amplitude, the CONTROL ERROR light will flash indicating improper control settings.

Output Levels

The output amplitude and offset are selected by independent pulse LOW LEVEL and HIGH LEVEL controls. Use the front panel voltage calibration marks for an open circuit load and divide the values by two when the PG 508 is operating into a 50 (load. The OUTPUT (VOLTS) controls are interlocked to prevent setting the HIGH LEVEL more negative than the LOW LEVEL. It is also impossible to set the controls for more than about 20 V peak to peak output amplitude into an open circuit or 10 V into 50 n.

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 base line reference level. The flexibility of this method is useful in certain applications such as logic testing. Either the high or low level can be varied without disturbing the other.

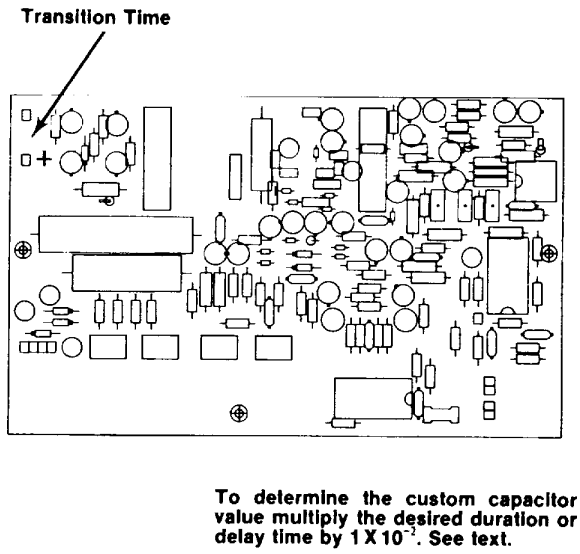


Fig. 1-3 . Location for transition custom timing capacitor .

The pulse high and low levels can be preset. Push the PRESET button and adjust the HIGH LEVEL and the LOW LEVEL potentiometers with a screwdriver for the desired output levels.

External Triggering and Gating

To change the TRIG/GATE IN input impedance remove the plug-in from the mainframe. Remove the left side cover. Set the slide switch, located on the Input board and labeled Input Impedance, to either the 50 n or the 1 MO position. In the 1 MO position the shunt capacitance is approximately 20 pF. A standard oscilloscope probe can be used to acquire the triggering signal from the external circuitry. If a compensated probe is used, calibrate the probe on the input of a 1 M) 20 pF oscilloscope first. A 10X probe allows triggering directly from high impedance sources such as MOS digital circuitry with an effective TRIG/GATE LEVEL range of ±30 V.

For external gating select the desired period and duration. Press the SYNC GATE pushbutton. Select the desired trigger slope with the + or - SLOPE button. The OUTPUT now consists of pulses, described by the front panel controls, whenever the TRIG/GATE IN input exceeds the TRIG/GATE LEVEL control setting.

To externally trigger the PG 508, connect the triggering signal to the TRIG/GATE IN connector. Select the slope on which triggering is desired with the + or - SLOPE button. Place the PERIOD switch in the EXT TRIG OR MAN position. Now adjust the TR IG/GATE LEVEL control for the desired triggering level. The output waveform commences about 48 ns after the triggering signal.

For external DURATION place the DURATION control in the EXT DUR position, and the PERIOD control in the EXT TRIG OR MAN position. The period and duration of the output waveform are now controlled by the triggering waveform. This is an extremely useful mode of operation for translating logic levels, etc. If the PERIOD is set for internal operation and the DURATION for external, the CONTROL ERROR light illuminates indicating an illegal mode of operation.

The TRIG'D/GATED indicator light functions as a TRIG/GATE level indicator. When the +SLOPE is selected and the external input level exceeds the threshold set by the TRIG/GATE LEVEL control, the light is on continuously. For input voltages below the threshold the light is continuously off. When the input transits through the threshold the light flashes. When the -SLOPE is selected the light behaves as for +SLOPE selection. However, the polarities are reversed.

The TRIG'D/GATED indicator light may be used as a logic level indicator for troubleshooting logic circuitry. Set the TRIG/GATE LEVEL control to a voltage equal to the midrange value of the logic voltage swing. If an attenuator probe is used for signal pickup, remember to consider the attenuation factor when setting the TRIG/GATE LEVEL voltage.

Trigger Output

The signal appearing at the connector is an approximate square wave. The leading edge (positive-going) precedes the output pulse by a specified fixed delay plus the delay as set by the DELAY control. In paired pulse operation, the leading edge precedes the first pulse by the fixed delay. The second pulse then appears after the delay as set by the DELAY control. In paired pulse operation, the leading edge) is also available at the front panel by moving a connector on the timing circuit board. See the illustration on the Rear Interface Connector Assignments at the rear of this manual for the location of this connector.

Manual Trigger

To use this feature place the PERIOD switch in the EXT TRIG OR MAN position. Set the TRIG/GATE LEVEL control fully clockwise. If the +SLOPE is selected, the manual trigger will occur when the MAN button is depressed. If the -SLOPE is selected, the trigger occurs when the button is released. The manual trigger causes one output pulse, or a set of paired pulses if the DELAY and UNDLY buttons are depressed.

Control Error Light

The CONTROL ERROR light helps to solve setup problems by indicating most control errors. A steady glow indicates static control setting errors while a flashing light indicates dynamic errors. In either case, the control settings do not correctly indicate the output. Check the control settings for compatibility. See Table 1-1. Dynamic functions monitored are period, delay, duration and t transition time.

OPERATING CONSIDERATIONS

Output Termination's and Connections

The PG 508 operates as a voltage source in series with an internal 50 n(impedance. Maximum pulse fidelity is obtained when the output operates into an external 50 n impedance. The output circuitry of the PG 508 is fully protected against any voltage transients when operating into passive loads.

EXT DUR and DELAY No delay

Listed below are static control settings that illuminate the CONTROL ERROR light and their corresponding operating modes. Some of these modes may be useful.

If the load has a dc voltage across it, connect a blocking capacitor in series with the OUTPUT connector and the load. Make certain the time constant of the capacitor and load is large enough to maintain pulse top flatness.

Control Settings	Operation
EXT TRIG OR MAN and SYNC GATE	External Trigger Mode
EXT DUR and Internal Period	Square Wave Mode
EXT TRIG OR MAN and SO WAVE (INT PERIOD)	External Duration Mode
SO WAVE (INT PERIOD) and SYNC GATE	Truncated square wave when gate ends
SO WAVE (INT PERIOD) and DELAY	No delay

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 508, 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 systems, determine the actual risetime of the device under test by using the following formula:

$R, = \sqrt{R_{21} + R_2^2 + R2\ 3\ .....}$

R, equals the overall rise or falltime of the entire measurement system and R1, R2, R3, etc., are the risetimes or falltimes of the individual components comprising the system.

External Voltage Control

The high and low level output voltages can be controlled externally through pins 22B and A at the rear interface connector. Fig. 1-4 shows the equivalent circuit.

Connections must be made from pad K to pad L and pad M to pad N located as shown on the adjustment location illustration in the fold out pages at the rear of this manual. Use ordinary hookup wire of the proper length. Solder the wire to the pads. Also note the location of the Ext Hi and Ext Lo potentiometers on the output board.

To use this feature, set the front panel controls as follows: depress the PRESET button (PRESET), place the PERIOD switch in the EXT TRIG OR MAN position, the DURATION in EXT DUR and the NORM COMPLEMENT switch in the NORM position (out). Use a screwdriver to center the Ext Hi and the preset HIGH LEVEL controls. Supply a voltage to the external high input (pin 22B on the rear interface connector) equal to the lowest external input voltage desired (maximum 20 V).

Now adjust the front panel preset HIGH LEVEL control for an OUTPUT voltage equal to the minimum desired output voltage. It may be necessary to adjust the preset LOW LEVEL control as the OUTPUT voltage is limited to 20 V peak to peak open circuit. The high level OUTPUT voltage is clamped by the low level OUTPUT voltage if this range is exceeded. Now apply a voltage equal to the highest external control voltage desired to the same rear interface connector (pin 22B). Adjust the Ext Hi potentiometer until the highest desired output voltage is obtained. It may be necessary to adjust the preset LOW LEVEL control to obtain the desired output. The high level OUTPUT voltage cannot go below the low level OUTPUT voltage due to the level control voltage clamps. The Ext Hi and the preset HIGH LEVEL controls interact. It may be necessary to repeat the above procedure several times until the desired results are obtained.

Now push the NORM COMPLEMENT switch (COMPLEMENT). Center the Ext Lo and preset LOW LEVEL potentiometers. Supply a voltage to pin 22A of the rear interface connector equal to the lowest external control voltage desired. Adjust the preset LOW LEVEL control for an OUTPUT voltage equal to the lowest OUTPUT voltage desired. Change this voltage to the highest desired external control voltage. Adjust the Ext Lo potentiometer for the highest OUTPUT voltage desired. As these adjustments interact, readjust the preset LOW LEVEL and the Ext Lo potentiometers for the desired results. Do not readjust the preset HIGH LEVEL or the Ext Hi potentiometers. The OUTPUT voltages now vary linearly and independently with the external control voltage.

Counted Burst Using the DD 501 Digital Delay Unit

This application permits pre-selecting the number of output pulses from the PG 508. The event is initiated by an externally applied signal or pulse, 5 ns or longer. The time duration of this signal or pulse has no effect on the output from the PG 508.

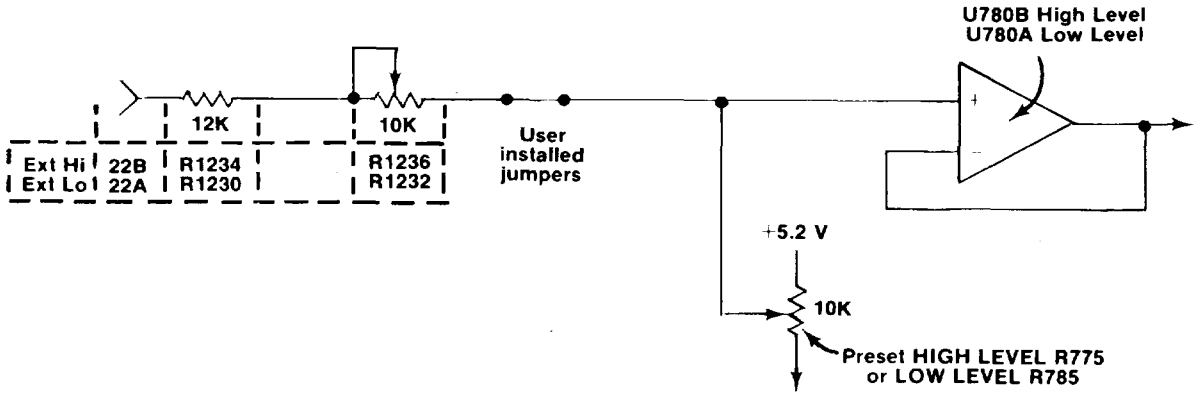


Fig . 1-4 . Equivalent circuit of external input for output voltage control .

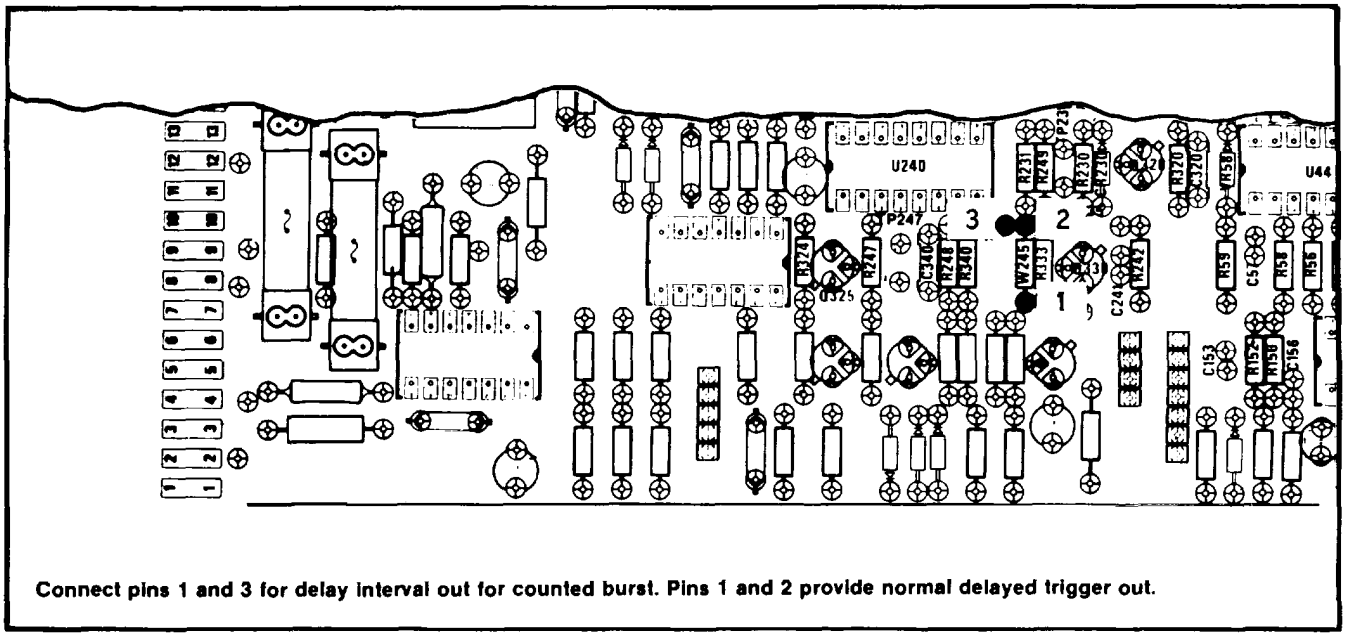


Fig . 1-5 . Location of trigger jumpers In DD 501 for selecting trigger or delay Interval output .

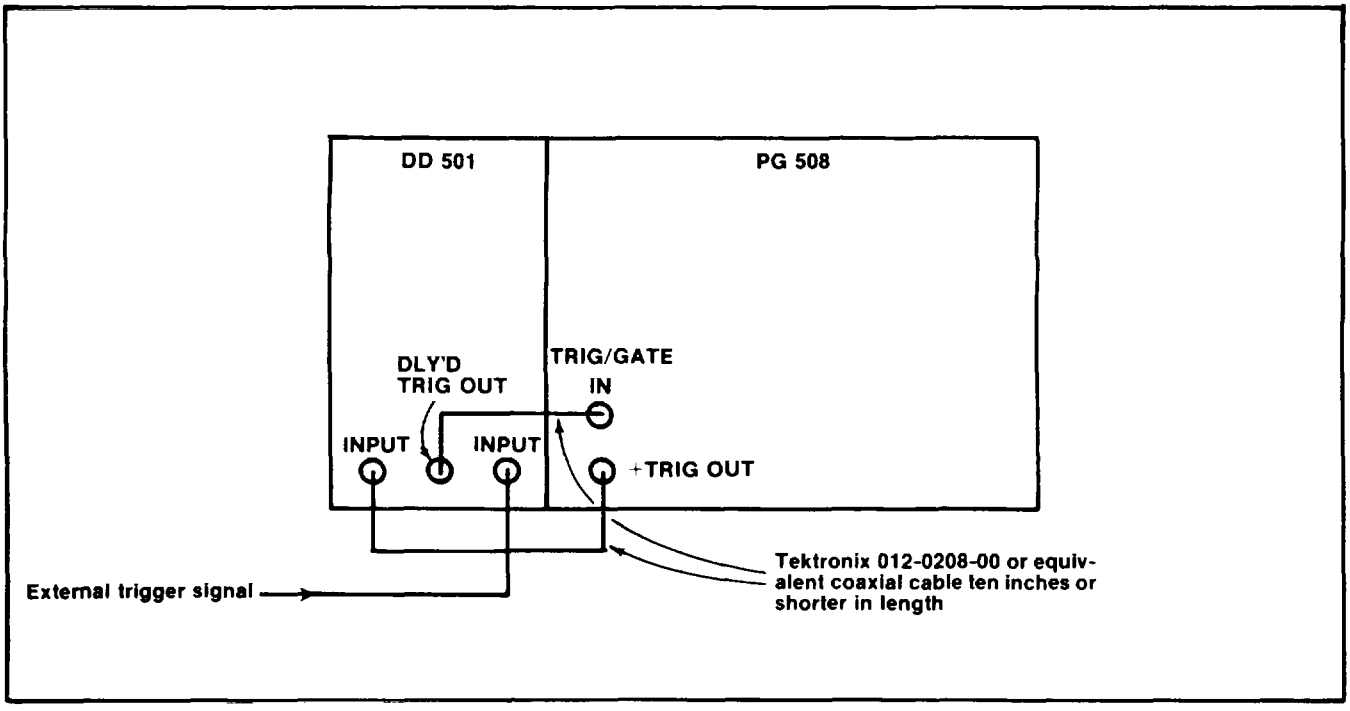


Fig . 1-6 . PG 508-DD 501 Interconnections for counted burnt operation .

To use this feature, place the DD 501 in the delay interval mode of operation by moving the wire strap as shown in Fig. 1-5 or changing connections, depending on the DD 501 available. Connect the PG 508 and the DD 501 as shown in Fig. 1-6. Use ten inch (Tektronix Part Number 012-0208-00) or shorter cables for interconnecting the two units to reduce delays.

Make certain the PG 508 TRIG/GATE IN input impedance is set for 50 n. (See External Triggering and Gating discussion and Fig. 1-2.) Set the controls of the PG 508 for the desired output waveform with the PG 508 in FREE RUN. Do not use the SQ WAVE mode. Place the PG 508 in the + SLOPE, SYNC GATE mode and set the TRIG/GATE LEVEL control at the 2 o'clock position. Select EVENTS + SLOPE, START + SLOPE and place the EVENTS and START LEVEL controls at the 2 o'clock position on the DD 501. The three TRIG'D lights on the DD 501 and the TRIG'D/GATED light on the PG 508 will be off until the DD 501 is triggered. Upon receipt of a trigger, all lights will illuminate. If not, check the setup and slightly adjust the LEVEL controls as necessary.

Set the EVENTS DELAY COUNT on the DD 501 for one less than the desired number of counts up to PG 508 repetition rates of about 20 MHz. See below for further information. If necessary, a single trigger may be obtained by rotating the DD 501 START LEVEL control through the 0 position, with no external trigger applied. A single trigger may also be obtained by using the TEKTRONIX manual (One Shot) Trigger Generator, Tektronix Part Number 016-0597-00. All other DD 501 and PG 508 operating controls function normally.

Due to propagation delays in the PG 508, DD 501 and the interconnecting cables, one or more pulses in addition to the desired number are generated when the PG 508 repetition rates are set between 20 MHz and 50 MHz. These extra pulses are consistent for any given frequency irrespective of the desired EVENTS DELAY COUNT setting. To determine the number of extra pulses for a given PG 508 period, set the PG 508 and the DD 501 controls as previously described. Now adjust the PG 508 TRIG/GATE LEVEL or the DD 501 EVENTS LEVEL for the same number of extra pulses at DD 501 EVENTS DELAY COUNT setting of zero and nine.

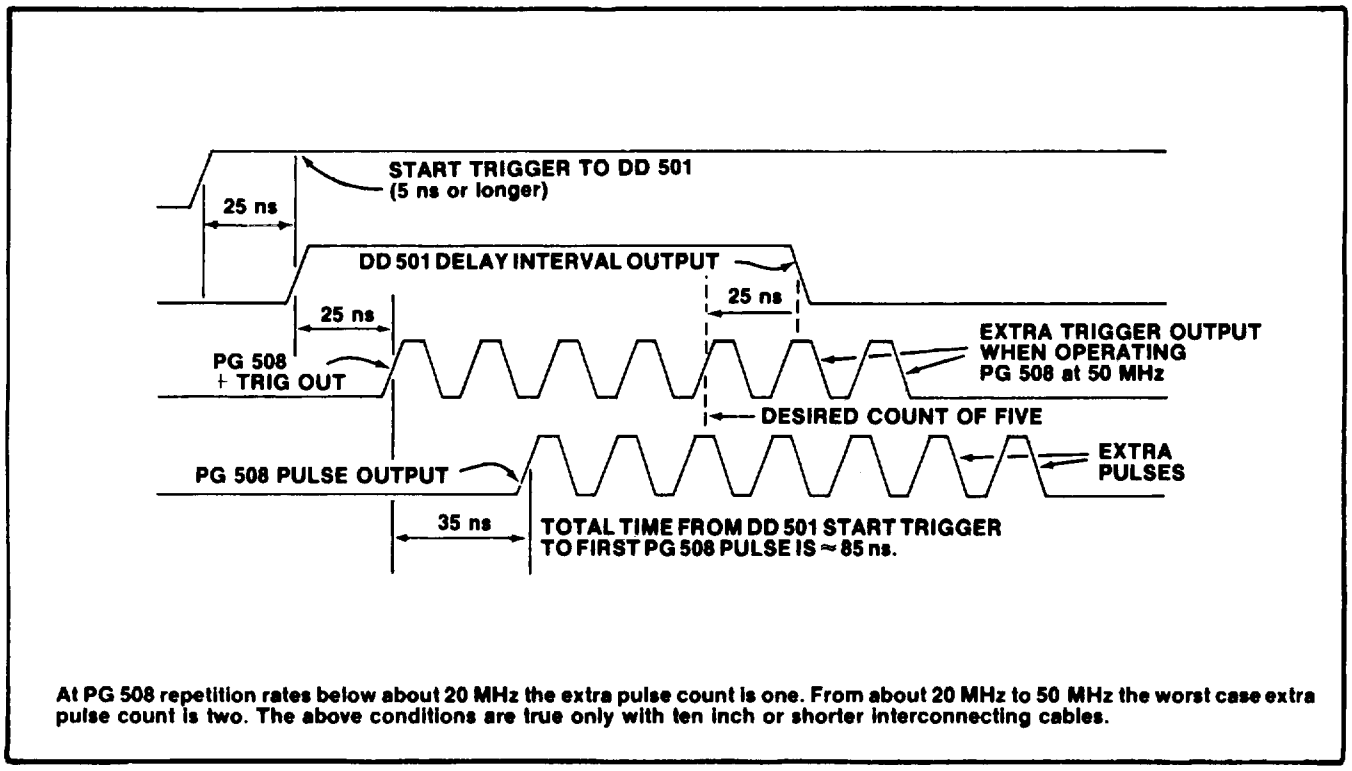


Fig . 1-7 . Typical propagation delays using PO 508 with DD 501 In counted burst mode at 50 MHz repetition rate .

Definitions of Pulse Characteristics The following is a glossary of common pulse characteristics used in this manual. They are illustrated in Fig. 1-8.

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

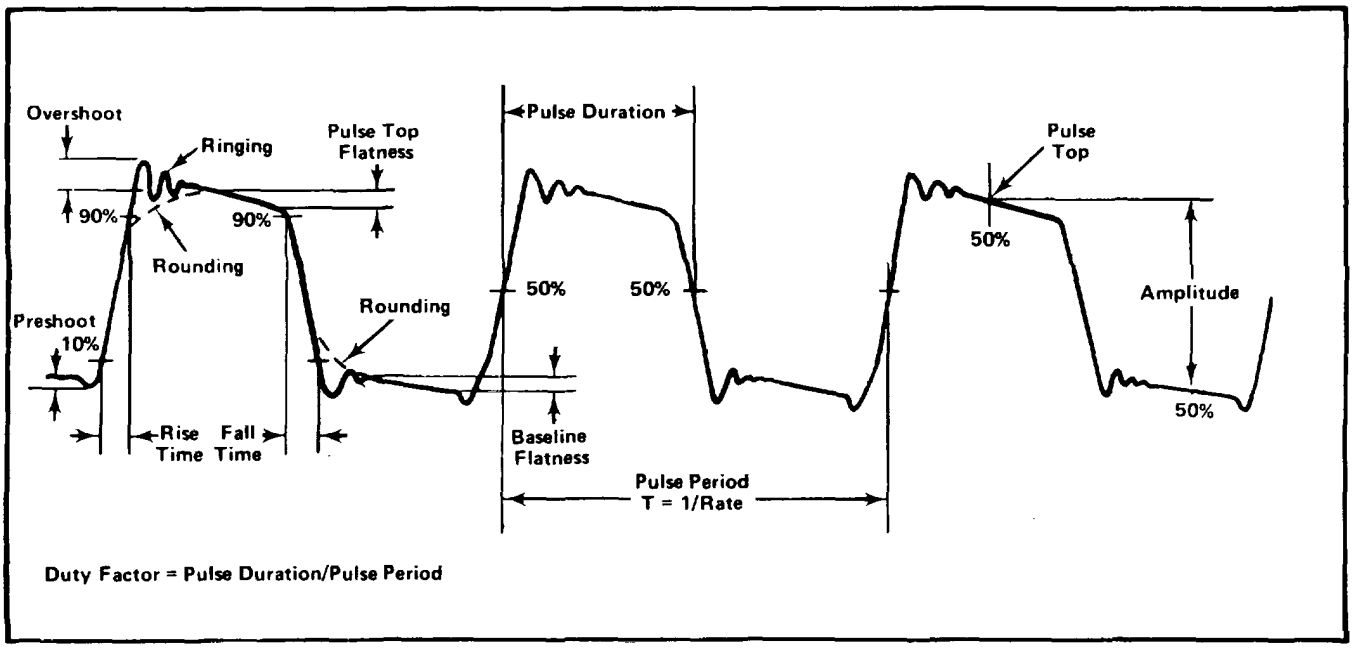


Fig . 1-8 . Pulse characteristics .

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

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

Ringing. Periodic aberrations that dampen in time, following the overshoot.

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

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

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

SPECIFICATIONS

PERIOD:

Range: <20 ns to >200 ms in seven decade steps plus variable, with overlap on all ranges. Periods longer than 200 ms can be obtained in custom range position.

Jitter: <0.1% +50 ps.

DELAY: (Time between leading transitions in the paired pulse mode)

Range- <10 ns to >100 ms in seven decade steps plus variable, with overlap on all ranges. Delays longer than 100 ms can be obtained in custom range position.

Factor: Delays to at least 70% of pulse periods for periods of 0.2ps to 20 ms, decreasing to at least 50% for a 20 ns period.

Jitter: <0.1% to +50 ps.

DURATION

Range <10 ns to >100 ms in seven decade steps plus variable, with overlap on all ranges. Durations longer than 100 ms can be obtained in custom range position. An additional position provides durations of approximately 50% of the period setting for square wave output.

Duty Factor: Pulse durations to at least 70% of pulse periods for periods of 0.2ps to 0 ms, decreasing to at least 50% for a 20 ns period.

Jitter: <0.1% +50 ps.

PULSE OUTPUT:

Transition Times: Independently adjustable leading and trailing transition times from <5 ns typical (<7 ns at some offset and amplitude levels) to >50 ms, measured from the 10% point to the 90% point, in six decade steps plus variable. Variable controls with 100:1 range (50:1 on 5 ns) provide overlap on all ranges. Transition times longer than 50 ms are obtainable in the custom range position.

Transition Linearity: Deviation from straight line <5% between the 10% and 90% point for transition times greater than 10 ns.

Amplitude. Pulse high and low levels independently adjustable over a ±20 V range from a 50 n low reactance source. Maximum pulse amplitude into a 50 n load is >10.V peak to peak; minimum is <0.5 V peak to peak. Maximum pulse amplitude into an open circuit is >20 V peak to peak; minimum is <1.0 V peak to peak. The preset level controls are adjustable over the same ranges.

Aberrations: <5%, +50 mV into a 50 (n load for pulse levels between ±5 V. May increase to <10%, +50 mV for pulse levels outside this range.

TRIGGER OUTPUT:

Amplitude: >+2 V from 50 n.

Source Impedance: 50 .Ω

Duty Cycle:
Internal Triggering -50%.

External Triggering Determined by duty cycle of triggering signal.

TRIGGER/GATE INPUT:
Sensitivity: 80 mV peak to peak to >10 MHz; 250 mV peak to peak to 50 MHz at 50 n input impedance.

Input Impedance: Internally selected, 50 n or 1 Mn paralleled by -20 pF.

Maximum Input: ±5 V peak into 50 n, ±20 V peak into 1 Mi.

Minimum Input Pulse Width: 10 ns.

Trigger Level:
Polarity: Front panel selectable, + or -slope.

Range: ±3 V.

TRIG'D GATED LIGHT:

Flashing: Input triggered at greater than approximately a 10 Hz repetition rate or following the input signal at slower repetition rates.

On: (Logic True) TRIG/GATE IN input potential above TRIG/GATE LEVEL setting with + SLOPE selected or below TRIG/GATE LEVEL setting with - SLOPE selected.

Off: (Logic False) TRIG/GATE IN input potential below TRIG/GATE LEVEL with + SLOPE selected or above TRIG/GATE LEVEL with - SLOPE selected.

Synchronous Gate: Rate generator starts synchronously with external gating signal and completes the last output pulse.

PULSE DELAY MODES:

Undelayed, delayed and paired. Paired pulse mode limited to 25 MHz. Minimum pulse separation governed by duration duty factor specification.

FIXED DELAYS:
Trigger Out to Pulse Out: -23 ns.

Gate Input to Trigger Out: -25 ns.

CONTROL ERROR LIGHT:
Steady On: Indicates invalid operating mode. Output is undefined.

Flashing: Timing control settings selected do not properly define the output pulse because valid limits have been exceeded.

Steady Off: Indicates valid operation for most control settings.

POWER REQUIREMENT:
Nominal: 40 Watts

Maximum: 45 Watts

POWER DISSIPATION:
Nominal: 25 Watts

Maximum: 28 Watts

WEIGHT: 3.5 lbs.

Environmental Requirements. The following paragraphs describe the environmental operating conditions for the pulse generator.

The pulse generator can be operated where the ambient temperature is in the range of 0° to +50^{0C,} and can be stored where the temperature range is -40° to +750 C. After storage at temperatures outside of the operating range, allow the chassis temperature to stabilize within the operating limits before applying power.

Components that require the most cooling are provided with individual heatsinks. Clearance must be provided on all sides for air flow. Do not block or restrict air flow through any holes in the cabinet by placing objects on or against the pulse generator.

Two thermal cutouts in the pulse generator provide protection by interrupting power to the unit if the internal temperature exceeds a safe operating level. Power is automatically restored when the temperature returns to a safe level. Operation in confined areas or near heat-producing equipment may cause the thermal cutouts to actuate.

The normal operating position of the pulse generator is horizontal, setting on a flat surface, on the four feet provided on the bottom surface, or with the front bail extended, lifting the front panel for ease in reading or adjusting controls. However, under difficult operating conditions (such as limited space), the pulse generator may be used in other positions without impairment of the electrical characteristics, including setting the cabinet on the four protective bumpers on the rear surface or left side. It is important to remember that, in positions other than normal horizontal position, characteristics such as cooling and resistance to shock and vibration are altered, therefore, operation in other than the normal position should be for short periods only and with more than normal care exercised to protect the pulse generator from damage.

Power Requirements. The pulse generator is designed to be operated from either a 115-volt nominal or 230-volt nominal line voltage source. In addition, one of three operating ranges may be selected around each nominal voltage. The voltage selector jumper in the power module allows selection of the operating voltage.

Space Requirements. The pulse generator is provided with feet on the bottom surface to provide space for cooling air flow, as well as the front bail. Maintain this clearance by always using the front bail or setting all four feet solidly on a flat surface. In addition, always maintain at least two inches of clearance at both sides, top, and rear of the unit.

Using the Rear Interface Connectors

See the accompanying chart for rear interface connector assignments For other functions not detailed here the small auxiliary board (E) has numerous connectors available Use the connections to make custom inputs or outputs to the PG 508 through the Power Module

Amplitude Monitor

These pins (25A) are connected to the OUTPUT terminal through a 27 k resistor and ground (26A) To use this function place the PERIOD control in the EXT TRIG OR MAN position and connect an accurate voltmeter to these terminals Now adjust the TRIG/GATE LEVEL control cw for the high steady state output voltage and ccw for the low steady state output voltage In this manner the output pulse amplitude levels may be precisely monitored.

External Level Control Inputs

See the discussion under the heading External Voltage Control in Section 1 of this manual for use of these terminals

Trig/Gate Input

These assignments provide rear interface input capabilities for the front panel TRIG/GATE IN input. The signal lead (24B) must be user installed but the ground (25B) Is factory wired To make the proper connections remove the cable extending from the TRIG/GATE IN connector to the input board by pulling the end from the socket on the board Install a twelve inch cable with the proper connectors, Tektronix Part No 175-1827-00, from the connector on the input circuit board labeled Trig/Gate In to the other connector on the output board labeled Trig/Gate In as shown in the illustration.

Trigger Output

The hot or signal lead (28B) must be user installed while the ground (27B) is factory wired To route this function through the rear interface connector remove the plug on the timing circuit board connected to the cable from the - TRIG OUT front panel connector This plug is shown on the illustration and is labeled Trig Out. Connect a six inch cable with the proper connectors, Tektronix Part No. 175-1824-00, from the connector labeled Trig Out in the illustration to the connector on the output board labeled - Trig Out in the illustration To obtain the complement trigger out signal connect the coaxial cable to the connector labeled Trig Comp in the illustration. The normal trigger output may be used simultaneously with the complement, through the rear connector, without disturbing the operation of either Figure 9. Locations for user installed rear interface connections.

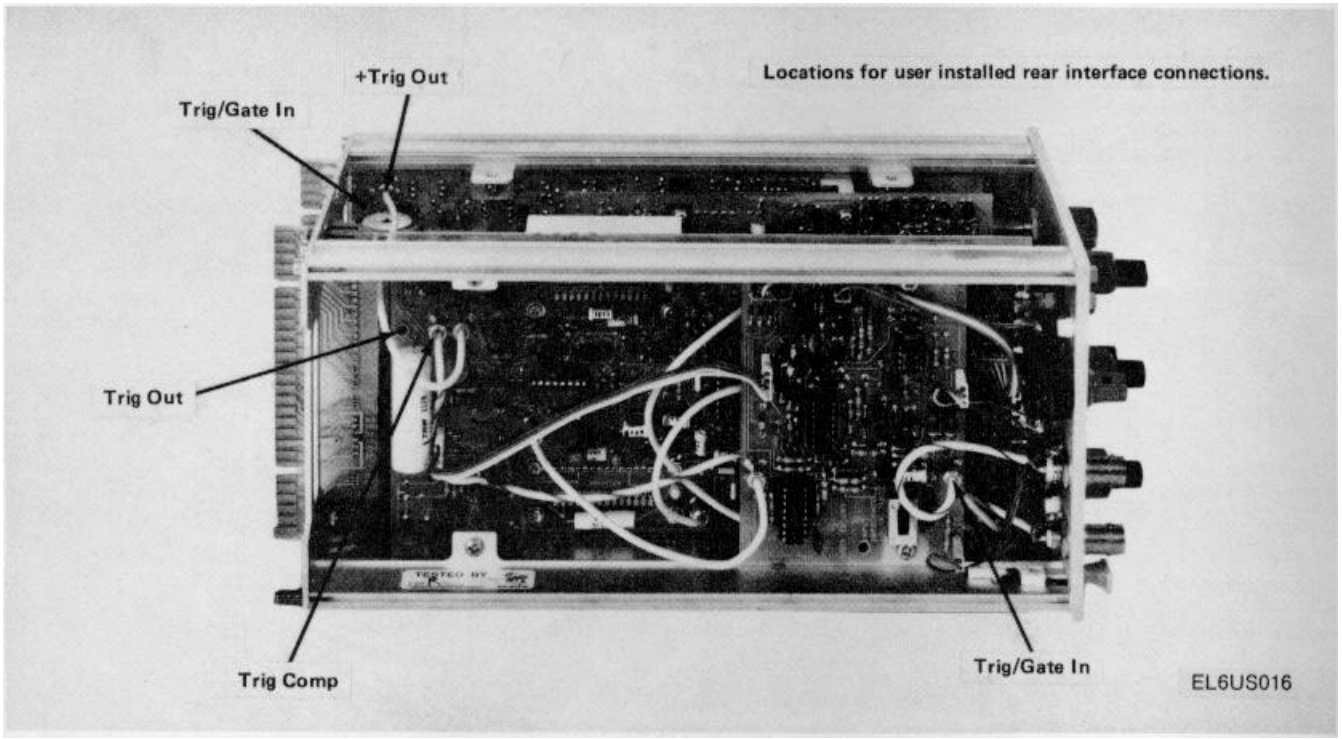


Figure 9 . Locations for user installed rear interface connections .

REAR INTERFACE CONNECTOR ASSIGNMENTS

Remarks	Recommended Loads	Output or Input	Pin B		Pin A	Output or Input	Recommended Loads	Remarks
Factory Wired		Trigger Out Common	28		28			
Factory Wired	50 Ω	Trigger Out	27		27			
			26		26	Amplitude Monitor Ground		Factory Wired
Factory Wired		Trig/Gate Input Common	25	Barrier Slot	25	Amplitude Monitor	>1 MΩ	Factory Wired
User installed		Trig/Gate Input	24		24			
			23		23			
Factory Wired		External High Level Control Input	22		22	External Low Level Control Input		Factory Wired
			21		21			
			20		20			
			19		19			
			18		18			
			17		17			
			16		16			
			15		15			
			14		14			
		25 V ac winding	*13		*13	25 V ac 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	10		**10	Emitter lead of pnp series-pass		
		±33.5 V common return	*9	TM 500 Barrier Slot	*9	±33.5 V common return		
		−33.5 V filtered dc	*8		*8	−33.5 V common return		
		Collector lead of npn series-pass	**7		**7	Emitter lead of npn series-pass		
		No connection	6		**6	Base lead of npn series-pass		
		17.5 V ac winding	*5		*5	17.6 V ac 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 V ac winding	*1		*1	25 V ac winding		
			B		A			

Rear View of plug-in

Assignments listed for pin 1A - 13A and 1B - 13B are available in all power modules; however only those pins marked with an asterisk (*) are used by the PG 508. Those connections marked with a double asterisk (**) are the only connections used on the E board.

THEORY OF OPERATION

Introduction

Refer to the block diagram and the schematics in the foldout pages at the rear of this manual as well as the following discussion to understand the operation of the PG 508.

Input Circuitry

This circuitry processes the external trigger or gating signal providing triggering waveforms for the period circuit. The 50 n input impedance for this circuitry is provided by R12, switched in or out by internal switch S12. When R12 is out of the circuit, the input impedance is 1 M n, obtained by R14 and R16. Diodes CR16and CR17 are protective diodes. The proper voltage at the drain of Q20 is set by VR20. The source voltage of Q20 is set by VR22. Impedance transformation, with no voltage shift, is obtained by source follower Q20. Constant current for 020 is supplied by Q22. A differential comparator is formed by Q25 and Q26. This comparator compares the trigger or gate input level with the level set by the front panel TRIG/GATE control. Constant current for this comparator is provided by Q30. Level control voltage for the differential comparator is provided by operational amplifier U40. The output, pin 6, swings over a range of f3 V. The voltage at TP36 is the triggering level voltage, as set by the TRIG/GATE LEVEL control. If the triggering or gating voltage at the base of 025 is more positive that TP36, then Q26 is conducting and 025 is off. This places the collector of Q26 more positive than the collector of Q25. When the gating or triggering waveform level drops below TP36, Q25 conducts and Q26 turns off.

This switching waveform is applied to the bases of U60A and U60B, operating as a differential pair. The collector of U60A drives U60C in a cascade mode of operation. The collector of U60C drives the base of U60D which, as an emitter follower, drives the input of U70B. This gate operates as a dual input Schmitt trigger shaper. When the emitter of U60D goes to about 4.2 V above ground, pin 7 of U70B goes high. When the emitter of U60D drops to about 3.8 V, pin 7 of U70B drops to its low level. The inverting output terminal, pin 6, is always in the opposite state from pin 7. Positive feedback for this portion of the Schmitt is provided by R72. If the unit is manually triggered, pin 10 of U70B is momentarily connected to +5 V. Pin 10 of U70B, along with R75 and R76 now acts as a Schmitt shaper for the manual trigger. This action holds the output, pin 7, high and the inverting output, pin 6, low as long as the MAN button is depressed.

When the plus slope is selected for triggering or gating, +5 V is applied to pin 4 of U70A. This gate is now inhibited and the signal passes through U70C. As the outputs of U70A and C are connected together, a high on either output overrides the low. Pin 13 of U70C is low as long as the anodes of CR82 and CR84 are low, which occurs when the logic circuitry has enabled the input circuitry. When the control logic is set to disable the input circuitry, the anodes of these diodes are raised to +5 V which disables gates U70A and U70C.

Pin 12 of U70C now shifts between the high and low state corresponding with the input gate or trigger. The output from U70C, pin 14, is passed to the period circuitry. A high at the output of U70C turns the period circuitry off and a low starts the period generator.

TRIG'D/GATED Light Circuitry

Transistors Q100, 0102, 0110 and their associated components compose the circuitry that operates the front panel TRIG'D/GATE light emitting diode. The pair Q100 and Q102 form a modified a stable multivibrator, while Q110 operates as a voltage source. When the output of U70A or U70C is high (period generator off) or the logic circuitry has inhibited the input circuitry, the base of 0Q100 is high. This causes the base of Q102 to be low through R106. The collector of Q102 is now high and the light emitting diode is off. When the base of Q100 goes low, the base of Q102 goes high, the collector goes low and the light emitting diode illuminates. The light emitting diode circuitry follows the triggering gate up to about a 5 Hz rate, i.e., about 100 ms on and 100 ms off. At faster gating frequencies, C106 inhibits the changing states of this circuitry at about the 5 Hz rate.

Triggered Mode

In the triggered mode of operation S200-2 is closed. This places a high on pin 10 of U140B locking pin 7 high and pin 6 low irrespective of the level on pin 11. This disables the period generator. Pin 15 of U140C now follows pin 4 of U140A in coincidence with the input triggering signal. Pin 14 of U140C drives Q244 and pin 15 drives Q240. The output from the collector of 0240 is in phase with the trigger or gate input signal providing the trigger output, and the phase of the waveform at the collector of Q244 is inverted.

Period Generator

This circuitry generates the internal period timing waveform. In this mode, U140B operates as an a stable multivibrator. When either input of U140B is high, pin 7 is high and pin 6 is low. The switched timing capacitances are connected from pin 7 to pin 11. These capacitors are switched by the period range switch. The period variable control, R190, varies the resistance in the negative feedback loop.

To start the period cycle, assume pin 7 of U140B goes high and pin 6 low. This positive step, at pin 7, is coupled through the period timing capacitor to pin 11. As the timing capacitor discharges through the resistances connected from pin 11 to pin 6, the voltage at pin 11 decays at a rate determined by the timing capacitor and these resistances. When the switching level (approximately 4 V) is reached, pin 7 goes low and pin 6 goes high. The negative step, at pin 7, is coupled through the timing capacitor, and appears at pin 11. The capacitor now charges through the resistances until the switching level is reached, and the period cycle repeats The symmetry adjustment compensates for the bias current through pin 11.

When the PERIOD switch is in any position other than EXT TRIG (MAN), switch S200-2 is opened. This lowers pin 10 of U140B and permits the period generator to operate during the external gate on time. During the time of the external gating signal pins 4 and 2 of U 140A are low. Pin 3 is high. As transistors Q150 and Q160 form a comparator, with their bases connected to pins 3 and 1 of U140A respectively, the collector of 0150 is low causing the emitter of Q175 to be low, as well as pin 11 of U140B. This allows the period generator to operate. During the gated off time this action reverses. Pin 11 of U140B rises and inhibits the period generator.

Resistor R170 and R165 adjust the lock up voltage at pin 11 of U140B so that, at turn on, the first period generated is identical in time with subsequent periods. Resistor R 165 is switched into the circuit only on the 20 ns range. Components R177 and C177 form a time constant to help compensate for first period error.

Delay Generator

This circuitry provides the delay for delayed or paired pulse operation. As the signal from the period generator of the external trigger input goes from high to low at pin 7 of U270B, pin 3 goes high. This causes pin 5 of U270A to go high and pin 2 low. Pin 13 of U270D and pin 9 of U300B go low. Pin 15 of U270D goes high but pin 10 of U300B does not follow until about 10 ns later, due to the delaying action of R275 and C275. When pin 9 of U300B goes low pin 6 goes high, assuming pin 11 is already low Pin 6 stays high until pin 10 goes high as described above. This action provides the delay generator with about a 10 ns trigger pulse under all input conditions

The positive-going trigger pulse, at pin 5 of U300A, causes pin 3 to go low and pin 2 high. Positive feedback through R300 and C300 causes pin 4 to go high. The low at the base of 0320 turns 0320 off. The emitter of Q320 goes negative at a rate determined by the timing capacitor and current source 0342, with its variable emitter resistances. As the emitter of 0320 goes negative, it pulls the base of 0294 negative which lowers pin 4 of U300A. When pin 4 reaches the switching threshold (=4.0 V) pin 2 goes low and pin 3 high. The timing capacitor is now discharged through 0320. The monostable delay generator is now reset for the next trigger pulse. Transistor Q290 provides a constant load for the power supplies irrespective of the current flowing through Q294.

Components R304, R306 and C304 provide a delay line for the CONTROL ERROR light. The output from the delay generator is connected to pin 13 of U300C. Pin 15 of U300C is high during the delay time and pin 14 low. Gates U360B and D provide a positive-going trigger at pin 15 of U360D when the delay time ends. Gates U360A and C provide a positive-going trigger at pin 14 when the delay time starts. As the delay time starts, pin 4 of U360A goes low as does pin 11 of U360C. Pin 10 of U360C is low as the anode of CR378 is grounded through the UNDLY switch. The low at pin 11 of U360C allows pin 14 to go high Pin 14 stays high until the propagation time through gate U360A and the delaying action of R364 and C366 allow the high generated in U360A, from pin 2, to reset U360C through pin 10. This causes pin 14 to return to its low state. The width of the output trigger pulse is about 6 ns.

To obtain the delayed trigger, the anode of CR378 is connected to +5 V disabling gate U360C. The anode of CR382 is grounded through the DLY switch. Gates U360B and U360D now operate in exactly the same manner as U360A and C A positive trigger pulse appears on pin 15 of U360D when the delay time ends (pin 6 of U360B goes from high to low). In the paired pulse mode both gates operate. Gate U360C provides a positive-going trigger at the start of the delay time and U360D a positive trigger at the end of the delay time.

Duration Generator

This circuitry generates the duration times. Gate U400B accepts the delayed or undelayed positive triggers from the delay generator. The result is a positive-going pulse at pin 5 or U400A. This triggers the duration generator which operates in the same manner as the delay generator. Refer to the discussion under the heading Delay Generator for a description of the duration generator operation. Gate U400C is an output buffer Pin

12 goes high during the pulse duration time and if pin 13 is low, pin 15 goes high and pin 14 low. Pin 13 controls U400C in the square wave and external duration modes.

Duration and Delay Control Error Light Circuitry

This circuitry illuminates the CONTROL ERROR light when the duration or delay times are greater than the periods of their respective triggers. The positive pulse from the duration generator is fed into the D input, pin 10, of U480A. The clock enable line is low. If the duration time is set so that a trigger pulse (connected to the clock in) for the next duration pulse occurs before the output of the duration generator goes low, the high on the D input, pin 10 of U480A, is transferred to the output, pin 1. This high is connected to the set input, pin 5, of U480B which causes the output, pin 2, of U480B to go high illuminating the error light. When the output, pin 2, of U480B goes high, the inputs to U480A and B are disabled through the clock enable line preventing further trigger inputs until both flip flops are reset. When the output, pin 2, of U480B goes and stays high, C487 starts to charge to the voltage on pin 2, through R490. This takes approximately 100 ms. When the reset inputs to U480A and B, pins 13 and 4, reach the high level (about 4.0 V) U480A and B are reset and C487 discharges through R490. When these reset inputs return to the low level both flip flops are ready to accept triggers and the error cycle is ready to repeat. If the delay time is set for a time greater than the period of the delay triggers, the high on pin 7 of U480B transfers to pin 2 directly, and the light is illuminated Reset takes place in the same manner as described above. Also connected to this circuitry is a line from the transition time board which also lights the CONTROL ERROR light.

The CONTROL ERROR light is also illuminated for certain improper control settings. Fig. 2-1 shows a simplified schematic for the CONTROL ERROR indicator logic and control settings causing illumination.

Variable Transition Time Circuitry

This circuitry controls the output transition times. Resistors R534 and R536 provide equivalent 50 n termination impedance for the normal (positive-going) input from the duration generator. Also, R520 and R522 provide an identical termination impedance for the complement input (negative-going) from the duration generator. These inputs drive the bases of 0525 and 0530. When the input from the duration generator is high and the complement is low, the collector of 0530 drops from ground to about -1/2 V. This turns Q565 on and Q560 off. The adjustable constant current through 0545, to +15 V, is now passed through R578, from the -15 V supply. Transistor Q560 is turned off as its base is connected to ground Zener diodes VR620 and VR630 0635 and then through 0630to charge the particular capacitor determined by the transition time selected. As the capacitor charges through a constant current source, the junction of CR584 and CR600 goes negative at a linear rate until the diode CR600 turns on. This diode serves as the negative clamp. The voltage at the anode of CR600 is set by R615 through Q608 and 0600 The voltage at the junction of CR584 and CR600 remains low for the pulse duration.

lower the voltage from the bases of 0565 and Q560 to the bases of 0625 and Q630 by about 7.5 V. Transistor Q625 is therefore off and Q630 is conducting. Current flows from -15 V through an adjustable current source

At the end of the pulse duration time, the collector of 0530 goes positive. This action turns 0565 off and Q560 on. Current from the +15 V supply flows through constant current source 0545, then through 0560 raising the1 junction of CR584 and CR600 at a linear rate determined by the capacitor value and the current available. The junction of CR584 and CR600 goes positive until CR584 turns on. The voltage at the cathode of CR584 is set by R570 through Q575 and 0580. Transistor 0625 is turned on, and Q630 off, passing current from constant current source 0635 through 0625, CR604, and R604 to ground. The leading and trailing transition times are varied independently by varying the amount of current passing through constant current source transistors 0635 and 0545.

The output waveform at the junction of CR584 and CR600 passes to the gate of fet 0680. This fet serves as a source follower for driving 0685 and Q690. These transistors compose a linear differential amplifier. The clamp levels for diodes CR584 and CR600 are set so that Q685 and 0690 are slightly overdriven. This serves to remove any ringing or other signal irregularities at the top and bottom of the waveform. Operational amplifier U665 provides, along with 0660, constant current for 0685 and Q690.

Transition Time Control Error Light Circuitry

This circuitry illuminates the control error light when the leading transition time is greater than the pulse1 duration time, or when the trailing transition time is greater than the pulse off time. The inverted signal from the leading and trailing generator appears at the base of 0704 through fet follower 0700. A differential amplifier is formed by 0704 and 0706. The output is taken from the collector of Q706. Transistors 0704 and 0706 are over-driven to reduce the window of comparison. During the pulse on time, the base of 0704 is negative with respect to ground. This action causes the collector of 0706 to also go negative, driving the base of Q715, an emitter follower negative. The emitter of Q715 is connected to pins 7 and 10, the D input of flip flops U720A and B.

The waveforms driving the transition time circuitry are also applied to gates U740A and B. Pin 6 of U740B is high during pulse time while pin 4 of U740A is low. The purpose of the four gates in U740 is to delay the signal ap-

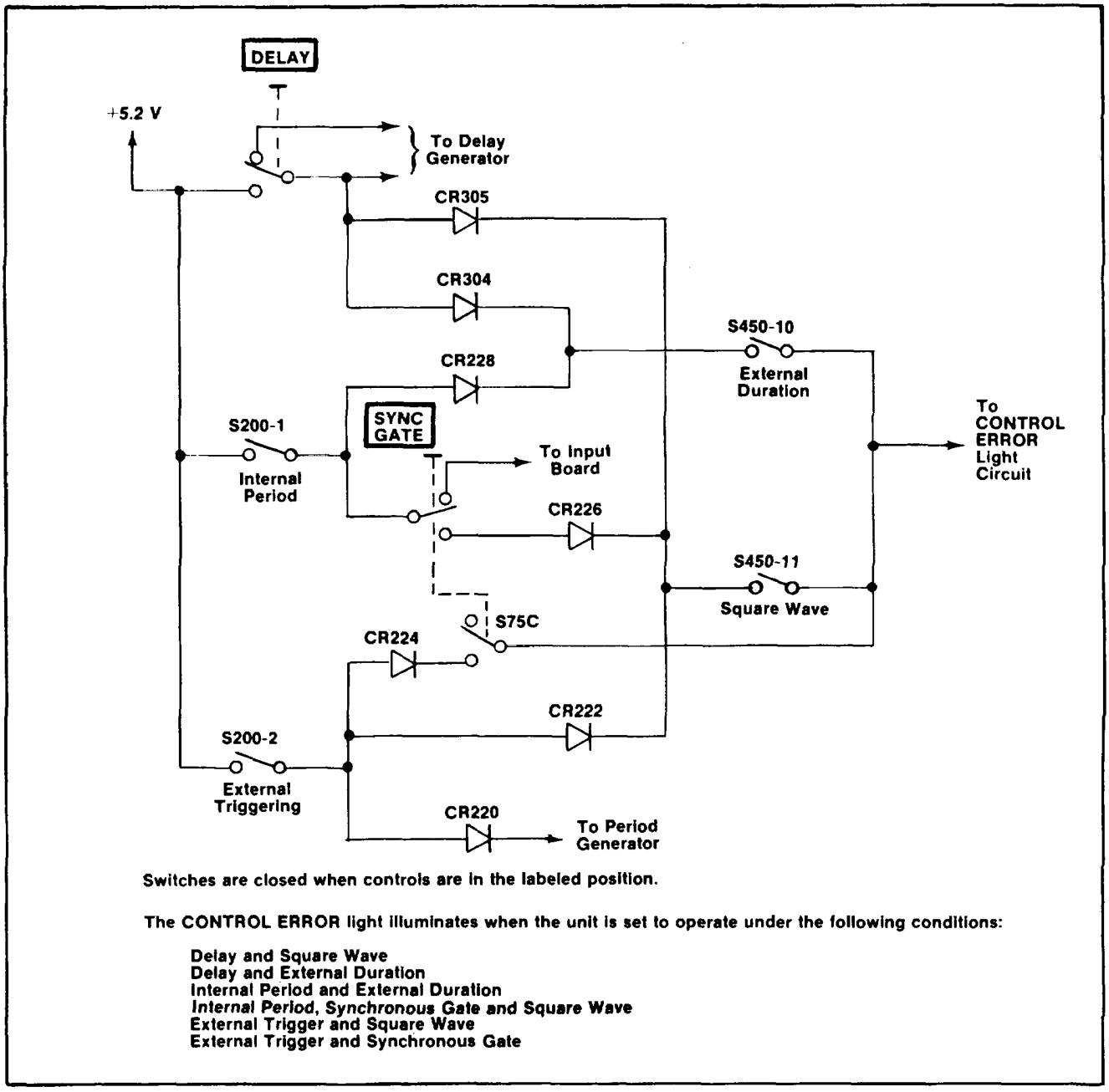


Fig . 2-1 . Simplified schematic for CONTROL ERROR Indicator logic with control settings causing Illumination .

proximately the same amount as the circuitry in the variable transition time generator. The positive-going waveform from pin 14 of U740C is fed through pin 6 to the clock input, pin 6, of flip flop U720A. The negative-going output from pin 15 is fed to the clock input pin 11, of flip flop U720B. Flip flop U720A senses the pulse trailing timing error and U720B, the pulse leading timing error. If the leading time from the output of the variable transition time generator is slow enough so that the D input of U720B has not dropped below approximately the 50% point, when the waveform at the clock input of flip flop U720B (waveform driving the transition time board) goes positive (end of pulse), the high on D input, pin 10, transfers to the output, pin 15, and the CONTROL ERROR lamp is lit.

When pin 15, of flip flop U720B goes high, C734 starts to charge through R728. When the voltage at pin 13 of U720B and pin 5 of U720A reaches the high level (-4.0 V), both flip flops are reset to their initial conditions and the CONTROL ERROR light goes out. If the trailing time of the

pulse is slow enough so that the D input of flip flop U720A has not reached the high level when the pulse at the clock terminal (pin 6) of flip flop U720A goes high (leading portion of the next pulse driving the transition circuitry) the 0 terminal, pin 3, of flip flop U720A goes high. This high is connected to the set terminal, pin 12, of U720B causing the 1 terminal of U720B to go high illuminating the CONTROL ERROR light. The on time and reset for this error indicating mode now proceeds as previously described.

Level Control Multiplier

This circuitry provides independent top and bottom level control of the output pulse by controlling the amplitude and offset of the drive signal to the linear output amplifier. Also included is circuitry to accomplish the normal complement function and the preset function. Control voltage clamps to ensure the output amplifier is not over driven are also provided.

Amplitude control of the signal occurs in the analog multiplier, U850. The pulse signal provides the X input, and the level control voltages provide the Y input. The X.Y product of these inputs is converted to a drive current for the output amplifier.

Input and complement pulses from the variable transition time generator are applied to the bases of Q825 and 0840. These transistors form a differential amplifier, supplied by constant current source U800B and 0820. A positive-going signal at the base of Q825, with the complementary (negative-going) signal at the base of 0840 causes the signal current at pin 11 of the multiplier to go negative and the signal current at pin 12 to go positive. When the pulse polarity reverses, at the bases of Q825 and 0840, the signal current also reverses polarity at pins 11 and 12. The difference between the currents at pins 11 and 12 corresponds to the X signal input for the multiplier.

The total current flowing from pins 2 and 3 of U850 is essentially equal to the current required by the constant current source, U895A and Q900. However, the difference in currents between these pins corresponds to the Y input signal for the multiplier.

The amplitude difference of these currents is controlled by U895B. This is a dc differential amplifier which amplifies the difference between the high & low level control voltages to produce the Y input signal. Gain adjustment for the Y input signal is provided by R885.

The high and low level control voltages are determined by their respective front panel controls, R770B and R770A. If the preset function is selected, the preset high and preset low potentiometers, R775 and R785, provide the control voltages. These voltages are buffered by unity gain amplifiers U780A and U780B. Both control voltages range between 0 and +5.2 V. When the control voltages are equal, the Y input is zero and the multiplier signal output (X.Y) equals zero. A difference of +2.6 V between the high and low level control voltages corresponds to maximum output amplitude from the pulse generator.

The normal complement switch inverts the level control voltage inputs to differential amplifier U895B. However, since the difference between the voltages is unchanged, the control voltage input signal has constant amplitude, but reverses polarity. This complements the pulse generator output. The normal complement balance adjustment, R910, ensures that the Y multiplier input responds equally to changes in either the high or low level control voltages.

The signal current at pins 5 and 6 of U850 is the pulse signal. Since 0845, in conjunction with U800B, provides a constant current sink, the current through R954, from the emitter of common base stage Q954, also contains signal current variations. The current driver for the output amplifier is Q954. The signal currents into pins 8 and 9 of U850 also contain the pulse signal. However constant current sink R847, and common base stage 0950 are included only as a balancing thermal load for the multiplier.

To obtain independent control of the output pulse high and low levels, the control voltages are averaged by resistor network R914, R915, R918 and R920. High and Low tracking potentiometers, R915 and R920, are adjustable to provide minimum interaction between pulse levels. The dc voltage from this network, along with the voltage from the offset adjustment R925, is summed and inverted by U930A. U930B proves further gain and level shifting and, in conjunction with 0945, serves as a level controlled offset generator. A dc current source to the collector of Q954 is provided by Q945. The collector of Q954 is the virtual ground input to the output amplifier.

When the high and low level control potentiometers are both at midrange (+2.6 V zero output) 0945 sources all the quiescent bias current required by 0954, which is approximately 15 mA. Therefore, there is no current drive to the output amplifier through R975 or Rl1055. If the high level control is turned fully cw (maximum output), the low level control voltage remains at +2.6 V. The high level control voltage increases to +5.2 V. This causes the voltage output of U930A to decrease, causing the offset generator U930B and 0945 to source approximately 20 mA. This is an increase of 5 mA. This difference in control voltage settings also causes maximum difference in the control voltage input signal to the multiplier. This action also causes 10 mA peak to peak signal current variations in the collector current of Q954. Since the signal current

variations and dc offset currents are summed at the collectors of Q945 and 0954, the output pulse high level changes to maximum voltage and the low level remains at OV.

It follows that any positive increase in either the high or low level control voltages causes an increase in the dc offset current. A decrease in either control voltage causes a decrease in offset current. However, signal current variations respond only to differences between these control voltages. The larger the voltage difference, the larger the signal current amplitude into the output amplifier

Since the dynamic range of the pulse generator output is 4 or - 20 V, and the maximum amplitude is only 20 V peak to peak, clamping circuits are provided to prevent the difference between the high and low level control voltages from exceeding +2.6 V, which corresponds to maximum output. A clamping circuit also prevents the high level from becoming less than the low level control voltage.

The level control unity gain amplifiers U780A and U780B contain a precision diode clamp composed of CR782, CR790, R780, and R782. Since the feedback for U780A is taken from the cathode of CR790, the voltage at the junction of CR782 and CR790 is equal to the low level control voltage plus one diode drop (CR790). If the high level attempts to decrease below the low level or attempts to increase above the high level control voltage, CR782 conducts clamping the high level at the low level voltage. Current limiting for U780B, during clamping, is provided by R780.

U800A is also configured as a precision clamping circuit. The output at pin 1 is equal to the low level control voltage plus 2.6 V plus one diode drop. Therefore, if the high level voltage attempts to exceed the low level plus 2.6 volts, or the low level is decreased more than 2.6V below the high level, CR805 conducts and the high level is clamped at the low level control voltage plus 2.6 volts. The low level control always overrides the high level control. Current limiting for U780B, during clamping, is provided by R780.

Output Amplifier

The positive and negative dc voltages for this amplifier are provided by dual power supplies which track the high and low level control voltages. These tracking supplies ensure that the positive potential is at least 6 V above the output pulse high level and the negative potential is at least 6 volts below the output pulse low level. This arrangement enables the pulse generator to provide a 40 V dynamic range, with a 20 V peak to peak maximum output pulse, while maintaining minimum power dissipation and voltage requirements for the amplifier transistors. The range of the positive tracking supply is +6 to +26 V, with a -6 to -26 V range for the negative supply.

The output circuit functions as a linear current driven operational amplifier with a closed loop transresistance gain of 2 V/mA. Negative feedback through R1042 to the input node (collectors of Q945 and Q954) causes a virtual ground at the input. A 10 mA peak to peak input signal creates a 20 V peak to peak output pulse (open circuit).

Since the output amplifier is a complementary circuit, only the operation of one side will be explained.

For a positive-going output pulse, current is driven into the input node. This action causes an increase in base current to Q975 which decreases the base drive to Q980. A cascode circuit is formed by 0980 and Q990, with R985 and L980 serving as a constant current source to the common collector-emitter connection. Therefore, when the base drive to Q980 is decreased, the current in Q990 increases. (The constant current source supplies approximately 60 mA which, with no signal, is equally divided between 0980 and 0990.) Another constant current source, Q1000, causes a 2.0 V drop across R1002. The emitter follower, Q995, buffers this potential and provides a voltage source for the base of the cascode transistor, Q990. An increasing current through Q990 increases the base current from the output parallel emitter followers, 01010 and Q1015. The emitters of these transistors drive the output positive through a network of resistors and capacitors. Components R1020, R1024, and C1024, in this network, are adjustable to provide an internal resistive 50 n termination for the output. Network C1048 and R1048, with potentiometer R1050, provides transient response peaking for the amplifier.

Equivalent biasing for the complementary output emitter followers is provided by CR990, R990, and CR992. With zero output, the quiescent current in each output follower is approximately 20 mA. The output potential is available at the rear interface connector, pin 25A, for monitoring the output amplitude.

Power Supply

The +11.5 Vdc from the mainframe provides the raw supply voltage for the series regulated +5.2 Vdc supply. The precision voltage regulator, U1210, includes a temperature compensated voltage reference supply at pin 6. The +5.2 V potentiometer, R1210, with the voltage divider R1209 and R1211 provides the reference input to the non-inverting input, pin 5. The output voltage is applied to the inverting input, pin 4, through R1217. Sensing differences in the two input potentials, the , regulator amplifier provides base current drive from pin 10

to the mainframe transistor used as the series pass element, until the inverting and non-inverting inputs are approximately equal. At this condition, the series pass transistor drops the voltage from the raw supply until the output is +5.2 V. Current limiting is provided by R1215. When the current from the supply exceeds approximately 1.1 A, the regulator provides no further base drive current to the series pass element and current limiting occurs.

The +33.5 Vdc from the mainframe is the raw supply for the regulated +15 Vdc. The 3-terminal voltage regulator, U1205, performs the entire regulating function. Current limiting occurs within U1205.

The -33.5 Vdc from the mainframe is the raw supply for the regulated -15 Vdc. As in the +15 Vdc supply a 3-terminal voltage regulator, U1335, provides the regulating function. However, due to additional load considerations, the raw supply is pre-regulated to decrease power dissipated by the integrated circuit. A shunt current path to the load is furnished by VR1330 and R1330. The zener voltage is also used to maintain base drive to the series pass mainframe transistor. This transistor is used as a pre-regulator to drop the voltage across U1335 to approximately 3.6 V Current limiting is also provided by the regulator, U1335.

The dual tracking supplies provide the positive and negative voltages required by the output amplifier. The voltage at the base of Q1255 varies from 0 V to +5.2 V depending on the setting of the HIGH LEVEL control. When the voltage at the base of Q1255 varies from 0 V to +2.6 V, the voltage at the collector of the series pass transistor is +6 V. As the voltage at the base of Q1255 varies from +2.6 V to +5.2 V, the voltage at the collector of the series pass transistor varies from +6 V to +26 V.

Transistor Q1255 and Q1270 form a differential comparator. The voltage at the base of Q1270 is referenced between the +5.2 V supply, ground and the output voltage. As the HIGH LEVEL control is moved in the positive direction, the collector of 01255 goes negative This increases current flow through Q1280 and therefore the series pass transistor in the mainframe which raises the + tracking supply voltage to the output amplifier Feedback to the differential comparator is provided by R1275. Transistor 01265 prevents the +V tracking supply from going lower than about +-6 V. The base of Q1265 is set at about 2.6 V. When the base of 01255 goes more negative than about 2 6 V, Q1265 comes into conduction holding the common emitter circuit at one diode drop from the base of 01265. If the base of 01255 is lowered further, Q1255 looses control of the circuit and the supply voltage remains at the level determined by 01265, t6 V.

Current limiters for this circuit are Q1285, Q1290 and Q1300 A differential comparator is formed by Q1285 and 01290. If the load on the 4 V supply exceeds the maximum current allowed for the voltage supplied, the voltage drop across R1282 becomes great enough that Q1285 comes into conduction. This action increases conduction in Q1270 reducing the current flow in Q1255. Finally, the conduction through the series pass transistor is limited to a safe value. The current through 01300 is determined by the actual supply output voltage. Therefore, the current limit varies proportionally with the supply voltage In most overload conditions, the supply folds back to minimum current. Diode CR1310 conducts should the -V supply go more negative than ground.

The V supply operates in the same manner as the +V 1supply. Only the polarities are reversed. Transistors11 01355 and 01370 are the basic comparator transistors The base of Q1355 varies between 0 V and +5.2 V The -V output is prevented from going more positive than about -6 V by Q1365 The series pass transistor is driven by Q1380. The comparator transistors for the current limiting circuitry are Q1385 and Q1395. The current source for the current comparator is Q1400. Diode CR1410 prevents the -V output from going more positive than ground.

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 (p/F).
Resistors = Ohms (i).

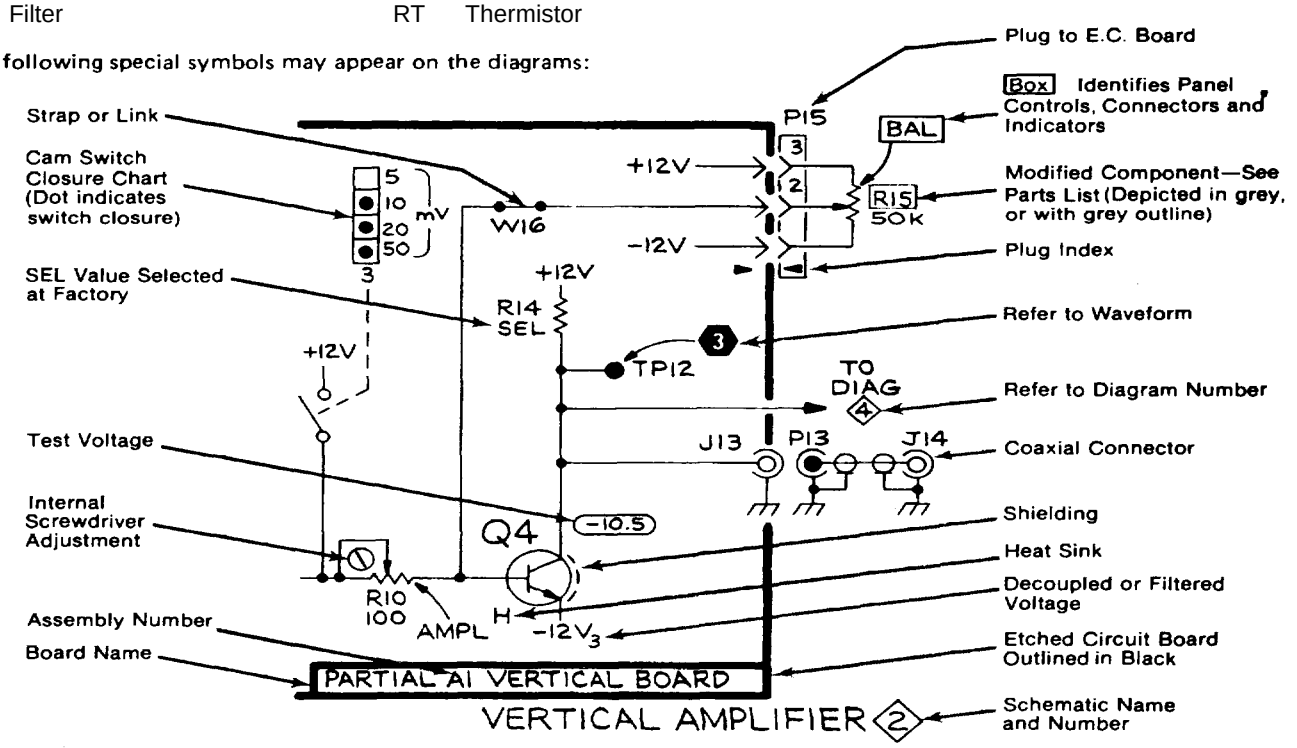
Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.
Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.
The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.
Abbreviations are based on ANSI Y1.1-1972.
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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

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

A	Assembly separable or repairable (circuit board, etc)	H	Heat dissipating device (heat sink. heat radiator, etc)	S	Switch or contractor
AT	Attenuator. fixed or variable	HR	Heater	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BT	Battery	J	Connector, stationary portion	TP	Test point
C	Capacitor. fixed or variable	K	Relay	U	Assembly, inseparable or non-repairable (integrated circuit. etc)
CB	Circuit breaker	L	Inductor. fixed or variable	V	Electron tube
CR	Diode, signal or rectifier	M	Meter	VR	Voltage regulator (zener diode. etc)
DL	Delay line	P	Connector, movable portion	W	Wirestrap or cable
DS	Indicating device (lamp)	0	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead			Z	Phase shifter
F	Fuse	R	Resistor, fixed or variable		
FL	Filter	RT	Thermistor		

The following special symbols may appear on the diagrams:



Maintenance

Refer to Appendix A for complete maintenance information.

I f trouble exists in the output amplifier, remove the + and - tracking power supply jumpers located as shown in the adjustment location illustration. This completely isolates the tracking power supplies from the output circuitry.

Circuit Board removal

To remove the output circuit board and gain access to the components on the variable transition timing board, first remove the four screws on the plug-in rear panel and remove the panel. Next remove the TRANSITION TIME knob. Disconnect the coaxial cable plugs and unplug all the wires connected to the output and transition time boards. Finally, remove the four screws holding the output board to the plug-in frame and remove the two boards by sliding toward the rear of the plug-in until the TRANSITION TIME shaft clears the front panel hole. Now lift the boards and remove them from the mainframe. To remove the input board remove the wires and cables to the input board and the two screws holding the board chassis. To remove the timing board, first remove the rear panel, as explained above. Then remove the PERIOD, DELAY, and DURATION knobs from their shafts. Disconnect all wires and cables leading to the timing board. Remove the four screws holding the timing board to the spacers. Slide the timing board toward the rear of the plug-in until the shafts clear the front panel and lift the board out.

Test Equipment

For adjustment of the PG 508, the following equipment is recommended:

Complete oscilloscope system, capable of faithful reproduction to at least 500 MHz. TEKTRONIX 5440 mainframe, 5A45 real time vertical amplifier, and 5B42 real time delaying sweep plug-in suggested.

50 Ω 42 inch coaxial cable with bnc connectors, Tektronix Part No. 012-0057-01, or equivalent.

General

Adjustments for the PG 508 are described below. For complete calibration procedures, refer to TB 11-6625 2980-35.

Output Voltage Control Knob Check or Adjustment

To check or reset the OUTPUT (VOLTS) control knobs, use the following procedure. Connect an oscilloscope to the PG 508 OUTPUT connector. Set the DURATION control to the SQ WAVE position, and the PERIOD control at the 2 ms position. Set the HIGH LEVEL knob for an output level of about +5 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 about -5 V, and the HIGH LEVEL for 0 V on the oscilloscope. If the HIGH LEVEL knob does not point to 0, loosen the setscrew and readjust.

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

For complete part information, refer to TM 11-6625-2980-24P.

INDEX NUMBERS

Items in this section are referenced by index numbers to **FO-16.**

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component

Detail Part of Assembly and/or Component
Attaching parts for Detail Part

Parts of Detail Part
Attaching parts for Parts of Detail Part

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation The separation symbol - - -* - - - indicates the end of attaching parts.

ITEM NAME

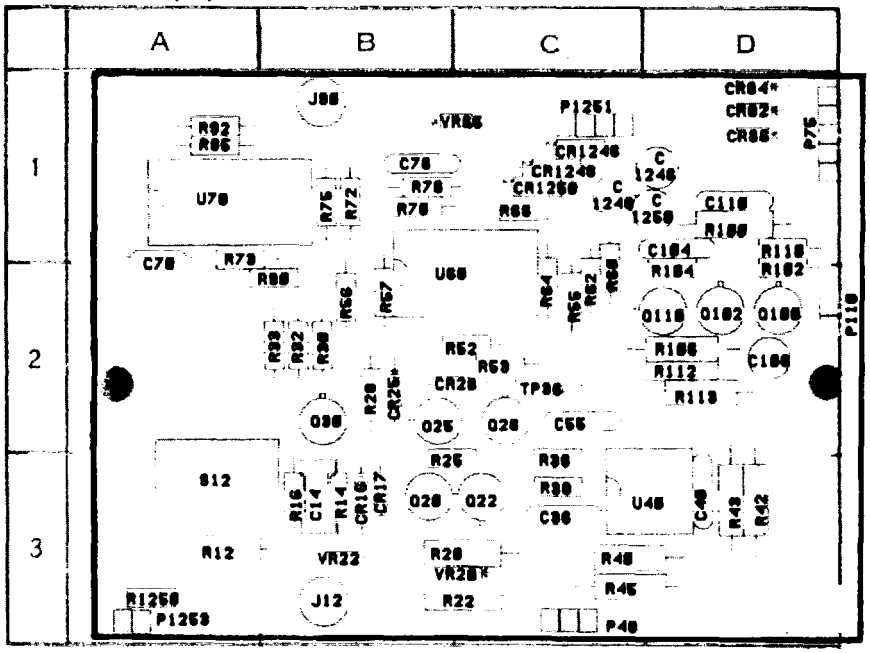
In the Parts List, an Item Name is separated from the description by a colon (:) Because of space limitations, an Item Name may sometimes appear as incomplete For further Item Name identification, the U S Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

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

PARTS LOCATION GRID

INPUT BOARD (A1)



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C14	B3	P12	B3	R32	B2	R102	D2
C36	C3	P48	C3	R33	B2	R104	D2
C40	D3	P75	D1	R36	C3	R106	D2
C55	C2	P90	B1	R38	C3	R110	D1
C70	A2	P110	D2	R40	C3	R112	D2
C76	B1	P1248	A3	R42	D3	R113	D2
C104	D1	P1251	C1	R43	D3	R1250	A3
C106	D2	P1253	A3	R45	C3		
C110	D1	R52	C2	S12	A3		
C1246	D1	Q20	B3	R53	C2		
C1248	C1	Q22	C3	R55	C2	TP36	C2
C1250	D1	025 B2	R56	B2			
026	C2	R57	B2	U40	D3		
CR16	B3	030 B2	R60	C2	U60	C2	
CR17	B3	Q100	D2	R62	C2	U70	Al
CR25	B2	0102	D2	R64	C2		
CR26	B2	Q110	D2	R66	C1	VR20	C3
CR82	D1	R70	B1	VR22	B3		
CR84	D1	R12	A3	R72	B1	VR65	C1
CR86	D1	R14	B3	R73	Al		
CR1246 C1	R16	B3	R75	B1			
CR1248 C1	R20	C3	R76	B1			
CR1250 C1	R22	C3	R90	B2			
R25	B3	R92	Al				
J12	B3	R28	B2	R95	Al		
J90	B1	R30	B2	R100	D1		

Figure 5-1 . A1 board component locations .

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Index No.	Qty	1 2 3 4 5	Name & Description
-1	2		SHIELD,ELEC: SIDE
-2	2		COVER,PLUG-IN:TOP AND BOTTOM
			(ATTACHING PARTS)
-3	2		SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL
			- - - * - - -
-4	1		KNOB,LATCH:
			(ATTACHING PARTS)
-5	1		PIN,KNOB SECRG:0.094 OD X 0.120 INCH LONG
			- - - * - - -
-6	3		KNOB:GRAY
	-		• EACH KNOB INCLUDES:
	1		• SETSCREW:5-40 X 0.125 INCH,HEX SOC STL
-7	3		KNOB:GRAY,0.25 ID X 0.706 OD,0.6H
	-		• EACH KNOB INCLUDES:
	2		• SETSCREW:5-40 X 0.125 INCH,HEX SOC STL
-8	1		KNOB:GRAY,O.81 ID X 0.392 OD,0.466 H
	1		• SETSCREW:4-40 X 0.125 INCH,HEX SOC STL
-9	1		KNOB:GRAY,0.126 IDX 0.588 OD,0.6H
	1		• SETSCREW:5-40 X 0.125 INCH,HEX SOC STL
-10	1		KNOB:0.252 ID X0.706 OD,0.6H
	1		• SETSCREW:5-40 X 0.125 INCH,HEX SOC STL
-11	3		KNOB:GRAY,0.127 IDX 0.5 OD,0.531H
	-		• EACH KNOB INCLUDES:
	1		• SETSCREW:5-40 X 0.125 INCH,HEX SOC STL
-12	7		PUSH BUTTON:GRAY
-13	2		CONNECTOR,RCPT, :BNC,FEMALE,W/HARDWARE
-14	2		TERMINAL,LUG:0.391" ID INT TOOTH
-15	1		CONNECTOR,RCPT,:BNC,FEMALE
-16	1		RESISTOR,VAR:(R48)
			(ATTACHING PARTS)
-17	1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS
-18	1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL
-19	1		RESISTOR,VAR:(R540 AND R655)
			(ATTACHING PARTS FOR EACH)
-20	1		NUT,PLAIN,HEX. :0.25-32 X 0.312 INCH,BRS
-21	1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL
-22	1		RESISTOR,VAR:(R770A AND B)
			(ATTACHING PARTS)
-23	1		NUT,PLAIN,HEX. :0.25-32 X 0.312 INCH,BRS
-24	4		BSHG,MACH.THD:HEX,0.375-32 X 0.438"LONG
			(ATTACHING PARTS)
-25	4		NUT,PLAIN,HEX. :0.375-32 X 0.50 INCH,STL
-26	3		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL
-27	1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL
-28	4		CLIP,ELECTRICAL:CAM SHAFT
-29	2		BUSHING,SLEEVE:PRESS MOUNT
-30	7		FRAME,PUSH BTN:PLASTIC
-31	1		PANEL,FRONT:
-32	1		LATCH,RETAINING:PLUG-IN
			(ATTACHING PARTS)
-33	1		SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL
			- - - * - - -
	1		RELEASE,LATCH:
-34	1		SUBPANEL,FRONT:
			(ATTACHING PARTS)
-35	4		SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL

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Index No.	Qty	1 2 3 4 5	Name & Description
-36	3		BASE,LAMPHOLDER:0.29 OD X 0.19 CASE
-37	3		LAMPHOLDER:WHITE PLASTIC
-38	3		WASHER,FLAT:0.265 ID X 0.375 OD INCH AL
-39	2		LAMP,LED: (DS110 AND DS1250) EPL
-40	1		LAMP,LED: (DS500)
-41	1		SHIELD,ELEC:REAR SUBPANEL
-42	1		CKT BOARD ASSY:AUXILLARY(A5)
-43	6		• CONTACT,ELEC:0.365L X 0.25 PH BRZ GOLD PL
-44	2		GUIDE,CKT BOARD:
			(ATTACHING PARTS FOR EACH)
-45	2		SCREW,MACHINE:2-56 X 0.312 INCH,RDH STL
-46	2		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS
-47	2		WASHER,LOCK:INTL,0.092 ID X 0.175"OD,STL
			- - - * - - -
-48	FT		PLASTIC CHANNEL:
-49	1		MARKER,IDENT:WARNING
-50	1		PANEL,REAR:
			(ATTACHING PARTS)
-51	4		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL
			- - - * - - -
-52	1		CKT BOARD ASSY:MAIN(A4)
			(ATTACHING PARTS)
-53	4		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL
-54	4		BRACKET,COVER:TOP AND BOTTOM
-55	4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL
-56	1		SCREW,MACHINE:6-32 X 0.250 BDGH,NYL,SLOT
-57	1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL
-58	1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL
			- - - * - - -
	-		• CKT BOARD ASSY INCLUDES:
-59	1		• MICROCIRCUIT,DI:(U1205)
-60	1		• SWITCH,PUSH:(S785 AND S865)
-61	4		• SPACER,PB SW:0.164 INCH LONG
-62	4		• SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT
-63	4		• HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H
-64	8		• INSULATOR,DISC:TO-5 TRANSISTOR
-65	4		• HEAT SINK,ELEC:0.422 H X 1.240 INCH OD
-66	3		• CONNECTOR BODY,:CKT CD MT,3 PRONG
-67	21		• SOCKET,PIN TERM:0.188 INCH LONG
-68	27		• CONTACT,ELEC:0.365L X 0.25 PH BRZ GOLD PL
-69	1		• SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE
-70	4		• TERM.,TEST PT:0.40 INCH LONG
-71	3		• LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L
-72	2		• LINK,TERM.CONNE:2 WIRE BLACK
-73	2		• CLAMP,LOOP:NYLON
-74	1		• HEAT SINK,DIODE:FINGER TYPE
			(ATTACHING PARTS)
-75	1		• SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL
-76	1		• NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL
			- - - * - - -
-77	1		• MICROCIRCUIT,LI: (U1335)
-78	3		• CONTACT,ELEC:1.37 INCH LONG
-79	1		• CONN BODY,BPL,EL:3 WIRE RED
-80	3		• CONNECTOR,TERM.:0.48" L,22-26AWG WIRE
-81	1		INS,STANDOFF:0.312 OD X 1.0 INCH LONG
			(ATTACHING PARTS)
-82	1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL
			- - - * - - -
	1		CKT BOARD ASSY:MAIN W/CAM SW
	1		• CONTACT,ELEC:GROUNDING
	1		• ACTR ASSY CAM S:RANGE(S590)
			(ATTACHING PARTS)
-83	4		• SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL
			- - - * - - -

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Index No.	Qty	1 2 3 4 5	Name & Description
	-		• • ACTUATOR ASSEMBLY INCLUDES:
-84	1		• • CONTACT,ELEC:GROUNDING
-85	2		• • NUT,PLAIN,HEX.:4-40 X 0.188-INCH,BRS
-86	1		• • SPRING,FLAT:GREEN COLORED
	1		• • SPRING,FLAT:RED COLORED
-87	2		• • ROLLER,DETENT:
-88	1		• • BEARING,CAM SW:FRONT
			(ATTACHING PARTS)
-89	1		• • RING,RETAINING:0.338 ID X 0.025" THK,STL
-90	1		• • ACTUATOR,CAM SW:RANGE
-91	1		• • SHAFT,CAM SW:
-92	4		• • NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS
-93	1		• • BEARING,CAM SW:CENTER/REAR
-94	1		• CKT BOARD ASSY:RISE AND FALL(A3)
-95	2		• • CONNECTOR BODY,:CKT BD MT,3 PRONG
-96	1		• • SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT
-97	3		• • SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN
-98	1		• • LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L
-99	B		• • CONTACT ASSY,EL:CAM SWITCH,TOP
-100	8		• • RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG
-101	2		• • SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE
-102	9		• • CONTACT,ELEC:0.365L X 0.25 PH BRZ GOLD PL
-103	6		• • SOCKET,PIN TERM:0.188 INCH LONG
-104	1		CKT BOARD ASSY:INPUT(A1)
			- - - * - - -
-105	2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL
			(ATTACHING PARTS)
	-		• CKT BOARD ASSEMBLY INCLUDES:
-106	16		• CONTACT,ELEC:0.365L X 0.25 PH BRZ GOLD PL
-107	1		• SWITCH,SLIDE: (S12)
-108	1		• SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT
-109	1		• TERM.,TEST PT:0.40 INCH LONG
-110	1		• SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE
-111	1		• SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE
-112	2		• CONNECTOR BODY,:CKT BD MT,3 PRONG
-113	2		• SOCKET,PIN TERM:0.188 INCH LONG
-114	4		SPACER,POST:0.312 OD X 0.812 INCH LONG
			(ATTACHING PARTS)
-115	2		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL
			- - - * - - -
-119	2		CABLE ASSY,RF:50 OHM COAX,8.0 LONG
	-		• EACH CABLE ASSY INCLUDES:
			• EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS
			• EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS
	1		CKT BOARD ASSY:TIMING W/CAM SW
			(ATTACHING PARTS)
-120	4		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL
	-		• CKT BOARD ASSY INCLUDES:
-121	2		• EXTENSION SHAFT:8.905 L X 0.125 DIA,AL,CRM
-122	1		• EXTENSION SHAFT:5.58 L X 0.125 DIA,AL,CRM
-123	3		• CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS
	4		• SETSCREW:4-40 X 0.125 INCH,HEX SOC STL
-124	1		• RESISTOR,VAR:(R190)
-125	2		• RESISTOR,VAR:(R335 AND R475)
-126	3		• SPACER,SWITCH:PLASTIC
-127	3		• CONTACT,ELEC:GROUNDING
	1		• ACTR ASSY CAM S:(S200)
			(ATTACHING PARTS)
-128	4		• SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL
			- - - * - - -

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Index No.	Qty	1 2 3 4 5	Name & Description
	-	• •	ACTR ASSY INCLUDES:
-129	1	• •	COVER,CAM SW:1.85 L X 0.876 H,AL
			(ATTACHING PARTS)
-130	4	• •	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL
-131	4	• •	WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL
			- - - * - - -
	1	• •	CONTACT,ELEC:GROUNDING
-132	2	• •	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS
-133	1	• •	SPRING,FLAT:GREEN COLORED
	1	• •	SPRING,FLAT:RED COLORED
-134	2	• •	ROLLER,DETENT:
-135	1	• •	BEARING,CAM SW:FRONT
			(ATTACHING PARTS)
-136	1	• •	RING,RETAINING:0.338 ID X 0.025" THK,STL
			- - - * - - -
-137	1	• •	ACTUATOR,SWITCH:CAM SWITCH
-138	1	• •	SHAFT,CAM SW:OUTER CONCENTRIC,W/DRIVER
-139	4	• •	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS
-140	1	• •	BEARING,CAM SW:CENTER/REAR
	1	•	ACTUATOR ASSY CAM S:(S330A,B)
			(ATTACHING PARTS)
-141	4	•	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL
			- - - * - - -
	-	• •	ACTR ASSY INCLUDES:
-142	1	• •	COVER,CAM SW:1.55 L X 0.876 H,AL
			(ATTACHING PARTS)
-143	4	• •	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL
-144	4	• •	SCREW,MACHINE:3-48 X 0.125,PNH,STL
			- - - * - - -
	1	• •	CONTACT,ELEC:GROUNDING
-145	2	• •	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS
-146	1	• •	SPRING,FLAT:GREEN COLORED
	1	• •	SPRING,FLAT:RED COLORED
-147	2	• •	ROLLER,DETENT:
-148	1	• •	BEARING,CAM SW:FRONT
			(ATTACHING PARTS)
-149	1	• •	RING,RETAINING:0.338 ID X 0.025" THK,STL
			- - - * - - -
-150	1	• •	ACTUATOR,SWITCH:CAM SWITCH
-151	1	• •	SHAFT,CAM SW:W/DRIVER
-152	4	• •	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS
-153	1	• •	BEARING,CAM SW:CENTER/REAR
	1	•	ACTR ASSY,CAM S: (S450)
			(ATTACHING PARTS)
-154	4	•	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL
			- - - * - - -
	-	• •	ACTR ASSY INCLUDES:
-155	1	• •	COVER,CAM SW:1.95 L X 0.876 H,AL
			(ATTACHING PARTS)
-156	4	• •	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL
-157	4	• •	WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL
			- - - * - - -
	1	• •	CONTACT,ELEC:GROUNDING
-158	2	• •	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS
-159	1	• •	SPRING,FLAT:GREEN COLORED
	1	• •	SPRING,FLAT:RED COLORED
-160	2	• •	ROLLER,DETENT:
-161	1	• •	BEARING,CAM SW:FRONT
			(ATTACHING PARTS)
-162	1	• •	RING,RETAINING:0.338 ID X 0.025" THK,STL
-163	1	• •	ACTUATOR,SWITCH:CAM SWITCH
-164	1	• •	SHAFT,CAM SW:OUTER CNCTRC,W/DRIVER

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Index No.	Qty	1 2 3 4 5 Name & Description
-165	4	• • NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS
-166	1	• • BEARING,CAM SW:CENTER/REAR
-167	1	• CKT BOARD ASSY:TIMING(A2)
-168	1	• • SWITCH,PUSH:(S380A,8)
-169	1	• • SWITCH,PUSH:(S380A,B,C)
-170	8	• • SPACER,PB SW:BROWN,0.275 INCH LONG
-171	4	• • LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L
-172	6	• • SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE
-173	37	• • CONTACT,ELEC:CKT CD SW,SPR
-174	9	• • SOCKET,PIN TERM:0.188 INCH LONG
-175	9	• • CONNECTOR BODY,:CKT CD MT,3 PRONG
-176	4	• • CONTACT,ELEC:0.55 INCH LONG
-177	8	• • CONTACT,ELEC:0.365L X 0.25 PH BRZ GOLD PL
-178	1	SPRING,GROUND:FLAT
	2	SUPPORT,PLUG-IN:
	2	WASHER,FLAT:0.141 ID X .04THK,AL,.21 9 OD
-179	1	FR SECT,PLUG-IN:LEFT SIDE,TOP AND BOTTOM
	1	FR SECT,PLUG-IN:TOP LEFT
-180	1	FR SECT,PLUG-IN:RIGHT SIDE,TOP AND BOTTOM
-181	1	FR SECT,PLUG-IN:RIGHT SIDE,TOP AND BOTTOM
-182	FT	WIRE,ELECTRICAL:2 WIRE RIBBON,18.063 FT L
-183	FT	WIRE,ELECTRICAL:3 WIRE RIBBON,0.250 FT L
-184	FT	WIRE,ELECTRICAL:4 WIRE RIBBON,12.042 FT L
-185	FT	WIRE,ELECTRICAL:5 WIRE RIBBON,0.500 FT L
-186	FT	WIRE,ELECTRICAL:6 WIRE RIBBON,0.625 FT L
-187	1	EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS
-188	1	EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS
-189	81	CONNECTOR,TERM.:0.48" L,22-26AWG WIRE
-190	2	CONN BODY,PL,EL:1 WIRE BROWN
-191	1	CONN BODY,PL,EL:2 WIRE BLACK
	2	CONN BODY,PL,EL:2 WIRE RED
	1	CONN BODY,PL,EL:2 WIRE ORANGE
-192	1	CONN BODY,PL,EL:3 WIRE YELLOW
-193	4	CONN BODY,PL,EL:4 WIRE YELLOW
	2	CONN BODY,PL,EL:4 WIRE GREEN
-194	2	CONN BODY,PL,EL:5 WIRE GREEN
-195	3	CONN BODY,PL,EL:6 WIRE BLUE

APPENDIX A
Section I. INSTALLATION PROCEDURE

Before you start...

1. Check the rear panel markings. If the factory settings are compatible with the available line voltage and frequency, insert the desired plug-ins. Use the bail to raise the front of the instrument.

...go to Operating Instructions...

2. If a change is needed, follow these steps:

WARNING

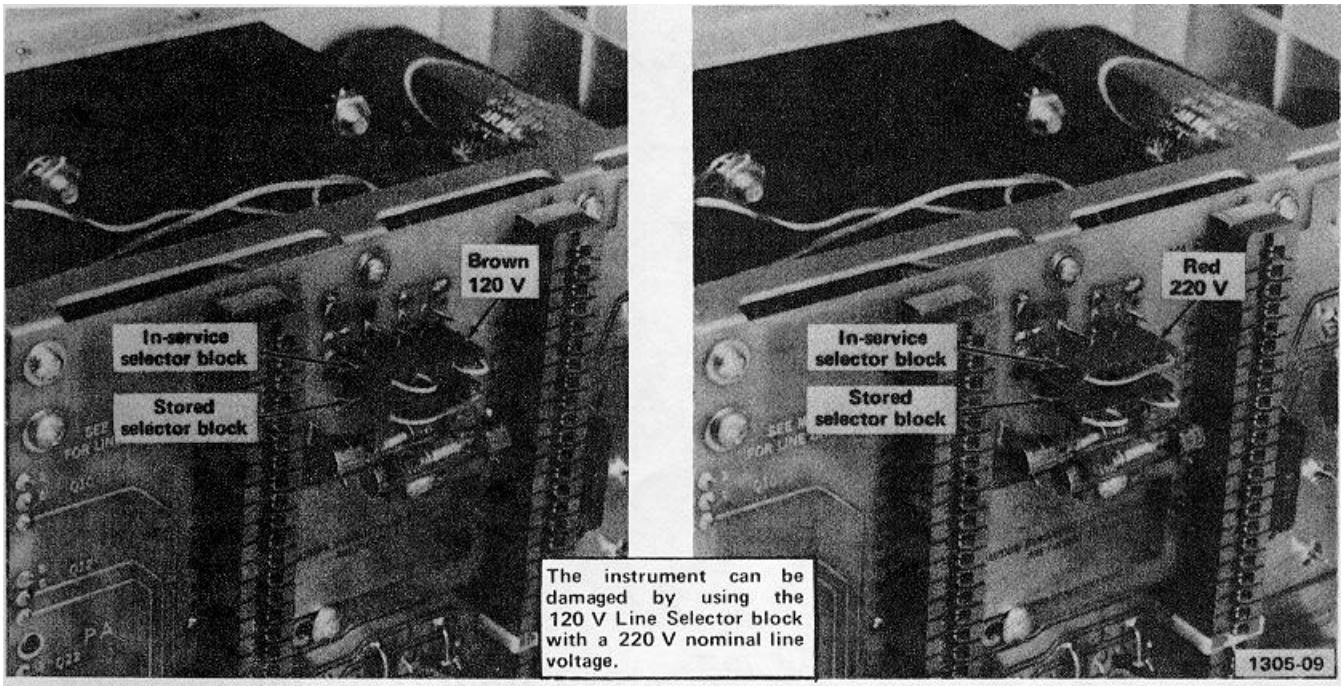
Use a proper power source. This instrument is designed to operate from a power source with its neutral at or near ground potential with a separate safety-earth conductor. It is not intended for operation from two phases of a multiphase system, or across the legs of a single-phase, three-wire system.

WARNING

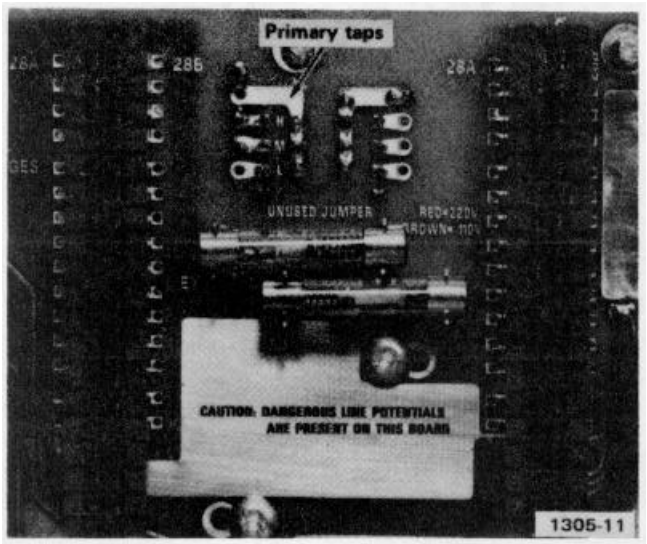
Avoid live circuits. Dangerous voltages exist at several points throughout this instrument. When the instrument is operated with the cover removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect power before cleaning the instrument, changing line selector blocks, or replacing parts.

a. **Line Selector Block(s)**

Remove the five hold-down screws on the top of the dust cover cabinet and lift the cabinet off. This gives easy access to the Line Selector blocks located on the main circuit board.



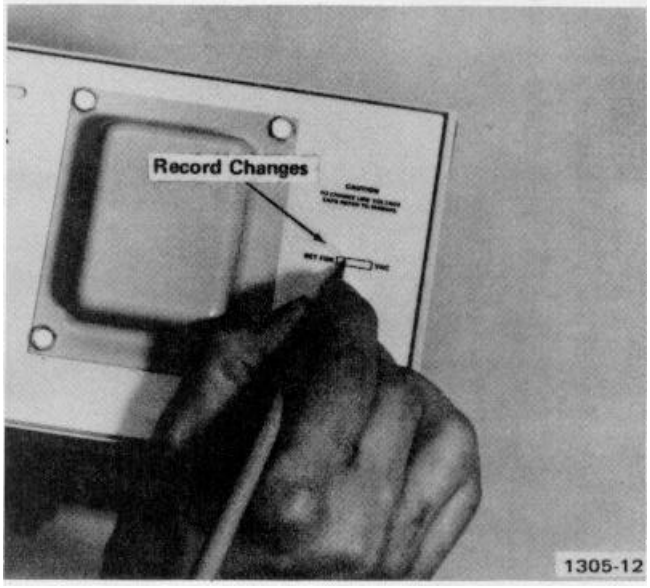
b. Line Range Taps



Universal Transformer

Line Selector Block Position	Regulating Ranges	
	120 Volts Nominal	220-Volts Nominal
L	90 VAC to 110 VAC	180 VAC to 220 VAC
M	99 VAC to 121 AC	198 VAC to 242 VAC
H	108 VAC to 132 VAC	216 VAC to 264 VAC
Line Fuse Data	1.6 A slow-blow	0.8 A slow-blow

c. Rear Panel



3. Replace the cabinet.
4. If necessary, change the line cord power plug to match the power source receptacle or use an adapter.
5. Plug the cord into the power source.
6. Insert the desired plug-ins.
7. Use the bail to raise the front of the instrument

...go to Operating Instructions...

TM 503 OPERATING INSTRUCTIONS

Section II. INTRODUCTION

Description

The TEKTRONIX TM 503 Power Module is a three-compartment-wide mainframe for the TM 500 Series of Modular Instrumentation. It accepts up to three independently functional plug-in modules to form a compact, versatile and low cost instrumentation system. The TM 503 is a basic power source and provides an interconnecting scheme for the other members of the TM 500 Series family. Factory options allow customer modification using signal access at the plug-in module/power module interface to provide rear panel inputs and outputs, and interconnections between compartments.

Power Source

This instrument is designed to operate from a power source with its neutral at or near earth (ground) potential with a separate safety-earth conductor. It is not intended for operation from two phases of a multiphase system, or across the legs of a single-phase, three-wire system.

Power Usage

With three plug-in modules installed, the TM 503 can require up to 120 W of power at the upper limits of the high line voltage ranges. Actual power consumption depends on the particular module combination and operating mode selected at any one time.

Operating Temperatures

The TM 503 can be operated in an ambient air temperature of 0°C to +500C. Thermal cutout devices protect the system by disconnecting the power to the TM 503 Power Module when internal temperatures rise above a safe operating level. These devices automatically return power to the unit when the internal temperatures return to a safe level.

Since the TM 503 can be stored in temperatures between -400C and +750C, allow the instrument's chassis to return to within the operating limits before applying power.

POWERING UP

Plug-in Modules

It is not necessary that all the plug-in compartments be utilized in order to operate the Power Module. The only modules needed are those necessary to accomplish the task.

CAUTION

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

Module Installation

1. Check the location of the white plastic barriers on the interconnecting jack to insure that their locations match the slots in the edge of the plug-in module's circuit board.

2. Align the plug-in module chassis with the upper and lower guides of the selected compartment. Push the module in and press firmly to seat the circuit board in the interconnecting jack. (Remove the plug-in module by pulling on the white release latch located in the lower left corner of each module.)

3. Pull the PWR button on the left side of the TM 503. Some plug-in modules have independent power switches, usually labeled OUTPUT, controlling application of mainframe power to the module itself. Push this button to activate the plug-in module.

Loading Considerations

With three plug-in modules installed, the TM 503 can require up to 120W of power from the line at high-line

voltage range settings. Actual power consumed, of course, depends on the particular module combination selected at any one time.

This power capability can best be utilized by carefully planning the functional combinations of plug-ins, their external loads, and the resulting power distributions. Optimum conditions would be (1) equal loads in all three compartments, (2) as much power as possible dissipated In external loads, and (3) operating in an ambient temperature around +250C.

The TM 503 provides each plug-in module with access to a pair of heat-sinked, chassis-mounted transistors, one NPN and one PNP. These Series-Pass transistors allow the plug-in modules to operate in power ranges not possible if the power had to be dissipated in the modules themselves.

Family Compatibility

Mechanically, the plug-in modules are very similar to other TEKTRONIX product families. However, they are not electrically compatible. Therefore, the TM 503 interface has barriers on the mating connectors between pins 6 and 7 to insure that incompatible plug-ins cannot be inserted. See figure below. A compatible module will have a matching slot between pins 6 and 7 of its main circuit board edge connector. This slot and barrier combination is the primary keying assignment.

Another identifier for TM 500-compatible plug-in modules is the white color of the release latch.

Customizing the Interface

The modularity of this instrumentation system provides for a host of functions to be performed by the plug-in modules. Specific functions are grouped into families or classes, of which there may be several plug-in module members. For instance, some classes are Power Supplies, Signal Sources, Measurement and so forth. Each modular member of a functional family will have a second slot peculiar to its family assignment located in its edge connector. The TM 503 user can "program" one or more compartments to accept only members of that family by installing a second barrier in the interface connector to match the module's slot location. Entire TM 503's could be "programmed" in this manner to set up instrumentation systems for specific work functions.

Jumper wires can be used to further specialize the interface. Compartments can be made to "talk" to each other by connecting jumpers on the back side of the interface board, using pins 14 through 28, A-side and B-side both, of the interconnecting jacks. See the following description of Option 2. Refer to each plug-in module's Manual for the I/O assignments of each pin at the rear interface. Once having made interconnections of a specialized nature, it is recommended that barriers be installed on the interconnecting jacks to insure module compatibility with the customized wiring.

Rear Panel

The rear sub-panel is punched for BNC and multi-pin connector mountings. Customer- or factory-installed connectors and wiring (see following description of catalog Option 2) This could provide external access to the interface for external I/O control. This feature makes the TM 500 Series Modular Instrumentation System very flexible in bench-top or rackmounted systems.

Option 2. This factory-installed option adds 25-mil squarepin connectors to the rear of the interconnecting jacks at all pin locations from pins 14A and B through pins 28A and B. This will keep the interface flexible by making it easy and fast to change customized wiring using prepared wires with squarepin receptacles and long-nose pliers or tweezers. It also protects the circuit board from damage by repeated soldering and unsoldering of jumper wires. This option also adds three BNC connectors and one 50-pin connector to the rear panel. These connectors are not pre-wired in order to give a system designer as much flexibility as possible. Instead, prepared jumpers, coax cables, and interconnection jack barriers are included in a kit.

Stacking and Rackmounting

TM 503's with their cabinets and feet in place may be stacked on top of each other. The feet provide clearance for the lower unit's handle and at the same time give adequate spacing for the necessary ventilation.

The TM 503 is designed to be half-rack width. Field conversion kits with slide-out tracks are available to mount one or two TM 503's in a standard 19-inch rack. Vertical space needed is 5 1/4 inches.

SPECIFICATIONS

Power Requirements

Line Voltage Ranges. Universal Transformer: 100, 110, 20, 200, 220, 240 VAC, all within 10%. Range changing or transformer accomplished with quick-change line-selector block

Line Frequency Ranges. Universal Transformer: 48 Hz to 440 Hz.

Power Consumption. Maximum primary power approximately 120 W at high line. Actual power consumption depends on plug-in selection and operating modes.

Power Cord Conductor Identification

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

Supplies (Unregulated)

Two 25 VAC windings, 500 mA each, supplied to each compartment, independently.

+33.5 V and -33.5 V, 1 A maximum each supply, shared by all compartments.

17.5 VAC and +11.5 V, 3.6 A maximum, shared in any combination between these two supplies and shared among all compartments

NOTE

Current and voltage ratings are for main frame maintenance only. In practice, not all available power may be used at once.

Temperature Range

Operating: 0°C to +50°C. Nonoperating: -40°C to +75°C.

Altitude Range

Operating: To 15,000 feet. Nonoperating: To 50,000 feet.

Other

Dimensions with Feet and Bail: H 6.0 in., W 8.7 in., L
15.3 in.

Weight without Plug-ins: Approximately 9.5 lb.

TM 503 SYSTEM MAINTENANCE

Section III. GENERAL

Introduction

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

Cabinet Removal

WARNING

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

Two screws on the top secure the cabinet to the TM 503 frame. Remove them and lift the cabinet straight up. Do not operate the system with the cabinet removed any longer than necessary for troubleshooting and calibration. Re-install the cabinet to protect the interior from dust and to remove personnel shock hazards.

Cleaning

WARNING

Adequate ventilation should be provided while using TRICHL ORO TRIFL UO ROE THA NE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flames; the products of decomposition are toxic and irritating. Since TRICHLORO TRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

Exterior. Loose dust may be removed with a soft cloth or a dry brush. Water and a mild detergent may be used; however, abrasive cleaners should not be used.

WARNING

Compressed air is dangerous and can cause serious bodily harm if protective means or methods are not observed to prevent a chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 p.s.i.f. and then only with effective chip guarding and personnel protective equipment. Do not use compressed air to dry parts when trichlorotrifluoroethane has been used.

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

Preventive Maintenance

Preventive maintenance steps performed on a regular basis will enhance the reliability of the instrumentation system. However, periodic checks of the semiconductors in the absence of a malfunction are not recommended as preventive maintenance measures. See the semiconductor checking information under Troubleshooting Techniques which follow. A convenient time to perform preventive maintenance is just before instrument calibration.

Calibration

To insure accurate signal generation and measurement, the performance of individual units comprising the system should be checked periodically. Refer to TB 11-6625-2980-35 for complete calibration procedures.

TROUBLESHOOTING AIDS

Introduction

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

Circuit Descriptions

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

Diagrams

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

Cam Switch Charts

Cam switches shown on the diagrams are coded on comprehensive charts to locate the cam number of the switch contact in the complete switch assembly, counting from the front, or knob end, toward the rear of the switch. The charts also indicate with a solid dot when each contact is closed.

Circuit Board Illustrations

Line illustrations showing component locations keyed with a grid scheme for each circuit board are usually placed on the back of a foldout page and sequenced as close as possible to an associated schematic. The GRID LOC column in the Electrical Parts Lists keys each component to the Location illustrations.

Component and Wiring Color Codes

Colored stripes or dots on electrical components signify electrical values, tolerances, etc., according to EIA standards. Components not color-coded usually have information printed on the body. The wiring coding follows the same EIA standards.

Testing Equipment

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

TROUBLESHOOTING TECHNIQUES

Introduction

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

Control Settings

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

System and Associated Equipment

Before proceeding with troubleshooting the TM 500 Series system, check that the instruments in the system are operating correctly. Check for proper interconnection between the power module and the plug-in modules. Check the line voltage at the power source. Check that the signal if properly connected and that the interconnecting cables and the signal source are not defective.

The associated plug-in modules can be checked for proper operation quickly by substituting other like units

known to be operating properly. If the trouble persists after substitution, then the power module is probably at fault. Moving a properly operating plug-in from compartment to compartment will help determine if one or more compartments has a problem.

Visual Check

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

Instrument Calibration

Check the calibration of the suspected plug-in module or the affected circuit if the trouble is obviously in a certain circuit. The trouble may only be a result of misadjustment or may be corrected by re-calibration. Complete calibration instructions are given in TB 11-6625-2980-35.

Circuit Isolation

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

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

Voltages and Waveforms

Often defective components can be located by using waveform and voltage indications when they appear on the schematic or in the calibration procedures. Such waveforms and voltage labels are typical indications and will vary between instruments. To obtain operating conditions similar to those used to take these readings, refer to the first diagram in the service sections.

Component Checking

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

Transistors and IC's. Turn the power switch off before removing or replacing any semiconductor.

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

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

Diodes. Do not use an ohmmeter that has a high internal current. High currents may damage the diode.

A diode may be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of between 800 mV and 3 V, the resistance should be very high in one direction and very low when the leads are reversed .

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

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

PARTS REPLACEMENT

Replacing

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

Circuit Boards. If a circuit board is damaged beyond repair, the entire assembly including all soldered-on components, can be replaced. Part numbers are given in the mechanical parts lists for the completely wired (670 prefix) board.

To remove or replace a board, proceed as follows:

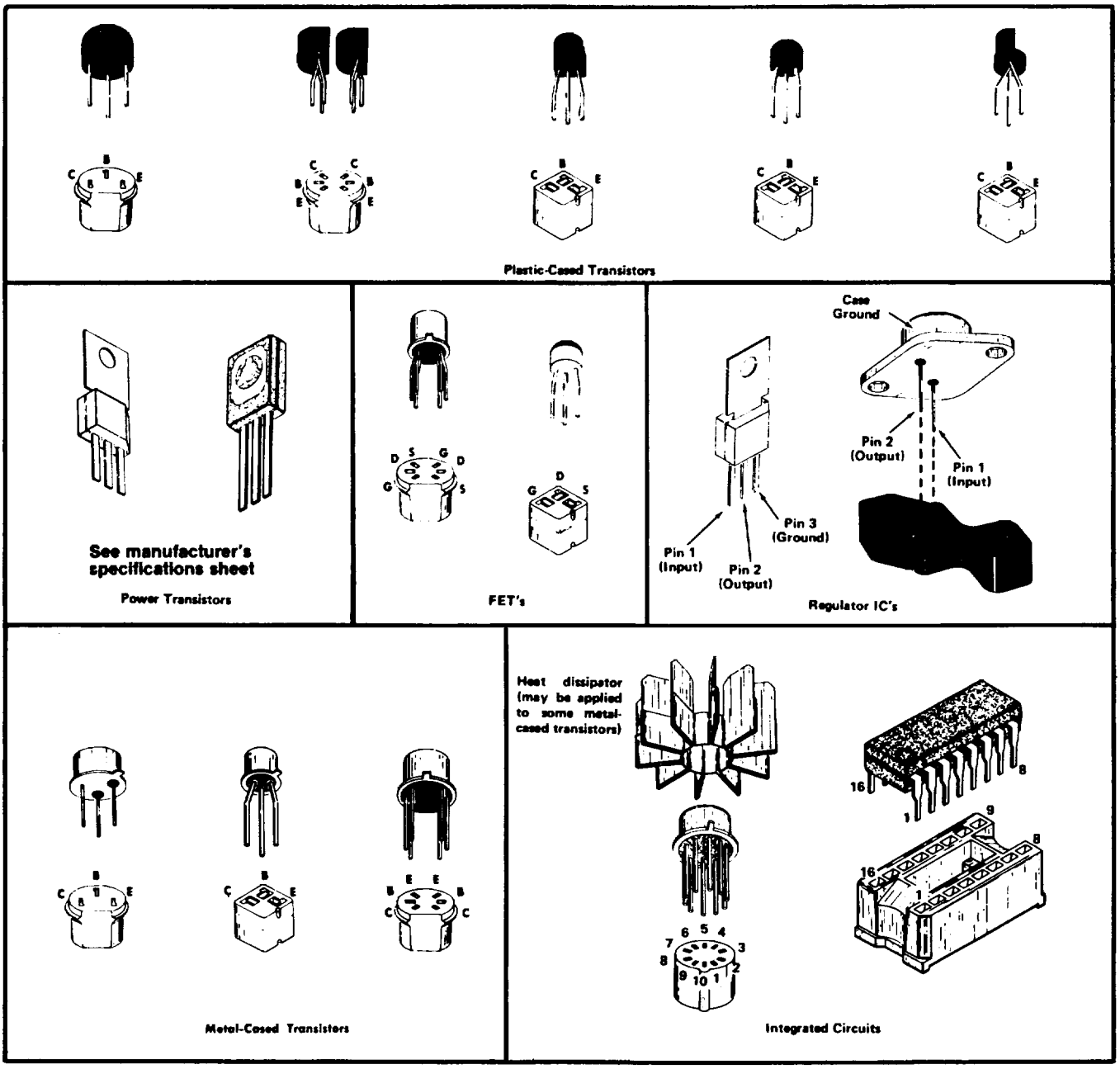
1. Disconnect all leads connected to the board (both soldered lead connections and solderless pin connections).

2. Remove all screws holding the board to the chassis or other mounting surface. Some boards may be held fast by plastic mounting clips around the board edges. For these, push the mounting clips away from the circuit board edges to free the board. Also, remove any knobs, etc., that would prevent the board from being lifted out of the instrument.

3. Lift the circuit board out of the unit. Do not force or bend the board.

4. To replace the board, reverse the order of removal. Use care when replacing pin connectors; if forced into place incorrectly positioned, the pin connectors may be damaged.

Transistors and IC's. Transistors and IC's should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance return them to their original sockets. Unnecessary replacement or switching of semiconductor devices may affect the calibration of the instruments. When a transistor is replaced, check the operation of the part of the instrument that may be affected.



Replacement semiconductors should be of the original type or a direct replacement. The above figure shows the lead configuration of the semiconductors used in this instrument system. When removing soldered-in transistors, use a suction-type de-soldering tool to remove the solder from the holes in the circuit board.

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

To replace one of the power transistors mounted on the Power Module chassis adjacent to the interface circuit board, first unsolder the leads. Then, loosen the nuts which clamp the transistor to the chassis. Remove the defective transistor. When replacing the transistor, use a mica washer on the metal tab to increase heat transfer from the transistor to the chassis.

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

Cam Switches. Repair of cam type switches should be undertaken only by experienced maintenance personnel. Switch alignment and spring tension of the contacts must be carefully maintained for proper operation of the switch.

The cam-type switches consist of rotating cam drums which are turned by front-panel knobs, and sets of spring-leaf contacts mounted on adjacent circuit boards. The contacts are actuated by lobes on the cams. These switches can be disassembled for inspection, cleaning, repair, or replacement as follows:

1. Remove the screws which hold the metal cover on the switch, and lift the cover off the switch. The switch is now open for inspection or cleaning.

2. To completely remove a switch from the circuit board, first remove any knobs or shaft extensions. Loosen the coupling at the potentiometer at the rear of the switch, and pull the long shaft out of the switch assembly.

3. Remove the screws (from the opposite side of the circuit board) which hold the cam drum to the board.

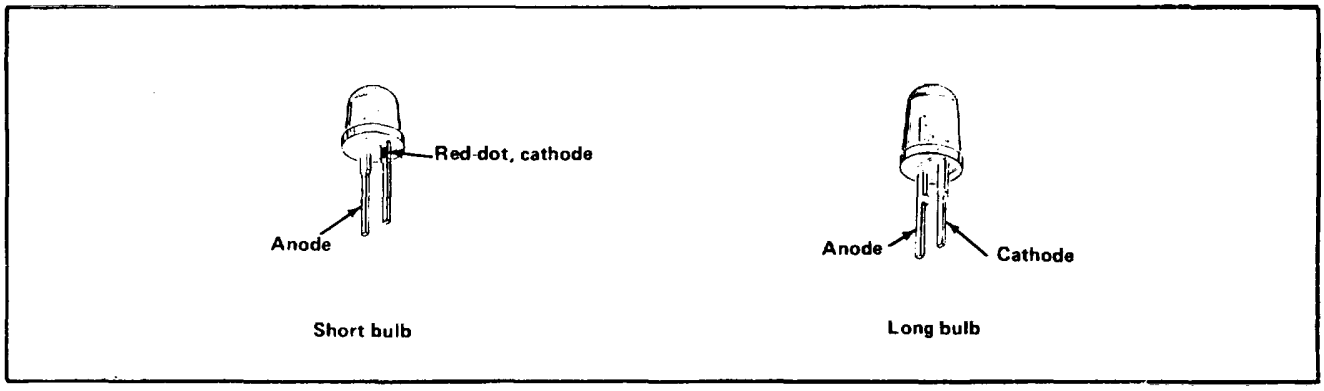
4. To remove the cam drum from the front support block, remove the retaining ring from the shaft on the front of the switch and slide the cam drum out of the support block. Be careful not to lose the small detent roller.

5. To replace defective switch contacts, follow the instructions given in the switch repair kit.

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

Pushbutton Switches. The pushbutton switches are not repairable and should be replaced as a unit if defective. Use a suction-type de-soldering tool to remove solder from the circuit board when removing these switches.

Light-Emitting Diodes. LED's used as indicators are mounted on the sub-panels with plastic sleeve sockets similar to the incandescent bulb mountings or they are soldered directly to a sub-assembly and so mounted that they protrude through holes in the panel. In these cases, the sub-assembly must be exposed and the anode and cathode lead orientations carefully noted before unsoldering the defective LED. See figure below for LED lead identifying information.



Power Transformer. Refer to the exploded view drawing at the rear of the Power Module manuals for disassembly of the rear panel to expose the power transformer. Refer to the schematic diagram color-coding information for correct wiring. After replacement, check out the power supply voltages before installing a plug-in module.

REPACKAGING FOR SHIPMENT

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

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Refer to the following table for carton test strength requirements.

2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.

4. Seal carton with shipping tape or industrial stapler.

SHIPPING CARTON TEST STRENGTH

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

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

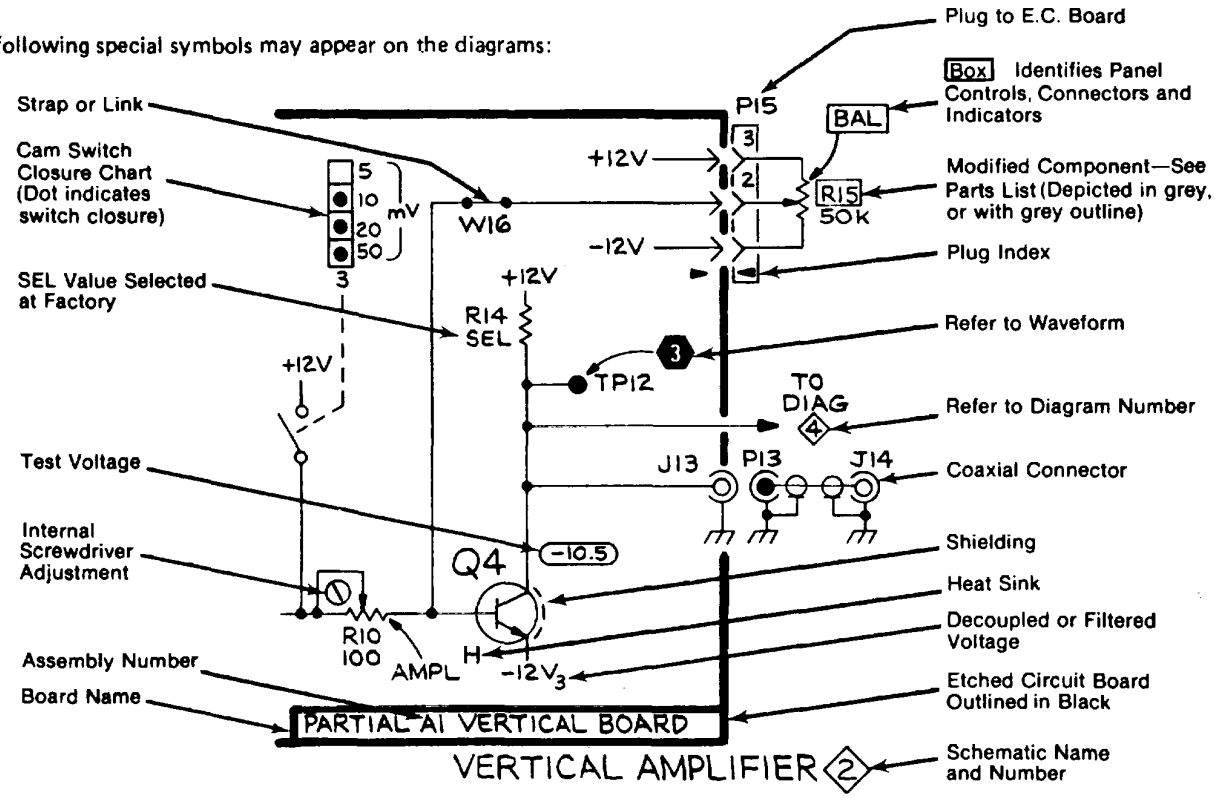
Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.
Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.
The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.
Abbreviations are based on ANSI Y1.1-1972.
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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

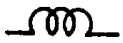
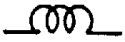
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

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

The following special symbols may appear on the diagrams:

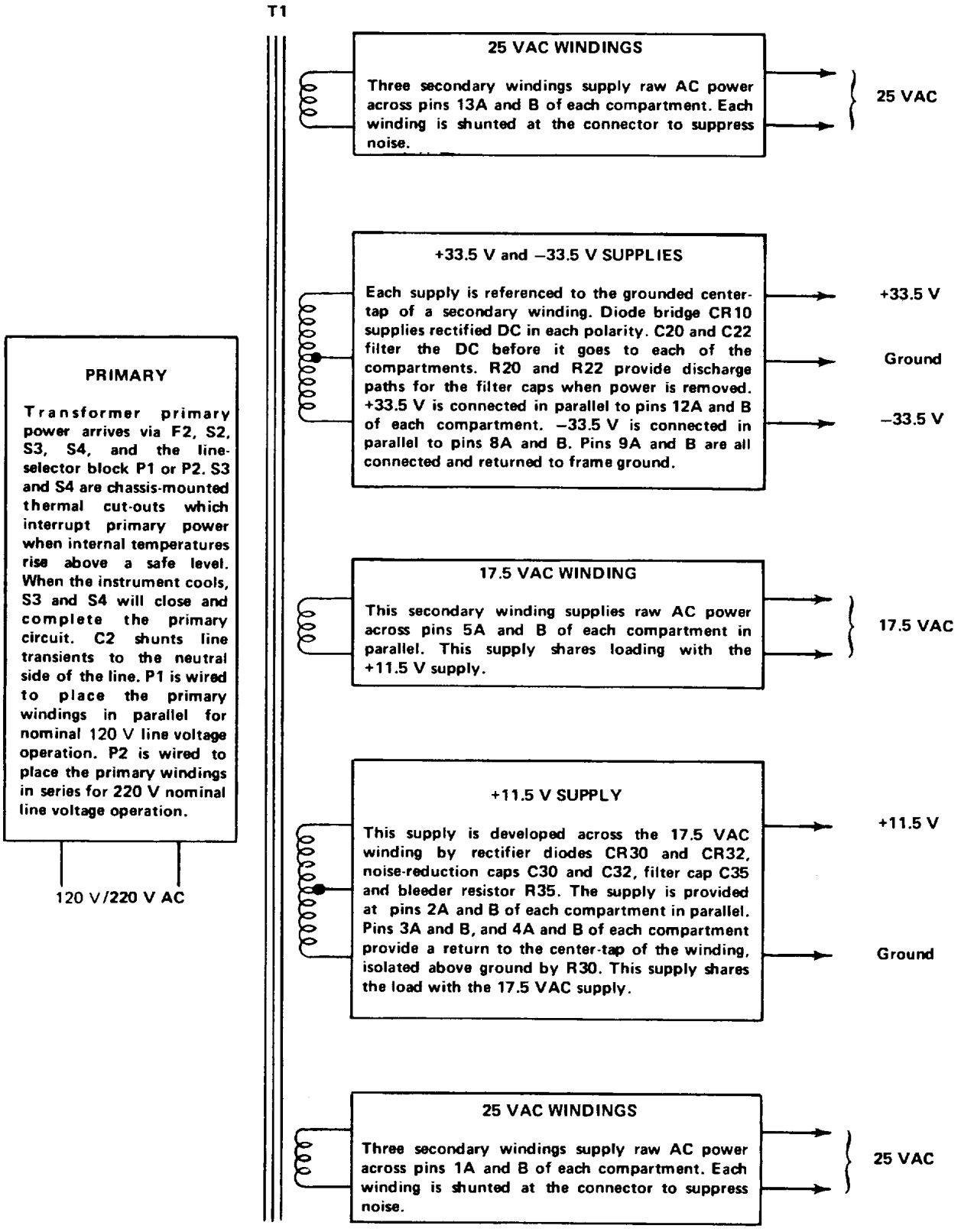


POWER MODULE INTERFACE PIN ASSIGNMENTS FRONT VIEW

	A		B	
No permanent I/O assignments. Refer to plug-in module manuals for specific assignments.	28		28	No permanent I/O assignments. Refer to plug-in module manuals for specific assignments.
	27		27	
	26		26	
	25		25	
	24		24	
	23		23	
	22		22	
	21		21	
	20		20	
	19		19	
	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.
Base lead of PNP Series-Pass.	11		11	Collector lead of PNP Series-Pass.
Emitter lead of PNP Series-Pass.	10		10	Transformer shield lead.
±33.5 V common return.	9		9	±33.5 V common return.
−33.5 V filtered DC.	8		8	−33.5 V filtered DC.
Emitter lead of NPN Series-Pass.	7		7	Collector lead of NPN Series-Pass.
Base lead of NPN Series-Pass.	6		6	No connection.
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.
	A		B	

1305-05

DETAILED BLOCK DIAGRAM



REPLACEABLE MECHANICAL PARTS

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

OOX Part removed after this serial number

INDEX NUMBERS

Items in this section are referenced by index numbers to **the figure on page A-23**.

INDICATION SYSTEM

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

1 2 3 4 5 *Name & Description*

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - - - - indicates the end of

Attaching parts 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 Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1can be utilized where possible.

ABBREVIATIONS

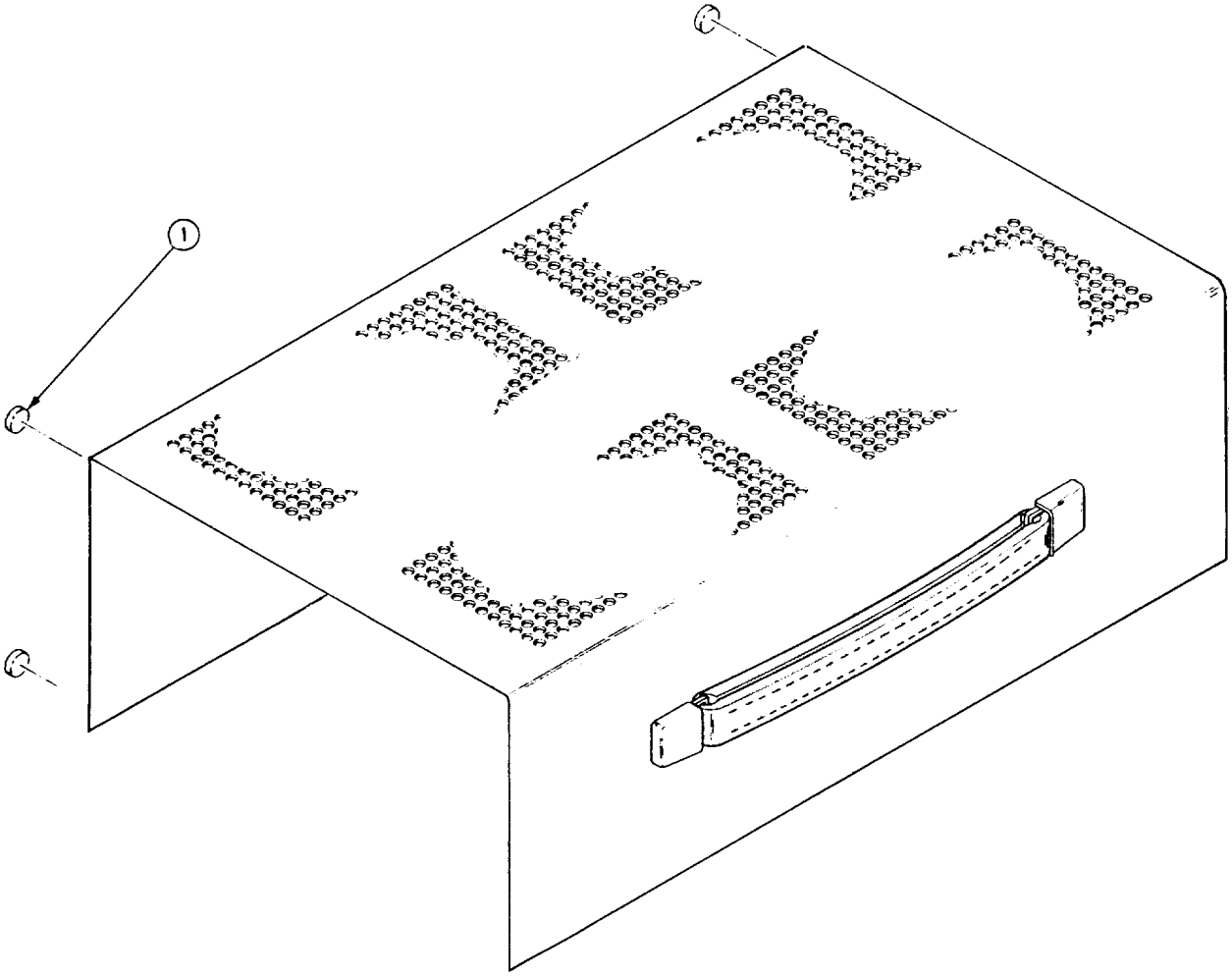
"	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
#	NUMBER SIZE	ELEC	ELECTRICAL	INCAND	INCANDESCENT	SECT	SECTION
ACTR	ACTUATOR	ELCTLT	ELECTROLYTIC	INSUL	INSULATOR	SEMICOND	SEMICONDUCTOR
ADPTR	ADAPTER	ELEM	ELEMENT	INTL	INTERNAL	SHLD	SHIELD
ALIGN	ALIGNMENT	EPL	ELECTRICAL PARTS LIST	LPHLDR	LAMPHOLDER	SHLDR	SHOULDERED
AL	ALUMINUM	EQPT	EQUIPMENT	MACH	MACHINE	SKT	SOCKET
1ASSEM	ASSEMBLED	EXT	EXTERNAL	MECH	MECHANICAL	SL	SLIDE
.ASSY	ASSEMBLY	FIL	FILLISTER HEAD	MTG	MOUNTING	SLFLKG	SELF-LOCKING
ATTEN	ATTENUATOR	FLEX	FLEXIBLE	NIP	NIPPLE	SLVG	SLEEVING
AWG	AMERICAN WIRE GAGE	FLH	FLAT HEAD	NON WIRE	NOT WIRE WOUND	SPR	SPRING
BD	BOARD	FLTR	FILTER	OBD	ORDER BY DESCRIPTION	SQ	SQUARE
BRKT	BRACKET	FR	FRAME or FRONT	OD	OUTSIDE DIAMETER	SST	STAINLESS STEEL
BRS	BRASS	FSTNR	FASTENER	OVH	OVAL HEAD	STL	STEEL
BRZ	BRONZE	FT	FOOT	PH BRZ	PHOSPHOR BRONZE	SW	SWITCH
BSHG	BUSHING	FXD	FIXED	PL	PLAIN or PLATE	T	TUBE
CAB	CABINET	GSKT	GASKET	PLSTC	PLASTIC	TERM	TERMINAL
CAP	CAPACITOR	HDL	HANDLE	PN	PART NUMBER	THD	THREAD
CER	CERAMIC	HEX	HEXAGON	PNH	PAN HEAD	THK	THICK
CHAS	CHASSIS	HEX HD	HEXAGONAL HEAD	PWR	POWER	TNSN	TENSION
CKT	CIRCUIT	HEX SOC	HEXAGONAL SOCKET	RCPT	RECEPTACLE	TPG	TAPPING
COMP	COMPOSITION	HLCPS	HELICAL COMPRESSION	RES	RESISTOR	TRH	TRUSS HEAD
CONN	CONNECTOR	HLEXT	HELICAL EXTENSION	RGD	RIGID	V	VOLTAGE
COV	COVER	HV	HIGH VOLTAGE	RLF	RELIEF	VAR	VARIABLE
CPLG	COUPLING	IC	INTEGRATED CIRCUIT	RTNR	RETAINER	W/	WITH
CRT	CATHODE RAY TUBE	ID	INSIDE DIAMETER	SCH	SOCKET HEAD	WSHR	WASHER
DEG	DEGREE	IDENT	IDENTIFICATION	SCOPE	OSCILLOSCOPE	XFMR	TRANSFORMER
DWR	DRAWER	IMPLR	IMPELLER	SCR	SCREW	XSTR	TRANSISTOR

Index No.	Qty	1 2 3 4 5	Name & Description
-1	1		COVER,CAL FXTR:W/HANDLE
			(ATTACHING PARTS)
-2	2		SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL
	1		SCREW,MIACHINE:8-32 X 0.188,TRH,SST
			- - - * - - -
	-		• COVER INCLUDES:
	1		• COVER,CAL FXTR:W/O HANDLE
-3	1		• HANDLE,CARRYING:
			(ATTACHING PARTS)
-4			
-5			
-6	2		• RIVET,BLIND:0.125 OD X 0.357 L,DOMED HEAD
	2		• WSHR,SHOULDERED:O.143" ID X 0.75" OD,BRS
			- - - * - - -
-7	1		EXTENSION SHAFT:13.612 L X 0.048 STL W/PB
			(ATTACHING PARTS)
-8	2		SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL
			- - - * - - -
-9	1		ADAPTER,SW ACTR:
-10	1		SWITCH,PUSH-PUL:1OA,250VAC
-11	1		BRACKET,ANGLE:CKT CARD SPRT,LEFT
			(ATTACHING PARTS)
-12	2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL
-13	4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL
-14	2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL
			- - - * - - -
-15	2		SWITCH,THERMO:(S3,S4)
			(ATTACHING PARTS FOR EACH)
-16	2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL
-17	2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL
			- - - * - - -
-18	1		TERMINAL,LUG:0.146 INCH DIA DE,45 DEG BEND
			(ATTACHING PARTS)
-19	1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL
			- - - * - - -
-20	1		TRANSFORMER: (T1
			(ATTACHING PARTS)
-21	4		SCREW,MACHINE:10-32 X 2.250" HEX.HD STL
-22	4		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL
-23	4		INS SLV,ELEC:0.187 ID X 1.50 INCH LONG
	4		WASHER,LOCK:INT,0.20 ID X0.376" OD,STL
	1		TERMINAL,LUG:SE #10
			- - - * - - -
	1		TERMINAL,LUG:SE #8
			(ATTACHING PARTS)
	1		NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL
			- - - * - - -
-24	1		COVER,ELEC XFMR:
-25	1		CKT BOARD ASSY:INTERFACE(A1)
-26	14		CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL
-27	3		CONNECTOR,RCPT,:28/56 CONTACT
-28	3		KEY,CONN PLZN:
-29	4		CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE
-30	1		RETAINER,CAP:
			(ATTACHING PARTS)
-31	2		SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL
-32	2		NUT,PLAIIJ,HEX. :6-32 X 0.25 INCH,BRS
			- - - * - - -

Index No.	Qty	1 2 3 4 5	Name & Description
-33	1		LINK,TERM. CONN:8,22 AWG,1.5 L
-34	1		LINK,TERM. CONN:8,22 AWG,1.5 L
-35	1		• BRACKET,REIF·F:
			(ATTACHING PARTS)
-36			• DELETED
-37	4		• RIVET,BLIND:0.125 DIA GRIP,AL
			- - - * - - -
			(ATTACHING PARTS FOR CKT BD ASSY)
-38	2		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL
-39	2		NUT,CHASSIS MTG:
-40	6		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL
-41	6		INSULATOR,WSHR:0.812 OD X 0.0025 INCH THK
	6		WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL
			- - - * - - -
-42	1		HEAT SINK,XSTR:
-43	1		HEAT SINK,XSTR:
-44	1		BRACKET,ANGLE:CKT CARD SPRT,RIGHT
			(ATTACHING PARTS)
-45	2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL
-46	4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL
-47	2		SCREW,HACHINE:6-32 X 0.312"100 DEG,FLH STL
			- - - * - - -
-48	4		LEG,ELEC EQUIP.:PLASTIC
			(ATTACHING PARTS FOR EACH)
-49	1		SCREW,MACHINE:8-32 X 1.5 INCH,PNH,STL
-50	1		NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL
-			- - * - - -
-51	1		PANEL,REAR:OPTION 2
			(ATTACHING PARTS)
	2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL
	2		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL
			- - - * - - -
-52	1		BSHG,STRAIN RLF:
-53	1		CABLE ASSY,PWR:
-54	1		FUSEHOLDER: W/MOUNTING HARDWARE
-55	1		WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPRN
-56	3		GUIDE,PL-IN:UPPER
			(ATTACHING PARTS FOR EACH)
-57	1		SCREW,MACHINE:2-56 X 0.188" 82 DEG,FLH,STL
			- - - * - - -
			- - - * - - -
	2		HINGE BLOCK,STA:LEFT
	2		HINGE BLOCK,STA:RIGHT
	1		STAND,ELEC EQPT:
-58	1		FLIPSTAND,CAB.:
	1		COVER,PWR SPLY:BOTTOM
	1		COVER,PWR SPLY:BOTTOM
	1		CAB.BOT,PWR SUP:
			(ATTACHING PARTS)
-59	4		SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL
			- - - * - - -

Index No	Qty 1 2 3 4 5	Name & Description
-	-	• CABINET BOTTOM ASSEMBLY INCLUDES:
-60	1	• CAB.BOT,PWR SUP:
-61	2	• FOOT,CABINET:LEFT FRONT AND RIGHT REAR
-62	2	• SPT PIVOT,FLIP:LEFT FRONT AND RIGHT REAR
		(ATTACHING PARTS FOR EACH)
-63	2	• SCREW,IMACHINE:6-32 X 0.75 INCH,FILH STL
-64	2	• NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL
		- - - * - - -
-65	2	• FOOT,CABINET:RIGHT FRONT AND LEFT REAR
-66	2	• SPT PIVOT,FLIP:RIGHT FRONT AND LEFT REAR
		(ATTACHING PARTS FOR EACH)
-67	2	• SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL
-68	2	• NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL
		- - - * - - -
-69	3	GUIDE,SLIDE:BLACK
		(ATTACHING PARTS)
-70	2	SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL
-71	1	SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL
		- - - * - - -
	1	MARKER,IDENT:MARKED "CAUTION"
	2	PLATE,IDENT:WARNING,TRANSISTORS
-72	1	FRAME ASSY,CAB:
-73	3	CONTACT,ELECTRICAL:
		(ATTACHING PARTS)
-74	3	EYELET,METALLIC:0.089 OD X 0.125" L,BRASS
		- - - * - - -

STANDARD ACCESSORIES



Index No	Qty	1 2 3 4 5	Nome & Description
-1	4		BUMPER,PLASTIC:0.45 DIA X 0.195 GRAY POLY
	1		MANUAL, TECH: INSTRUCTION

APPENDIX B

REFERENCES

DA Pam 310-4	Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrications Orders.
DA Pam 310-7	US Army Index of Modification Work Orders.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies, and Equipment Used by the Army.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TB 43-180	Calibration Requirements for the Maintenance of Army Materiel.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).
TM 11-6625-2980-24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) Pulse Generator AN/USM-359A. (To be published)

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

B-1. SCOPE

This appendix lists components of end item and basic issue items for the pulse generator to help you inventory items required for safe and efficient operation.

B-2. GENERAL

The Components of End Item and Basic Issue Items Lists are divided into the following sections:

a. Section II. Components of End Item. This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. Section III. Basic Issue Items. These are the minimum essential items required to place the pulse generator in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the pulse generator during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement BII, based on TOE/MTOE authorization of the end item.

B-3. EXPLANATION OF COLUMNS

The following provides an explanation of columns found in the tabular listings:

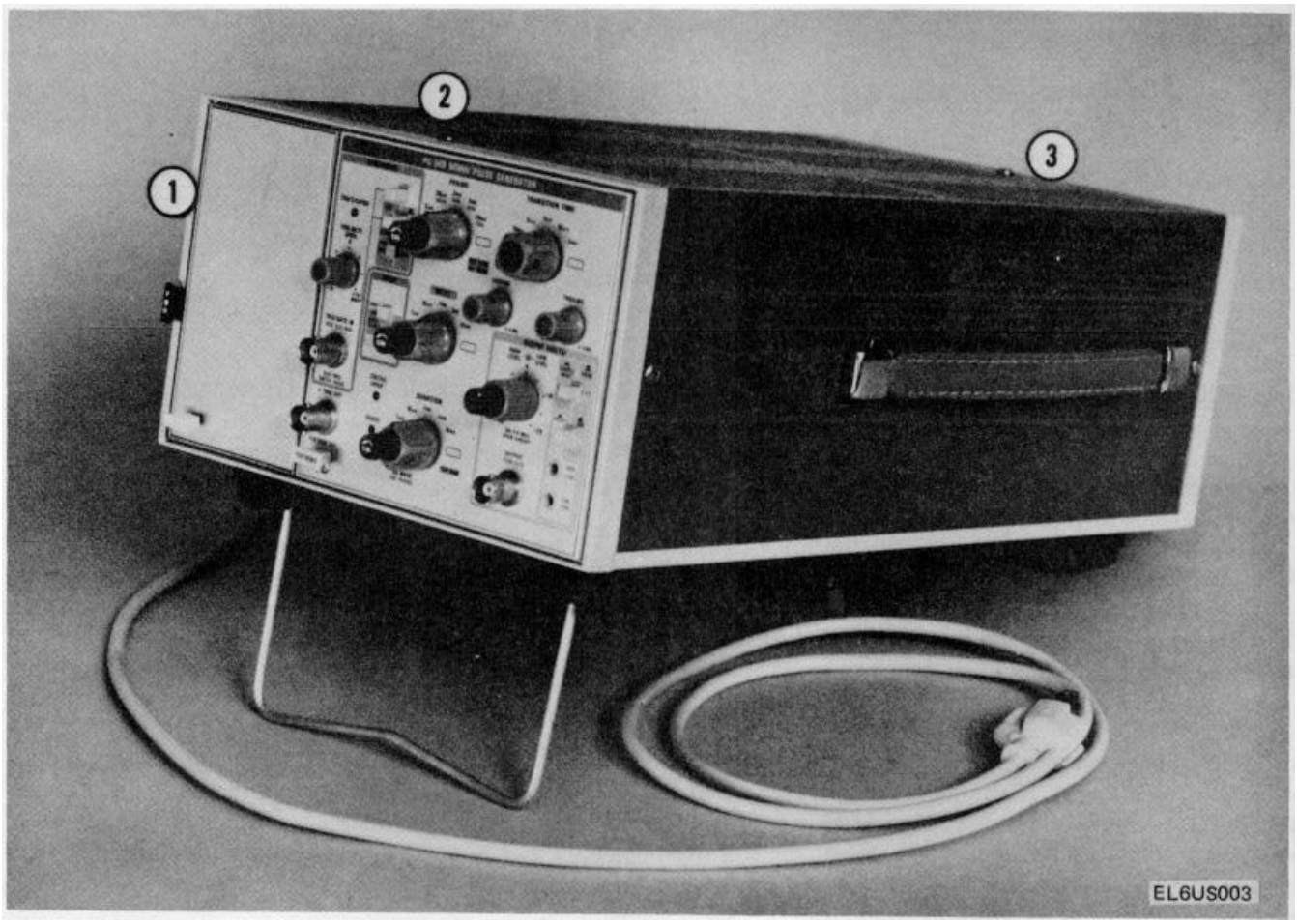
a. Column (1) - Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.

b. Column (2) - National Stock Number. Indicates the National stock number assigned to the item and will be used for requisitioning purposes.

c. Column (3) - Description. Indicates the Federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

d. Column (4) - Unit of Measure (U/M). Indicates the measure used in performing the actual operational/ maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr).

e. Column (5) - Quantity required (Qty rqr). Indicates the quantity of the item authorized to be used with/on the equipment.



Pulse generator AN/USM-395A.

SECTION II. COMPONENTS OF END ITEM

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	Usable On Code	(4) U/M	(5) Qty rqr
1		PANEL, BLANK: (80009) 016-0195-03		EA	1
2	6625-01-051-6639	PLUG-IN UNIT, ELECTRONIC TEST EQUIPMENT. SG-1178/USM-359A (80009) PG-508		EA	1
3	6625-00-373-7528	POWER SUPPLY. PP-7578/USM-359A (80009) TM-503		EA	1

SECTION III. BASIC ISSUE ITEMS

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number Usable On Code	(4) U/M	(5) Qty rqr
		MANUAL, TECHNICAL: TM 11-6625-2980-14	EA	1

APPENDIX E

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

E-1. General

This appendix provides a summary of the maintenance operations for the Pulse Generator AN/USM-359A. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

E-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating conditions, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

E-3. Column Entries (Section II)

a. Column 1.Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of task-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C - Operator/Crew
O - Organizational
F - Direct Support
H - General Support
D - Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

E-4. TOOL and Test Equipment Requirement (Section III)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nonmenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specified tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

E-5. Remarks (Section IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

SECTION II. MAINTENANCE ALLOCATION CHART
FOR
PULSE GENERATOR AN/USM-359A
TEKTRONIX PG-508T NSN 6625-01-077-4620

(1)	(2)	(3)	(4) MAINTENANCE LEVEL					(5)	(6)
			UNIT		INTERMEDIATE		DEPOT		
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	C	O	F	H	D	TOOLS AND EQUIPMENT	REMARKS
00	PULSE GENERATOR AN/USM-359A	Inspect		0.1				Visual External Simple Operational	
		Test		0.2				1 thru 15	
		Calibrate					2.0	1 thru 15	
		Repair				1.0		1 thru 15	
		Overhaul					10.0	1 thru 15	
01	PLUG-IN UNIT, ELECTRONIC TEST EQUIPMENT SG-1178/USM-359A	Inspect				0.2		15	
		Test				0.5		1 thru 15	
		Replace				0.1		12	
		Repair				1.0		1 thru 15	
0101	CIRCUIT CARD ASSY (Al) INPUT 670-4273-01	Inspect				0.1		12	
		Test				0.2		7,9,12,15	
		Replace				0.1		12	
		Repair					0.2	1 thru 15	
0102	CIRCUIT CARD ASSY (A2) TIMING 670-4274-02	Inspect				0.1		12	
		Test				0.5		7,9.12,15	
		Replace				0.1		12	
		Repair					0.2	1 thru 15	
0103	CIRCUIT ASSY (A3) TRANSITION TIMING 670-4275-02	Inspect				0.2		12	
		Test				0.5		1,7,9,12,15	
		Replace				0.1		12	
		Repair					0.2	1 thru 15	
0104	CIRCUIT ASSY (A4) OUTPUT 670-4276-01	Inspect				0.1		12	
		Test				0.5		7,9,13,15	
		Replace				0.1		12	
		Repair					0.2	1 thru 15	
0105	CIRCUIT CARD ASSY (A5) AUXILIARY 670-4272-00	Inspect				0.1		12	
		Test				0.2		7,9, 12	
		Replace				0.1		12	
		Repair					0.2	1 thru 15	
0106	CIRCUIT CARD ASSY (A6) + CAM SWITCH 672-0557-001	Inspect				0.1		12	
		Test				0.5		1,7,9,12,15	
		Replace				0.1		12	
		Repair					0.2	1 thru 15	
0107	CIRCUIT ASSY (A7) + CAM SWITCH 672-0558-01	Inspect				0.2		12	
		Test				0.5		1,7,9,12,15	
		Replace				0.1		12	
		Repair					0.2	1 thru 15	
02	POWER SUPPLY PP-7578/USM-359A	Inspect				0.2		12	
		Test				0.5		1,7,9,12,15	
		Replace				0.1		12	
		Repair					0.2	1 thru 15	

SECTION II. MAINTENANCE ALLOCATION CHART
FOR
PULSE GENERATOR AN/USM-359A
TEKTRONIX PG-508T NSN 6625-01-077-4620

(1)	(2)	(3)	(4) MAINTENANCE LEVEL					(5)	(6)
			UNIT		INTERMEDIATE		DEPOT		
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	C	O	F	H	D	TOOLS AND EQUIPMENT	REMARKS
0201	CIRCUIT CARD ASSY (Al)	Inspect				0.1		12	
	670-2024-00	Test				0.5		1,7,9,12,15	
	POWER MODULE TM-503 INTERFACE	Replace				0.1		12	
		Repair					0.2	1 thru 15	
03	BLANK PLUG-IN PANEL	Inspect				0.1		12	
	PN 016-0195-03	Replace				0.1		12	
		Repair				0.1		12	

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR PULSE GENERATOR AN/USM-359A/TEKTRONIX PG-508T

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H,D	Oscilloscope, 0S-262 (P)/U, Equivalent to TEKTRONIX Type 7623A	6625-01.007-9416	
2	H,O	Amplifier, Dual Trace AM-6785/U, equivalent to TEKTRONIX Type 7A26	6625-00-361-5318	
3	H,D	Time Base, TD-1159/U, equivalent to TEKTRONIX Type 7B53A	6625-00-261-5139	
4	H,D	Digital Delay 7Dll	6625-00-506-1132	
5	H,D	Generator, Square-Wave, equivalent to TEKTRONIX Type PG 501	6625-00-520-5179	
6	H,D	Counter-Timer, equivalent to TEKTRONIX Type DC 504	6625-01-022-3254	
7	H,D	Multimeter, ANIUSM-451, equivalent to Ballantine Type 9632M	6625-00-060-6804	
8	H,D	Power Module, PP-7578/USM-359A, equivalent to TEKTRONIX Type TM 503	6625-00-373-7528	
9	H,D	Extender, Plugin, equivalent to TEKTRONIX Part No. 067-0645-02	4931-01.0394036	
10	H,D	Cable, 2 ea, 50 Ohms, RG-58/U, 41 In., equivalent to TEKTRONIX Part No. 012-0057-01	6625-00-4954831	
11	H,D	Termination, equivalent to TEKTRONIX Part No. 011-0049-01	5985-00-087-4954	
12	H,D	Tool, Kit, Electronic Equipment TK-100/G	5180-00-605-0079	
13	H,D	Auto Transformer, Variable, TF 510/U, equivalent to General Radio W1OMT3VM	6210-00-054-7794	
14	H,D	Test Set, Semiconductor, TS-1836D/U	6625-00-138-7320	
15	H,D	Cable, 20 in. (Two Pin-to-Pin BNC) TEKTRONIX Part No. 175-1178-00		

APPENDIX F
EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

F-1. SCOPE

This appendix lists expendable supplies and materials you will need to operate and maintain the pulse generator. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

F-2. EXPLANATION OF COLUMNS

a. Column(10)- Item number. Not used.

b. Column(2)- Level. This column identifies the lowest level of maintenance that requires the listed item.

(enter as applicable)

C - Operator/Crew
0 - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column(3)- National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column(4)- Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number.

e. Column(5)- Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

SECTION II. EXPENDABLE SUPPLIES AND MATERIALS

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
	0	8020-00-721-9657	Brush, paint	ea
	0	7920-00-862-6710	Cloth, lint-free	yd
	0		Paint	oz
	0		Sandpaper	sh
	0		Detergent	oz
	0	6850-00-105-3084	Trichlorotrifluoroethane	qt

*U.S. GOVERNMENT PRINTING OFFICE: 1981- 703-029: 1049

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

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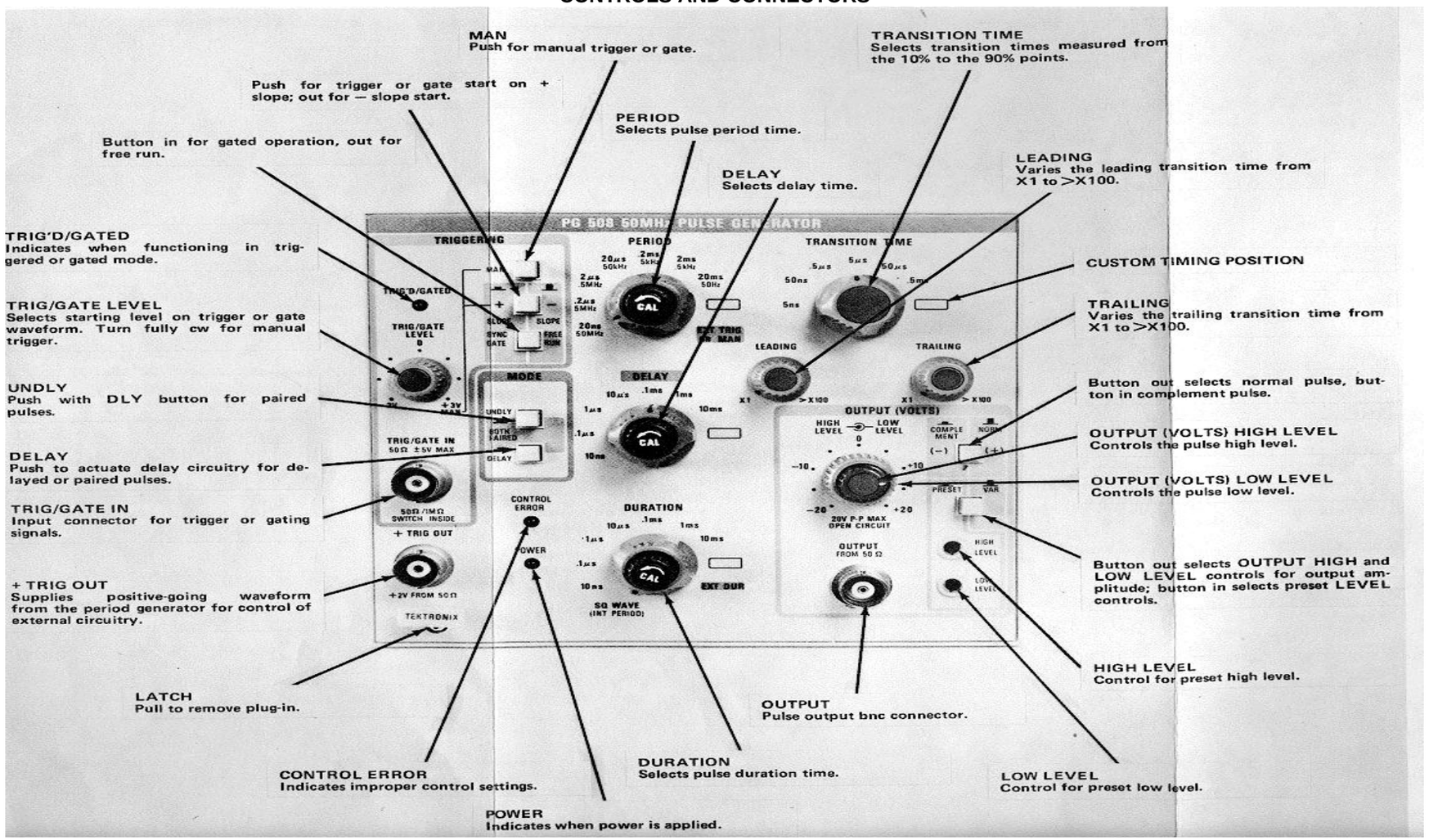
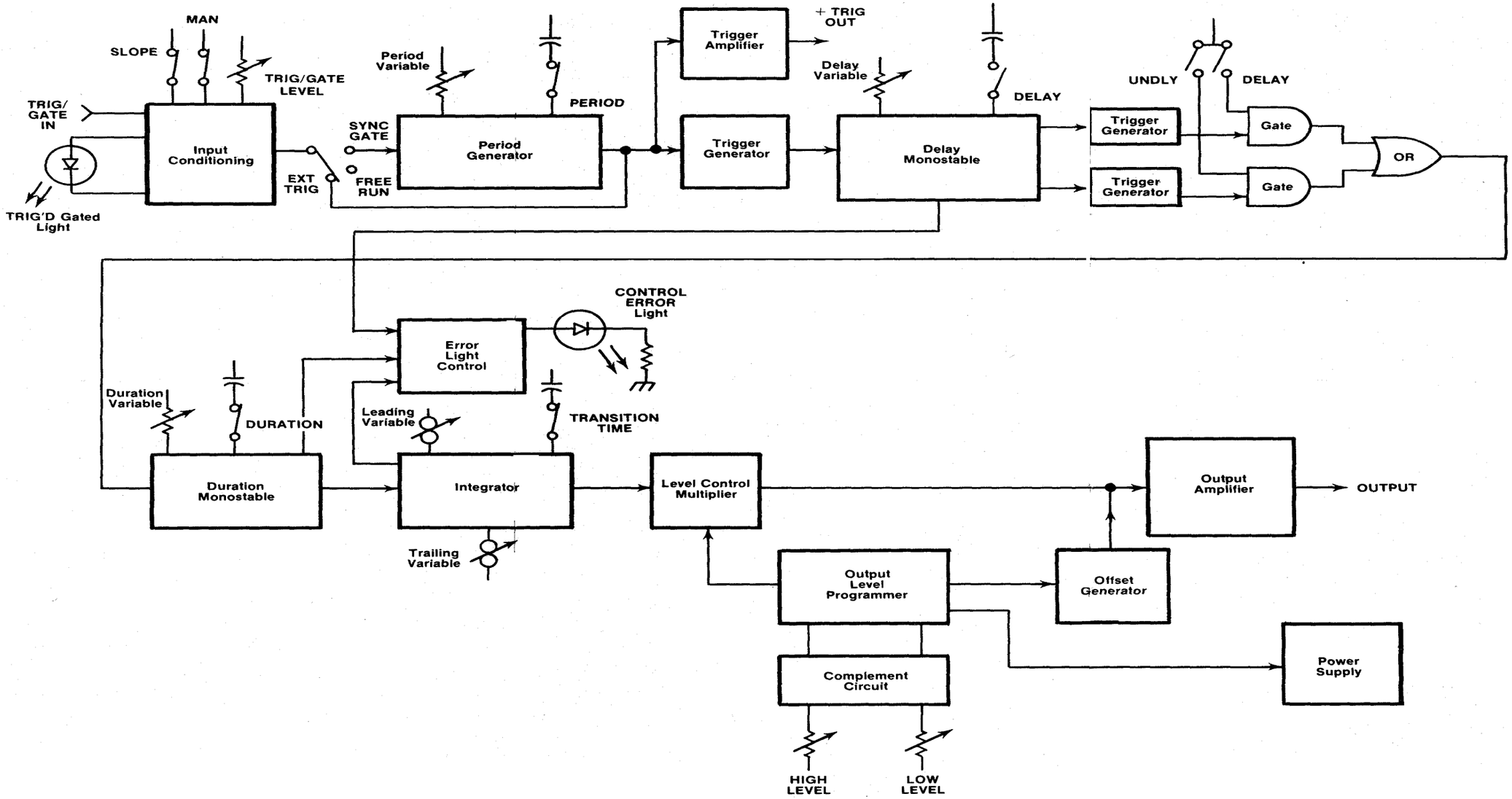
To be distributed in accordance with DA Form 12-34B, Requirements for TMDE/Calbr & Repair.

CONTROLS AND CONNECTORS



FO-1. Controls and connectors



FO-2. Block Diagram

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
OSCILLOSCOPE SYSTEM	TEKTRONIX SC 504. USE A TEKTRONIX P6006 OR P6054 10X PROBE.
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

TRIG/GATE IN	SIGNAL GENERATOR OUTPUT OF 500 Hz AT 150 mV p-p.		
TRIG/GATE LEVEL	SET FOR TRIG'D/GATED INDICATOR FLASHING.		
SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	UNDLY	TRANSITION TIME	5 ns
PERIOD	EXT TRIG	LEADING, TRAILING	FULLY CCW
DURATION	EXT DUR	ALL CAL CONTROLS	FULLY CCW
		DELAY	ANY
		HIGH LEVEL	+5 V
		LOW LEVEL	-5 V

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

WAVEFORMS:

WAVEFORM CONDITIONS ARE THE SAME AS VOLTAGE CONDITIONS WITH THE FOLLOWING EXCEPTIONS:

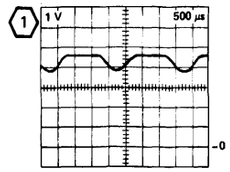
SLOPE -/+	+	SYNC GATE/FREE RUN	SYNC GATE
MODE	PULSE PAIR	DURATION	10 µs
PERIOD	.2 ms	DELAY	.1 ms
		TRANSITION TIME	5 µs

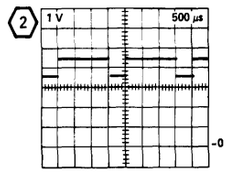
OSCILLOSCOPE SETTINGS:

USE TEE CONNECTOR ON SIGNAL GENERATOR OUTPUT TO EXTERNALLY TRIGGER BOTH THE PULSE GENERATOR AND THE OSCILLOSCOPE. SET FOR AC COUPLE, AUTO MODE AT + LEVEL. USE A 10X PROBE.

NOTE

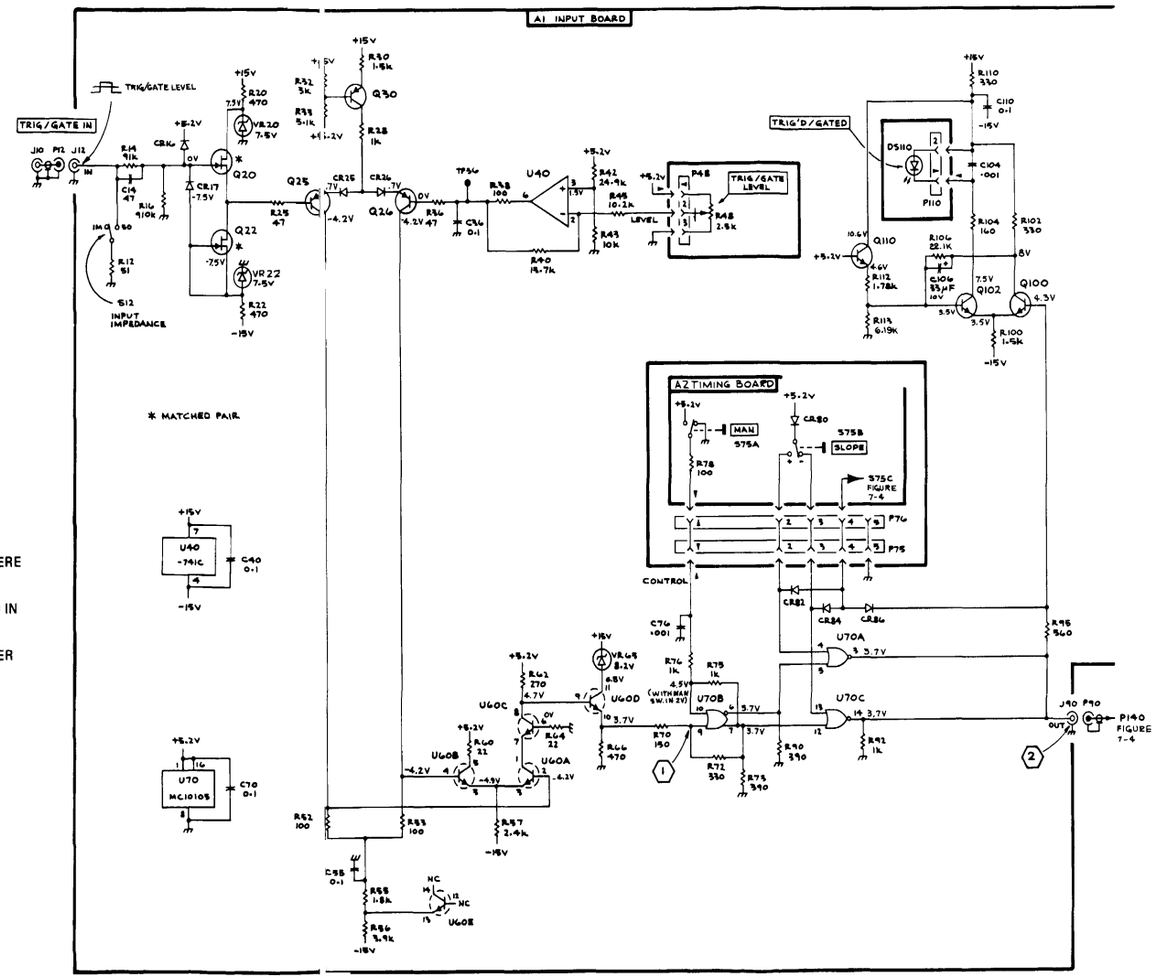
VOLTAGES AND WAVEFORMS MAY VARY BETWEEN INSTRUMENTS.





NOTES

1. ALL VOLTAGES ARE POSITIVE EXCEPT WHERE NEGATIVE POLARITIES ARE SHOWN.
2. ALL RESISTANCE VALUES ARE EXPRESSED IN OHMS UNLESS OTHERWISE SPECIFIED.
3. CAPACITANCE VALUES OF ONE OR GREATER ARE EXPRESSED IN PICOFARADS (pF). CAPACITANCE VALUES OF LESS THAN ONE ARE EXPRESSED IN MICROFARADS (µF).



FO-3. Input circuit schematic diagram.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
OSCILLOSCOPE SYSTEM	TEKTRONIX SC 504. USE A TEKTRONIX P6006 OR P6054 10X PROBE.
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	DELAY	TRANSITION TIME	5 ns
PERIOD	.2 ms	LEADING, TRAILING	FULLY CCW
DURATION	10 µs	ALL CAL CONTROLS	FULLY CCW
		DELAY	.1 ms
		HIGH LEVEL	+5 V
		LOW LEVEL	-5 V

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

WAVEFORMS:

WAVEFORM CONDITIONS ARE THE SAME AS VOLTAGE CONDITIONS WITH THE FOLLOWING EXCEPTIONS:

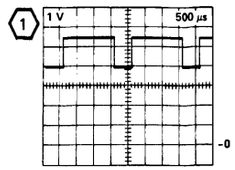
TRIG/GATE IN	SIGNAL GENERATOR OUTPUT OF 500 Hz AT 150 mV p-p.
TRIG/GATE LEVEL	SET FOR TRIG'D/GATED INDICATOR FLASHING.
SLOPE -/+	+
MODE	PULSE PAIR
SYNC GATE/FREE RUN	SYNC GATE

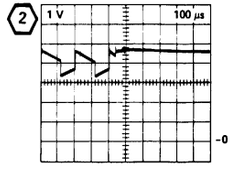
OSCILLOSCOPE SETTINGS:

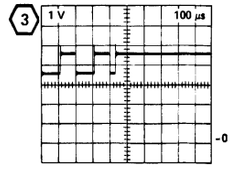
USE TEE CONNECTOR ON SIGNAL GENERATOR OUTPUT TO EXTERNALLY TRIGGER BOTH THE PULSE GENERATOR AND THE OSCILLOSCOPE. SET FOR AC COUPLE, AUTO MODE AT + LEVEL. USE A 10X PROBE.

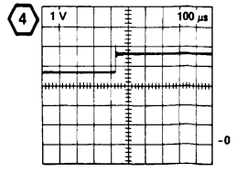
NOTE

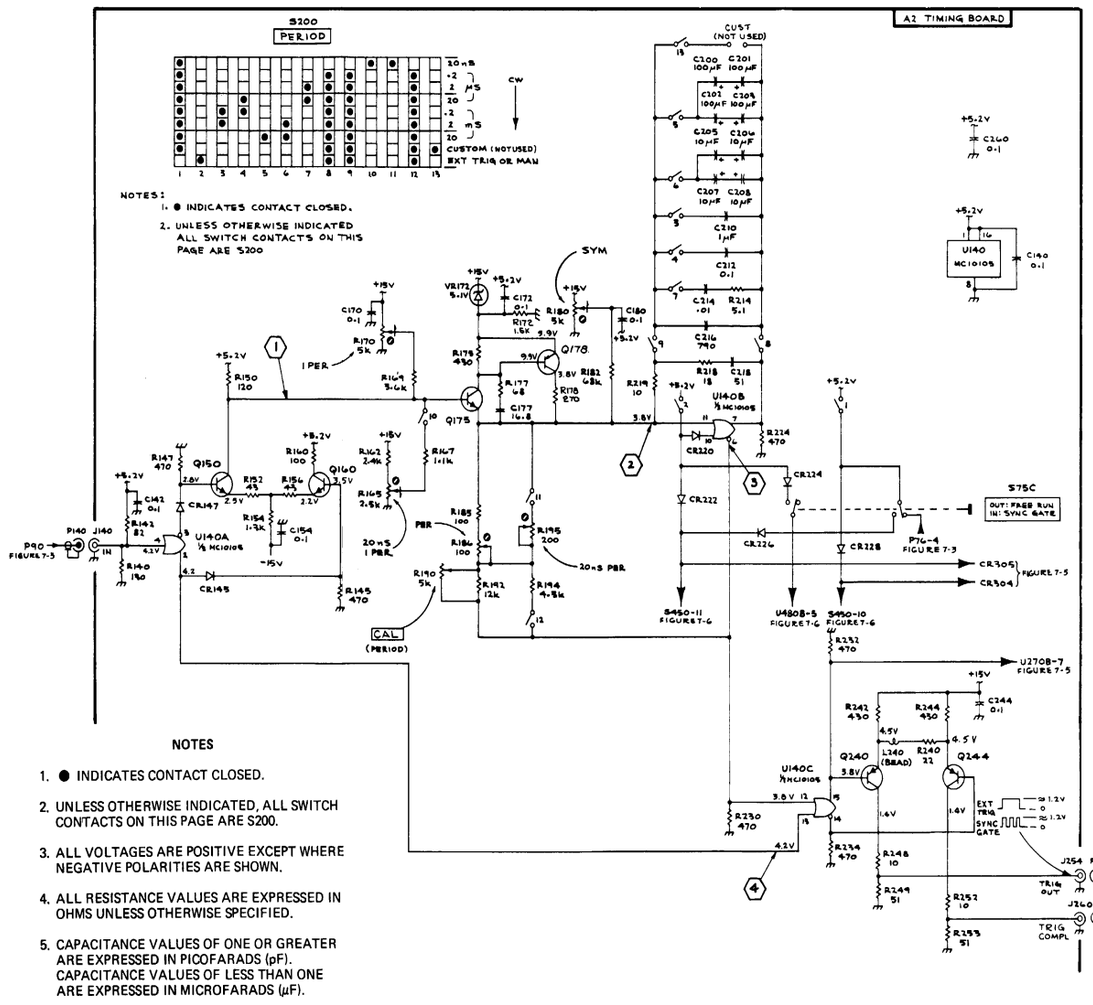
VOLTAGES AND WAVEFORMS MAY VARY BETWEEN INSTRUMENTS.











NOTES

1. ● INDICATES CONTACT CLOSED.
2. UNLESS OTHERWISE INDICATED, ALL SWITCH CONTACTS ON THIS PAGE ARE S200.
3. ALL VOLTAGES ARE POSITIVE EXCEPT WHERE NEGATIVE POLARITIES ARE SHOWN.
4. ALL RESISTANCE VALUES ARE EXPRESSED IN OHMS UNLESS OTHERWISE SPECIFIED.
5. CAPACITANCE VALUES OF ONE OR GREATER ARE EXPRESSED IN PICOFARADS (pF). CAPACITANCE VALUES OF LESS THAN ONE ARE EXPRESSED IN MICROFARADS (µF).

FO-4. Period generator schematic diagram

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
OSCILLOSCOPE SYSTEM	TEKTRONIX SC 504. USE A TEKTRONIX P6006 OR P6054 10X PROBE.
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	DELAY	TRANSITION TIME	5 ns
PERIOD	2 μs	LEADING, TRAILING	FULLY CCW
DURATION	10 μs	ALL CAL CONTROLS	FULLY CCW
DELAY	1 μs	HIGH LEVEL	+5 V
		LOW LEVEL	-5 V

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

WAVEFORMS:

WAVEFORM CONDITIONS ARE THE SAME AS VOLTAGE CONDITIONS WITH THE FOLLOWING EXCEPTIONS:

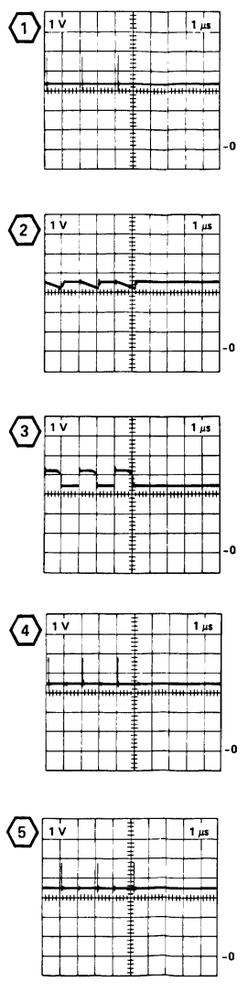
TRIG/GATE IN	SIGNAL GENERATOR OUTPUT OF 50 kHz AT 150 mV p-p.
TRIG/GATE LEVEL	SET FOR TRIG'D/GATED INDICATOR FLASHING.
SLOPE -/+	-
MODE	PULSE PAIR
SYNC GATE/FREE RUN	SYNC GATE

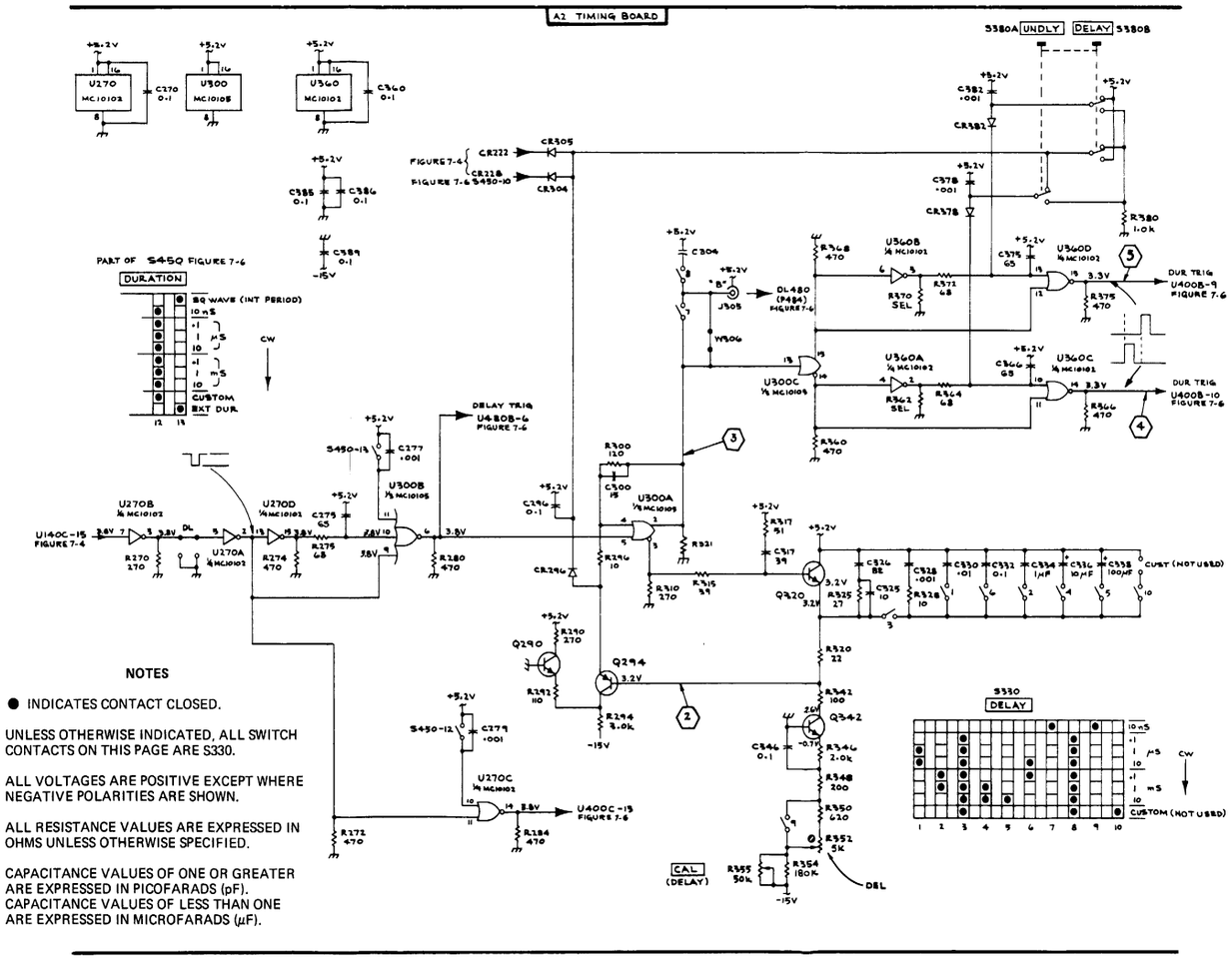
OSCILLOSCOPE SETTINGS:

USE TEE CONNECTOR ON SIGNAL GENERATOR OUTPUT TO EXTERNALLY TRIGGER BOTH THE PULSE GENERATOR AND THE OSCILLOSCOPE. SET FOR AC COUPLE, AUTO MODE AT + LEVEL.

NOTE

VOLTAGES AND WAVEFORMS MAY VARY BETWEEN INSTRUMENTS.





FO-5. Delay generator schematic diagram.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
OSCILLOSCOPE SYSTEM	TEKTRONIX SC 504. USE A TEKTRONIX P6006 OR P6054 10X PROBE.
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	DELAY	TRANSITION TIME	50 ns
PERIOD	2 μs	LEADING, TRAILING	FULLY CCW
DURATION	.1 μs	ALL CAL CONTROLS	FULLY CCW
DELAY	1 μs	HIGH LEVEL	+5 V
		LOW LEVEL	-5 V

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

WAVEFORMS:

WAVEFORM CONDITIONS ARE THE SAME AS VOLTAGE CONDITIONS WITH THE FOLLOWING EXCEPTIONS:

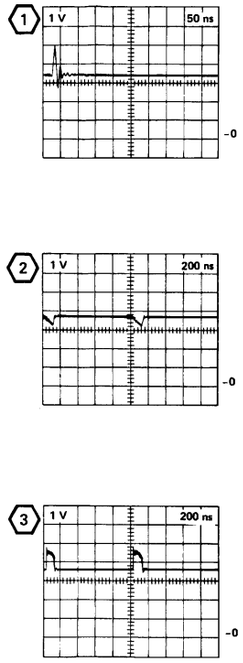
TRIG/GATE IN	SIGNAL GENERATOR OUTPUT OF 50 kHz AT 150 mV p-p.
TRIG/GATE LEVEL	SET FOR TRIG'D/GATED INDICATOR FLASHING.
SLOPE -/+	+
MODE	PULSE PAIR
SYNC GATE/FREE RUN	SYNC GATE

OSCILLOSCOPE SETTINGS:

USE TEE CONNECTOR ON SIGNAL GENERATOR OUTPUT TO EXTERNALLY TRIGGER BOTH THE PULSE GENERATOR AND THE OSCILLOSCOPE. SET FOR AC COUPLE, AUTO MODE AT + LEVEL.

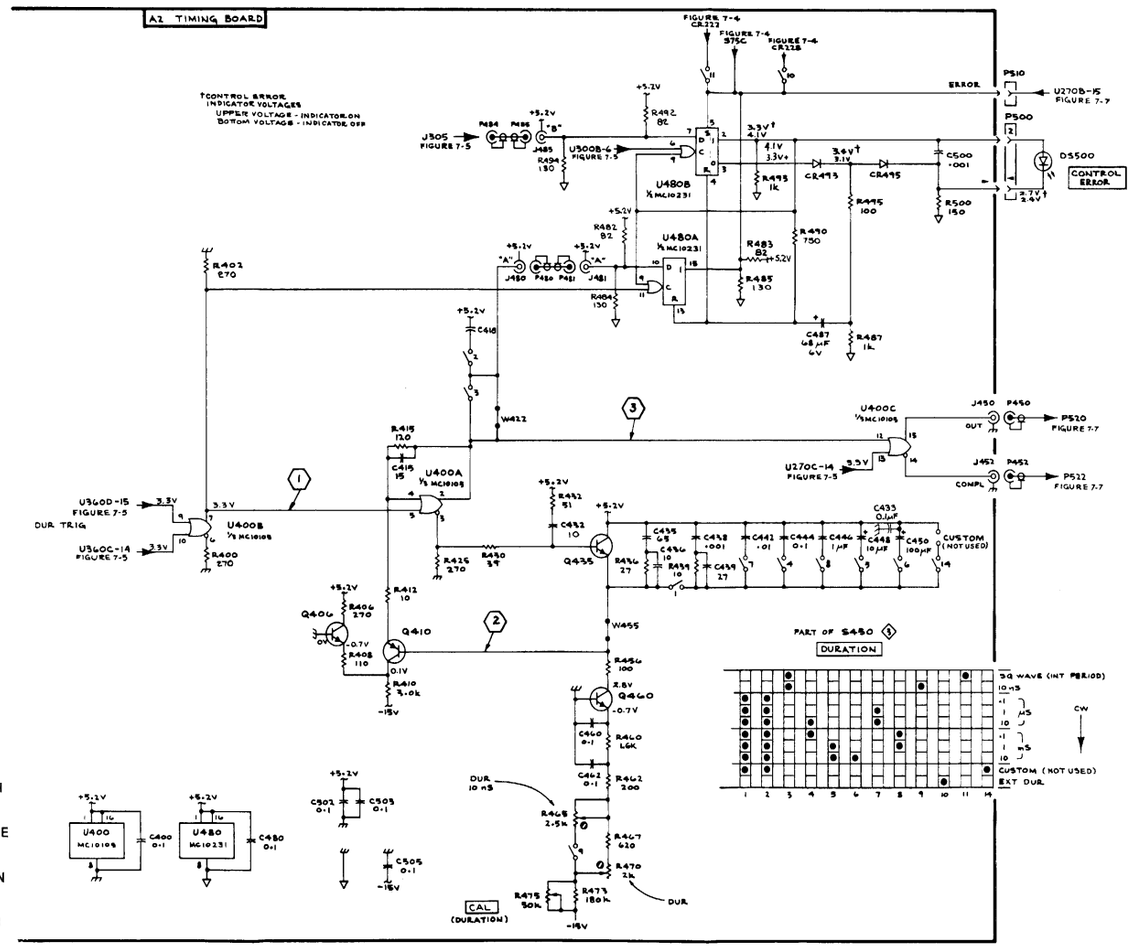
NOTE

VOLTAGES AND WAVEFORMS MAY VARY BETWEEN INSTRUMENTS.



NOTES

1. ● INDICATES CONTACT CLOSED.
2. UNLESS OTHERWISE INDICATED, ALL SWITCH CONTACTS ON THIS PAGE ARE S450.
3. ALL VOLTAGES ARE POSITIVE EXCEPT WHERE NEGATIVE POLARITIES ARE SHOWN.
4. ALL RESISTANCE VALUES ARE EXPRESSED IN OHMS UNLESS OTHERWISE SPECIFIED.
5. CAPACITANCE VALUES OF ONE OR GREATER ARE EXPRESSED IN PICOFARADS (pF). CAPACITANCE VALUES OF LESS THAN ONE ARE EXPRESSED IN MICROFARADS (μF).



FO-6. Duration generator and control error circuit schematic diagram.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
OSCILLOSCOPE SYSTEM	TEKTRONIX SC 504. USE A TEKTRONIX P6006 OR P6054 10X PROBE.
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	DELAY	TRANSITION TIME	5 ns
PERIOD	.2 ms	LEADING, TRAILING	FULLY CCW
DURATION	10 μs	ALL CAL CONTROLS	FULLY CCW
DELAY	.1 ms	HIGH LEVEL	+5 V
		LOW LEVEL	-5 V

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

WAVEFORMS:

WAVEFORM CONDITIONS ARE THE SAME AS VOLTAGE CONDITIONS WITH THE FOLLOWING EXCEPTIONS:

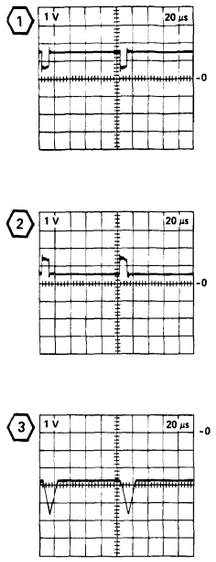
TRIG/GATE IN	SIGNAL GENERATOR OUTPUT OF 500 Hz AT 150 mV p-p.
TRIG/GATE LEVEL	SET FOR TRIG'D/GATED INDICATOR FLASHING.
SLOPE -/+	+
MODE	PULSE PAIR
SYNC GATE/FREE RUN	SYNC GATE
TRANSITION TIME	5 μs

OSCILLOSCOPE SETTINGS:

USE TEE CONNECTOR ON SIGNAL GENERATOR OUTPUT TO EXTERNALLY TRIGGER BOTH THE PULSE GENERATOR AND THE OSCILLOSCOPE. SET FOR AC COUPLE, AUTO MODE AT + LEVEL.

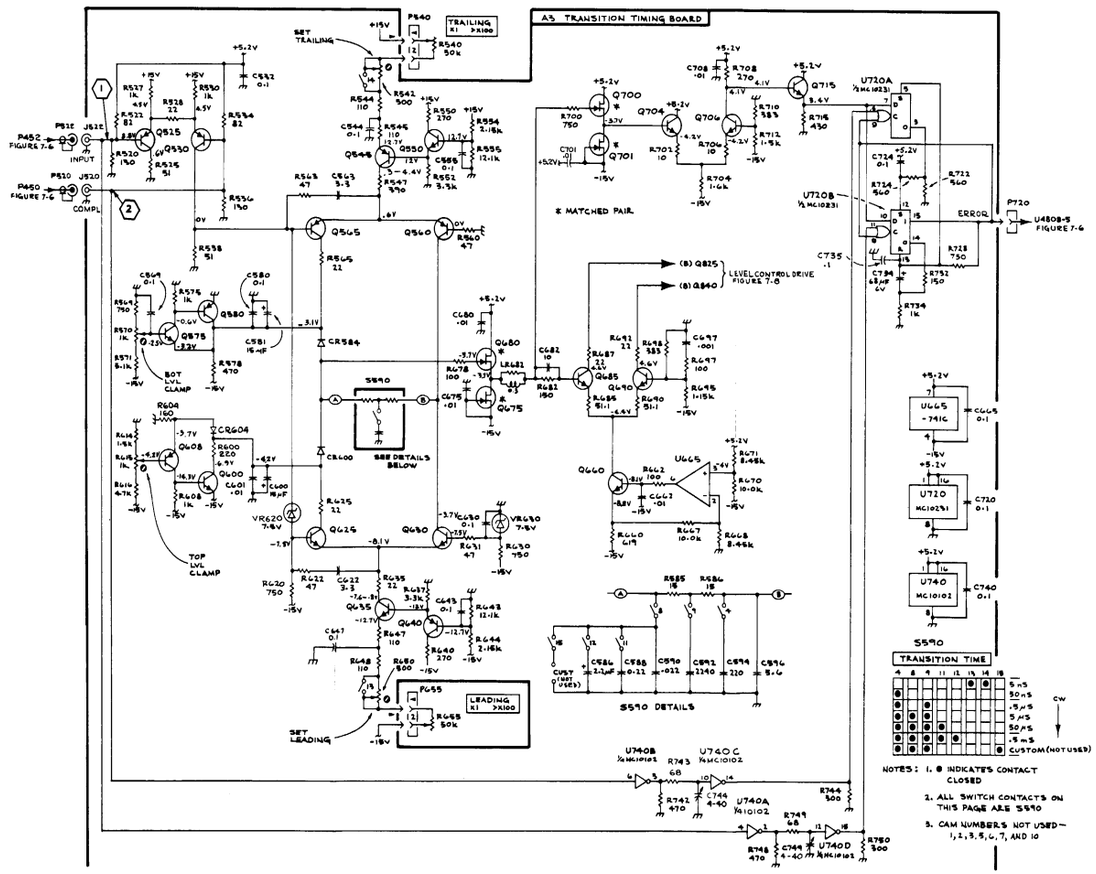
NOTE

VOLTAGES AND WAVEFORMS MAY VARY BETWEEN INSTRUMENTS.



NOTES

1. ● INDICATES CONTACT CLOSED.
2. ALL SWITCH CONTACTS ON THIS PAGE ARE S590.
3. CAM NUMBERS NOT USED – 1, 2, 3, 5, 6, 7, AND 10.
4. ALL VOLTAGES ARE POSITIVE EXCEPT WHERE NEGATIVE POLARITIES ARE SHOWN.
5. ALL RESISTANCE VALUES ARE EXPRESSED IN OHMS UNLESS OTHERWISE SPECIFIED.
6. CAPACITANCE VALUES OF ONE OR GREATER ARE EXPRESSED IN PICOFARADS (pF). CAPACITANCE VALUES OF LESS THAN ONE ARE EXPRESSED IN MICROFARADS (μF).
7. INDUCTANCE VALUES ARE EXPRESSED IN MICROHENRYS (μH).



FO 7. Transition time generator schematic diagram

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
OSCILLOSCOPE SYSTEM	TEKTRONIX SC 504. USE A TEKTRONIX P6006 OR P6054 10X PROBE.
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	DELAY	TRANSITION TIME	5 ns
PERIOD	.2 ms	LEADING, TRAILING	FULLY CCW
DURATION	10 µs	ALL CAL CONTROLS	FULLY CCW
DELAY	.1 ms	HIGH LEVEL	+5 V
		LOW LEVEL	-5 V

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

WAVEFORMS:

WAVEFORM CONDITIONS ARE THE SAME AS VOLTAGE CONDITIONS WITH THE FOLLOWING EXCEPTIONS:

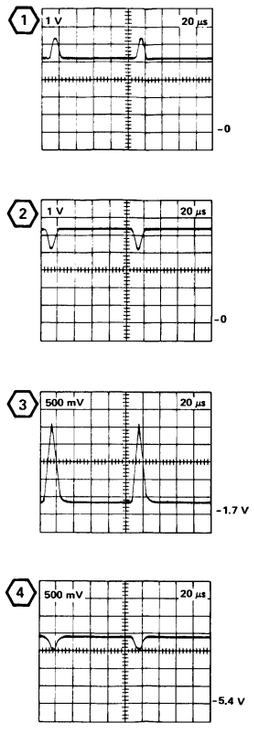
TRIG/GATE IN	SIGNAL GENERATOR OUTPUT OF 500 Hz AT 150 mV p-p.
TRIG/GATE LEVEL	SET FOR TRIG'D/GATED INDICATOR FLASHING.
SLOPE -/+	+
MODE	PULSE PAIR
SYNC GATE/FREE RUN	SYNC GATE
TRANSITION TIME	5 µs

OSCILLOSCOPE SETTINGS:

USE TEE CONNECTOR ON SIGNAL GENERATOR OUTPUT TO EXTERNALLY TRIGGER BOTH THE PULSE GENERATOR AND THE OSCILLOSCOPE. SET FOR AC COUPLE, AUTO MODE AT + LEVEL.

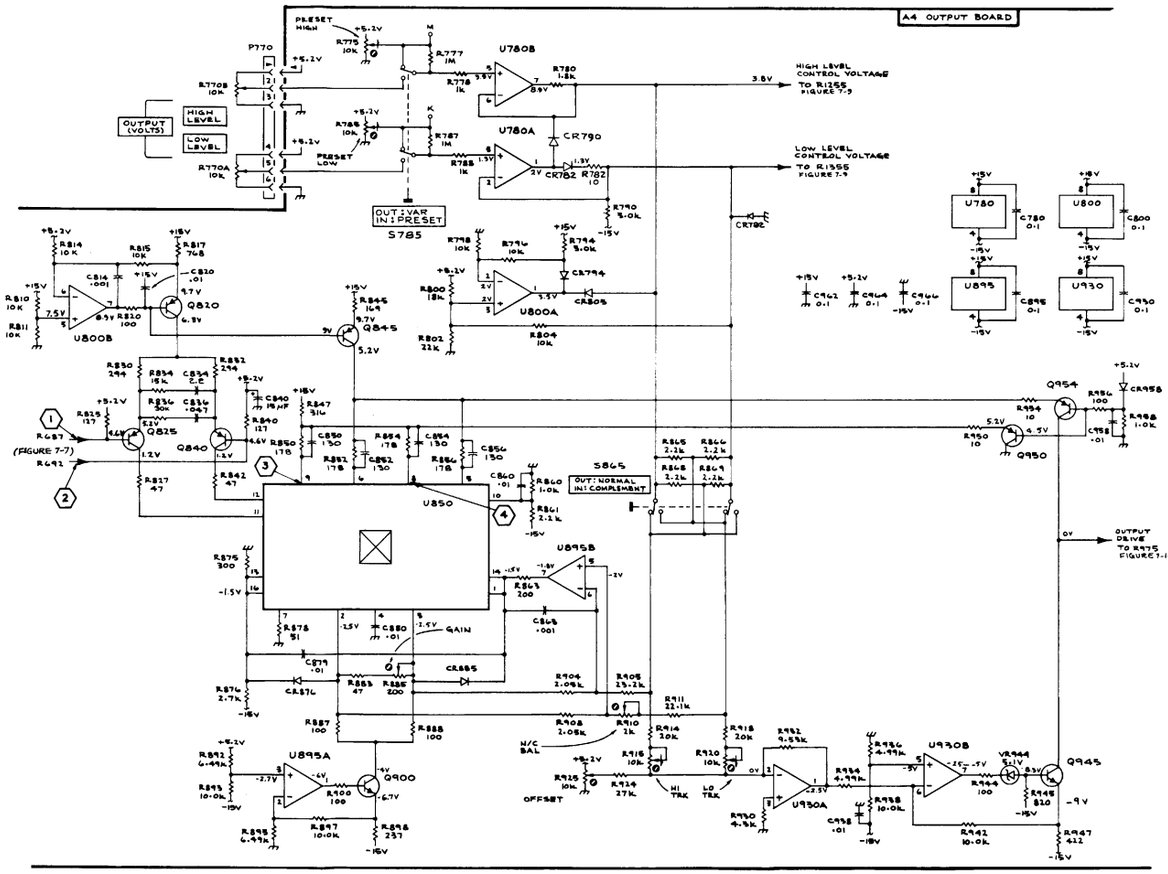
NOTE

VOLTAGES AND WAVEFORMS MAY VARY BETWEEN INSTRUMENTS.



NOTES

1. ALL VOLTAGES ARE POSITIVE EXCEPT WHERE NEGATIVE POLARITIES ARE SHOWN.
2. ALL RESISTANCE VALUES ARE EXPRESSED IN OHMS UNLESS OTHERWISE SPECIFIED.
3. CAPACITANCE VALUES OF ONE OR GREATER ARE EXPRESSED IN PICOFARADS (pF). CAPACITANCE VALUES OF LESS THAN ONE ARE EXPRESSED IN MICROFARADS (µF).



FO -8. Level control multiplier schematic diagram.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
OSCILLOSCOPE SYSTEM	TEKTRONIX SC 504. USE A TEKTRONIX P6006 OR P6054 10X PROBE.
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	DELAY	TRANSITION TIME	5 ns
PERIOD	.2 ms	LEADING, TRAILING	FULLY CCW
DURATION	10 μs	ALL CAL CONTROLS	FULLY CCW
DELAY	.1 ms	HIGH LEVEL	+5 V
		LOW LEVEL	-5 V

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

WAVEFORMS:

WAVEFORM CONDITIONS ARE THE SAME AS VOLTAGE CONDITIONS WITH THE FOLLOWING EXCEPTIONS:

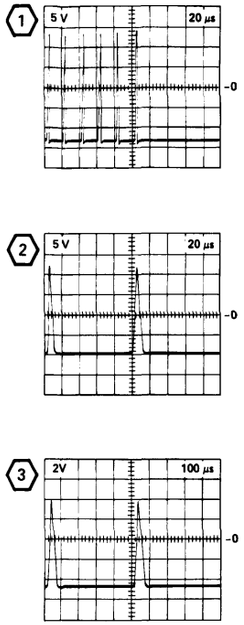
TRIG/GATE IN	SIGNAL GENERATOR OUTPUT OF 500 Hz AT 150 mV p-p.
TRIG/GATE LEVEL	SET FOR TRIG'D/GATED INDICATOR FLASHING.
SLOPE -/+	+
MODE	PULSE PAIR
SYNC GATE/FREE RUN	SYNC GATE
TRANSITION TIME	5 μs

OSCILLOSCOPE SETTINGS:

USE TEE CONNECTOR ON SIGNAL GENERATOR OUTPUT TO EXTERNALLY TRIGGER BOTH THE PULSE GENERATOR AND THE OSCILLOSCOPE. SET FOR AC COUPLE, AUTO MODE AT + LEVEL.

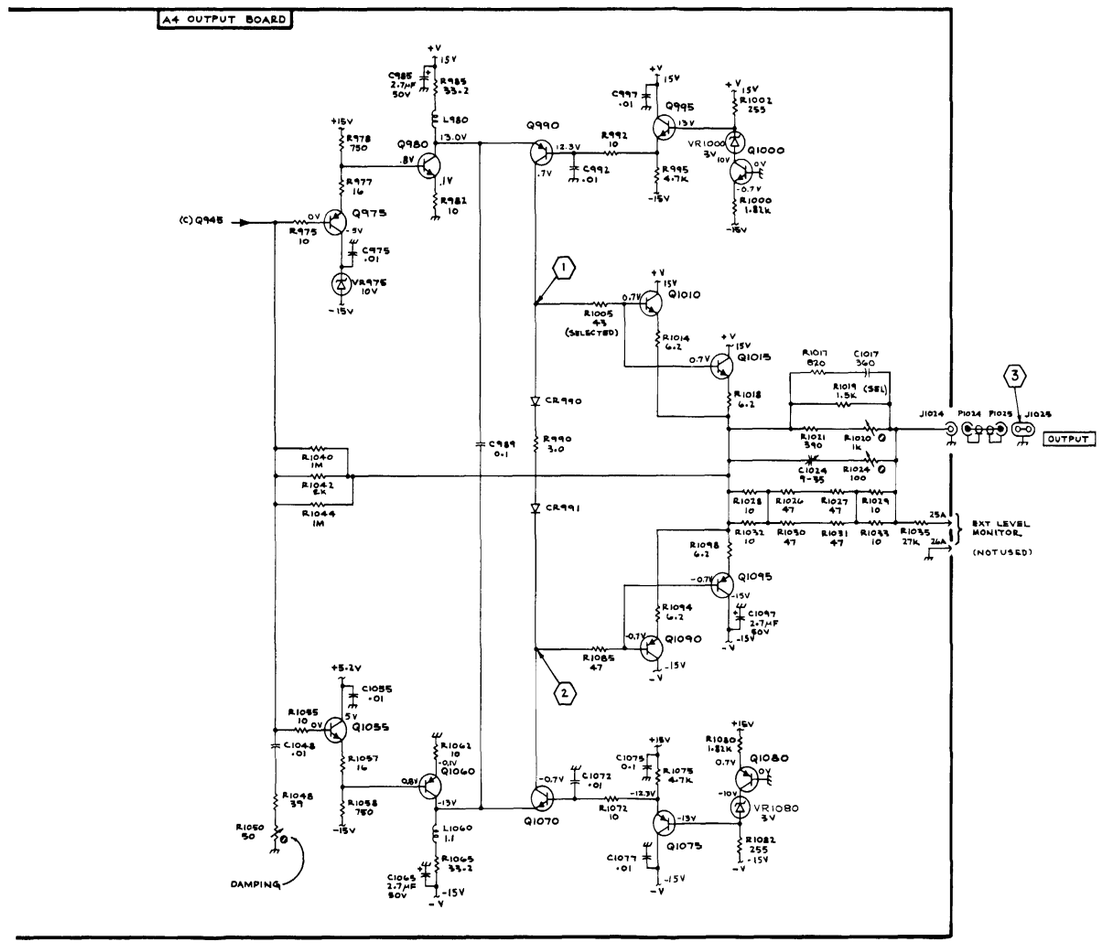
NOTE

VOLTAGES AND WAVEFORMS MAY VARY BETWEEN INSTRUMENTS.



NOTES

1. +V and -V ARE + AND - TRACKING VOLTAGES FROM FIGURE 7-9.
2. ALL VOLTAGES ARE POSITIVE EXCEPT WHERE NEGATIVE POLARITIES ARE SHOWN.
3. ALL RESISTANCE VALUES ARE EXPRESSED IN OHMS UNLESS OTHERWISE SPECIFIED.
4. CAPACITANCE VALUES OF ONE OR GREATER ARE EXPRESSED IN PICOFARADS (pF). CAPACITANCE VALUES OF LESS THAN ONE ARE EXPRESSED IN MICROFARADS (μF).
5. INDUCTANCE VALUES ARE EXPRESSED IN MICROHENRYS (μH).



FO -9. Output amplifier schematic diagram.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

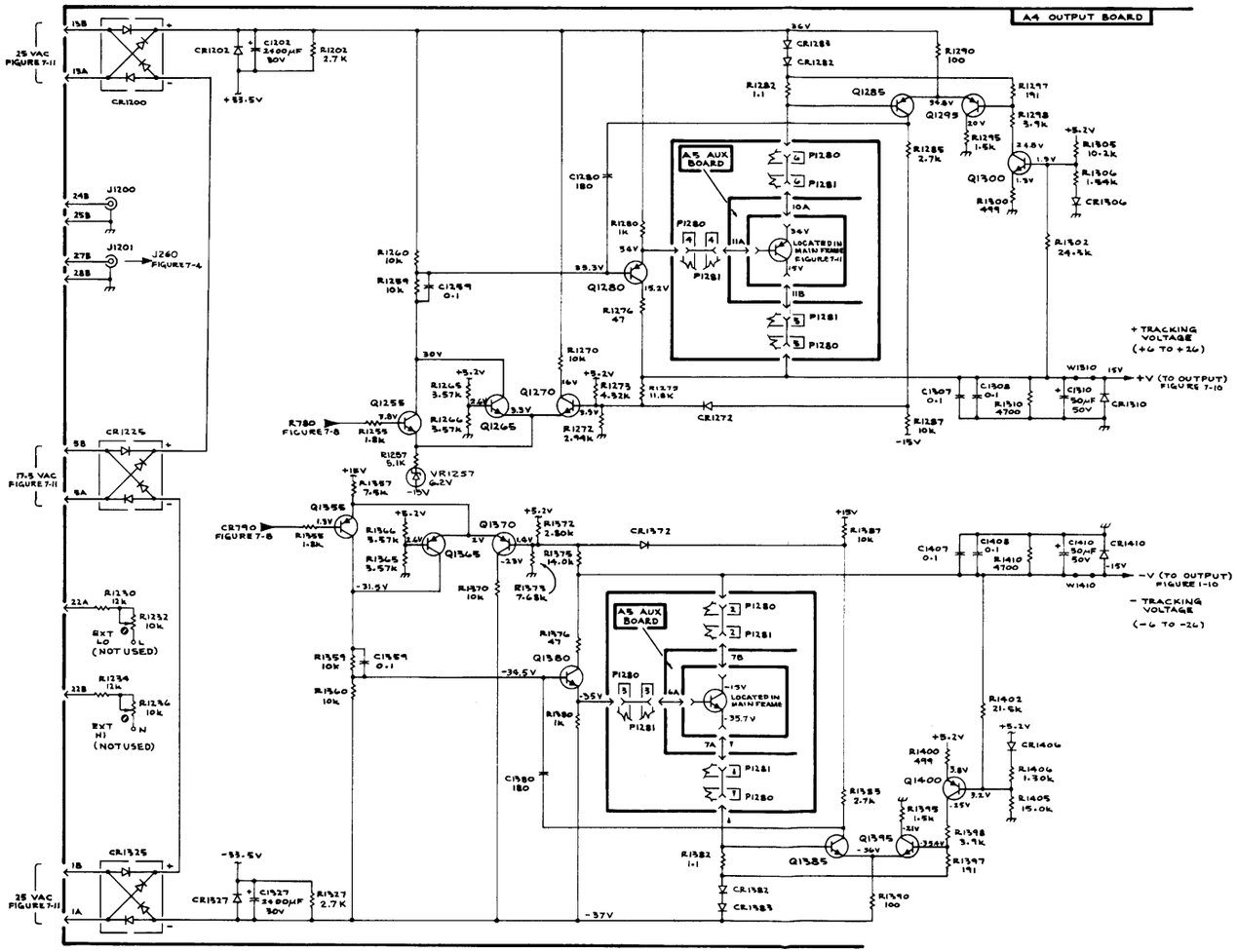
SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	DELAY	TRANSITION TIME	5 ns
PERIOD	.2 ms	LEADING, TRAILING	FULLY CCW
DURATION	10 μs	ALL CAL CONTROLS	FULLY CCW
DELAY	.1 ms		

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

NOTE

VOLTAGES MAY VARY BETWEEN INSTRUMENTS.



FO-10. Tracking voltage supply schematic diagram

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

SLOPE -/+	-	SYNC GATE/FREE RUN	FREE RUN
MODE	DELAY	TRANSITION TIME	5 ns
PERIOD	.2 ms	LEADING, TRAILING	FULLY CCW
DURATION	10 μs	ALL CAL CONTROLS	FULLY CCW
DELAY	.1 ms	HIGH LEVEL	+5 V
		LOW LEVEL	-5 V

ALL VOLTAGES POSITIVE EXCEPT WHERE NEGATIVE POLARITIES ARE SHOWN.

VOLTMETER SETTINGS:

VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND. ALL RESISTANCE VALUES ARE EXPRESSED IN OHMS. CAPACITANCE VALUES OF ONE OR GREATER ARE EXPRESSED IN PICOFARADS (pF). CAPACITANCE VALUES OF LESS THAN ONE ARE EXPRESSED IN MICROFARADS (μF).

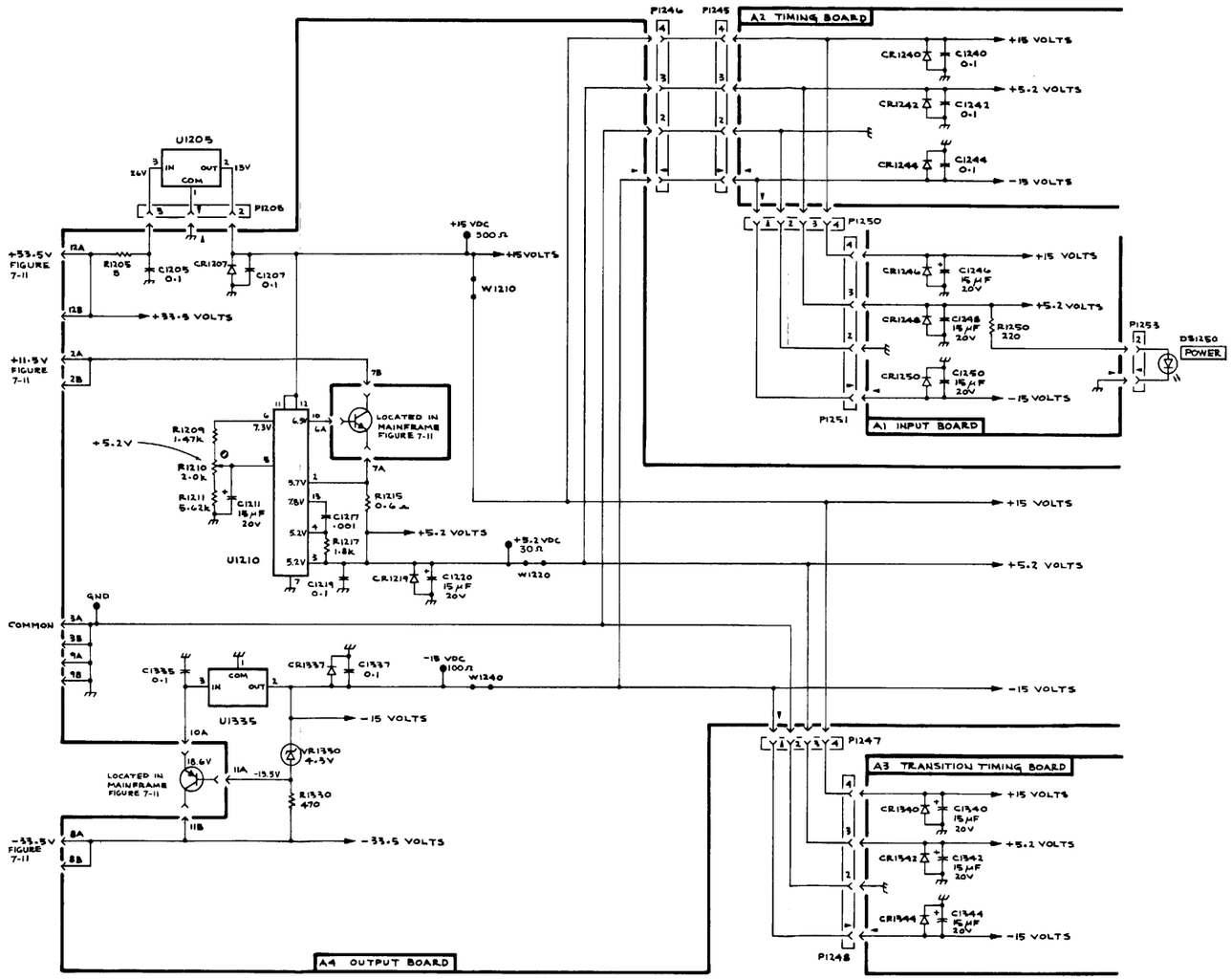
RESISTANCE MEASUREMENTS:

RESISTANCE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

ALL SETTINGS THE SAME AS ABOVE. POWER SWITCH TO OFF. OHMMETER SETTINGS. OHMMETER SET TO CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

NOTE

VOLTAGES AND RESISTANCES MAY VARY BETWEEN INSTRUMENTS.



FO-11. PG 508 power supply schematic diagram.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

DANGEROUS POTENTIALS EXIST AT SEVERAL POINTS THROUGHOUT THIS INSTRUMENT. WHEN THE INSTRUMENT IS OPERATED WITH THE COVERS REMOVED, DO NOT TOUCH EXPOSED CONNECTIONS OR COMPONENTS. SOME TRANSISTORS HAVE VOLTAGES PRESENT ON THEIR CASES. DISCONNECT THE POWER SOURCE BEFORE REPLACING PARTS.

RECOMMENDED TEST EQUIPMENT

ITEM	RECOMMENDED TYPE
VOLTMETER (NON-LOADING DIGITAL MULTIMETER)	TEKTRONIX DM 501 DIGITAL MULTIMETER.

VOLTAGE MEASUREMENTS:

VOLTAGE MEASUREMENTS ON THIS DIAGRAM WERE MADE UNDER THE FOLLOWING CONDITIONS:

WITH PLUG-IN UNIT REMOVED.

VOLTMETER SETTINGS:

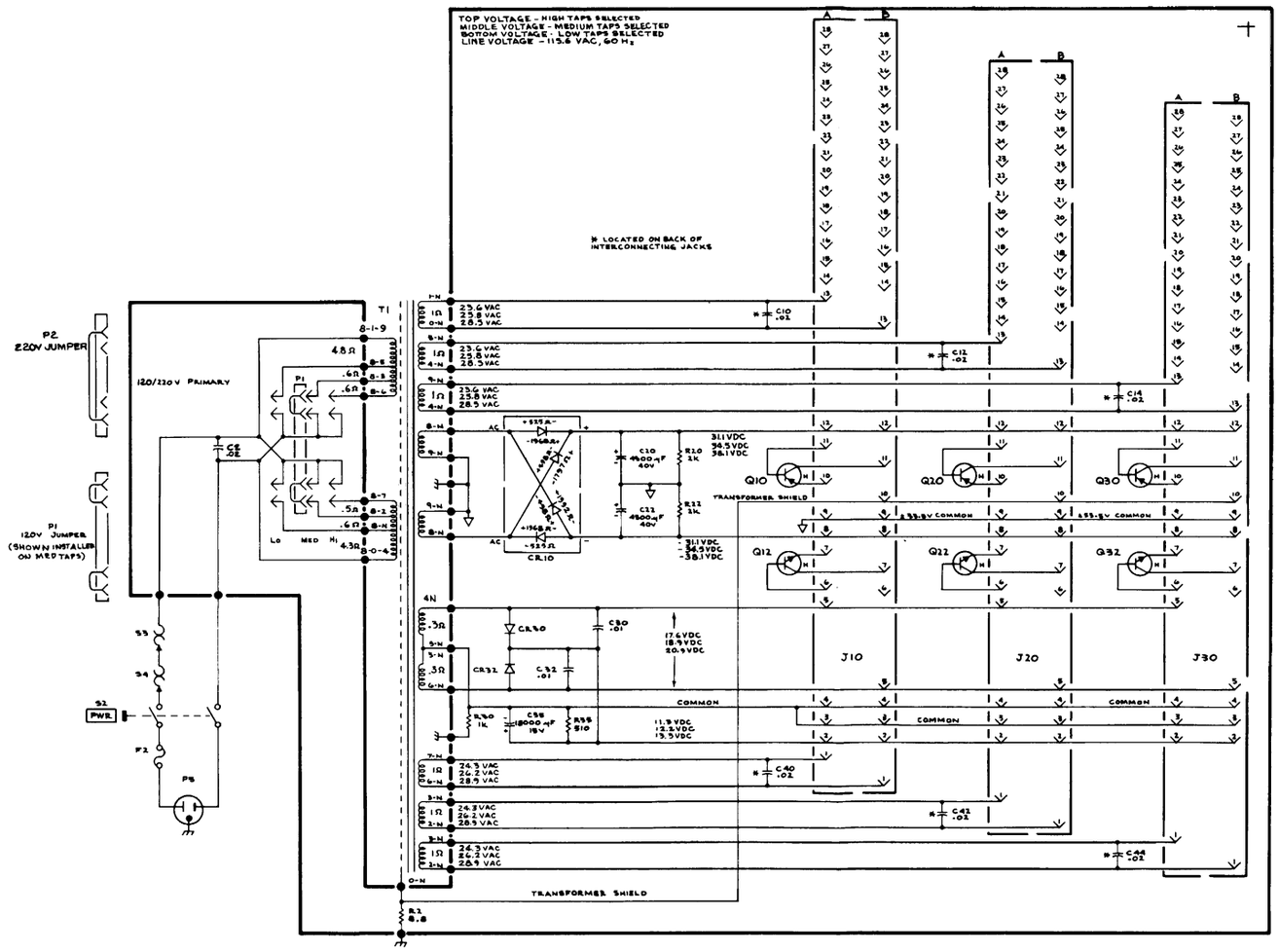
VOLTMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

RESISTANCE MEASUREMENTS:

RESISTANCE MEASUREMENTS MADE WITH POWER SWITCH OFF AND PLUG-IN UNIT REMOVED. TRANSFORMER INPUT WINDING MEASUREMENTS MADE WITH INPUT JUMPER REMOVED. OHMMETER SET FOR CLOSEST TO MID-SCALE READING WITH COMMON TERMINAL ATTACHED TO CHASSIS GROUND.

NOTE

VOLTAGES MAY VARY BETWEEN INSTRUMENTS.

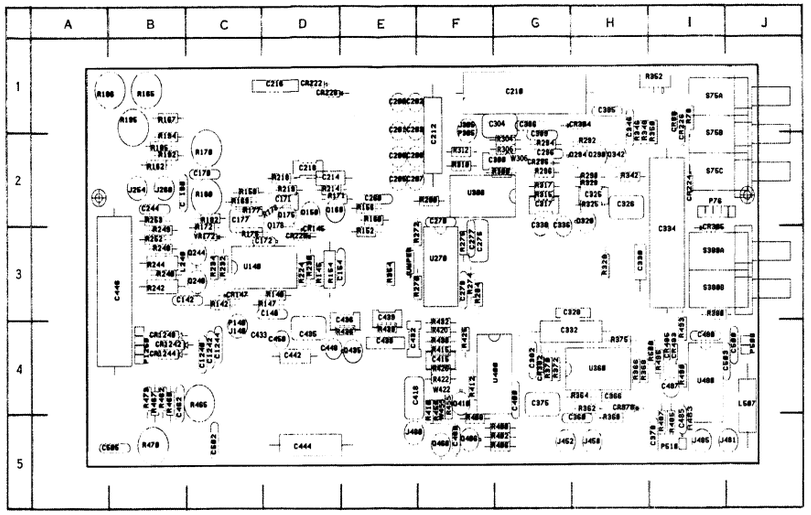


FO-12. TM 503 power supply schematic diagram.

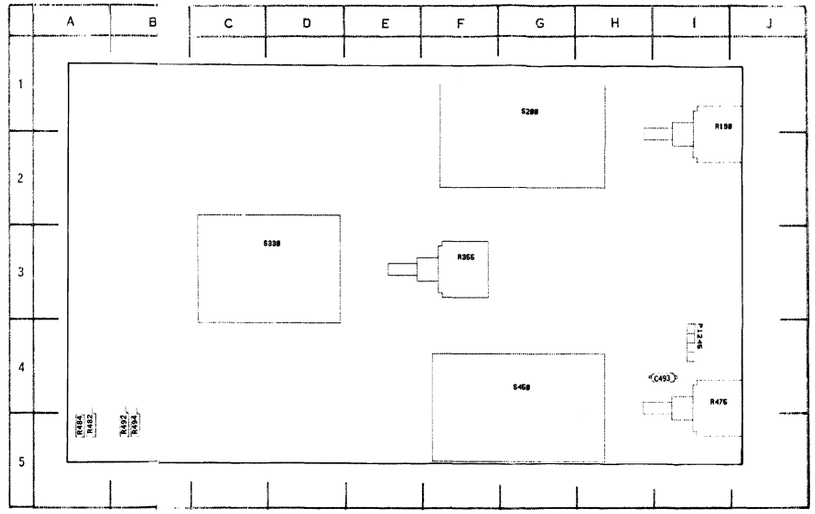
PG 508

PARTS LOCATION GRID

TIMING BOARD (A2)



(BACKSIDE) TIMING BOARD (A2)



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C140	D3	C218	D2	C360	H5	C450	D4	CR296	G2	L240	B3	Q406	F5	R171	D2	R242	B3	R312†	F2	R375	H4	R462	B4	U140	C3
C142	B3	C244	B2	C366	H4	C460	F5	CR304	H1	L507†	J4	Q410	F4	R172	C3	R244	B3	R315	G2	R380	I3	R465	C4	U270	F3
C154	D3	C260	E2	C375	G4	C462	B4	CR305	I2			Q435	E4	R175	C3	R248	B3	R317	G2	R400	G5	R467	B4	U300	F2
C170	C2	C270	F2	C378	I5	C480	I4	CR378	H4	P76	I2	Q460	F5	R177	C2	R249	B3	R320	H2	R402	G5	R470	B5	U360	H4
C171†	D2	C275	F3	C382	G4	C485†	I5	CR382	G4	P140	C4			R178†	D2	R252	B3	R325	H2	R406	G5	R473†	B4	U400	F4
C172	C3	C277	F3	C385	H1	C487	I4	CR493	I4	P305	F1	R78	I1	R180	C2	R253	B2	R328	H3	R408	F5	R475*	I4	U480	I4
C177	C2	C279	F3	C386	G1	C493*†	I4	CR495	I4	P500	J4	R140	D3	R182	C2	R270	E3	R342	H2	R410	F4	R482††	I4		
C180	B2	C296	G2	C389	G1	C500	J4	CR1240	B4	P510	I5	R142	C3	R185	B2	R272	E3	R346	H1	R412	F4	R483†	I5		
C200	E1	C300	G2	C400	G4	C502	C5	CR1242	B4	P1246*	I4	R145	D3	R186	A1	R274	F3	R348	H1	R415	F4	R484*†	A5	VR172	C3
C201	E1	C304†	G1	C415	F4	C503	J4	CR1244	B4	P1250	B4	R147	D3	R190*	I1	R275	F3	R350	I1	R420†	F4	R485	I5		
C202	E1	C317	G2	C418†	E4	C505	B5					R150	C2	R192	B2	R280	F2	R352†	I1	R422†	F4	R487	I5		
C203	E1	C325	H2	C432†	E4	C1240	C4	J140	C4	Q150	B2	R152	E3	R194	B2	R284	F3	R354†	E3	R425	F4	R490	I4	W306†	G2
C205	E2	C326	H2	C433†	C4	C1242	C4	J254	B2	Q180	B2	R154	D3	R195	B1	R290	H2	R355*	F3	R426†	F4	R492††	J4	W422†	F4
C206	E2	C328	H3	C435	D4	C1244	C4	J260	B2	Q175	B2	R156	E2	R214	D2	R292	H2	R360	H5	R430	F4	R493	I4	W455†	F4
C207	E2	C330	H3	C436	D3			J305	F1	Q178†	D3	R160	E2	R218	D2	R294	G2	R362	H4	R432	F4	R494*†	B5		
C208	E2	C332	G4	C438	E4	CR145	D3	J450	H5	Q240	C3	R162	B2	R219	D2	R296	G2	R364	H4	R436	E4	R495	I4		
C210	G1	C334	I2	C439	E3	CR147	C3	J452	G5	Q244	C3	R165	B1	R224	D3	R300	G2	R366	H4	R439	E4	R500	I4		
C212	F1	C336	G2	C442	D4	CR220	D3	J480	E5	Q290	H2	R167	B1	R230	D3	R304†	G2	R368	H4	R455†	F4	S75	I1		
C214	D2	C338	G2	C444	D5	CR222	D1	J481	J5	Q294	H2	R169	C2	R232	C3	R306†	G2	R370	G4	R456	F4	S200*	G1		
C216	D1	C346	H1	C446	A3	CR224	I2	J485	I5	Q320	H2	R170	C2	R234	C3	R310	F2	R372	G4	R460	B4	S330*	C3		
				C448	D4	CR226	I1			Q342	H2			R240	B3							S380	I3		
						CR228	D1															S450*	G4		

REV. B APR 1978

*On back of board

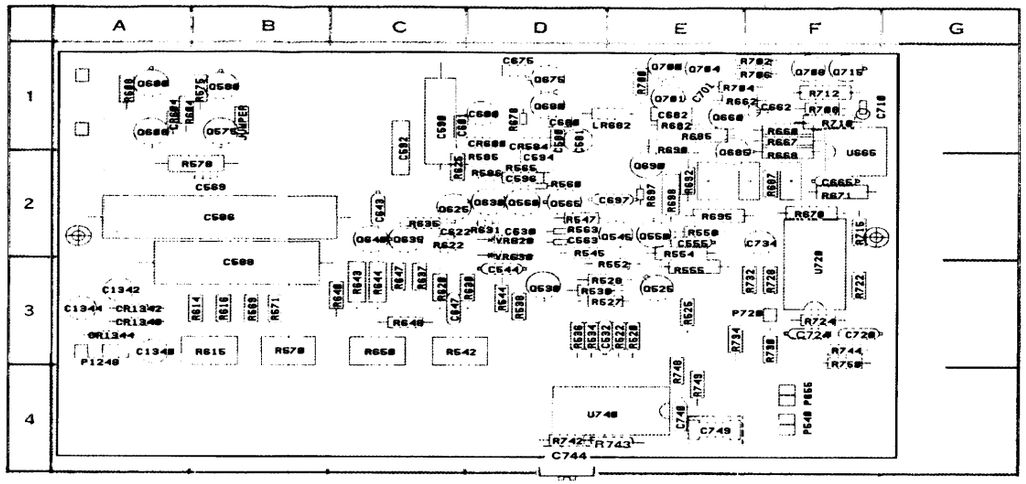
†See Parts List for serial number ranges.

††R482 & R492 moved to back of board effective SN B020245.

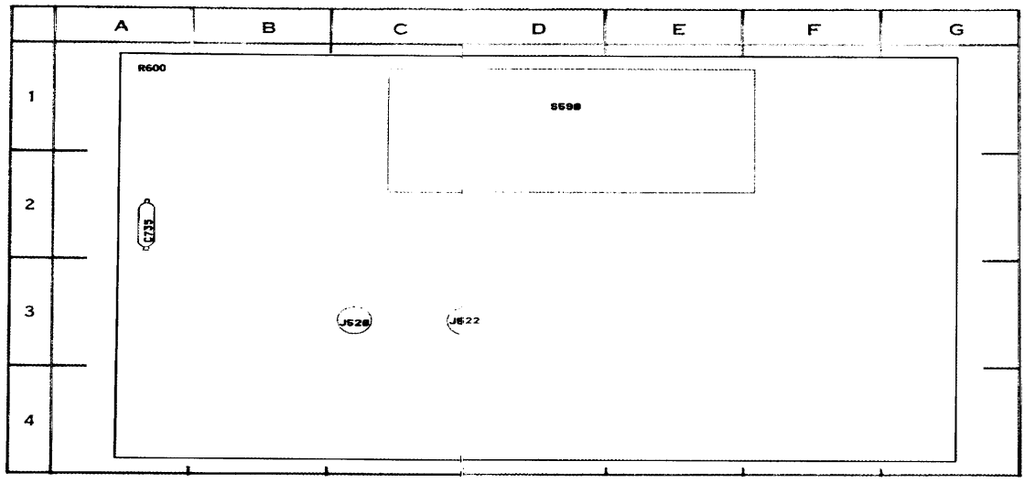
FO-13. A2 board component locations.

PARTS LOCATION GRID

TRANSITION TIMING BOARD (A3)



(BACKSIDE) TRANSITION TIMING BOARD (A3)



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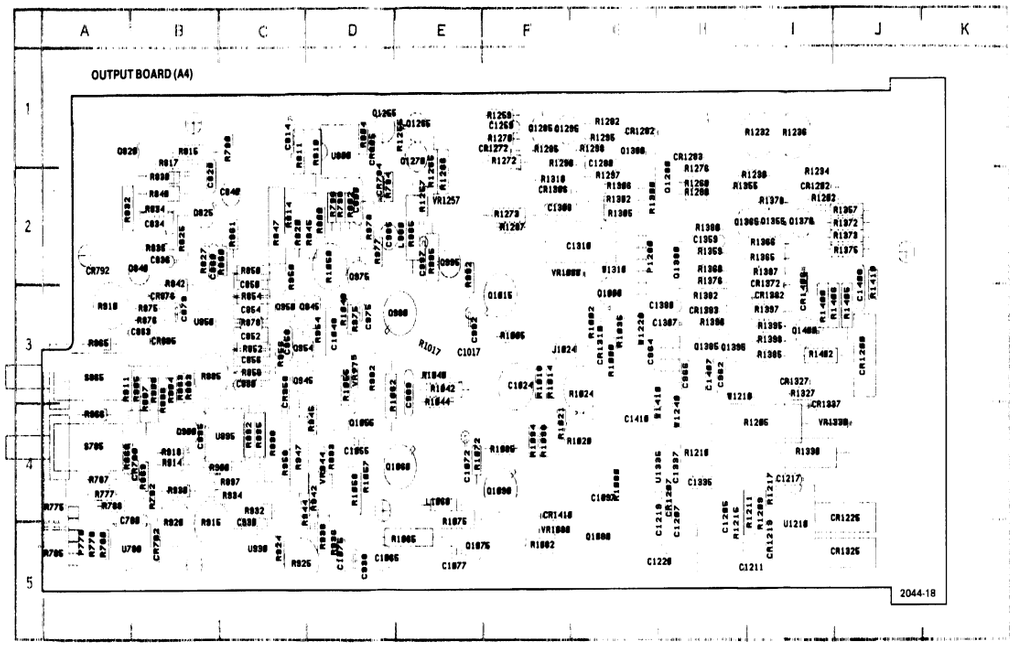
C544	D3	C697	E2			Q701	E1	R563	D2	R644	C3	R708	F1	U720	F2
C555	E2	C701	E1			Q704	E1	R565	D2	R647	C3	R710	F1	U740	E4
C563	D2			P248	A3	Q706	F1	R569	B3	R648	C3	R712	F1		
C569	B2	C708	F1	P540	F4	Q715	F1	R570	B3	R650	C3	R715	F2	VR620	C2
C580	D1	C720	F3	P655	F4			R571	B3	R660	F1	R722	F3	VR630	C2
C581	D1	C724	F3			R520	E3	R575	B1	R662	E1	R724	F3		
C586	B2	C734	F2			R522	E3	R578	A2	R667	F1	R728	F3		
C588	B3	C735*†	A2			R525	E3	R585	D2	R668	F1	R730†	F3		
C590	C1			Q525	E3	R527	D3	R586	D2	R670	F2	R732	F3		
C592	C1	C740	E4	Q530	D3	R528	D3	R600*†	A1	R671	F2	R734	E3		
C594	D2	C744†	D4	Q545	E2	R530	D3	R604	A1	R678	D1	R742	E4		
C596	D2	C749†	E4	Q550	E2	R534	D3	R608	A1	R682	E1	R743†	D4		
C600	D1	C1340	A3	Q560	D2	R536	D3	R614	B3	R685	E1	R744	F3		
C601	D1	C1342	A3	Q565	D2	R538	D3	R615	B3	R687	F2	R748	E4		
C622	C2	C1344	A3	Q575	B1	R542	C3	R616	B3	R690	E1	R749	E4		
C630	D2			Q580	B1	R544	D3	R620	C3	R692	E2	R750	F3		
C643	C2			Q600	A1	R545	D2	R622	C2	R695	E2				
C647	C3	CR584	D1	Q608	A1	R547	D2	R625	C2	R697	E2				
C662	F1	CR600	D1	Q625	C2	R550	E2	R630	C3	R698	E2				
C665	F2	CR604	A1	Q630	D2	R552	E3	R631	D2	R700	E1	S590	D1		
C675	D1	CR1340	A3	Q635	C2	R554	E2	R635	C2	R702	F1				
C680	D1	CR1342	A3	Q640	C2	R555	E3	R637	C3	R704	E1				
		CR1344	A3	Q660	E1			R640	C3						
				Q675	D1										
				Q680	D1										
				Q685	E1										
				Q690	E2										
		J520*	C3												
		J522*	D3												

†See Parts List for serial number ranges.

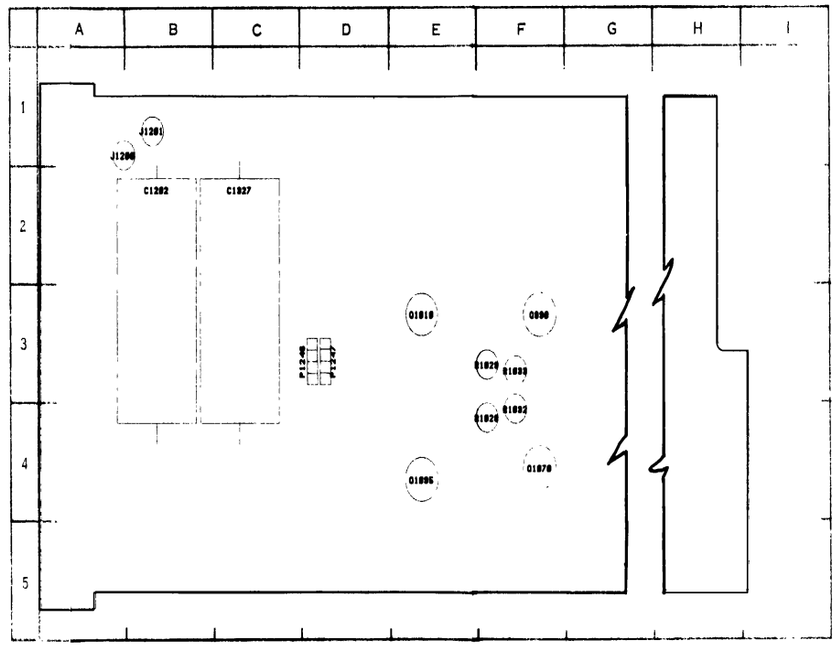
*On back of board.

FO-14. A3 board component locations.

PARTS LOCATION GRID



(BACKSIDE) OUTPUT BOARD (A4)



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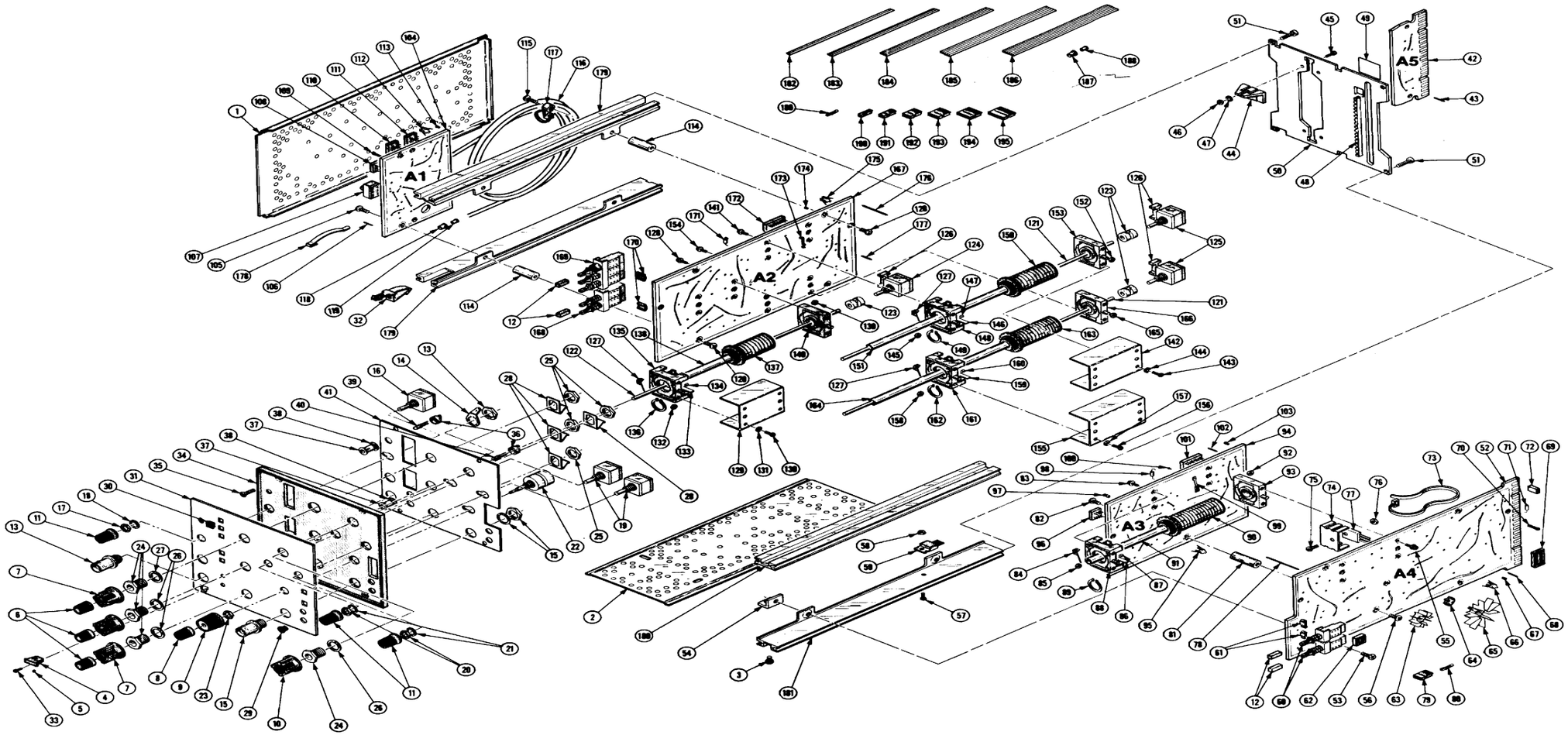
C780	A5	C962	H3	C1211	I5	CR782	B5	CR1382	I3	Q845	D3	Q1270	E1	R790	C1	R845	D2	R893	D4	R942	D4	R1018	F3	R1080	G4	R1266	E2	R1355	H2	R1405	J3	W1210	H3
C800	D2	C964	G3	C1217	I4	CR790	B4	CR1383	H3	Q900	B4	Q1280	H2	R794	D2	R847	C2	R895	C4	R944	C4	R1020	G4	R1082	F5	R1270	F1	R1357	J2	R1406	I3	W1220	G3
C814	C1	C966	H3	C1219	H5	CR792†	A2	CR1406	I2	Q945	C3	Q1285	F1	R796	D2	R850	C2	R897	C4	R945	D4	R1021	F4	R1085	F4	R1272	F1	R1359	H2	R1410	J3	W1240	H4
C820	B2	C975	D3	C1220	H5	CR794	D2	CR1410	F4	Q950	C3	Q1295	F1	R798	D2	R852	C3	R898	C4	R947	C4	R1024	G3	R1094	F4	R1273	F2	R1360	H2			W1310	G2
C825	A2	C985	D2	C1259	F1	CR805	D1			Q954	C3	Q1300	G1	R800	D2	R854	C3	R900	C4	R950	C2	R1028*	F4	R1098	F4			R1365	I2	S785	A4	W1410	G4
C832	A2	C987	E3			CR876	B3	J1024	F3	Q975	D2	Q1355	I2	R802	D2	R856	C3	R904	B3	R954	D3	R1029*	F3	R1202	I2	R1276	H2	R1366	I2	S865	A3		
C834	B2	C988	E4	C1280	G1	CR885	B3	J1200*	A1	Q980	F3	Q1365	I2	R804	D1	R860	C2	R905	B3	R956	C3	R1032*	F4	R1205	I4	R1280	H2	R1370	I2				
C836	B2	C989	E3	C1307	H3	CR958	C3	J1201*	B1	Q990*	F3	Q1370	I2	R810	D1	R861	C2	R908	B3	R958	C4	R1033*	F3	R1209	I4	R1282	G1	R1372	J2	U780	B5		
C840	C2	C992	E3	C1308	F2	CR1200	J3			Q995	E2	Q1380	H2	R811	C1	R863	B3	R910	A3	R975	D3	R1035	G3	R1210	H4	R1285	F1	R1373	J2	U800	D1		
C850	C2	C997	E2	C1310	G2	CR1202*	B2	L980	E2	Q1000	G3	Q1385	H3	R814	C2	R865	A3	R911	A3	R977	D2	R1040	E3	R1211	I4	R1287	F2	R1375	J2	U850	B3		
C852	C3	C1017†	E3	C1327*	C2	CR1207	H4	L1060	E4	Q1010*	E3	Q1395	H3	R815	B1	R866	A4	R914	B4	R978	D2	R1042	E3	R1215	H5	R1290	F2	R1376	H2	U895	C4		
C854	C3	C1024	F3	C1335	H4	CR1215	J4			Q1015	F3	Q1400	I3	R817	B1	R868	A4	R915	B4	R982	D3	R1044	E4	R1217	I5	R1295	G1	R1380	H2	U930	C5		
C856	C3	C1048	D3	C1337	H4	CR1219	I5	P770	A5	Q1055	D4			R820	C2	R869	B4	R918	B4	R985	E2	R1048	D3	R1230	I2	R1297	G2	R1382	H3	U1210	I5		
C860	B2	C1055	D4	C1359	H2	CR1225	J5	P1205	H5	Q1060	D4	R775	A4	R825	B2	R875	B3	R920	B4	R987	E3	R1050	D2	R1232	I1	R1298	G1	R1385	I3	U1335	H4		
C863	B3	C1065	D5			CR1272	F1	P1246*	D3	Q1070*	F4	R777	A4	R827	B2	R876	B3	R924	C5	R988	E4	R1055	D3	R1234	I2	R1300	G2	R1387	I2				
C879	B3	C1072	E4	C1380	H3	CR1282	G1	P1247*	D3	Q1075	E5	R778	A5	R830	B2	R878	C3	R925	C5	R992	E2	R1057	D4	R1236	I1	R1302	G2	R1390	H3	VR944	D4		
C880	C3	C1075	D5	C1407	H3	CR1283	H1	P1280	G2	Q1080	G5	R780	A5	R832	A2	R883	B3	R930	B3	R995	E2	R1058	D4	R1255	E1	R1305	G2	R1395	I3	VR975	D3		
C895	B4	C1077	E5	C1408	J3	CR1306	F2			Q1090	F4	R782	B4	R834	B2	R885	B3	R932	C4	R1000	G3	R1062	D3	R1257	E2	R1306	G2	R1397	I3	VR1000	F2		
C930	C5	C1097	G4	C1410	G4	CR1310	G3	Q820	A1	Q1095*	E4	R785	A5	R836	B2	R887	B3	R934	C4	R1002	G3	R1065	E5	R1259	F1	R1310	F2	R1398	I3	VR1080	F5		
C938	D5	C1202*	B2			CR1325	J5	Q825	B2	Q1255	D1	R787	A4	R840	B2	R888	B3	R936	D5	R1005	F3	R1072	E4	R1260	H2	R1327	I3	R1400	I3	VR1257†	E2		
C958	C3	C1205	H5			CR1327*	I3	Q840	B2	Q1265	E1	R788	A4	R842	B3	R892	C4	R938	D5	R1014	F3	R1075	E5	R1265	E2	R1330	I4	R1402	I3	VR1330	J4		
		C1207	H5			CR1337	I4													R1017†	E3												
						CR1372	I3																										

†See Parts List for serial number ranges.

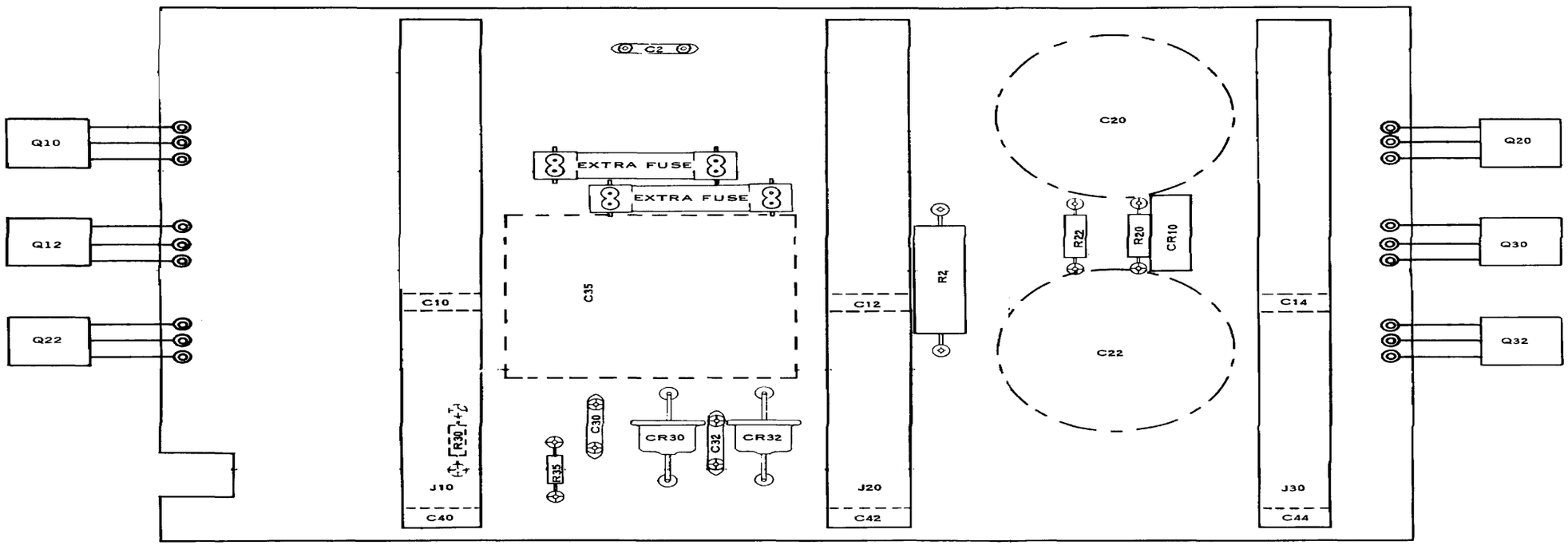
*On back of board.

FO-15. A4 board component locations.



FO-16. PG 508 exploded view.

PARTS LOCATION GRID



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

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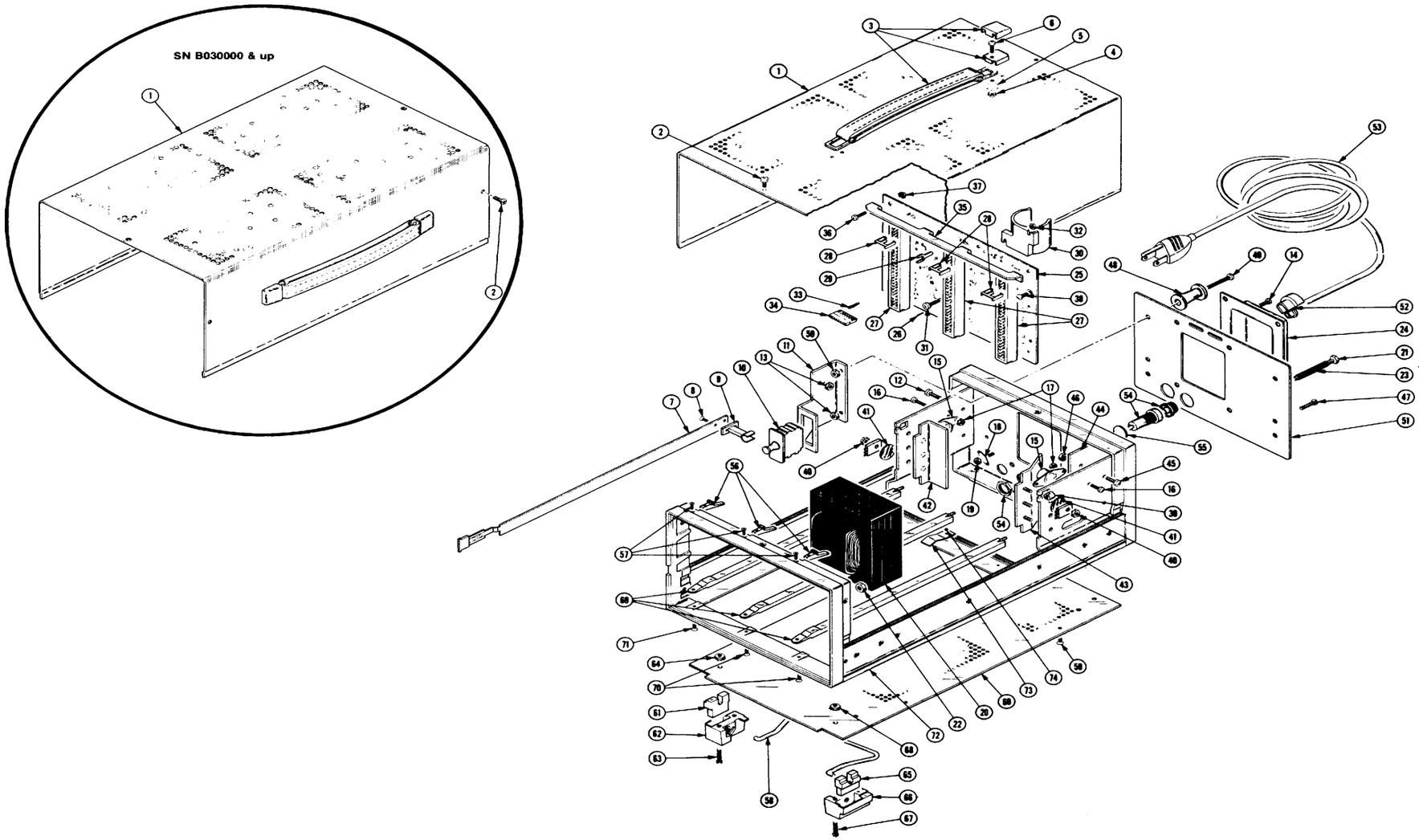
C10	D4	CR30	E5	Q30	K3
C12	G4	CR32	F5	Q32	K4
C14	I4	CR32	F5		
C20	H2			R2	G4
C22	H4	J10	D6	R20	H3
C30	E5	J20	G6	R22	H3
C32	E5	J30	I6	R30	D5
C35	E4			R35	D6
C40	D6	Q10	A2		
C42	F6	Q12	A3		
C44	I6	Q20	K2		



TM 503 POWER MODULE

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