

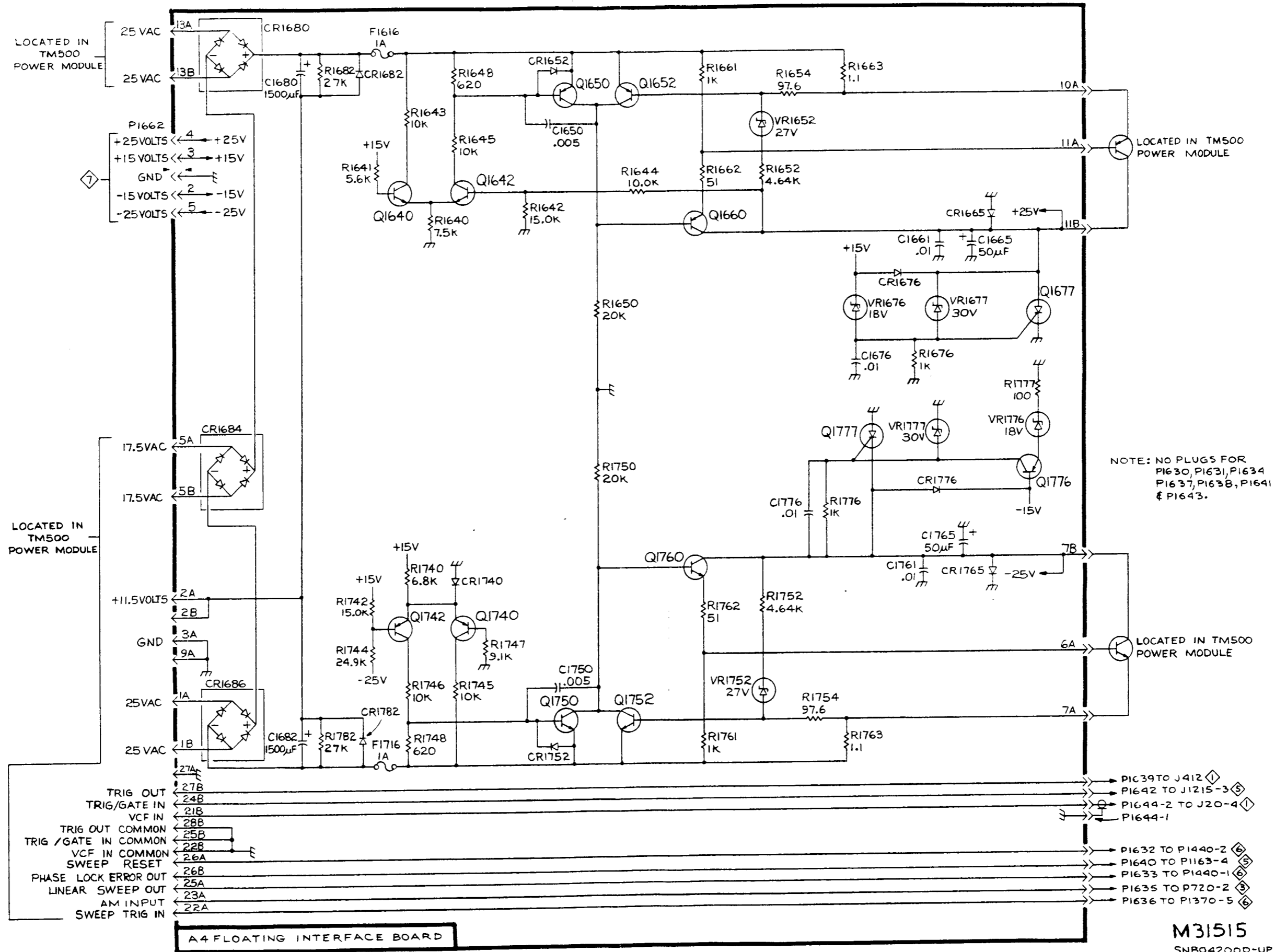
**TEKTRONIX®**

**FG 504  
40 MHz  
FUNCTION  
GENERATOR**

INSTRUCTION MANUAL

Tektronix, Inc.  
P.O. Box 500  
Beaverton, Oregon 97077

Serial Number \_\_\_\_\_



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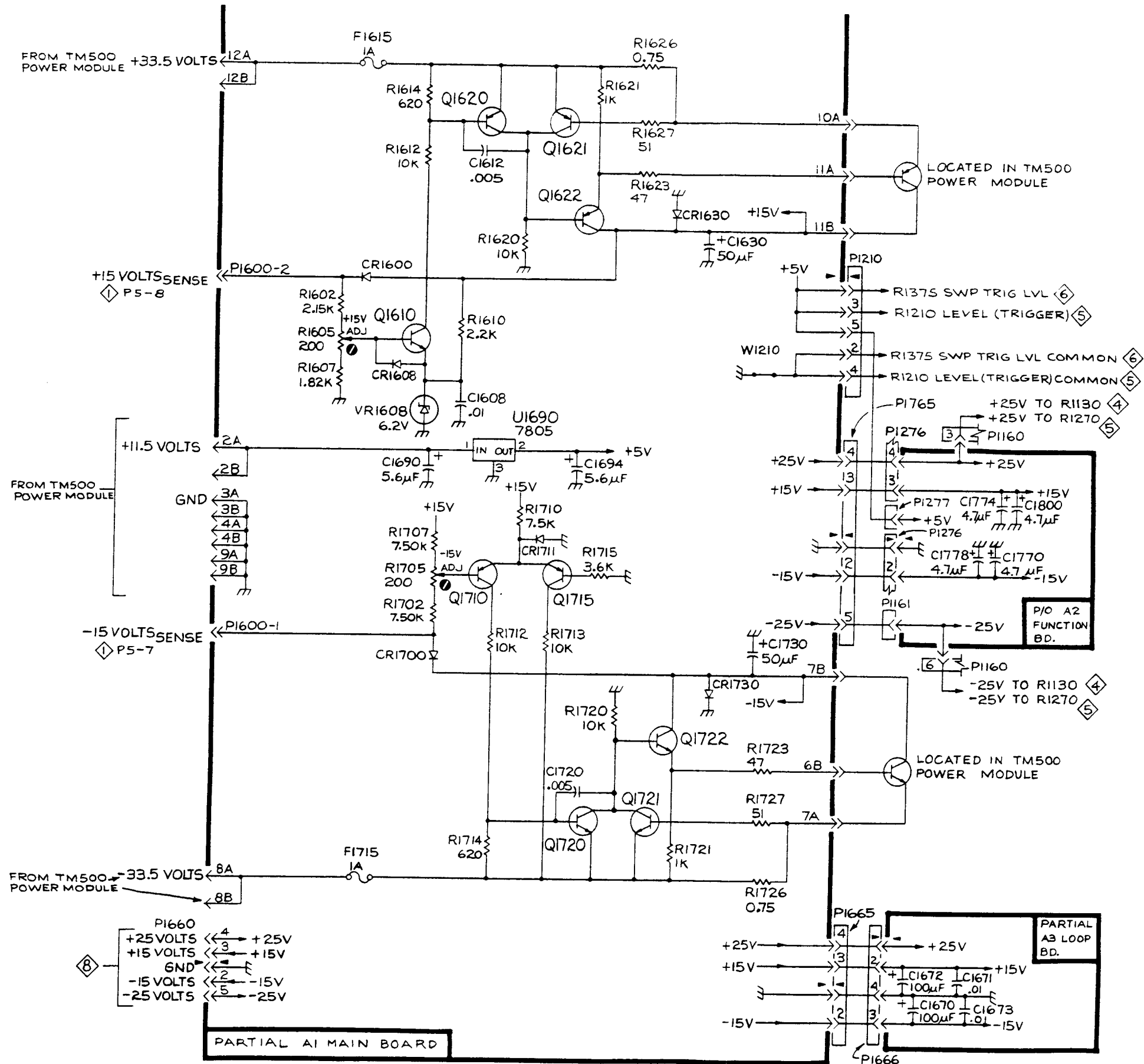
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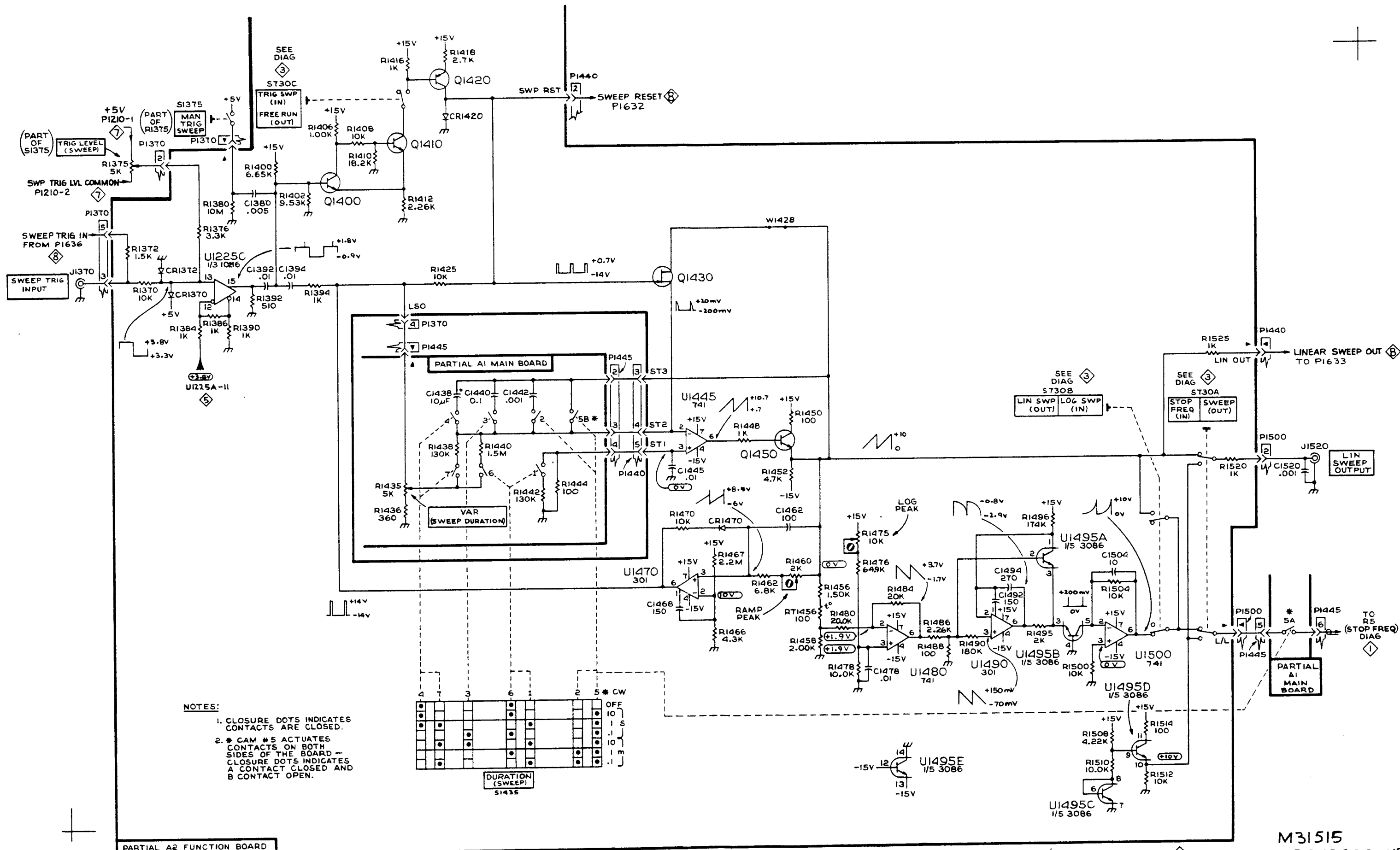
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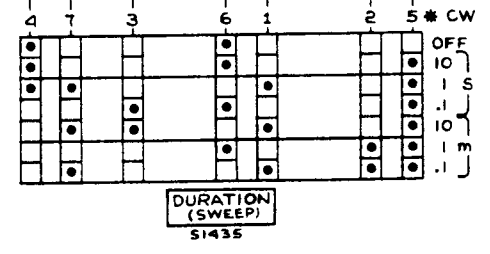


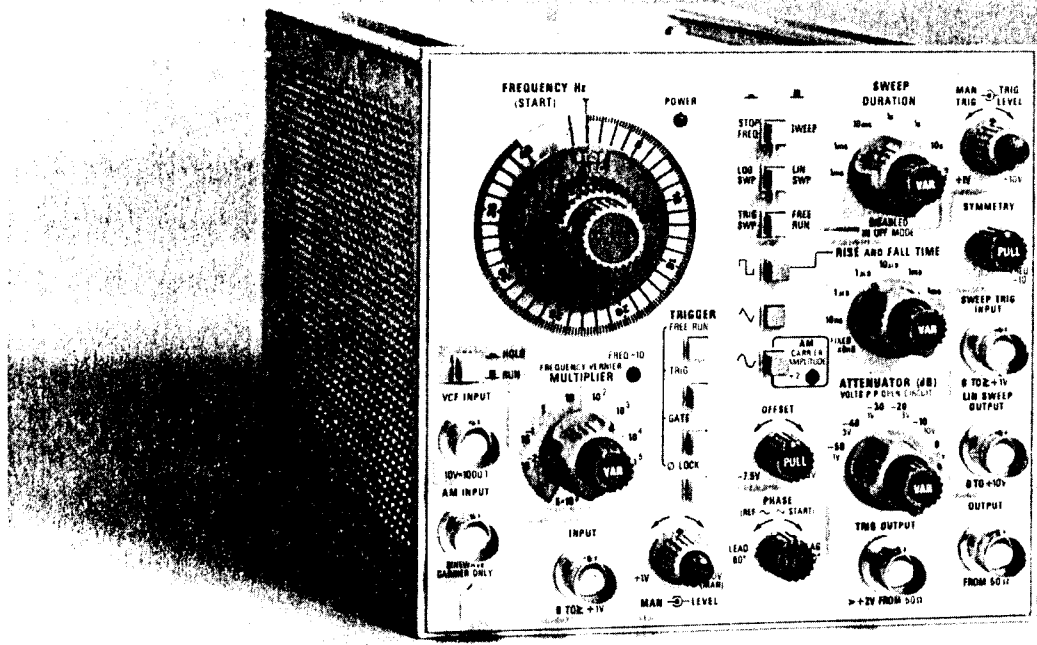
# TABLE OF CONTENTS

<b>SECTION 1 OPERATING INSTRUCTIONS</b>	<b>Page</b>	<b>SECTION 2 THEORY OF OPERATION (cont)</b>	<b>Page</b>
Instrument Description	1-1	Offset Circuitry	2-3
Initial Operation	1-1	Gating and Triggering Circuitry	2-3
Functions Available At Rear Connector	1-1	Phase Locked Loop Circuitry	2-4
Operating Considerations		Sweep Circuitry	2-4
Output Connections	1-2	Logarithmic Converter	2-4
Risetime And Falltime	1-3	Power Supplies	2-5
Impedance Matching	1-3	<b>SECTION 3 ADJUSTMENT PROCEDURE</b>	
Basic Operation		Services Available	3-1
Free Running Output	1-3	Maintenance	3-1
Triggered and Gated Operation	1-4	Circuit Board Removal	3-1
Voltage Controlled Frequency Operation	1-4	Test Equipment	3-1
Custom Timing Capacitor Selection	1-4	Adjustment Procedure	
Phased Locked Operation	1-5	<b>SECTION 4 REPLACEABLE ELECTRICAL PARTS</b>	
Amplitude Modulating Input	1-6	<b>SECTION 5 DIAGRAMS</b>	
Internal Sweep Operation	1-6	Symbols and Reference Designators	
External Input Signals	1-6	Adjustment Location Illustration	
Basic Waveform Capabilities	1-7	Loop Board Parts Location Grid	
Applications	1-10	Front Panel Controls and Connectors	
Tone Burst Testing	1-10	Function Board Parts Location Grid	
Filter Testing	1-10	Block Diagram	
Pulse Shaping	1-11	Rear Interface Connector Assignments	
Electrical Characteristics	1-12	Main Board Parts Location Grid	
<b>SECTION 2 THEORY OF OPERATION</b>		Main Loop Circuit Diagram	
Triangle Generator Or Main Loop	2-1	Backside Main Board Parts Location Grid	
Variable Rise and Fall Circuitry	2-2	Square Buffer/Variable Rise & Fall Circuit Diagram	
Square Wave Generator	2-2	Sine Shaper & Buffer Circuit Diagram	
Sine Shaper, Buffer and Modulating Circuitry	2-2	Output Circuit Diagram	
Amplitude Modulating Input Circuitry	2-3	Trig-Gate-Phase Lock Circuit Diagram	
Output Amplifier	2-3	Sweep Circuit Diagram	
Output Attenuator	2-3	Power Supply Circuit Diagram	
		<b>SECTION 6 REPLACEABLE MECHANICAL PARTS</b>	
		<b>CHANGE INFORMATION</b>	

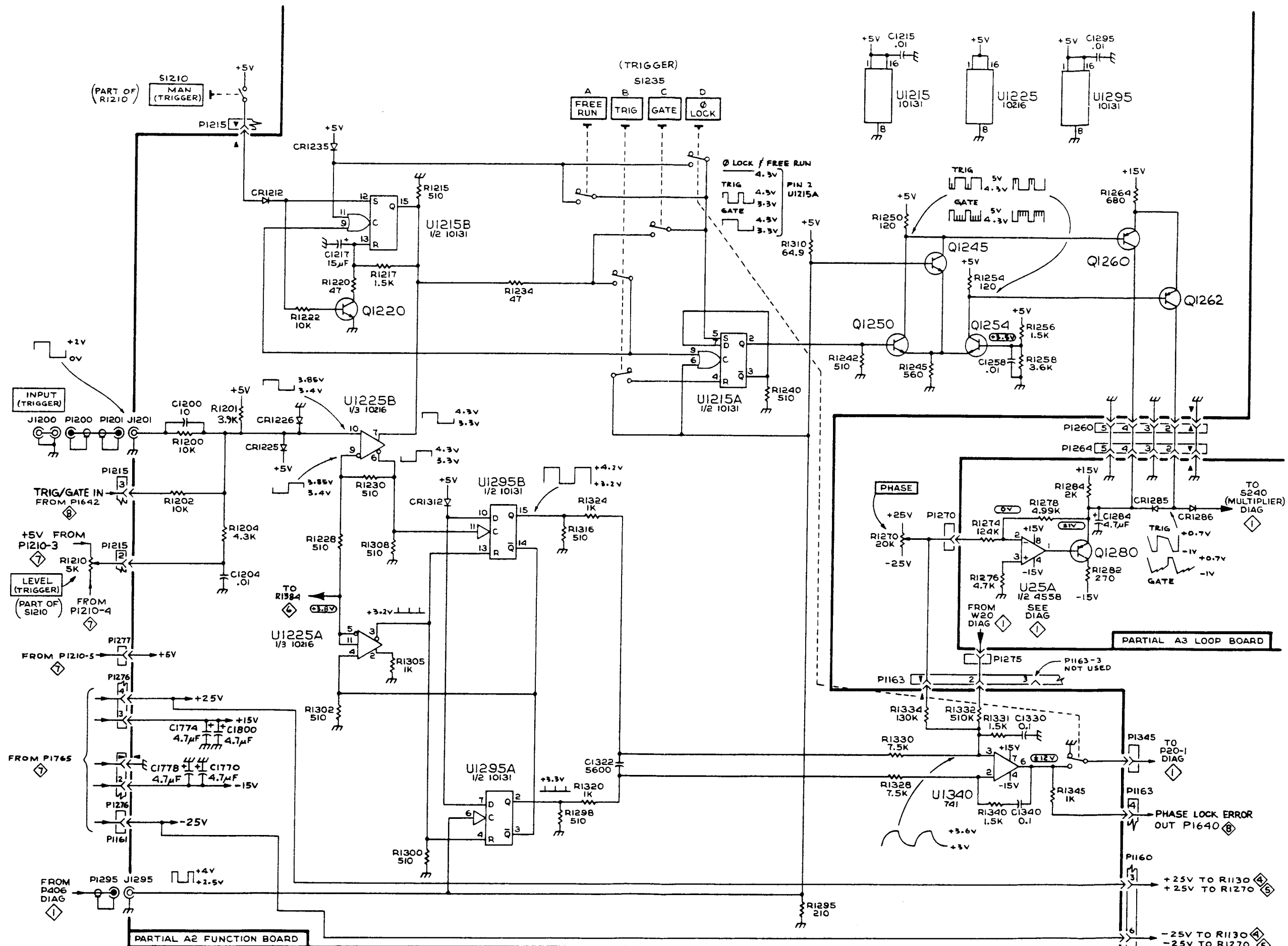


- NOTES:
1. CLOSURE DOTS INDICATES CONTACTS ARE CLOSED.
  2. \* CAM #5 ACTUATES CONTACTS ON BOTH SIDES OF THE BOARD - CLOSURE DOTS INDICATES A CONTACT CLOSED AND B CONTACT OPEN.





2028-01





# OPERATING INSTRUCTIONS

## Instrument Description

The FG 504 Function Generator provides low distortion sine, square, triangle, ramp, and pulse waveforms over the frequencies from 0.001 Hz to 40 MHz in ten decades. A user-definable custom frequency range is also available. The output amplitude is 10 mV to 30 V peak-to-peak into an open circuit and 5 mV to 15 V peak-to-peak into a 50  $\Omega$  load. The output impedance is 50  $\Omega$ . The FG 504 may be swept between the START and STOP FREQ dial settings with a linear or logarithmic sweep. The output may be phase locked, gated, or triggered for single cycle output. The output waveform may be shifted  $\pm 80^\circ$  from the triggering waveform. The symmetry of the output waveform may also be varied. For the slower frequencies, the output may be held at any level by pushing the front panel button labeled HOLD.

A voltage-controlled frequency (VCF) input controls the output frequency from an external voltage source. The output frequency can be swept above or below the selected frequency, to a maximum of 1000:1, depending on the polarity and amplitude of the VCF input and the selected output frequency. Provision is also made for amplitude modulating the sinewave output from an external source.

The variety of swept and modulated signals available from the FG 504 make it especially useful for such applications as testing amplifier or servo-system response, distortion, and stability. It is useful for fm generation, as a beat frequency oscillator, as a gated triggered or phase-locked logic interface, or as a source for various ramp or pulse waveforms. It is also useful as a source for amplitude modulated signals for various purposes.

## Initial Operation

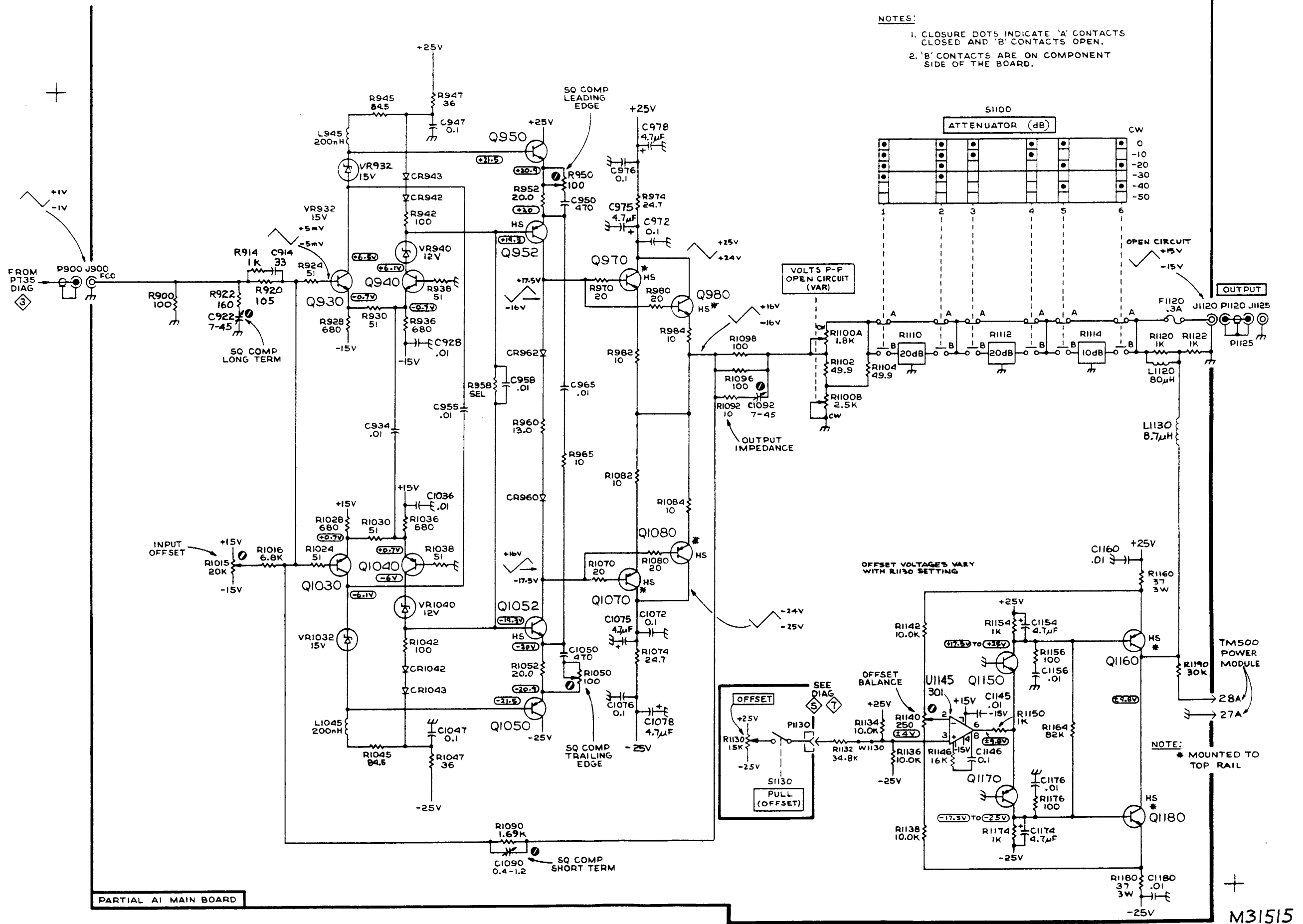
The FG 504 is ready for use when received. It operates in two compartments of any of the TM 500 series power modules excluding the TM 501.

Turn off the power module before installing or removing the FG 504. (Refer to the power module instruction manual for line voltage requirements and power module operation.) See Fig. 1-1 for installation/removal procedure. Check that the FG 504 is fully inserted in the power module. Pull the power switch on the power module. Check that the green POWER light on the FG 504 is on.

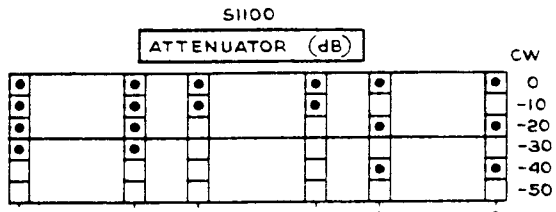
The Controls, Connectors, and Adjustments foldout page in Section 5 gives a complete description of the front panel controls and connectors. Notice the front panel outline colors. The output frequency controls are outlined in blue, the trigger in green, and the internal sweep in orange.

## Functions Available At Rear Connector

Refer to the rear connector assignment illustration in the Diagrams section of this manual for pin assignments. A slot between pins 23 and 24 on the rear connector identifies the FG 504 as a member of the signal source family. A barrier may be inserted in the corresponding position of the power module connector to prevent other than signal source plug-ins from being used in that compartment. This protects the plug-in should specialized connections be made to that compartment. Consult the Building A system section of the power module manual for further information.



- NOTES:
1. CLOSURE DOTS INDICATE 'A' CONTACTS CLOSED AND 'B' CONTACTS OPEN.
  2. 'B' CONTACTS ARE ON COMPONENT SIDE OF THE BOARD.



OPEN CIRCUIT +15V  
-15V

VOLTS P-P OPEN CIRCUIT (VAR)

OUTPUT IMPEDANCE

OFFSET VOLTAGES VARY WITH R1130 SETTING

NOTE: \* MOUNTED TO TOP RAIL

PARTIAL A1 MAIN BOARD

M31515

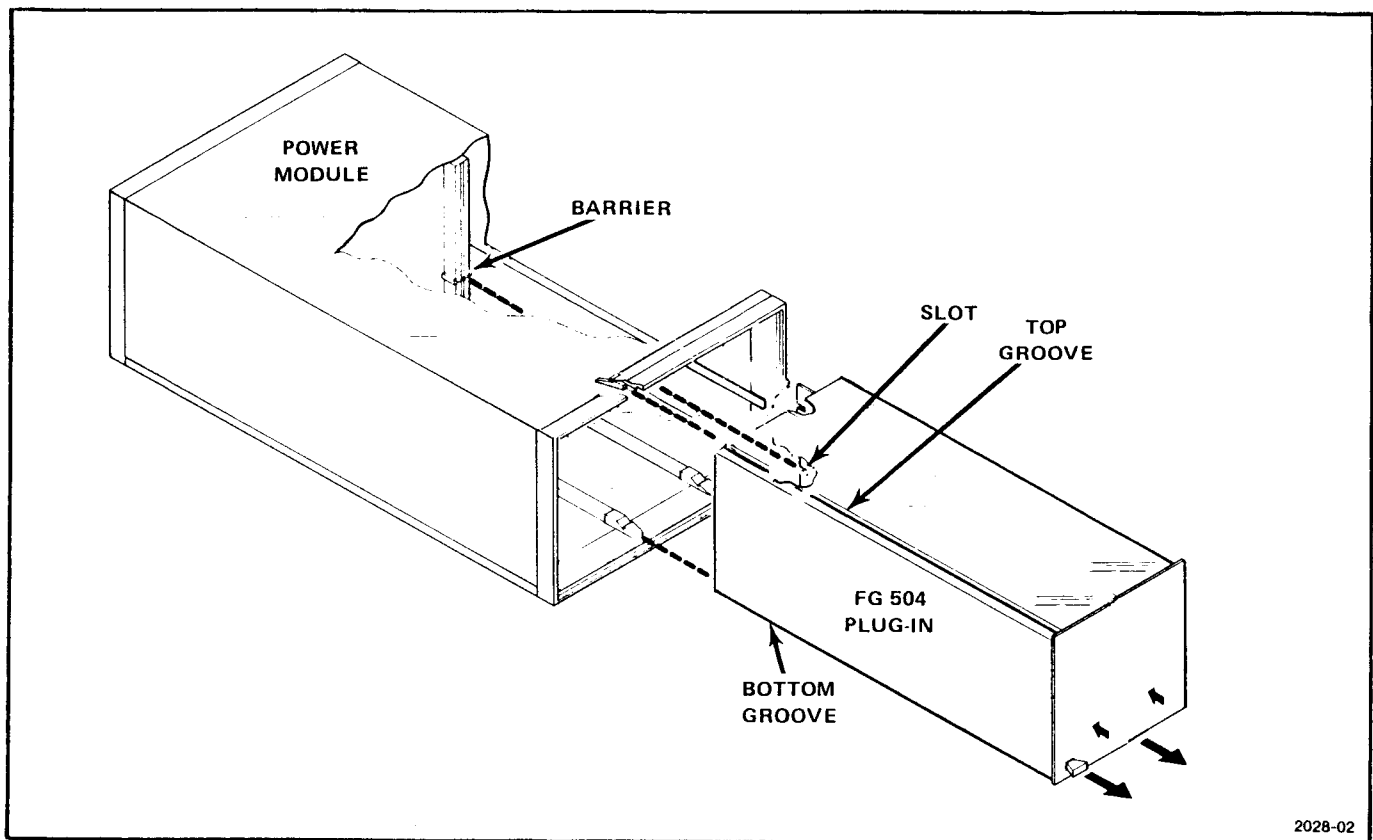


Fig. 1-1. FG 504 Installation and Removal.

## OPERATING CONSIDERATIONS

### Output Connections

The output of the FG 504 is designed to operate as a 50  $\Omega$  voltage source working into a 50  $\Omega$  load. At higher frequencies, an unterminated or improperly terminated output will cause excessive aberrations on the output waveform (see Impedance Matching discussion). Loads less than 50  $\Omega$  will reduce the waveform amplitude.

Excessive distortion or aberrations, due to improper termination, are less noticeable at the lower frequencies (especially with sine and triangle waveforms). To ensure waveform purity, observe the following precautions:

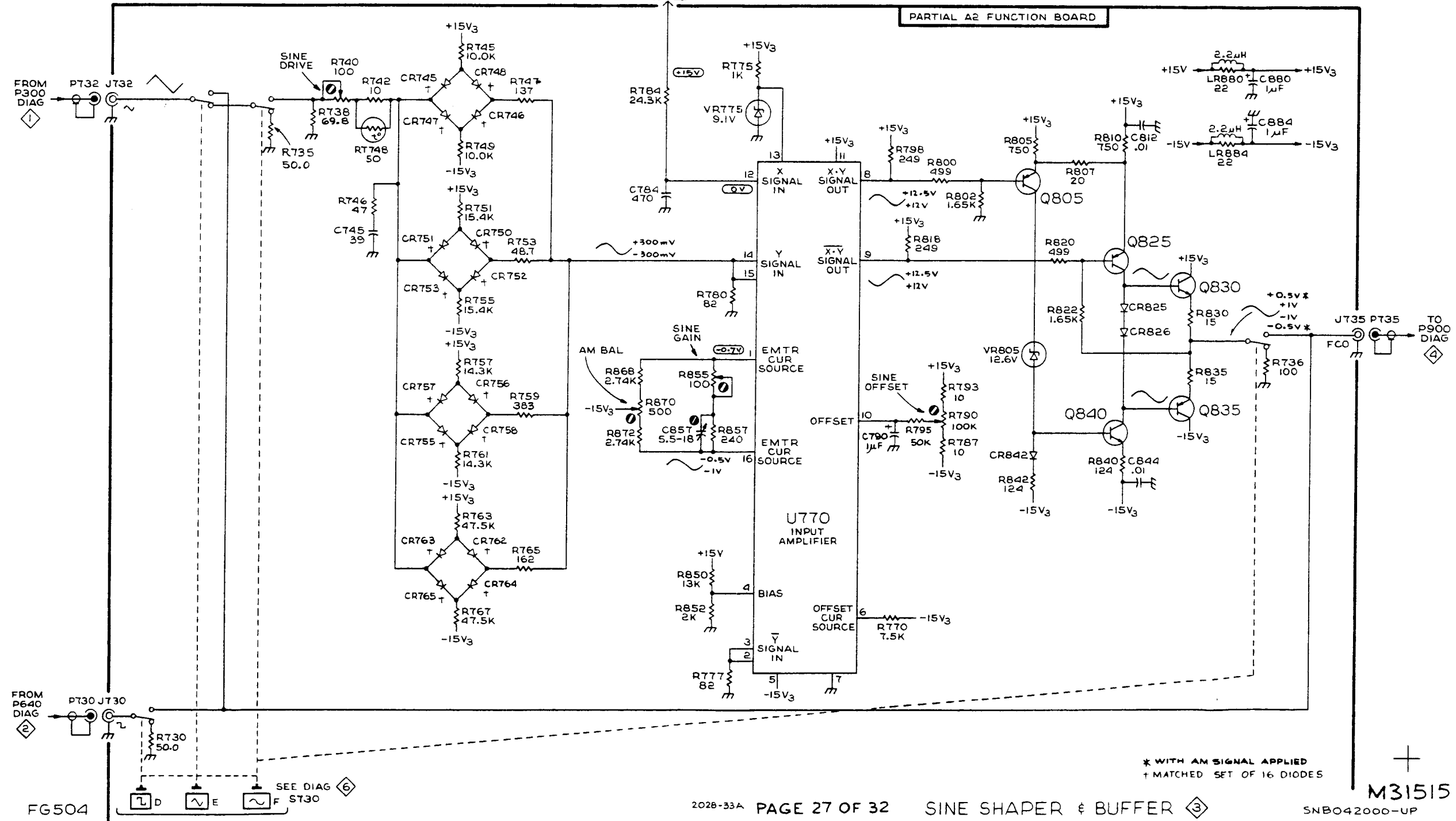
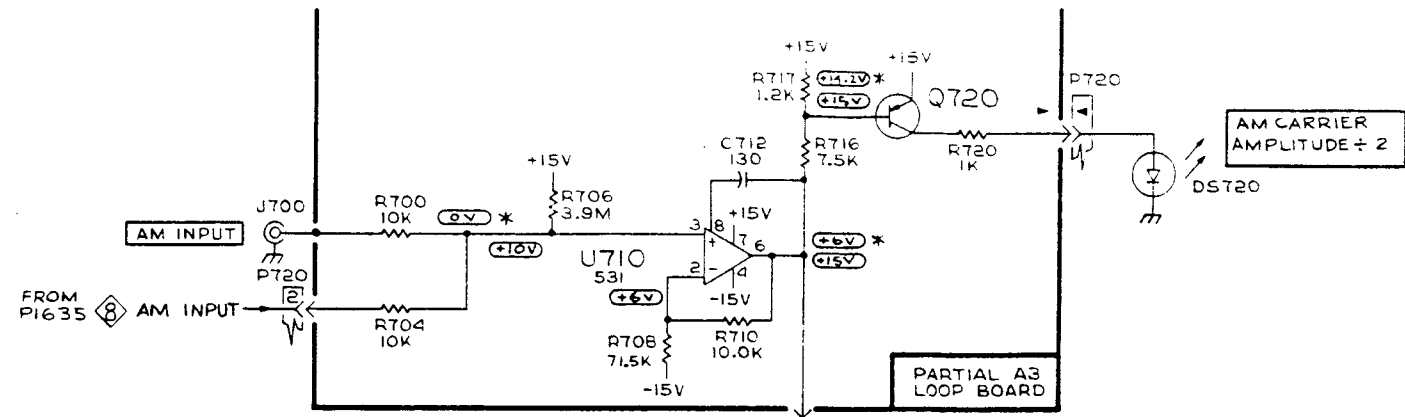
1. Use good quality 50  $\Omega$  coaxial cables and connectors.
2. Make all connections tight and as short as possible.
3. Use good quality attenuators, if it is necessary to reduce waveform amplitude to sensitive circuits.
4. Use terminators or impedance-matching devices to avoid reflections when using long cable (6 feet or more).

5. Ensure that attenuators, terminations, etc. have adequate power handling capabilities for the output waveform.

If there is a dc voltage across the output load, use a coupling capacitor in series with the load. The time constant of the coupling capacitor and load must be long enough to maintain pulse flatness.

### NOTE

*If the FG 504 is used in early models of the TM 500 Series Power Modules, ripple on the output waveform can be excessive in some cases. The ripple results from Power Module transformer phasing that is incompatible with FG 504 operation; however, the problem is easily cured. See "Checking Transformer Phasing" in the Adjustment Procedure section of this manual.*



FG504

SEE DIAG ST30

\* WITH AM SIGNAL APPLIED  
† MATCHED SET OF 16 DIODES

M31515

### Risetime and Falltime

If the output pulse from the FG 504 is used to measure the rise or falltime of a device, consider the risetime characteristics of the associated equipment used. If the risetime of the device under test is at least ten times longer than the combined risetimes of the FG 504 plus the monitoring oscilloscope and associated cables, the error introduced will not exceed 1%. This error can generally be ignored. When the rise or falltime of the test device is less than ten times as long as the combined risetimes of the testing system, the actual risetime of the system must be determined. This is found from the risetime of each component making up the system. The total risetime equals the square root of the sum of the squares of the individual risetimes, or:

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

Once the risetime of the system is known, the risetime of the device under test can be found by using the preceding method.

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

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

### Impedance Matching

As a pulse travels down a transmission line, each time it encounters a mismatch (or an impedance different than that of the transmission line), a reflection is generated and sent back along the line to the source. The amplitude and polarity of the reflections are determined by the impedance mismatch encountered. If the impedance mismatch is higher than the line, the reflection will be of the same polarity as the applied signal. If it is lower, the reflection will be of opposite polarity.

If the reflected signal returns before the pulse is ended, it adds to or subtracts from the amplitude of the pulse. This distorts the pulse shape and amplitude.

If the FG 504 is driving a high impedance such as the 1 MΩ input impedance (paralleled by a stated capacitance) of the vertical input to an oscilloscope, connect the transmission line to a 50 Ω attenuator, 50 Ω termination, and then the oscilloscope input. The attenuator isolates the input capacitance of the device, and the FG 504 is properly terminated.

## BASIC OPERATION

### Free Running Output

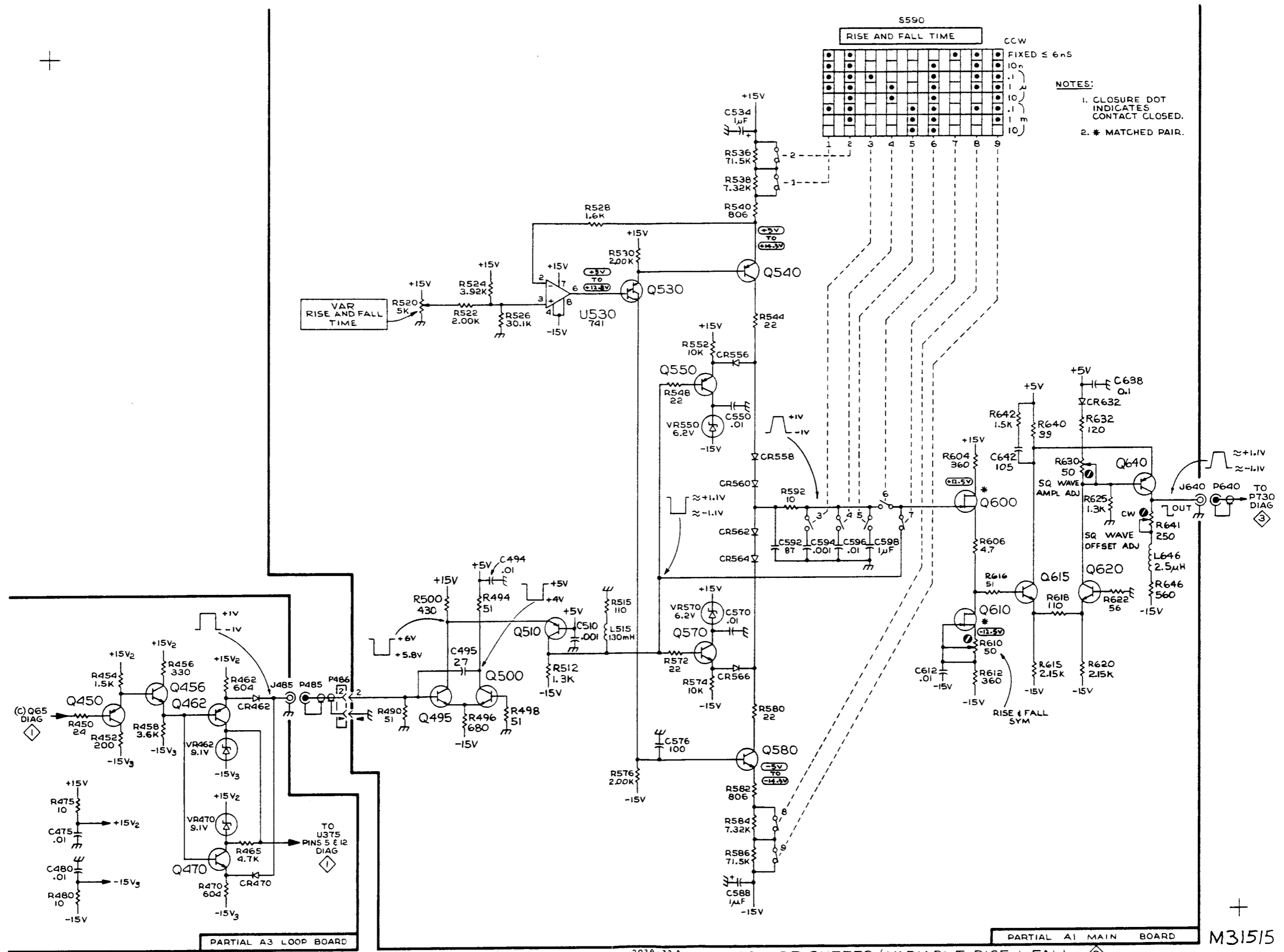
Select the desired waveform (square, triangle, or sine) by pushing the appropriate button marked SQUAREWAVE, TRIANGLE, or SINEWAVE. Push the FREE RUN button. Make certain the SWEEP DURATION switch is in the OFF position. Select the desired frequency with the MULTIPLIER and FREQUENCY Hz (START) dials. The FREQUENCY VERNIER control permits fine frequency adjustments. Connect the load to the OUTPUT terminal. Make certain the HOLD button is out. Set the ATTENUATOR control for the desired peak-to-peak output amplitude. Use the VAR knob to vary the amplitude between the steps.

The waveforms without offset center around 0 V. To offset the waveforms, pull and rotate the OFFSET control for the desired offset. If a square-wave output is selected, adjust the RISE and FALL TIME control for the desired values. The VAR knob varies these times between the

control steps. A trigger signal, one for each cycle of the selected waveform, is available at the TRIG OUTPUT connector.

When using the sine or ramp waveform output with the MULTIPLIER in the slowest five positions, the waveform output may be stopped by pushing the HOLD button. The waveform generator stops and the FG 504 outputs a dc voltage equal to the voltage the ramp or sine waveform reached when the button was pushed. This feature does not operate on the square waveform.

When pulled out, the SYMMETRY control divides the output frequency (FREQ ÷ 10 indicator lit) by ten and varies the time based symmetry of the selected waveform. Pull this control and turn for the desired symmetry using any of the three basic waveforms.



### Triggered Or Gated Operation

With the FG 504 set for free running operation as described in the previous paragraphs, apply the triggering or gating signal to the INPUT connector. If only one cycle of the output waveform per trigger is desired, push the TRIG button and set the LEVEL control for the level on the triggering waveform at which the output waveform is to commence. If more than one cycle of the output waveform is desired, press the GATE pushbutton. The FG 504 output now commences at the triggering level and continues until the waveform at the input connector drops below the triggering level. The output duration is now the duration of the gating waveform. The number of cycles per burst may be approximated by dividing the gating signal duration by the period of the FG 504 output frequency. In the gated mode of operation, the FG 504 always completes the last cycle. If, at the termination of the gating waveform, less than approximately 270° of the last cycle remains, an additional cycle is completed.

In triggered or gated operation the PHASE control varies the start of the triangle or sine output waveform by ±80°. This phase change is measured from the 0 V, 0° point on the output waveform.

To manually trigger or gate the FG 504, turn the LEVEL control fully clockwise and push the TRIG or GATE button as desired. In the TRIG mode, pushing the MAN button triggers one cycle of the output waveforms. In the GATE mode, the selected output waveform continues as long as the MAN button is depressed.

### Voltage Controlled Frequency Operation

The output frequency of the FG 504 can be swept over a frequency range of 1000:1, depending on the MULTIPLIER setting, by applying a 0 V to 10 V signal to the VCF INPUT connector. See Fig. 1-2 for the maximum vcf range for each MULTIPLIER setting. It may be necessary to vary the FREQUENCY VERNIER control to obtain the full 1000:1 swept range or the lowest swept frequency desired.

The polarity of the vcf input signal determines the direction the output frequency is swept from the frequency set by the MULTIPLIER, FREQUENCY Hz (START), and FREQUENCY VERNIER controls. A positive-going voltage raises the frequency while a negative-going voltage lowers the frequency. A voltage that varies symmetrically about 0 V sweeps the output frequency symmetrically about the center frequency determined by the frequency controls (see Fig. 1-3).

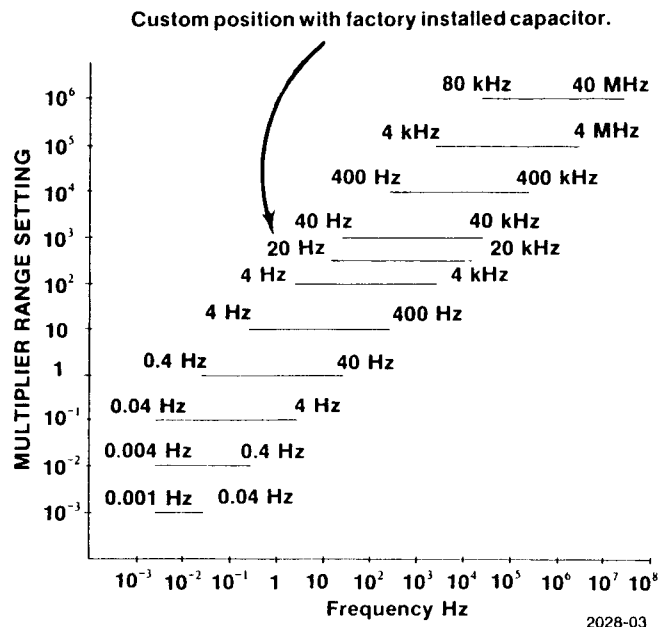


Fig. 1-2. Graph showing range of frequencies for each MULTIPLIER setting that can be swept with a 0 to 10 V signal applied to the VCF INPUT.

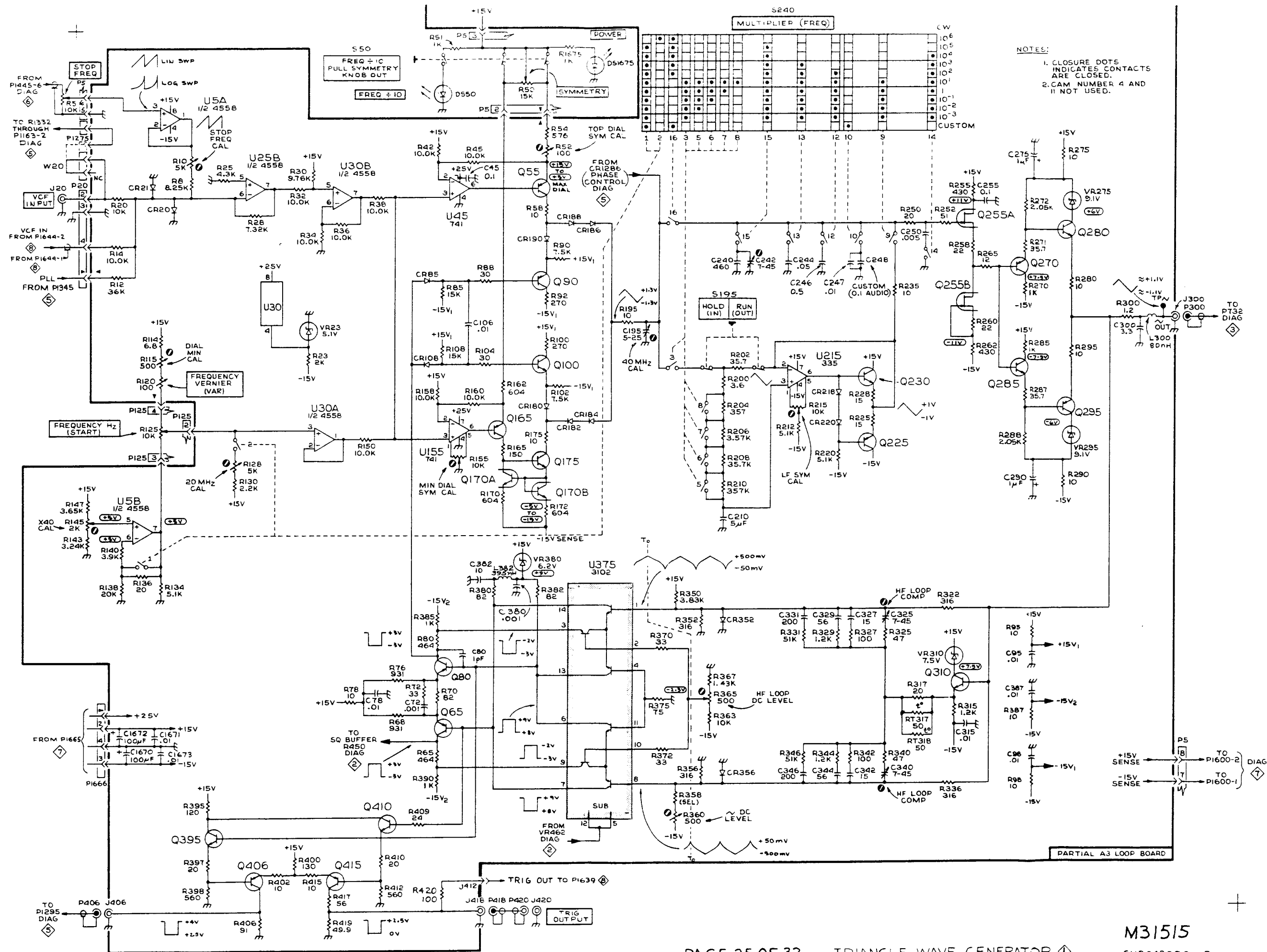
Since the vcf input amplitude versus frequency is a linear relationship, the frequency output may be determined from the vcf input amplitude and the FREQUENCY Hz dial position. VCF sensitivity is the highest possible dial setting (40) times the MULTIPLIER range divided by the maximum VCF input voltage (10 V). In the FG 504, this is a nominal sensitivity (Hz per V) of 4 X MULTIPLIER setting; a one-volt change at the VCF INPUT will change the output frequency 4 kHz.

### Custom Timing Capacitor Selection

This feature permits the user to install a custom swept frequency range. The .5 X 10<sup>3</sup> position of the MULTIPLIER switch is used for the custom range. The factory-installed capacitor (C248) for this position of the MULTIPLIER switch provides a swept range from 20 Hz to 20 kHz. Calculations to determine the capacitor value for a custom range are as follows:

$$C_{cus} = \frac{2200}{F_{max}}$$

where C<sub>cus</sub> is in μF and F<sub>max</sub> (the maximum frequency required for the custom range) is in Hz.



NOTES:  
 1. CLOSURE DOTS INDICATES CONTACTS ARE CLOSED.  
 2. CAM NUMBER 4 AND 11 NOT USED.



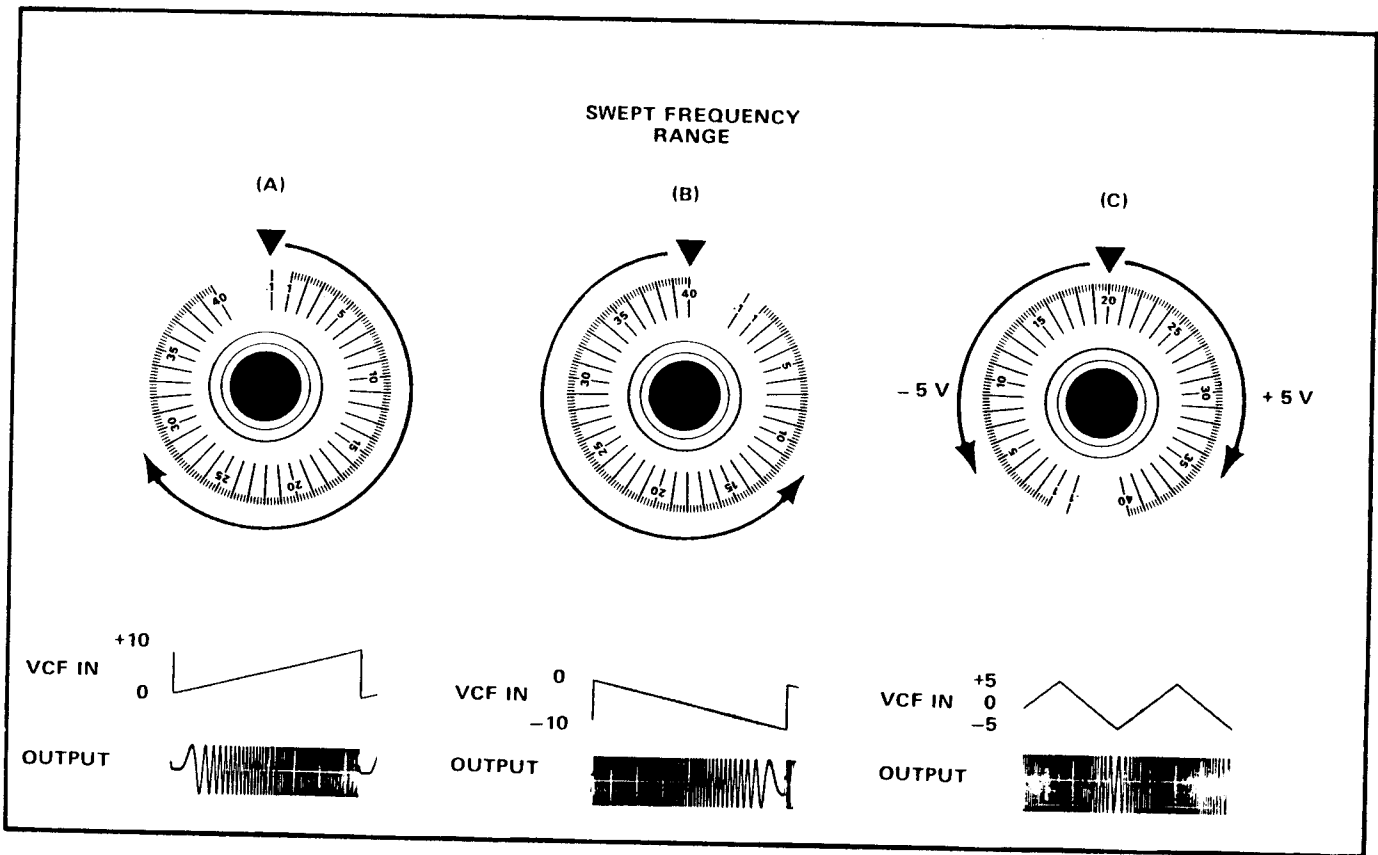


Fig. 1-3. Swept frequency range with 10 V signal applied to VCF IN connector.

Assuming a swept frequency range from 10 Hz to 10 kHz, the maximum frequency is 10 kHz. Substituting this into the preceding equation gives:

$$C_{cus} = \frac{2.2 \times 10^3}{1 \times 10^4} = .22 \mu\text{F}$$

Replace C248 (see Diagram 1) with the value of capacitor required for the custom swept frequency range. If the capacitor for the custom range is to be installed inside the instrument, physical size may be a limitation if the frequencies are so low that a large capacitor is required. Low leakage, mylar dielectric capacitors provide the truest waveforms.

### Phase Locked Operation

The frequency of the output waveform may be synchronized with an externally-applied reference signal. The output frequency of the FG 504 must be set to within  $\pm 10$  major dial divisions of the frequency of the externally applied signal (the "1" on the dial is the lowest major dial division). Connect the reference signal to the INPUT connector and push the  $\phi$ LOCK pushbutton. The PHASE control varies the phase of the output waveform  $\pm 80^\circ$  with respect to the reference signal waveform. The LEVEL control adjusts the triggering point on the reference waveform.

Proper adjustment of the LEVEL and PHASE controls is easier if they are adjusted first in the TRIG mode. Set the FREE RUN frequency of the FG 504 somewhat higher than the frequency of the reference signal applied to the INPUT connector, and then select the TRIG mode. Adjust the LEVEL control for stable triggering and (if using an oscilloscope) adjust the output frequency of the FG 504 until it is nearly the same as the frequency of the signal applied to the INPUT connector. Set the PHASE control at 12 o'clock (for  $0^\circ$  with sine-wave selected) and press  $\phi$ LOCK. Readjust the PHASE control, if necessary, to obtain a stable output at the desired phase. The PHASE control range continuously decreases above 4 MHz.

A jumper located on the Loop board allows the VCF INPUT to function as a phase modulating input when the FG 504 is operated in the PHASE LOCK loop mode. The location of this jumper is shown in the illustration on the Internal Adjustments Procedure foldout page at the rear of this manual. The phase modulating input voltage limits are  $\pm 2.5$  V, with an upper frequency limit of 1 kHz. When phase locked, the phase modulating voltage varies the output phase by approximately  $5^\circ/\text{V}$ .

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
CHANGE TO:							
1-1	200-1837-01		2		COVER, PLUG-IN: TOP AND BOTTOM	80009	200-1837-01
-49	386-2795-01		1		SUBPANEL, FRONT:	80009	386-2795-01
-53	337-1967-01		1		SHIELD, ELEC: REAR SUBPANEL	80009	337-1967-01
-71	333-2380-00		1		PANEL, REAR:	80009	333-2380-00
-195	426-1460-00		1		FR SECT, PLUG-IN: RIGHT	80009	426-1460-00
	210-0406-00		2		NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS	73743	2X12161-402 .
	211-0028-00		2		SCREW, MACHINE: 4-40 X 0.188 " BDGH, NYL, SLOT	95987	OBD .
	210-0921-00		2		WASHER, MICA: 0.50 X 0.141 X 0.005 INCH THK	80009	210-0921-00 .
	213-0227-00		4		SCREW, TPG, TF: 6-32 X 0.5, SPCL TYPE, FLH	83385	OBD
	213-0192-00		2		SCR, TPG, THD FOR: 6-32 X 0.50 INCH, PNH STL	87308	OBD
	211-0232-00		4		SCREW, MACHINE: 4-40 X 0.25, FIL, STL	83385	OBD
-196	179-2398-02		1		WIRING HARNESS: CHASSIS	80009	179-2398-02
-204	179-2399-01		1		WIRING HARNESS: FRONT PANEL	80009	179-2399-01

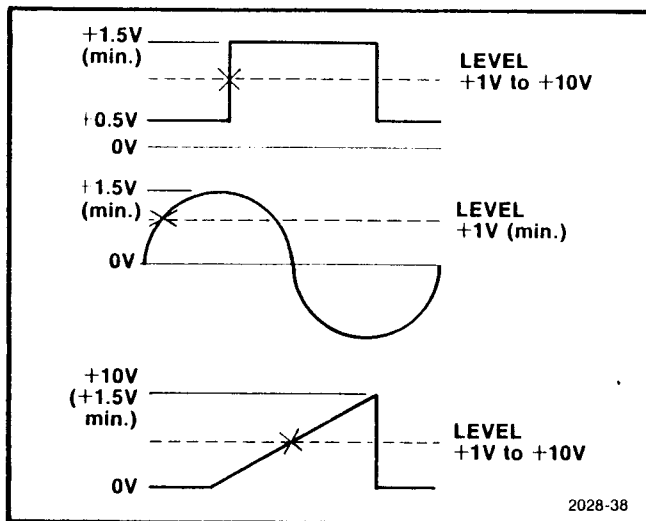


Fig. 1-4. Trigger signal amplitude requirements and triggering points.

### Amplitude Modulating Input

To amplitude modulate the output waveform, connect the modulating signal to the AM INPUT connector. Push the SINEWAVE pushbutton and set the FREQUENCY Hz dial for the desired carrier frequency. Refer to the Amplitude Modulation Input specification at the rear of this section and Figs. 1-16 and 1-17 for more information about this mode of operation.

### Internal Sweep Operation

Select the time for one complete sweep with the SWEEP DURATION control. Use the VAR knob to obtain sweep times between steps. Set the FREQUENCY Hz (START), STOP FREQ, and MULTIPLIER dials for the desired swept frequencies. Select either a logarithmic or linear sweep rate by pushing or releasing the LOG LIN SWP pushbutton. Release the STOP FREQ pushbutton. Use the FREQUENCY VERNIER control to set the START frequency when sweeping from frequencies lower than the "1" calibration figure on the dial. If a triggered sweep is

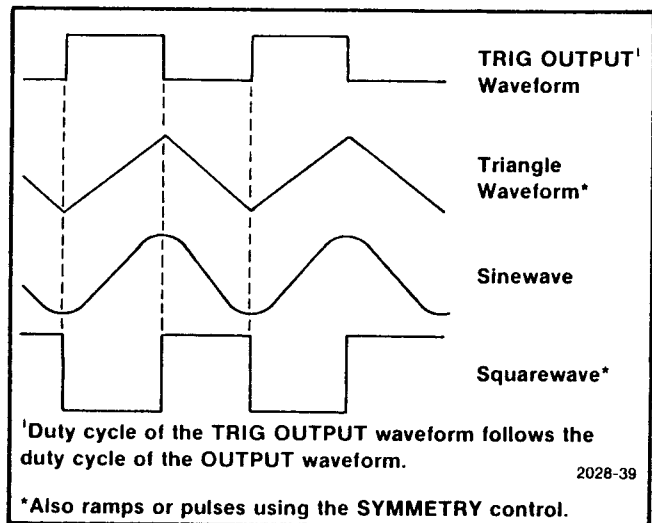


Fig. 1-5. Phase relationships between various OUTPUT waveforms and the TRIG OUT waveform.

desired, push the TRIG SWP pushbutton and connect the trigger signal to the SWEEP TRIG INPUT connector. Adjust the LEVEL control so the sweep starts at the desired level on the triggering waveform. If free running operation is desired, release the TRIG SWP pushbutton. The sweep may be stopped and the output frequency held at any time by pushing the STOP FREQ pushbutton. The linear sweep voltage is available at the SWEEP OUTPUT connector.

### External Input Signals for Trigger, Gate, Phase Lock, and Sweep Trig Modes

External input signals for these modes must be at least 1 V p-p around the dc voltage set by the LEVEL control (+1 V to +10 V). With the LEVEL control at or near minimum, the external signal must, at least, pass through +0.5 V and +1.5 V. For example, an external signal whose amplitude is symmetrical about 0 V (such as a sine wave) must be at least 3 V p-p (+1.5 V to -1.5 V). Typical input signals are as shown in Fig. 1-4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
ADDS; CONT					
RI682	315-0273-00		RES., FXD, CMPSN:27K OHM, 5%, 0.25W	01121	CB2735
RI721	315-0102-00		RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
RI723	315-0470-00		RES., FXD, CMPSN:47 OHM, 5%, 0.25W	01121	CB4705
RI727	315-0510-00		RES., FXD, CMPSN:51 OHM, 5%, 0.25W	01121	CB5105
RI745	315-0103-00		RES., FXD, CMPSN:10K OHM, 5%, 0.25W	01121	CB1035
RI747	315-0912-00		RES., FXD, CMPSN:9.1K OHM, 5%, 0.25W	01121	CB9125
RI776	315-0102-00		RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
RI777	315-0101-00		RES., FXD, CMPSN:100 OHM, 5%, 0.25W	01121	CB1015
RI782	315-0273-00		RES., FXD, CMPSN:27K OHM, 5%, 0.25W	01121	CB2735
VR1676	152-0590-00		SEMICOND DEVICE:ZENER, 18V, 5% AT 7MA	04713	1N967B
VR1677	152-0282-00		SEMICOND DEVICE:ZENER, 0.4W, 30V, 5%	04713	1N972B
VR1776	152-0590-00		SEMICOND DEVICE:ZENER, 18V, 5% AT 7MA	04713	1N967B
VR1777	152-0282-00		SEMICOND DEVICE:ZENER, 0.4W, 30V, 5%	04713	1N972B
WI210	131-0566-00		LINK, TERM. CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1

# BASIC WAVEFORM CAPABILITIES

The following photographs illustrate the basic waveform capabilities of the FG 504.

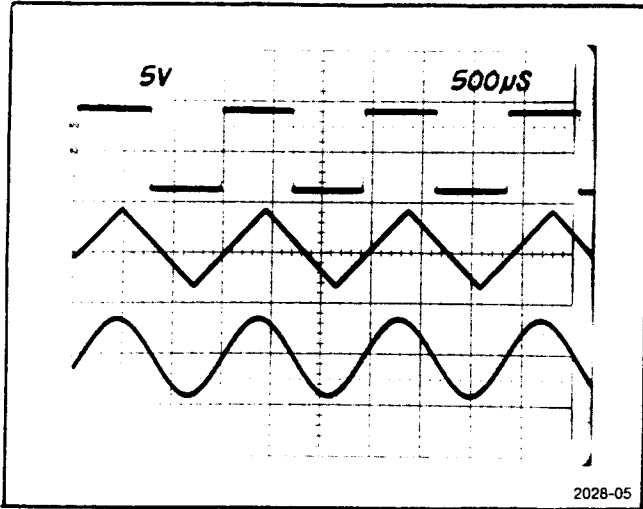


Fig. 1-6. BASIC FUNCTIONS, Square, triangle, and sine waveforms are selected by front panel pushbutton.

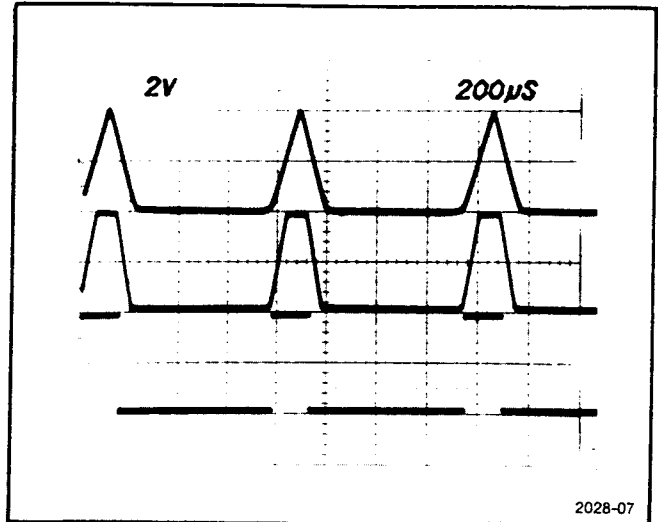


Fig. 1-8. VARIABLE RISE AND FALL TIMES. By varying the rise and fall times in the square wave mode various pulse shapes are formed.

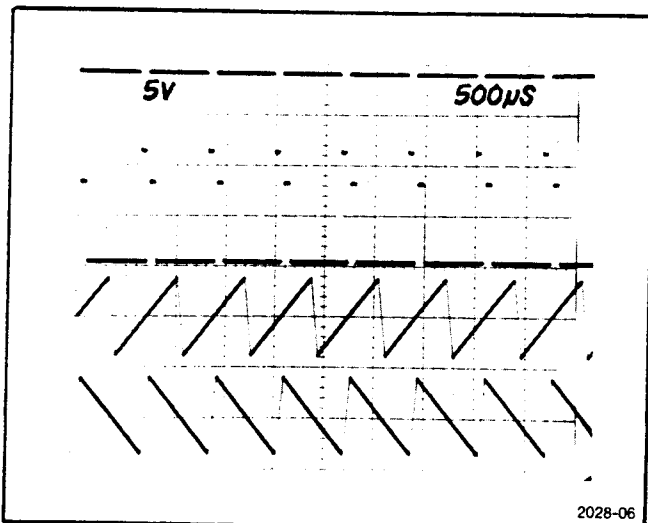


Fig. 1-7. RAMPS AND PULSES. These are obtained from the basic waveforms by using the SYMMETRY control.

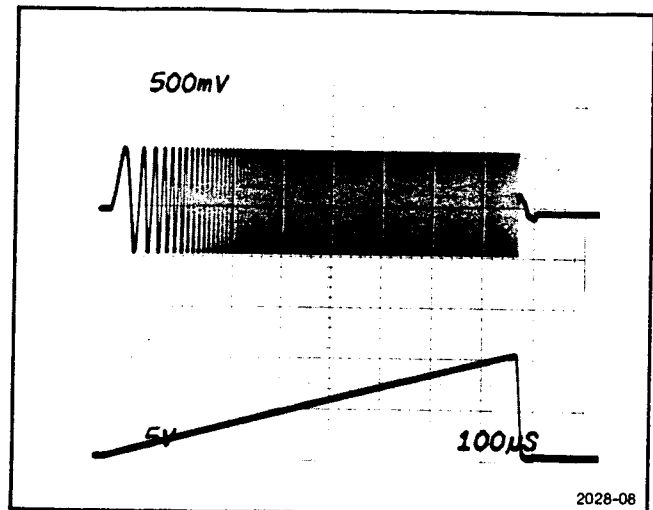


Fig. 1-9. LINEAR SWEEP. Select the start and stop frequencies and the internal linear ramp for a swept output from the start to stop frequencies in the selected time.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
ADDS :						
C45	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N147 C 104K
C247	283-0238-00			CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C382	283-0648-00			CAP.,FXD,MICA D:10PF,5%,100V	00853	D151C100DC
C494	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C928	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1036	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1145	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1160	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1180	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1661	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1676	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1761	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1776	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
CR1420	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1600	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1652	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1676	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1684	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR1686	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR1700	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1740	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1752	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1776	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1782	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
F1616	159-0116-00			FUSE,CARTRIDGE:1A,125V,0.4 SEC,0.17 LEADS	75915	273001
F1716	159-0116-00			FUSE,CARTRIDGE:1A,125V,0.4 SEC,0.17 LEADS	75915	273001
L300	108-0552-00			COIL,RF:80NH	80009	108-0552-00
L382	108-0330-00			COIL,RF:0.4UH	80009	108-0330-00
L1130	108-0057-00			COIL,RF:8.8UH	80009	108-0057-00
Q1621	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1677	151-0515-01			TRANSISTOR:50V,8A	04713	2N4441
Q1721	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1740	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1776	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1777	151-0515-01			TRANSISTOR:50V,8A	04713	2N4441
R641	311-1921-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	72-191-0
R1201	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1488	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100ROF
R1621	321-0102-00			RES.,FXD,FILM:113 OHM,1%,0.125W	91637	MFF1816G113ROF
R1623	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1627	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R1641	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1643	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1645	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1676	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

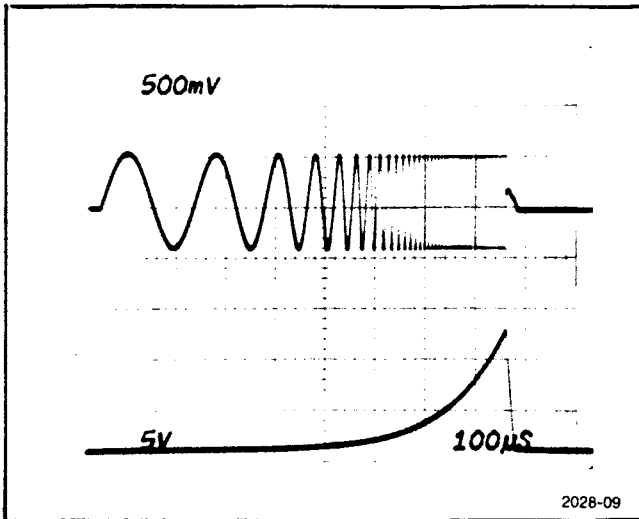


Fig. 1-10. LOGARITHMIC SWEEP. Use the same setup as in Fig. 1-9. Select the logarithmic ramp. The frequency is swept at a logarithmic rate. The logarithmic ramp voltage is not externally available.

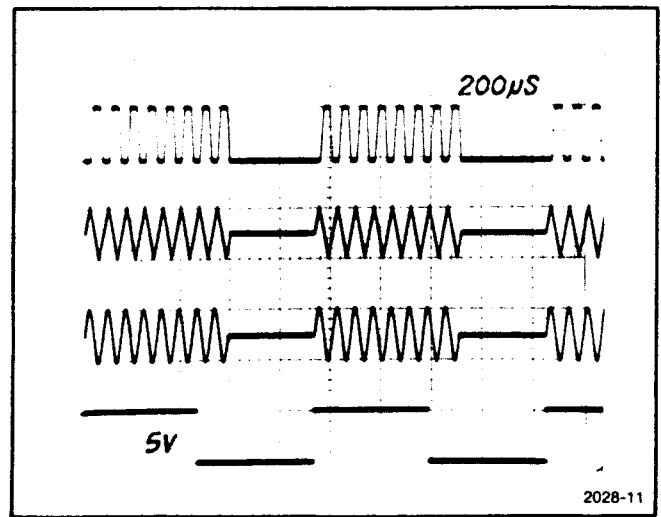


Fig. 1-12. GATED OPERATION. The top three traces are various output waveforms and the bottom trace is the gating waveform applied to the trigger INPUT connector with the GATE pushbutton depressed. Note the additional cycle completed after the waveforms are gated off.

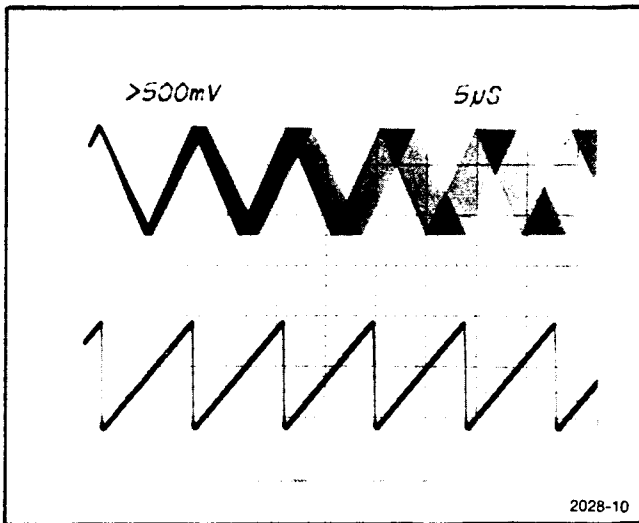


Fig. 1-11. NARROW BAND SWEEP. The top trace shows the triangle waveform swept by a linear ramp. The start frequency is 9.52 kHz and the stop frequency is 10.52 kHz. This function is useful for narrow band sweep testing. The bottom trace is the sweeping ramp.

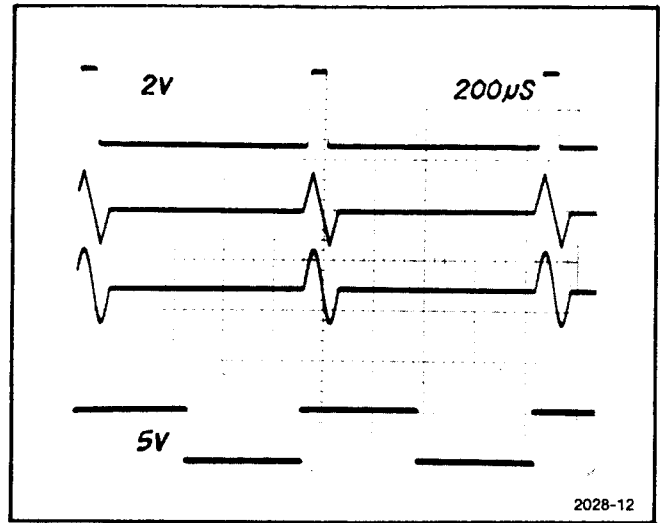


Fig. 1-13. TRIGGERED OPERATION. The top three traces are the various output traces selected. The bottom trace is the triggering waveform applied to the trigger INPUT connector with the TRIG mode selected. Note that only one cycle of the output waveforms is completed.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CHANGE TO; CONT						
R1612	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1626	308-0755-00			RES.,FXD,WW:0.75 OHM,5%,2W	75042	BWH-R7500J
R1642	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R1644	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1650	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R1702	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R1705	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91A R200
R1707	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R1712	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1713	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1715	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R1726	308-0755-00			RES.,FXD,WW:0.75 OHM,5%,2W	75042	BWH-R7500J
R1740	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R1742	323-0306-00			RES.,FXD,FILM:15K OHM,1%,0.50W	75042	CECT0-1502F
R1744	323-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.50W	91637	MFF1226G24901F
R1746	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1750	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
VR1608	152-0280-00			SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
REMOVES						
C618	281-0510-00			CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	72982	301-000C0G0220M
C632	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C946	283-0353-00			CAP.,FXD,CER DI:0.1UF,10%,50V	16546	W050FH104KPSS
C1046	283-0353-00			CAP.,FXD,CER DI:0.1UF,10%,50V	16546	W050FH104KPSS
C1488	283-0191-00			CAP.,FXD,CER DI:0.022UF,20%,50V	72982	8121N075Z5U0223M
C1691	285-1101-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	19396	223K02PT485
CR1622	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CRI722	152-0061-00			SEMICONV DEVICE:SILICON,175V,100MA	80009	152-0061-00
LR977	108-0520-00			COIL,RF:2.2UH (WOUND ON A 10 OHM RES)	80009	108-0520-00
LR1077	108-0520-00			COIL,RF:2.2UH (WOUND ON A 10 OHM RES)	80009	108-0520-00
Q906	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q914	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q1675	151-0506-00			TRANSISTOR:SILICON,SCR	03508	C106B2
R492	317-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.125W	01121	BB2005
R902	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R904	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R906	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R910	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R916	301-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
R983	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1083	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1600	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1624	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1674	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1692	304-0104-00			RES.,FXD,CMPSN:100K OHM,10%,1W	01121	GB1041
R1700	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1724	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
VR1675	152-0241-00			SEMICONV DEVICE:ZENER,0.4W,33V,5%	80009	152-0241-00
VR1740	152-0227-00			SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0227-00



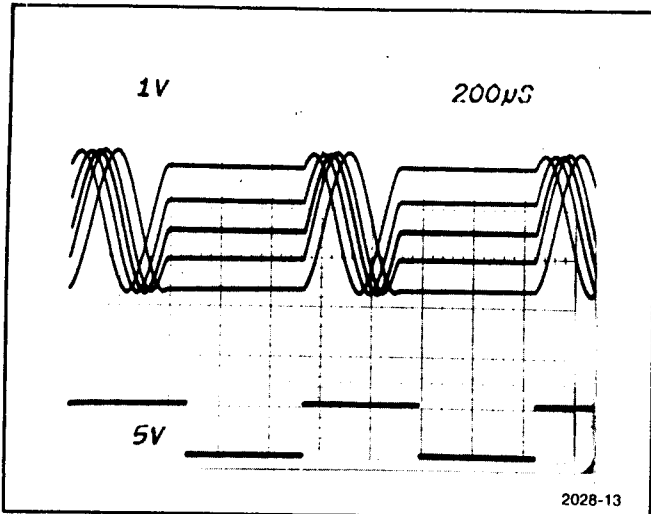


Fig. 1-14. PHASE CONTROL OPERATION. This photograph illustrates PHASE control usage in the triggered mode. The five super-imposed traces illustrate the effect of the phase control. This control provides approximately  $\pm 80^\circ$  of shift. The bottom trace is the triggering waveform.

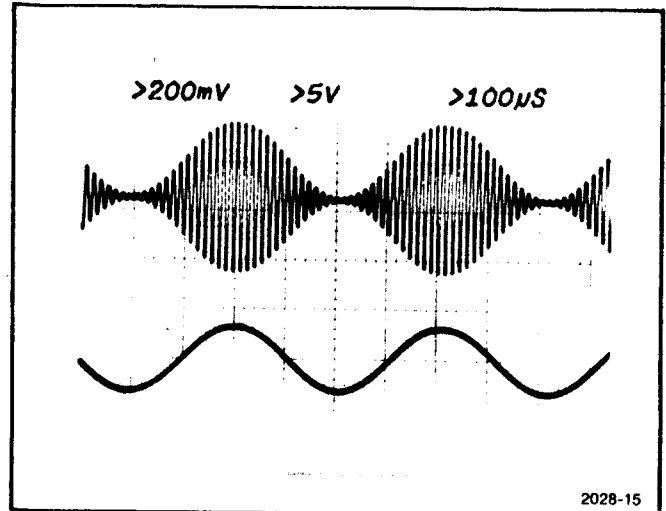


Fig. 1-16. AMPLITUDE MODULATION. The top trace shows the 100% modulated envelope and the bottom trace the modulating signal.  $-5$  V on the modulating signal equals 0% modulation and  $+5$  V equals 100% modulation.

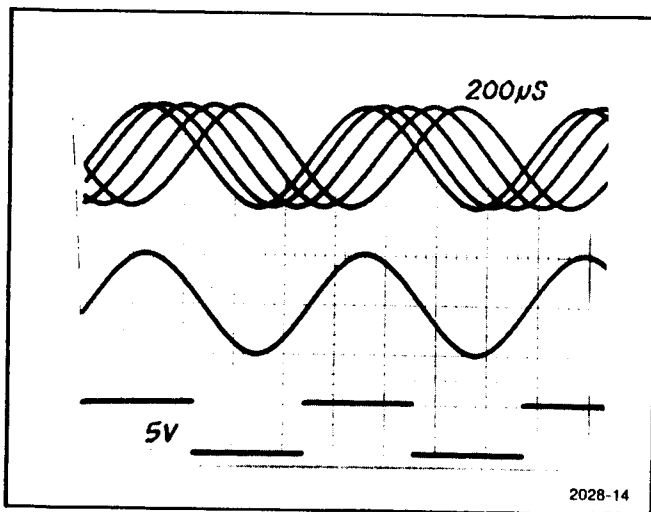


Fig. 1-15. PHASE LOCKED LOOP. The bottom trace is the signal applied to the INPUT connector in the  $\phi$  LOCK mode of operation. The middle trace is the output phase locked to the input signal. The top traces show the effect of the PHASE control.

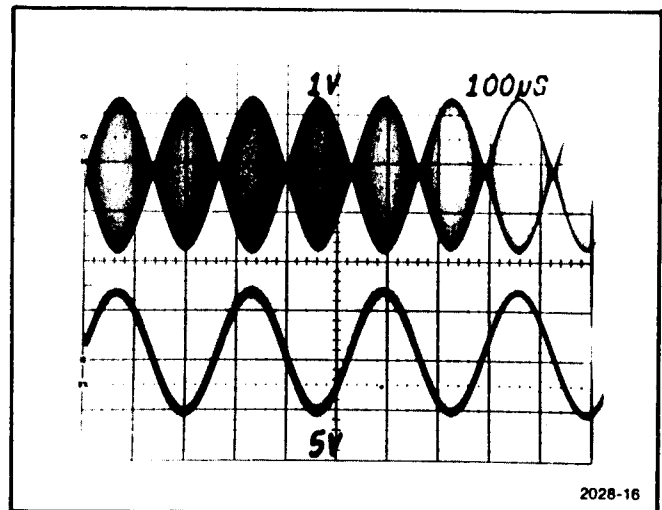


Fig. 1-17. SUPPRESSED CARRIER MODULATION. The top trace shows a double sideband suppressed carrier modulation envelope while the bottom trace displays the modulating waveform. The upper peak of the modulating waveform is at 0 V and the bottom peak is at  $-10$  V. The overall level of the modulating waveform must be carefully adjusted for true suppressed carrier operation.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CHANGE TO; CONT						
R288	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	91637	MFF1816G20500F
R295	321-0001-00			RES.,FXD,FILM:10 OHM,1%,0.125W	75042	CEATO-10R00F
R367	321-0208-00			RES.,FXD,FILM:1.43K OHM,1%,0.125W	91637	MFF1816G14300F
R490	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R528	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R530	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R576	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R615	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R616	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R618	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R620	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R622	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R625	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R630	311-1258-00			RES.,VAR,NONWIR:50 OHM,10%,0.50W	32997	3326P-T02-500
R632	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R642	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R646	301-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.50W	01121	EB5615
R730	321-0771-01			RES,FXD,FILM:50 OHM,0.54,0.125W	91637	MFF1816G50R00D
R735	321-0771-01			RES,FXD,FILM:50 OHM,0.54,0.125W	91637	MFF1816G50R00D
R738	321-0082-00			RES.,FXD,FILM:69.8 OHM,1%,0.125W	91637	MFF1816G69R80F
R740	311-1175-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	73138	66WR101KSM
R900	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100ROF
R914	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R920	321-0099-00			RES.,FXD,FILM:105 OHM,1%,0.125W	91637	MFF1816G105ROF
R922	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R924	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R930	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R938	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R950	311-1244-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3386X-T07-101
R960	321-0012-00			RES.,FXD,FILM:13 OHM,1%,0.125W	91637	MFF1816G13R00F
R965	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1024	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R1038	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R1050	311-1244-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3386X-T07-101
R1090	322-0215-00			RES.,FXD,FILM:1.69K OHM,1%,0.25W	75042	CEBT0-1691F
R1132	321-0341-00			RES.,FXD,FILM:34.8K OHM,1%,0.125W	91637	MFF1816G34801F
R1140	311-1921-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	72-191-0
R1160	308-0619-00			RES.,FXD,WW:37.0 OHM,1%,3W	14193	SA30
R1180	308-0619-00			RES.,FXD,WW:37.0 OHM,1%,3W	14193	SA30
R1204	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R1282	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1448	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1452	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1475	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R1476	321-0367-00			RES.,FXD,FILM:64.9K OHM,1%,0.125W	91637	MFF1816G64901F
R1478	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1480	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R1484	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R1486	321-0227-00			RES.,FXD,FILM:2.26K OHM,1%,0.125W	91637	MFF1816G22600F
R1602	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R1605	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91A R200
R1607	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R1610	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225

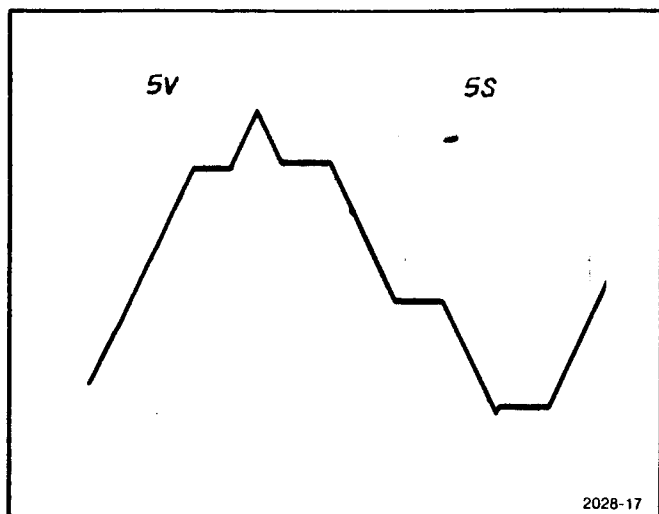


Fig. 1-18. LOW FREQUENCY HOLD. The output of the FG 504 in the lowest five MUPLTIPLIER settings can be held at any level by pushing the HOLD button. The steps on this time exposure were obtained in this manner.

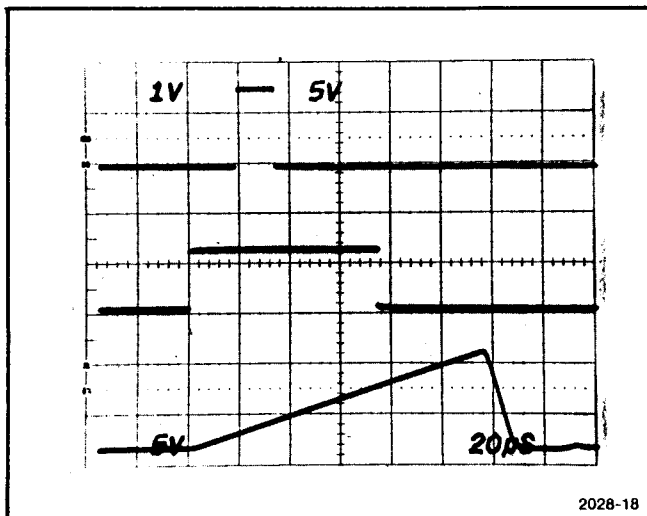


Fig. 1-19. DELAYED OPERATION. A wide range of delay times are available by using the internal sweep generator as a delay generator. The middle trace is the underlayed input signal applied to the SWEEP TRIG INPUT. The bottom trace is at the LIN SWP OUT connector. This ramp is applied to the external trigger INPUT connector. The top trace is the delayed output pulse. The amount of delay is proportional to the sweep duration and the setting of the TRIG LEVEL control. Be sure when using the sweep as a delay generator to set the STOP FREQ dial fully ccw.

## APPLICATIONS

### Tone Burst Testing

The FG 504, with an external pulse generator, may be used for tone burst testing. Connect the output of a Tektronix PG 501 or other pulse generator to the trigger INPUT connector. Select the GATE mode of operation. Set the external pulse generator for the desired pulse duration and repetition rates. Now select the desired sweep time for the FG 504. Select the start and stop frequencies. The output of the FG 504 will now be a series of tone bursts as shown in Fig. 1-20.

### Filter Testing

The swept frequency capabilities of the FG 504 make it quite suitable for sweep testing filters. When using the FG 504 in this application, it is best to use the LOG SWP Mode. Figs. 1-21 and 1-22 illustrate the advantages of using logarithmic sweeps.

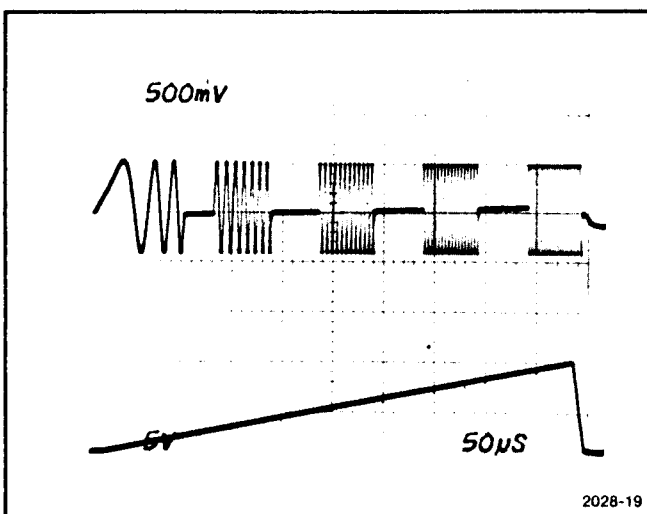


Fig. 1-20. TONE BURST TESTING. The lower trace is the linear ramp from the LIN SWEEP OUTPUT terminal.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CHANGE TO:						
A1	670-3842-03			CIRCUIT BD ASSY:MAIN	80009	670-3842-03
A2	670-3841-03			CIRCUIT BD ASSY:FUNCTION	80009	670-3841-03
A3	670-3840-02			CIRCUIT BD ASSY:LOOP	80009	670-3840-02
A4	670-3797-02			CIRCUIT BD ASSY:FLOAT INTERFACE	80009	670-3797-02
C495	283-0094-00			CAP.,FXD,CER DI:27PF,1%,200V	72982	835-583-COG0270K
C550	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C570	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C588	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C592	283-0632-00			CAP.,FXD,MICA D:87PF,1%,100V	00853	D151E870FC
C594	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102FO
C596	283-0238-00			CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C612	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C638	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C642	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D153F1050FO
C914	283-0642-00			CAP.,FXD,MICA D:33PF,+/-0.5PF,300V	00853	D10-3E330G0
C934	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C955	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C958	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C965	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C978	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C1078	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C1092	281-0158-00			CAP.,VAR,CER DI:7-45PF,50V	73899	DVJ-5006
C1146	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1156	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1176	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
C1608	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061X7R0103M
L646	108-0509-00			COIL,RF:2.5UH	80009	108-0509-00
L1045	108-0181-01			COIL,RF:0.2UH	80009	108-0181-01
Q640	151-0369-00			TRANSISTOR:SILICON,PNP	01295	SKA6664
Q952	151-0285-01			TRANSISTOR:SILICON,PNP,SEL	80009	151-0285-01
Q970	151-0211-02			TRANSISTOR:SILICON,NPN,SEL	80009	151-0211-02
Q980	151-0211-02			TRANSISTOR:SILICON,NPN,SEL	80009	151-0211-02
Q1052	151-0211-02			TRANSISTOR:SILICON,NPN,SEL	80009	151-0211-02
Q1070	151-0285-01			TRANSISTOR:SILICON,PNP,SEL	80009	151-0285-01
Q1080	151-0285-01			TRANSISTOR:SILICON,PNP,SEL	80009	151-0285-01
Q1622	151-0462-00			TRANSISTOR:SILICON,PNP	80009	151-0462-00
Q1660	151-0462-00			TRANSISTOR:SILICON,PNP	80009	151-0462-00
Q1722	151-0439-00			TRANSISTOR:SILICON,NPN	80009	151-0439-00
R54	322-0170-00			RES.,FXD,FILM:576 OHM,1%,0.25W	75042	CEBT0-5760F
R162	322-0172-00			RES.,FXD,FILM:604 OHM,1%,0.25W	75042	CEBT0-6040F
R170	322-0172-00			RES.,FXD,FILM:604 OHM,1%,0.25W	75042	CEBT0-6040F
R172	322-0172-00			RES.,FXD,FILM:604 OHM,1%,0.25W	75042	CEBT0-6040F
R270	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R271	321-0054-00			RES.,FXD,FILM:35.7 OHM,5%,0.125W	91637	MFF1816G35R70F
R272	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	91637	MFF1816G20500F
R280	321-0001-00			RES.,FXD,FILM:10 OHM,1%,0.125W	75042	CEAT0-10R00F
R285	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R287	321-0054-00			RES.,FXD,FILM:35.7 OHM,5%,0.125W	91637	MFF1816G35R70F

**Pulse Shaping**

The external triggering feature of the FG 504 adapts for pulse shaping. Connect the pulse to be shaped to the trigger INPUT connector and place the FG 504 in the square-wave mode. The triggering level may be selected with the TRIG LEVEL control. The rise and fall times, levels, and symmetry of the clean output pulse may be changed as desired. Fig. 1-23 illustrates this application.

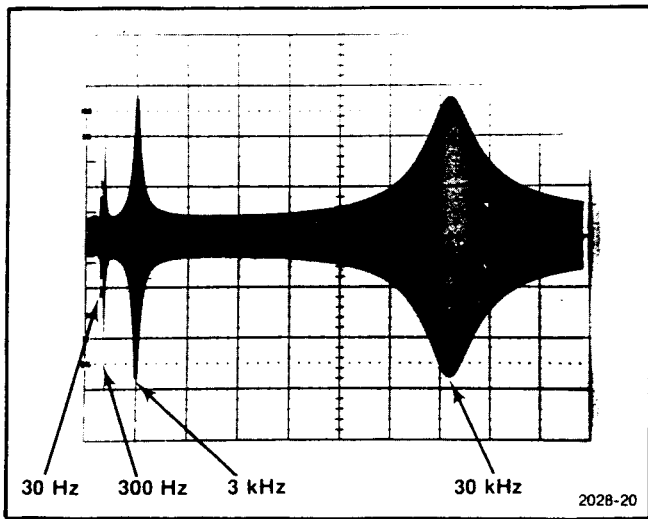


Fig. 1-21. Linear sweep showing skewed spacing of filter output frequencies.

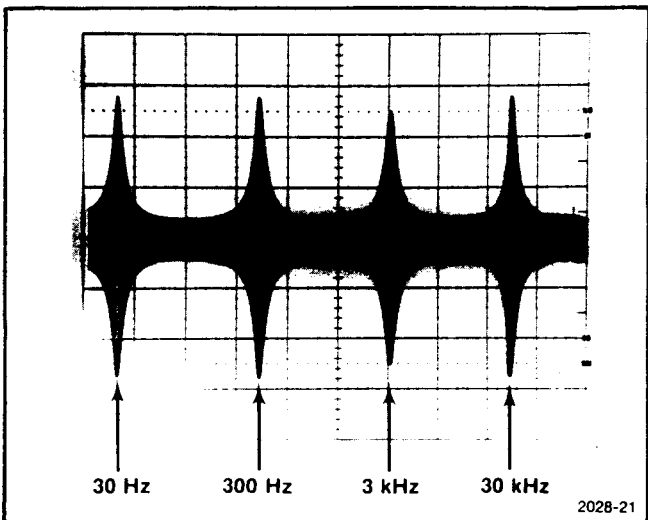


Fig. 1-22. Logarithmic sweep showing even spacings of filter output frequencies.

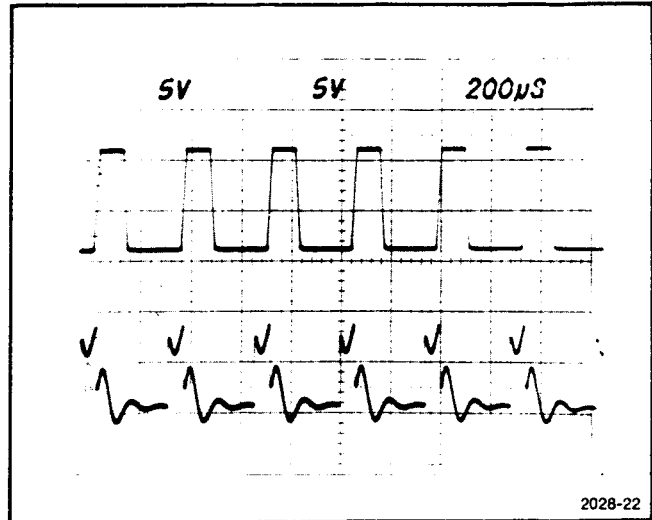
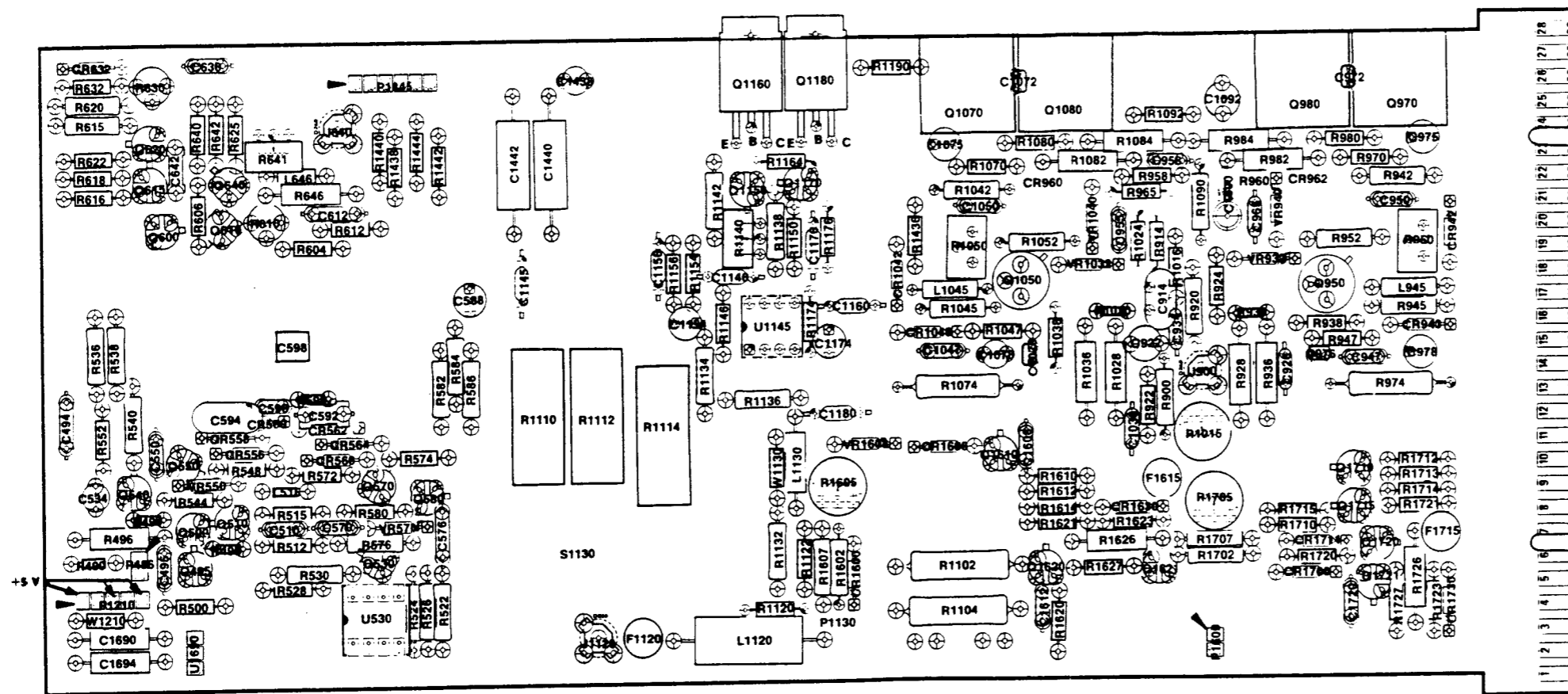
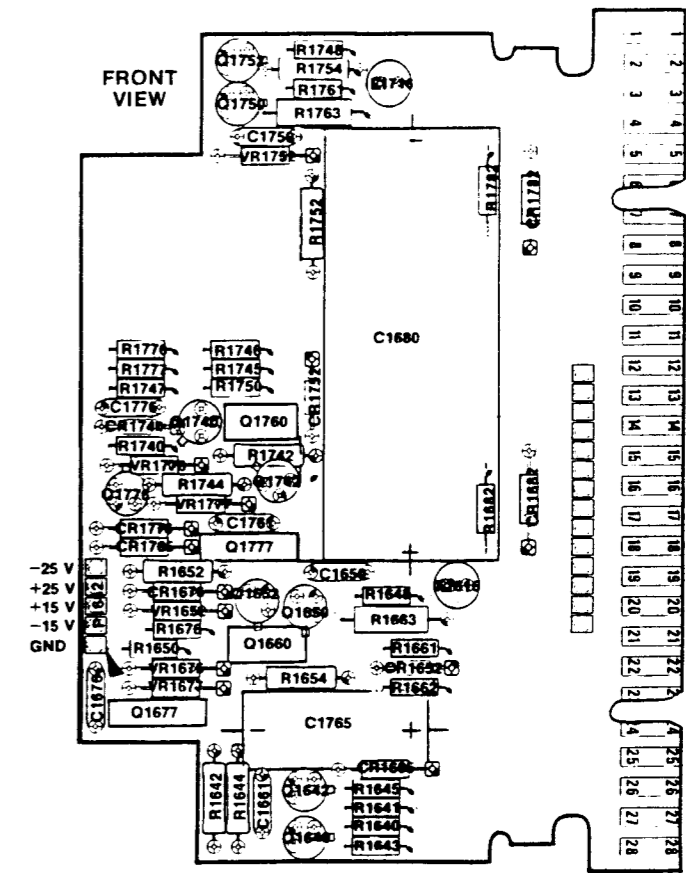


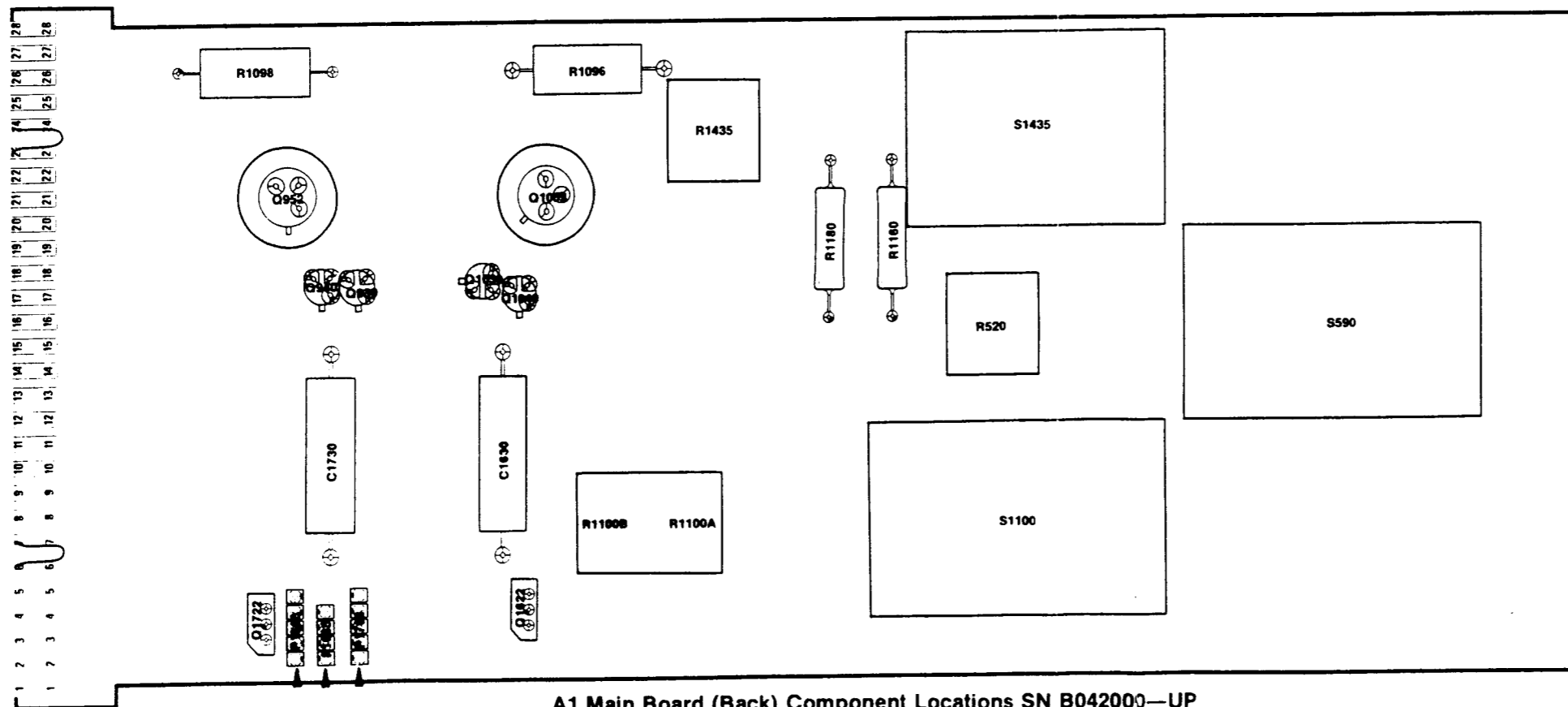
Fig. 1-23. PULSE SHAPING CAPABILITIES. The lower trace is the triggering signal.



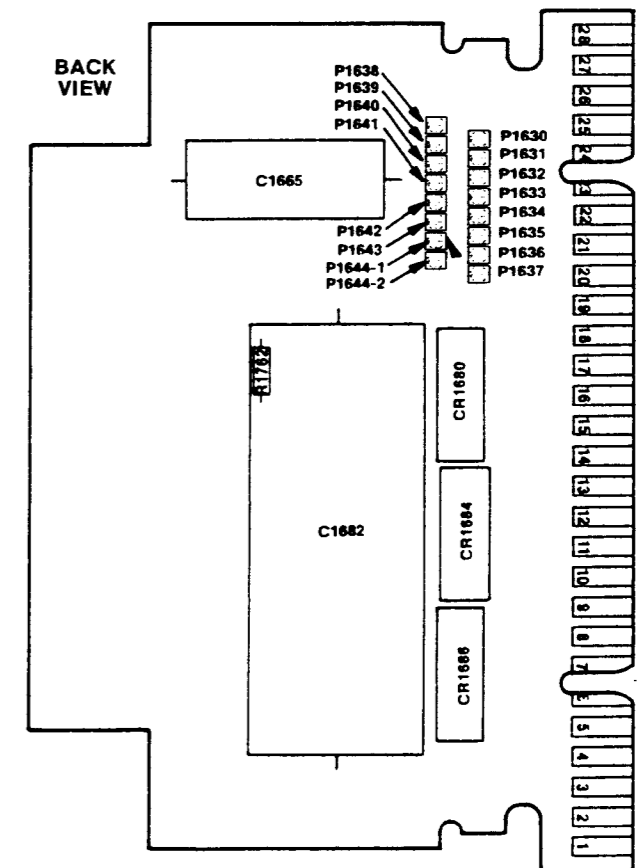
A1 Main Board (Front) Component Locations SN B042000-UP



A4 Floating Interface Board Component Locations SN B042000-UP



A1 Main Board (Back) Component Locations SN B042000-UP



# ELECTRICAL CHARACTERISTICS

## Performance Conditions

The electrical characteristics are valid only if the FG 504 is calibrated at an ambient temperature between +20°C and +30°C, and operated between 0°C and +50°C, unless otherwise noted. Forced air circulation in the power module (TM 515, TM 506, RTM 506, or equivalent) is required for operation above +40°C ambient.

## WAVEFORMS:

Sine, Triangle, and Square: Ramps and Pulses by use of the VARIABLE SYMMETRY control.

## FREQUENCY RANGE:

Sine, Triangle, and Square Waveforms: 0.001 Hz to 40 MHz calibrated range.

Ramps, Pulses, or waveforms requiring use of VARIABLE SYMMETRY control: 0.001 Hz to nominally 4 MHz.

Multiplier switch has position for user-determined range by capacitor selection. Maximum frequency is 400 kHz. A 5  $\mu$ F capacitor provides a full scale frequency of 400 Hz. Instruments are shipped from the factory with a capacitor installed to cover the 20 Hz to 20 kHz range in the  $.5 \times 10^3$  position.

## VARIABLE SYMMETRY:

Duty Cycle Range: 7% to 93% (20% to 80% on triangle and sine waveforms above 1 MHz). Actuation of VARIABLE SYMMETRY control divides output frequency by approximately ten.

## OUTPUT AMPLITUDE:

30 V p-p into an open circuit, 15 V p-p into 50  $\Omega$ .

## OFFSET RANGE:

$\pm 7.5$  V into an open circuit,  $\pm 3.75$  V into 50  $\Omega$ . Signal plus offset may not exceed peak output amplitude of  $\pm 15$  V into an open circuit or  $\pm 7.5$  V into 50  $\Omega$ . Offset defeatable by front panel control.

## OUTPUT ATTENUATOR:

Open Circuit Voltages:

Attenuator Step	Maximum Output Voltage (p-p)
0 dB	30 V
-10 dB	9.5 V
-20 dB	3 V
-30 dB	950 mV
-40 dB	300 mV
-50 dB	95 mV

Variable -20 dB: Extends minimum signal amplitude to 10 mV. See squarewave aberrations specification.

Accuracy:  $\pm 0.5$  dB/decade.

## FREQUENCY RESOLUTION:

1 part in  $10^4$  of full scale setting using the FREQUENCY VERNIER control.

## FREQUENCY STABILITY:

$\leq 0.05\%$  for 10 minutes,  $\leq 0.1\%$  for 1 hour,  $\leq 0.5\%$  for 24 hours. The FREQUENCY Hz dial must be on the calibrated portion. The instrument must be in a constant ambient temperature between 0°C and +50°C and checked after a 1 hour warmup.

## DIAL SCALE:

1 to 40 calibrated, 0.1 to 1 uncalibrated.

## DIAL ACCURACY (+15°C to +35°C)

### Start Dial:

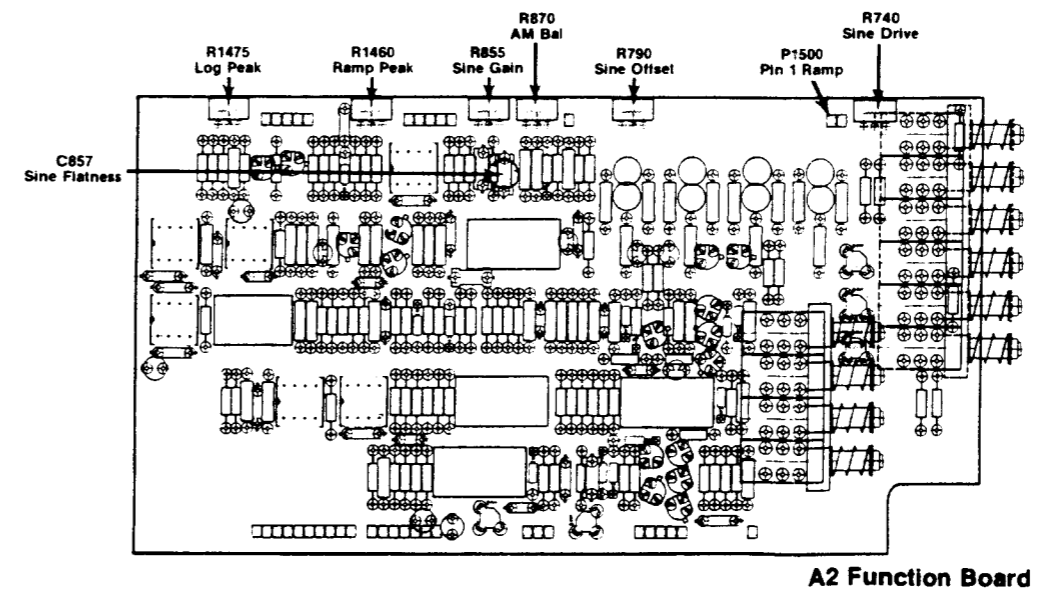
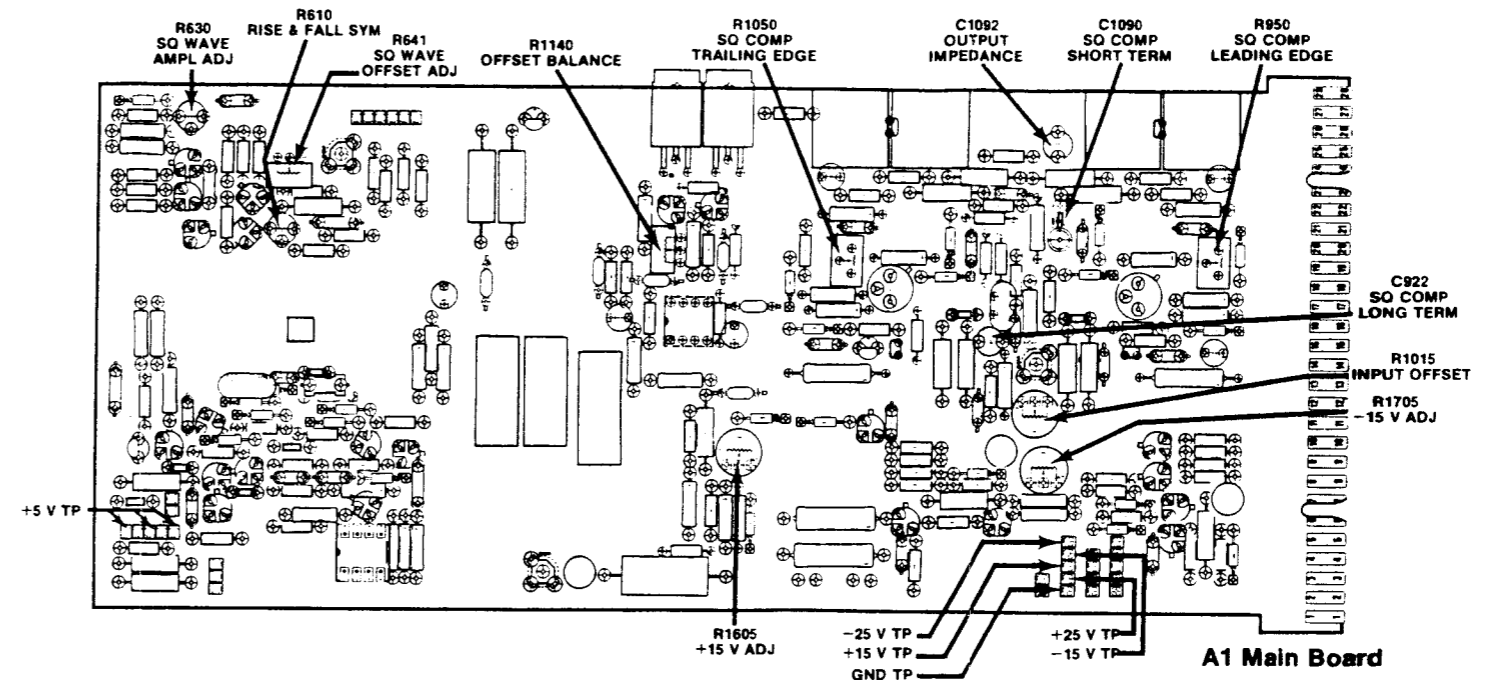
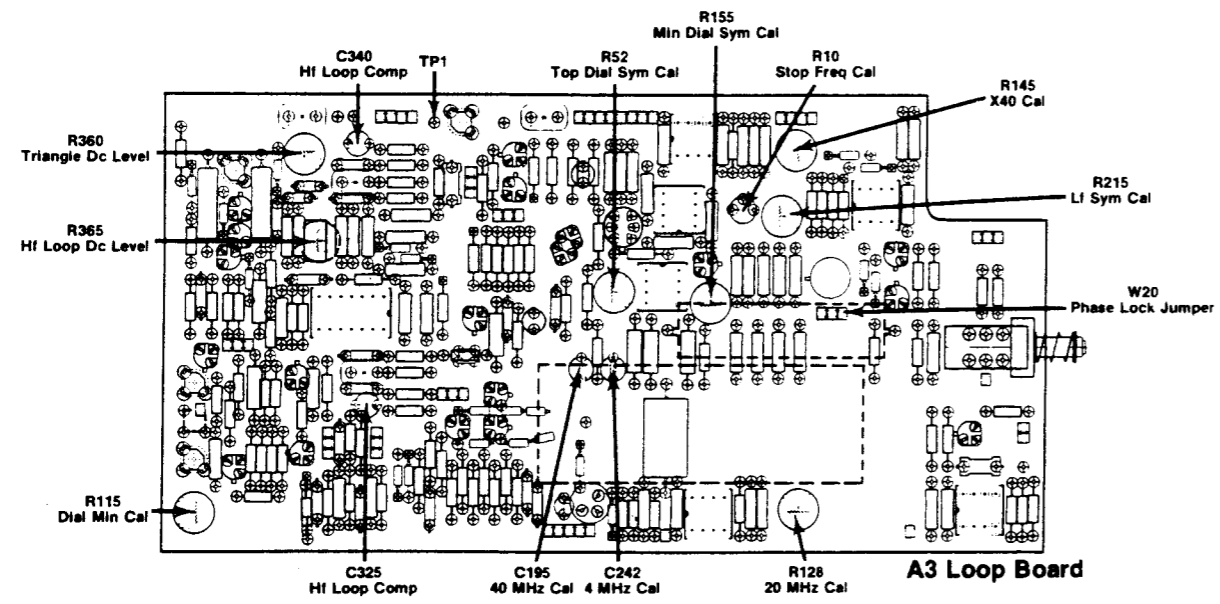
Within  $\pm 3\%$  of full scale from 0.001 Hz to 4 MHz.  
Within  $\pm 6\%$  of full scale from 4 MHz to 40 MHz.

### Stop Frequency Dial:

Within 5% of the difference between the start and stop frequencies plus the FREQUENCY Hz (START) dial error. Uncalibrated on  $10^n$  MULTIPLIER setting.

# ADJUSTMENT LOCATIONS

SN B042000—UP





**AMPLITUDE FLATNESS:**

Sinewave (reference at 10 kHz):  
 Within  $\pm 5$  dB from 0.001 Hz to 40 kHz.  
 Within  $\pm 2$  dB from 40 kHz to 40 MHz.

Triangle (reference at 10 kHz):  
 Within  $\pm 0.5$  dB from 0.001 Hz to 40 kHz.  
 Within  $\pm 2$  dB from 40 kHz to 40 MHz.

Squarewave (reference at 10 kHz):  
 Within  $\pm 0.5$  dB from 0.001 Hz to 20 MHz.  
 Within  $\pm 2$  dB from 20 MHz to 40 MHz.

Sine, Triangle, and Squarewave Amplitude Match:  
 Within  $\pm 1$  dB at 10 kHz.

**SINEWAVE DISTORTION (Total Harmonic Distortion):**

$\leq 0.5\%$  from 20 Hz to 40 kHz. Greatest harmonic is at least 30 dB down from 40 kHz to 1 MHz and 20 dB down from 1 MHz to 40 MHz. Typically  $\leq 1\%$  from 0.001 Hz to 20 Hz. Measured under the following conditions: terminated in 50  $\Omega$ , at  $\pm 25^\circ\text{C} \pm 10^\circ\text{C}$  ambient, with zero offset,  $\leq 30$  dB attenuation and with the FREQUENCY Hz (START) dial set between 4 and 40.

**SQUAREWAVE:**

Rise and falltime (FIXED):  $\leq 6$  ns.

Aberrations:  $\leq 5\%$  p-p +30 mV into a 50  $\Omega$  load.

**TRIANGLE SYMMETRY**

Within 1% from 10 Hz to 400 kHz, within 5% from 400 kHz to 40 MHz on calibrated portion of FREQUENCY Hz dial. Typically within 2% from 0.001 Hz to 10 Hz.

**TRIANGLE LINEARITY:**

Within 1% from 10 Hz to 400 kHz, within 2% from 400 kHz to 4 MHz, within 10% from 4 MHz to 40 MHz measured from the 20% to 80% points on the waveform. Typically within 2% from 0.001 Hz to 10 Hz.

**VARIABLE RISE AND FALLTIME (Square and Pulse Waveforms):**

Range: 10 ns to 100 ms in 7 steps measured from 10% to 90% points on waveform. Variable control has  $\geq 10X$  range. Period waveform must exceed combined rise and falltimes by  $\geq 20\%$ .

**MAXIMUM DIAL, VCF, and SWEEP RANGE:**

MULTIPLIER	FREQUENCY RATIO
$10^6$	500:1
$10^5 - 10^2$	1000:1
10, 1, $10^{-1}$ , $10^{-2}$	100:1
$10^{-3}$	40:1

Lowest instrument frequency is 0.001 Hz.

**LINEAR or LOGARITHMIC SWEEP:**

Accuracy: Limited by Start and Stop Frequency dial specifications. Can be set more accurately using an external frequency monitor.

Sweep Duration: 100 s to 0.1 ms in six decades. Variable control overlaps decades.

Stop Frequency to Swept Stop Frequency Error: Within 2% maximum from 100 s to 1 ms sweep duration. Within 10% maximum from 1 ms to 0.1 ms sweep duration.

Linear Sweep Output:

Amplitude: 0 V to +10 V from 1 k $\Omega$ .

Amplitude Accuracy: Within  $\pm 5\%$  from 100 s to 1 ms, within  $\pm 10\%$  from 1 ms to 0.1 ms.

Sweep Trigger Input:

Input Sensitivity: 1 V p-p.

Trigger Level: 1 V through 10 V.

Maximum Input: +20 V.

Manual Trigger: Front panel control.

**AMPLITUDE MODULATION INPUT:**

A nominal 5 V p-p signal provides 100% modulation of a sinewave carrier from dc to 4 MHz with  $< 5\%$  distortion at 70% modulation when driven from a source impedance of  $\leq 600 \Omega$ . From 4 MHz to 40 MHz there is  $\leq 10\%$  distortion at 65% modulation. Distortion specifications valid for modulating frequencies from 20 Hz to 20 kHz. Modulation frequency bandwidth is dc to 110 kHz. A modulating source impedance of  $\leq 10 \text{ k}\Omega$  ensures proper modulation and divides the output amplitude by 2. Input impedance is  $> 1 \text{ m}\Omega$ .

CHANGE:	DESCRIPTION
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27. Adjust Sine Gain (R855)

Adjust R855 (Sine Gain) on the A2 FUNCTION board so the sine wave amplitude exactly matches the triangle waveform amplitude while alternately pressing the sine-wave and triangle pushbuttons. Disconnect all cables.

28. Adjust Sine Drive (Distortion) (R740, R155, R52, R360, R215)

Push the sine-wave pushbutton in. Set the FREQUENCY Hz (START) dial to 40. Connect the FG 504 OUTPUT connector through a 50 Ω cable to a 50 Ω termination at the distortion analyzer input (use a bnc female-to-banana plug adapter if necessary). Set the distortion analyzer to 40 kHz. Adjust R740 (Sine Drive) on the A2 FUNCTION board for minimum distortion. It may be necessary to slightly re-adjust R52 (Top Dial Sym Cal) in Step 6 and R360 (Triangle Dc Level) in Step 5 to achieve a minimum distortion reading on the distortion analyzer. Change the FREQUENCY Hz (START) dial setting to 4 and the distortion analyzer to 4 kHz. Touch up R740 (Sine Drive) and R155 (Min Dial Sym Cal) for minimum distortion reading. Repeat this step as necessary to achieve minimum distortion reading. Set the MULTIPLIER to 10 and distortion analyzer to 40 Hz. Touch up R215 (LF Sym Cal) adjustment in Step 8 for least distortion (0.5% or less). Remove power from the FG 504, disconnect test equipment and extender cables. Re-connect R14 to its original circuit connection.

END OF SN B042000-UP ADJUSTMENT PROCEDURE.

## Operating Instructions—FG 504

### VOLTAGE CONTROLLED FREQUENCY INPUT:

Nominal sensitivity: 4 X MULTIPLIER setting per volt. A positive-going voltage increases frequency.

Maximum Frequency: 40 X MULTIPLIER setting.

Minimum Frequency: Maximum frequency divided by VCF range of MULTIPLIER setting (see DIAL, VCF, and SWEEP RANGE headings).

Slew Rate: 0.3 V/ $\mu$ s maximum.

Input Impedance: 10 k $\Omega$ .

### EXTERNAL TRIGGER/GATE/PHASE LOCK INPUT:

Input Impedance:  $\leq$  10 k $\Omega$ .

Sensitivity: 1 V p-p.

Level: +1 to +10 V.

Maximum Input Amplitude: +20 V.

Trigger Mode: (For triggering a single cycle of main generator waveform).

Minimum Period: 75 ns.

Maximum Triggered Frequency: 20 MHz.

Gate Mode: (For gating multiple-cycle bursts of main generator waveform).

Minimum Period: 75 ns.

Maximum Gated Frequency: 20 MHz.

Duration of gate determines number of output cycles with integral number of cycles completed.

### Phase Lock Mode:

Frequency Range: 100 Hz to 40 MHz.

Capture Range:  $\pm$ 10 major dial divisions from 100 Hz to 4 MHz;  $\pm$ 8 major dial divisions from 4 MHz to 40 MHz.

Phase Adjustment Range:  $\pm$ 80° from 100 Hz to 4 MHz.

Tracking Range: Generator will lock to a changing external signal, without readjusting the PHASE control, within  $\pm$ 10 major dial divisions from 100 Hz to 4 MHz, and within  $\pm$ 1 MHz from 4 MHz to 40 MHz.

### GATE AND TRIGGER PHASE CONTROL:

Phase Adjustment Range: Triangle and sine waveforms only,  $\pm$ 80° from 0.001 Hz to 10 MHz.

### MANUAL TRIGGER/GATE:

Available at front panel.

### TRIGGER OUTPUT:

0 V to  $\leq$  2 V from 50  $\Omega$ .

### HOLD MODE:

Drift: 10% of p-p output amplitude/hour.

Range: 0.001 Hz to 400 Hz.

### POWER CONSUMPTION:

48 W from power module.

### POWER DISSIPATION:

24 W maximum in plug-in.

CHANGE:	DESCRIPTION
---------	-------------

24. Adjust Rise and Fall Time Symmetry (R610)

Connect the FG 504 OUTPUT through a 50 Ω cable and a 50 Ω termination to the real-time oscilloscope vertical input. Push the square-wave pushbutton in. Set the MULTIPLIER to 10<sup>4</sup>, FREQUENCY Hz (START) dial to 10, RISE AND FALL TIME to .1 μs, and VAR RISE AND FALL TIME control fully cw. Obtain a waveform display of one complete cycle centered vertically and horizontally on the graticule. Adjust R610 (Rise and Fall Sym) on the A1 MAIN board so that the top and bottom of the waveform are equal in duration.

25. Adjust AM Balance (R870)

Connect a 1 kHz triangle waveform of +2.5 V and -2.5 V (5 V p-p) amplitude (produced from a generator external to the FG 504) through a 50 Ω cable to the AM INPUT connector on the FG 504. Connect a 50 Ω cable from the trigger output connector on the triangle generator to the external trigger input on the oscilloscope and set the oscilloscope for external triggering. Push the FG 504 sine-wave pushbutton in. Set the FREQUENCY Hz (START) dial to 30. Adjust the oscilloscope time base to display several cycles of the modulation envelope. Adjust the external triangle generator dc offset and amplitude controls for a display with 100% modulation level, 1 ms/div modulation rate, and about 10 to 16 V p-p amplitude with no clipping of peaks. Vertically center the waveform envelope valleys to graticule center. Adjust R870 (AM Bal) on the A2 FUNCTION board so the positive and negative peaks of the envelope are equidistant from the valleys of the waveform envelope. Disconnect the 50 Ω cables from the triangle generator to the FG 504 and test oscilloscope external trigger input connector. Set the oscilloscope for internal triggering.

26. Adjust Sine Offset (R790)

Set the FG 504 MULTIPLIER to 10<sup>3</sup>, and FREQUENCY Hz (START) dial to 10. Push the triangle pushbutton in. Adjust the oscilloscope vertical sensitivity for approximately 8-divisions of display, and adjust the time base sweep speed for about 5 cycles of triangle waveform. Set the oscilloscope vertical input coupling to ground and center the trace vertically. Return the input coupling to the dc position. Push the sine-wave pushbutton in. Adjust R790 (Sine Offset) on the A2 FUNCTION board so the sine-wave peaks are symmetrical above and below the 0 V (center) oscilloscope graticule line.

# THEORY OF OPERATION

## Triangle Generator or Main Loop (Diagram 1)

This circuitry consists of a diode bridge, timing capacitors, positive and negative current sources, and the semiconductor switches necessary to generate the basic triangle waveform.

The current sources are controlled by the FREQUENCY Hz (START) and STOP controls, as well as the sweep, when operating in the swept frequency mode.

The calibration voltage for the FREQUENCY Hz (START) dial is supplied via operational amplifier U5B and potentiometer R145. On the highest MULTIPLIER setting ( $10^6$ ), R128 is switched into the circuit to improve the linearity of the FREQUENCY Hz (START) dial. This frequency control voltage is fed into operational amplifier U30A. When the FG 504 operates in the swept frequency mode, the sweep ramp is fed to operational amplifier U25B through STOP FREQ control R5 and buffer U5A. This control sets the maximum ramp voltage applied to the input of U25B. This action sets the maximum or upper limit in the swept frequency mode. The voltage controlled frequency input voltage, phase lock loop correction voltage, and the sweep ramp voltage, through the STOP FREQ dial, are summed at pin 6 of U25B. Operational amplifier U30B serves as a level shifter. These voltages and the voltage from the FREQUENCY Hz (START) dial are summed at pins 3 of U45 and U155. The voltage at pins 3 of U45 and U155 increases for a decrease in frequency and decreases for an increase in frequency. The output from U155 is fed to the base of Q165. The output from U45 controls positive current source transistor Q55.

The SYMMETRY control adjusts the current balance between the positive and negative current sources. The collector of Q165 connects to the base of Q175. A current mirror is formed by transistors Q170A, B, and Q175. The matched pair of transistors, Q170A and B, have equal emitter-to-base voltages. Therefore, their collector currents are equal. This ensures that the collector current of Q165 exactly matches the collector current of Q175.

To understand the operation of the triangle generator loop, assume that switch driver Q100 is conducting and Q90 is off. Current flows from the negative current source through CR180. Diodes CR182 and CR184 are back-

biased with no current flowing. No current flows through CR190. Current from the positive current source flows through diodes CR188 and CR186, charging the timing capacitors. In the slowest five MULTIPLIER switch settings, a capacitance multiplier replaces the timing capacitors; switches S240-3 and 9 close and S240-16 opens. This capacitance multiplier consists of U215, Q230, Q225 and their associated resistors and capacitors. The positive timing current flows through Q225 and R202 to the positive current source. With switches S240-5, 6, 7, and 8 closed, exactly one-tenth of the current flows through R200 to charge C210 because R200 is one-tenth of R202. This has the effect of multiplying the value of C210 by a factor of ten. The multiplying factor is increased as additional resistances are added in series with C210. For this discussion, the voltage at pin 3 of U215 ramps up. The voltage between pins 2 and 3 of U215 remains at zero and the action of U215, Q225, and Q230 causes the current through R202 to remain constant.

The positive-going ramp is applied to the gate of fet Q255A. The other half of the fet buffer, Q255B, supplies constant current to Q255A. The ramp at the source of Q255A drives a set of two complementary Darlington amplifiers. Transistors Q270 and Q280 compose one set; Q285 and Q295 the other. The ramp output is taken from the emitters of Q280 and Q295.

The ramp is also fed to the base of Q310 to the negative input of comparator amplifier U375 through R322, and to the positive input of U375 through R336. The waveform at the emitter of Q310 serves to compensate the drive currents for high frequency components at the inputs of U375.

With the ramp rising in the positive direction, the voltage at pin 3 of U375 is about 0.4 V more positive than the voltage at pin 9. This makes U375 inoperative. As the ramp rises in the positive direction, pin 6 of U375 goes positive and pin 7 negative. Pin 7 of U375 connects to the base of switching transistor Q65 and pin 6 connects to the base of Q80. As the ramp continues in the positive direction, Q80 decreases conduction and Q65 increases conduction until the pair switches. Pin 3 of U375 now goes from about  $-2.8$  V to about  $-3.2$  V and pin 9 goes to about  $-2.8$  V. This action disables the lower pair of transistors in U375 and enables the upper pair. When Q80 ceases

CHANGE:	DESCRIPTION
	<p>20. Adjust 20 MHz Timing (R128)</p> <p>Set the FREQUENCY Hz (START) dial to exactly 20. Set the MULTIPLIER to <math>10^6</math>. Adjust R128 (20 MHz Cal) on the A3 LOOP board for a frequency of 20 MHz within specification limits (17.6 MHz to 22.4 MHz) for all three functions - square, triangle, and sinewave. NOTE: 20 MHz Cal will interact with 40 MHz Cal.</p> <p>21. Check and Adjust High Frequency Dial Tracking (R128, C195, C325, C340)</p> <p>Check that the output frequency from 4 MHz to 40 MHz is within specification limits for all three function waveforms. If dial tracking is not within specification limits, it may be necessary to slightly readjust R128 (20 MHz Cal), C195 (40 MHz Cal), and C325 and C340 (HF Loop Comp) to achieve proper dial accuracy. Optimum tracking will result if C325 and C340 (HF Loop Comp) adjustments are performed so as to maintain symmetrical amplitude flatness around the graticule vertical center line. Repeat Step 15 and check that amplitude flatness is within specification limits. If necessary, repeat steps 15 through 21.</p> <p>22. Adjust Stop Frequency Dial Range (R10)</p> <p>With the FG 504 MULTIPLIER at <math>10^6</math>, push the STOP FREQ/SWEEP button in to STOP FREQ mode. Set SWEEP DURATION to 10s and FREQUENCY Hz (START) dial to 1. Rotate the STOP FREQ dial so that the index mark points to 40 on the FREQUENCY Hz (START) dial. Change the MULTIPLIER setting to <math>10^3</math> and adjust R10 (Stop Freq Cal) on the A3 LOOP board for a frequency of 40 kHz. Disconnect termination and cable from frequency counter and FG 504.</p> <p>23. Adjust Linear and Logarithmic Sweep Amplitude (R1460, R1475)</p> <p>Set the real-time oscilloscope time base for 2 ms/division, trigger source to internal, and the vertical for dc coupled .2 V/division sensitivity. Connect a 10X probe to the oscilloscope vertical input, the probe ground clip to the FG 504 chassis, and connect the probe tip to P1500 Pin 1 Ramp on the A2 FUNCTION board. Change the FG 504 SWEEP DURATION setting to 10 ms. Record the voltage level displayed on the oscilloscope. Release the FG 504 STOP FREQ/SWEEP button out to the SWEEP mode, and adjust R1460 (Ramp Peak) on the A2 FUNCTION board for a display voltage level at the peak of the ramp equal to the previously recorded voltage. Push the FG 504 LOG SWP/LIN button in to the LOG SWP mode, and adjust R1475 (Log Peak) on the A2 Function board so the peak of the logarithmic ramp is at the same amplitude as the originally recorded voltage. Set SWEEP DURATION to OFF.</p>

## Theory of Operation—FG 504

conduction, Q90 comes into conduction and Q100 ceases conduction. Current now flows through Q90, diode CR190, and the positive current source, Q55. Bridge diodes CR188 and CR186 are back-biased. No current flows through CR180 as Q100 is off. Current from the negative current source now flows through diodes CR182 and CR184. This action charges the timing capacitors in the negative direction, causing a negative-going ramp at the output. As the ramp goes negative, the output of U375 at pin 14 gradually goes positive. Pin 13 of U375 gradually goes negative. When the ramp reaches a voltage sufficiently negative, Q65 turns off, Q80 comes into conduction, the positive current source is connected to the timing capacitors, and the previously described cycle repeats. The bases of emitter followers Q410 and Q395 are connected to the non-inverting outputs of U375. The outputs from these emitter followers drive the bases of common emitter amplifiers Q415 and Q406, which generate the TRIG OUT and synchronizing signals.

### Variable Rise and Fall Circuitry (Diagram 2)

This circuitry consists of variable positive and negative sources, a current switch with the necessary integrating capacitors, and an output buffer. Transistor Q540 serves as the positive current source while Q580 serves as the negative current source. The rise and fall times are changed by varying the current through the constant current sources and by changing the values of the integrating capacitors.

The current available to charge the integrating capacitors, C592 through C598, is varied by switching R536, R538, R584, and R586 into the emitter circuit of Q540 and Q580 as necessary. The current is also varied by the VAR control through U530 and Q530. When the VAR control is in the calibrated position, the wiper is at the grounded end of the control. This action increases the current through the emitter resistances of the current source transistors. An increase in charging current for the integrating capacitors reduces the rise and fall times of the waveforms.

The current switch determines which current source is connected to the integrating capacitors. Transistors Q495, Q500, and Q510 form a clipping and speed-up circuit for the square-wave coming from the Main Loop. When the square-wave driving this circuitry is positive with respect to ground, Q570 is conducting. Current from the negative current source passes through CR566, Q570, and VR570 to the +15 V supply. Diodes CR562 and CR564 are back-biased, preventing current flow to the integrating capacitors. Transistor Q550 is off, causing current from the positive constant current source to pass through diodes CR558 and CR560. This current charges the integrating capacitor, causing the gate of fet Q600 to move

at a controlled rate in the positive direction. In the FIXED position of the RISE and FALLTIME switch, the current switch and the integrating capacitors are bypassed through switch S590-7. Fet Q600 serves as a fet follower with Q610 supplying constant current. The source of Q600 drives the base of Q615, which forms a differential pair with Q620. Clipping takes place in this differential circuitry. A differentially driven amplifier, Q640, restores to the output signal the amplitude lost in the clipping process.

### Square Wave Generator

Switching transistor Q65 generates the square-wave. When the ramp is rising in the positive direction, the collector of Q65 is in its most negative state. This signal is passed to the base of Q450. The emitter of Q450 drives the base of Q465. These transistors form a Darlington amplifier. The emitter of Q465 drives Q462 and Q470. When Q456 is conducting, Q462 is off; Q470 is conducting with CR470 back-biased. Current flows through CR462 and the square-wave moves in the positive direction. When the switching waveform changes state, Q462 comes into conduction, back-biasing CR462. The square-wave now moves in the negative direction by current through CR470 as Q470 is not conducting.

### Sine Shaper, Buffer, and Modulating Circuitry (Diagram 3)

This circuitry generates the sine-wave from the basic triangle waveform by means of a four step approximation. The sine-wave is also amplitude modulated, if desired, by this circuitry and buffered for delivery to the output amplifier.

The sine shaper consists of four diode bridges, CR745, CR751, CR757, and CR763. These bridges are connected between the +15 V and -15 V supplies. The resistors from the common anodes and cathodes of each bridge are equal in value. These resistance values for each bridge are, however, different from the other bridges. As the triangle waveform (applied through R742) rises, the amount of current supplied to U770 pin 15 varies from each bridge. As the triangle rises and as the outputs from the bridges are summed at the input of U770, each bridge gradually reduces conduction. The non-linear characteristics of the diodes prevent sharp transitions as the diode bridges cease conduction. The opposite action occurs as the triangle waveform decays to 0 V. The result, at pin 15 of U109, is a close approximation of a pure sine-wave.

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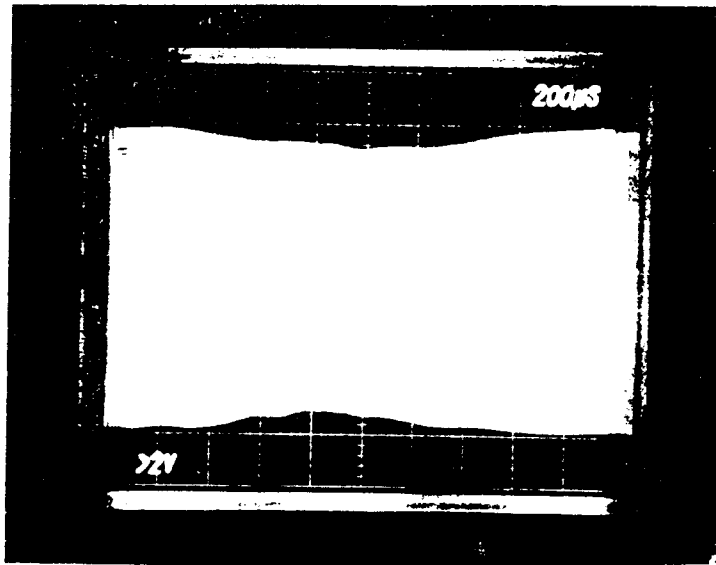


Fig. Step 15: Amplitude flatness should appear similar to photograph after adjustment. Note dip in center with the amplitude increasing toward outer edges.

16. Adjust Sine Flatness (C857)

Push the sine-wave pushbutton in. Set the FREQUENCY Hz (START) dial to 40. Adjust C857 (Sine Flatness) on the A2 FUNCTION board for 5.5 div sine-wave amplitude. Disconnect 50 Ω cables and termination.

17. Adjust Top Dial Calibration (R145)

Set the FG 504 MULTIPLIER to  $10^3$ . Set the FREQUENCY Hz (START) dial to exactly 40. Connect TRIG OUTPUT through a coaxial cable and 50 Ω termination to a frequency counter. Adjust R145 (X40 Cal) on the A3 LOOP board for a reading of 40 kHz within ±3% (±1.2 kHz). Change the MULTIPLIER setting to  $10^4$  and check for a reading of 400 kHz within ±3% (±12 kHz).

18. Adjust  $10^6$  Range Timing (C195)

Change the MULTIPLIER to  $10^6$ . Adjust C195 (40 MHz Cal) on the A3 LOOP board for a readout of  $\geq 40$  MHz in all three functions - square, triangle, and sinewave.

19. Adjust  $10^5$  Range Timing (C242)

Change the FG 504 MULTIPLIER setting to  $10^5$ . Adjust C242 (4 MHz Cal) on the A3 LOOP board for a readout of 4 MHz within 3% (±120 kHz).



The output from the sine shaper is fed into U770, a transconductance multiplier. This multiplier is used to amplitude-modulate the sine-wave. The output from the multiplier is taken at pins 8 and 9; the amplitude modulating signal inputs at pin 12. Internal adjustment R855 sets the sine-wave gain for U770, and R870 shifts dc levels so that the sine-wave is modulated equally in both positive and negative directions. Centering of the sine-wave with respect to ground is accomplished with internal adjustment R790. The differential output from the multiplier is applied to the bases of input transistors Q825 and Q805 of the output buffer amplifier. This output amplifier provides gain as well as differential to single-ended output conversion. This is an operational amplifier. The collector of Q825 directly drives the base of output emitter follower Q830. The collector of Q805, with level shifting, drives the base of Q840. This transistor provides phase inversion. Its collector drives the base of emitter follower output transistor Q835. Feedback takes place through R822. The single-ended output passes to the function switch.

### Amplitude Modulating Input Circuitry

The amplitude modulating signal is applied to the input of operational amplifier U710. The output at pin 6 drives the transconductance multiplier and the base of Q720. This transistor drives the AM indicator lamp. With no modulating signal, the voltage at the output of U710 is about +15 V. The indicator lamp lights when the voltage is about +10 V and 100% modulation occurs when the voltage reaches about +5 V.

### Output Amplifier (Diagram 4)

This circuitry is an inverting operational amplifier. The input stage, driven by emitter followers Q906 and Q914, consists of pairs of differential amplifiers Q930 and Q940 complemented by Q1030 and Q1040. The configuration is such that for a positive-going input waveform, the collectors of Q930 and Q1030 both move in the negative direction. Under the same conditions, the collectors of Q940 and Q1040 both move in the positive direction. These pairs differentially drive transistor pairs Q950, Q952, and Q1050, Q1052 respectively. Voltage gain takes place in this stage. The output from pairs Q950 and Q952 is taken at the collector of Q952, and for pairs Q1050 and Q1052 at the collector of Q1052. For a negative-going input signal, the above mentioned collectors both move in the positive direction. Components R950, C950, C1050, R1050, C965 and R965 provide high frequency compensation and R1015 adjusts the dc balance for the entire amplifier.

The collector of Q952 drives the base of output emitter followers Q970 and Q980 while Q1052 drives Q1070 and Q1080. The feedback path is through R1090 and C1090 to the bases of Q930 and Q1030.

### Output Attenuator

The output from the output amplifier is fed to the output attenuator circuitry. The variable amplitude control (R1100A and B), with resistors R1102 and R1104, form a bridged T attenuator with a maximum attenuation of approximately 20 dB. Thick film attenuator chips R1110, R1112, and R1114 provide a total of 50 dB of additional attenuation. These attenuators are compensated resistive dividers.

### Offset Circuitry

Output offset is adjusted by R1130, the OFFSET control. Should additional positive offset be desired, the OFFSET control is moved in the negative direction. This causes the output of U1145 to move in the negative direction. Through the action of Q1150 and Q1170, the bases of Q1160 and Q1180 move in the negative direction. This causes their common collector circuit to move in the positive direction, increasing current flow through R1122. The dc offset generated by the increased current flow is passed to the OUTPUT terminal through R1120 and L1120.

### Gating and Triggering Circuitry (Diagram 5)

In this circuitry, U1225B operates as an ecl line receiver. In the FREE RUN mode, the set input (pin 5) for D flip flop U1215A is connected to +5 V through CR1235. This places a high on the Q output at pin 2. This action lowers the combined collectors of Q1245 and Q1250 and reduces conduction in Q1254, turning Q1262 off and Q1260 on. No current flows through diodes CR1285 and CR1286. The triangle generator is now free to run. In the GATE mode of operation, the set input of U1215A is connected to the output of U1225B. When the input gate is high, the circuit functions as in the normal mode with Q1262 off and Q1260 on, allowing the triangle generator to run. When the input gate goes low, the next positive-going pulse at pin 6 (clock) from the triangle generator causes the Q terminal to go low. This action resets the flip flop for the next trigger. However, Q1262 does not conduct until the sync pulse at the base of Q1245 goes low at the peak of the triangle ramp. This action allows completion of the last cycle. With Q1262 on, the triangle generator is prevented from operating through CR1286. In the triggered mode, the output of the trigger shaper is connected to the clock input of U1215A. The triggering signal causes the clock terminal to go high. This transfers the level at the D input to the Q input. If the Q output is high ( $\bar{Q}$  low), the triangle generator runs until a positive-going synchronizing signal, which occurs at the start of the up ramp, forces the Q output low. At the start of the down ramp, the synchronizing signal goes low, which causes Q1262 to conduct and turns Q1260 off. The triangle now ramps down until CR1286 comes into conduction. This point is determined by the setting of the phase control, which

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and the sampling system external trigger input. Disconnect the 50 Ω cable and 10X attenuator from the sampling oscilloscope system and re-connect the cable to a 50 Ω termination at the real-time oscilloscope vertical input.

15. Adjust Amplitude Flatness (R365, C325, C340)

Set FG 504 controls as follows:

SWEEP DURATION	1 ms
VAR	ccw
Triangle pushbutton	in
FREQUENCY Hz (START)	1
STOP FREQ	40
MULTIPLIER	10 <sup>3</sup>
FREQUENCY VERNIER	cw
RISE AND FALL TIME	FIXED < 6 ns
VAR	ccw
ATTENUATOR (dB)	0 dB
VAR	cw
TRIGGER	
FREE RUN	in
All other buttons	out

Connect a 50 Ω coaxial cable from the FG 504 LINEAR SWEEP OUTPUT to the real-time oscilloscope external trigger input. Set the time base sweep speed to 0.2 ms per division and trigger externally on the negative slope of the waveform. Adjust the oscilloscope vertical sensitivity for a 6-division display. Set the FG 504 MULTIPLIER to 10<sup>6</sup>. Adjust the SWEEP DURATION VARIABLE so only one envelope is visible across the entire horizontal graticule. Vertically center the left side of this envelope. Adjust R365 (HF Loop DC Level) on the A3 LOOP board so that the right side of the envelope is also vertically centered on the graticule. Adjust C325 and C340 (HF Loop Comp) on the A3 LOOP board so that the rest of the waveform is approximately symmetrical around the center horizontal graticule line with minimum amplitude in the center. (See photograph on page 13.) Considerable interaction exists between C325 and C340. Readjust as necessary to obtain the best symmetry and amplitude flatness. Check that the peak-to-peak amplitude of the envelope is between 4.8 divisions and 7.5 divisions at all points on the waveform. Set the FG 504 SWEEP DURATION to off.

## Theory of Operation—FG 504

determines the voltage at the output of U25A and at the cathode of CR1285. The next positive-going trigger from U1225B causes pin 9 of U1215A to go positive. This transfers the high on the D input to the Q output, allowing the triangle generator to commence the next cycle.

### Phase Locked Loop Circuitry

This circuitry provides a dc output voltage proportional to the difference in frequency between an external triggering signal and a synchronizing signal from the voltage-controlled oscillator.

The trigger input signal is fed into inverter U1225B. This integrated circuit is an ecl line receiver. It is connected to operate as a Schmitt trigger for trigger shaping purposes. The inverted output is fed to the input of one of two D type flip flops (U1295B). The C input of the other D flip flop (U1295A) is connected to the sync signal from the oscillator. Both D inputs are always high. They are connected to +5 V through CR1312. On the positive-going transition of either, the sync signal for U1295A or the triggering signal for U1295B, the highs on the D inputs are transferred to the Q outputs. The  $\bar{Q}$  outputs connect to the input of U1225A, which is also an ecl line receiver. The lows on the  $\bar{Q}$  terminals create a high on pin 3 of U1225A, which is connected to the reset input of both flip flops. This action resets both flip flops. They are now ready to repeat the previously described cycle.

The Q outputs are connected through a low pass filter composed of R1324, R1320, and C1322 to the input of U1340. If the frequency of the synchronizing signal is higher than the triggering signal, the resulting current difference at the input of U1340 causes the output of U1340 to go negative. This action is reversed (+ input terminal positive) if the frequency of the triggering signal is greater than the sync signal. The phase control sets the voltage at the input of U1340 so that wide differences in frequency are within the capture range of the circuitry. The voltage at the output of U1340 adjusts the frequency of the voltage controlled oscillator to the triggering frequency. This voltage swings between  $\pm 12$  V.

### Sweep Circuitry (Diagram 6)

The sweep trigger is applied to pin 13 of U1225C. The TRIG LEVEL control adjusts the dc level at pin 13 of U1225C, an ecl line receiver. Protective diodes CR1370 and CR1372 are also connected to pin 13. When the voltage at pin 13 reaches about +3.5 V, pin 15 goes from about +3.5 V to about +4.0 V. This positive-going step is differentiated through C1392 to the base of Q1400. (The MAN TRIG button also creates a positive step at the base of Q1400). Transistors Q1500 and Q1410 compose a Schmitt trigger. The base of Q1400 goes positive, causing

the base of Q1410 to go negative. When operating in the TRIG SWEEP mode, the collector of Q1410 rises, turning Q1420 off. This action turns fet Q1430 off, allowing the integrator formed by U1445, Q1450, and their associated components to ramp up. The slope of the positive-going ramp is determined by the setting of the VAR control, the resistance in series with its wiper, and the value of the capacitor connected from pin 2 to the emitter of Q1450.

As the ramp rises, the voltage at pin 3 of U1470 also rises. When this voltage reaches the voltage at pin 2 of U1470, the output immediately switches positive. The positive step at the output of U1470 turns fet Q1430 on, discharging the timing capacitors and returning the sweep to the starting level. When pin 3 of U1470 goes lower than pin 2, during the sweep fall, CR1470 turns on. This closes the positive feedback loop for U1470 and the output switches immediately to about  $-13$  V. If the sweep is running in the triggered mode, this negative transition is differentiated by C1394, which resets the Schmitt trigger circuit composed of Q1400 and Q1410. The cycle then repeats at the next trigger pulse. In the free running mode, when pin 6 of U1470 goes negative, Q1430 is turned off and the free running cycle repeats.

### Logarithmic Converter

In the bipolar transistor, the relationship between the collector current and the emitter-to-base voltage is precisely logarithmic over a wide current range.

The linear ramp is fed to pin 2 of U1480 through temperature compensating resistor RT1456. Operational amplifier U1480 is used as an attenuator (gain is considerably less than one) and an inverter. Resistor RT1456 decreases in value with increasing temperature to compensate for the decreasing gain with temperature of U1495A. Transistors U1495A and B are on a common substrate so that their base-to-emitter voltages remain constant with temperature, assuming equal collector currents. The operation of this circuit can be easily understood if it is assumed pin 3 of U1490 is ground rather than returned to the output of U1480. Pin 3 of U1490 is actually connected to the output of U1480 to improve the temperature characteristics of the circuit without introducing significant error in the linear to logarithmic conversion.

As the ramp voltage at the base of U1495A changes linearly, the emitter voltage of U1495A changes through the action of U1490 to maintain a constant current through R1496. The linear emitter voltage change of U1495A drives the emitter of U1495B, causing the current drive for U1500 to become logarithmic. This logarithmic current is converted to a voltage change by U1500 and fed through the

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on the A1 MAIN board for minimum reflected aberration behind the rising and falling edges of the square wave. Disconnect the 50 Ω cables from the FG 504 OUTPUT and oscilloscope vertical input.

13. Adjust Square Wave Amplitude and DC Level (R630, R641)

Connect the FG 504 OUTPUT through a 50 Ω coaxial cable to a 50 Ω termination at the oscilloscope vertical input. Set the MULTIPLIER to 10<sup>2</sup>. Adjust the oscilloscope vertical sensitivity, triggering, and sweep speed to display at least one cycle of the square wave at a calibrated 2 V/div amplitude. Adjust R630 (Sq Wave Ampl Adj) on the A1 MAIN board for a peak-to-peak amplitude of 15 volts to 15.9 volts. Set the oscilloscope vertical input coupling to ground and center the trace vertically. Return vertical input coupling to dc, and adjust R641 (Sq Wave Offset Adj) on A1 MAIN board for square wave positive and negative peaks equidistant above and below graticule center. Disconnect the 50 Ω cable and termination from the FG 504 and oscilloscope.

14. Adjust Output Amplifier Response (C922, C1090, R950, R1050)

Connect the FG 504 OUTPUT through a 50 Ω coaxial cable to a 10X attenuator at the vertical input of the sampling oscilloscope system. Connect the FG 504 TRIG OUTPUT through a 50 Ω coaxial cable to a 50 Ω termination attached to the external trigger input on the sampling oscilloscope.

Set the FG 504 MULTIPLIER to 10<sup>5</sup>. Adjust the sampling system vertical sensitivity and sweep speed to display at least one complete cycle of the square wave at about 6-divisions amplitude. Adjust triggering to view the leading edge of the positive-going slope. Adjust C922 (Sq Comp Long Term) on the A1 MAIN board for optimum square corner in the first 100 ns from the rising and falling edges. Adjust C1090 (Sq Comp Short Term) on the A1 MAIN board for optimum square corner with aberrations less than 5% over the first 20 ns from the rising and falling edges. Adjust R950 (Sq Comp Leading Edge) on the A1 MAIN board for minimum rise time, optimum square corner, and minimum aberrations over the first 20 ns from the leading edge. Adjust R1050 (Sq Comp Trailing Edge) on the A1 MAIN board for minimum fall time, optimum square corner, and minimum aberrations over the first 20 ns from the trailing edge. Check that rise time and fall time of the square wave is equal to or less than 6 ns. Repeat Step 14 as necessary to achieve minimum aberrations (equal or less than 5% + 30 mV) and rise time of equal or less than 6 ns. Disconnect the 50 Ω cable and termination between the FG 504 TRIG OUTPUT

LOG LIN SWP switch to the frequency control circuitry. The output ramp changes from 0 V to 10 V. When operating in the STOP FREQ mode, the sweep output line connects to 10 V provided by U1495D and C operating as a simple voltage divider. This provides a fixed voltage to the stop frequency potentiometer and only the stop frequency is outputted.

### Power Supplies (Diagram 7)

There are five power supplies: +5 V,  $\pm 15$  V, and  $\pm 25$  V. All supplies with the exception of the +5 V supply are referenced to the +15 V supply. Potentiometer R1605 adjusts the +15 V supply. Resistor R1602 is connected to the +15 V supply on the A board. Diode VR1608 serves as the reference diode for this supply. Should the load on the +15 V supply increase, the voltage at the base of Q1610 will drop slightly. This causes the base of Q1620 to go slightly positive, reducing conduction. The base of Q1622 now goes slightly negative, thus increasing conduction in the series pass transistor located in the power module. This supplies more current for the +15 V supply and restores the voltage to the preset level. The power module supplies +33.5 V dc through rear interface contacts 12A and B for the operation of this supply.

The reference for the -15 V supply is taken from the junction of CR1711 and R1710. Resistor R1705 sets the level of the -15 V supply with respect to the +15 V supply. Resistor R1702 is connected to the -15 V supply on the A board. Should the load on the -15 V supply decrease, the voltage at the base of Q1710 goes more negative through R1702. This increases conduction through Q1710 and Q1720. The collector of Q1720 goes negative, reducing conduction in Q1722. Conduction is reduced through the series pass transistor in the power module, thus restoring

the -15 V supply to its preset level. The power module supplies -33.5 V dc through contacts 8A and B for the operation of this supply.

The two 25 V and the 17.5 V ac windings are connected to rectifier bridge CR1680. The dc output from this bridge supplies the  $\pm 25$  V regulators. Transistors Q1640 and Q1642 operate as a differential amplifier. The base of Q1640 connects the +15 V supply through R1644. Should the load increase, the voltage momentarily drops. This action causes the collector of Q1642 to go positive. This reduces conduction in Q1650, causing the collector to go slightly more negative. This causes increased conduction in the series pass transistor in the mainframe, through emitter follower Q1660, restoring the output voltage to its previous level. Current limiting is accomplished through Q1652. Excessive current ( $\approx 500$  mA) through R1663 causes Q1652 to turn on. This action reduces current flowing in Q1660 and the series pass transistor in the power module.

The -25 V supply operates in a similar manner. Should the load on this supply decrease, the -25 V supply will momentarily go more negative. This action increases conduction in Q1742. The conduction in Q1750 is increased, causing the collector of Q1750 and the base of Q1760 to go more negative. This action restores conduction in the series pass transistor in the power module. Current limiting is accomplished through Q1752 and R1763 in the same manner as described for the +25 V supply.

The +5 V dc is supplied from +11.5 V dc from the power module through regulator U1690. This regulator also provides short circuit limit at approximately 750 mA.

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b. Mechanical dial adjustment: Use a 1/16" Allen wrench to loosen set screws on the dial coupling behind the front panel. Use long nose pliers to rotate R125 potentiometer shaft until the counter reads 1.00 kHz. With the FREQUENCY Hz (START) dial set to 1, tighten the coupling set screws.

c. Set the FREQUENCY Hz (START) dial to 30 and check that STOP FREQ dial will rotate fully ccw and stop with the index mark aligned with the index mark on the panel. If alignment is correct, proceed to part e; if not correct, perform part d.

d. Use a 0.050" Allen wrench to loosen the STOP FREQ knob set screws, then remove the knob. Turn the potentiometer shaft to the ccw end and re-install the STOP FREQ knob so index mark is aligned with front panel index mark. Tighten the set screws.

e. Set the STOP FREQ dial fully clockwise and check that it stops with its index mark within approximately 5 degrees of 40 on the FREQUENCY Hz (START) dial.

f. Repeat Step 9, parts a through e, as necessary for correct dial calibration. Disconnect the 50 Ω cable and termination from the FG 504 and counter.

10. Adjust Residual Offset (R1140)

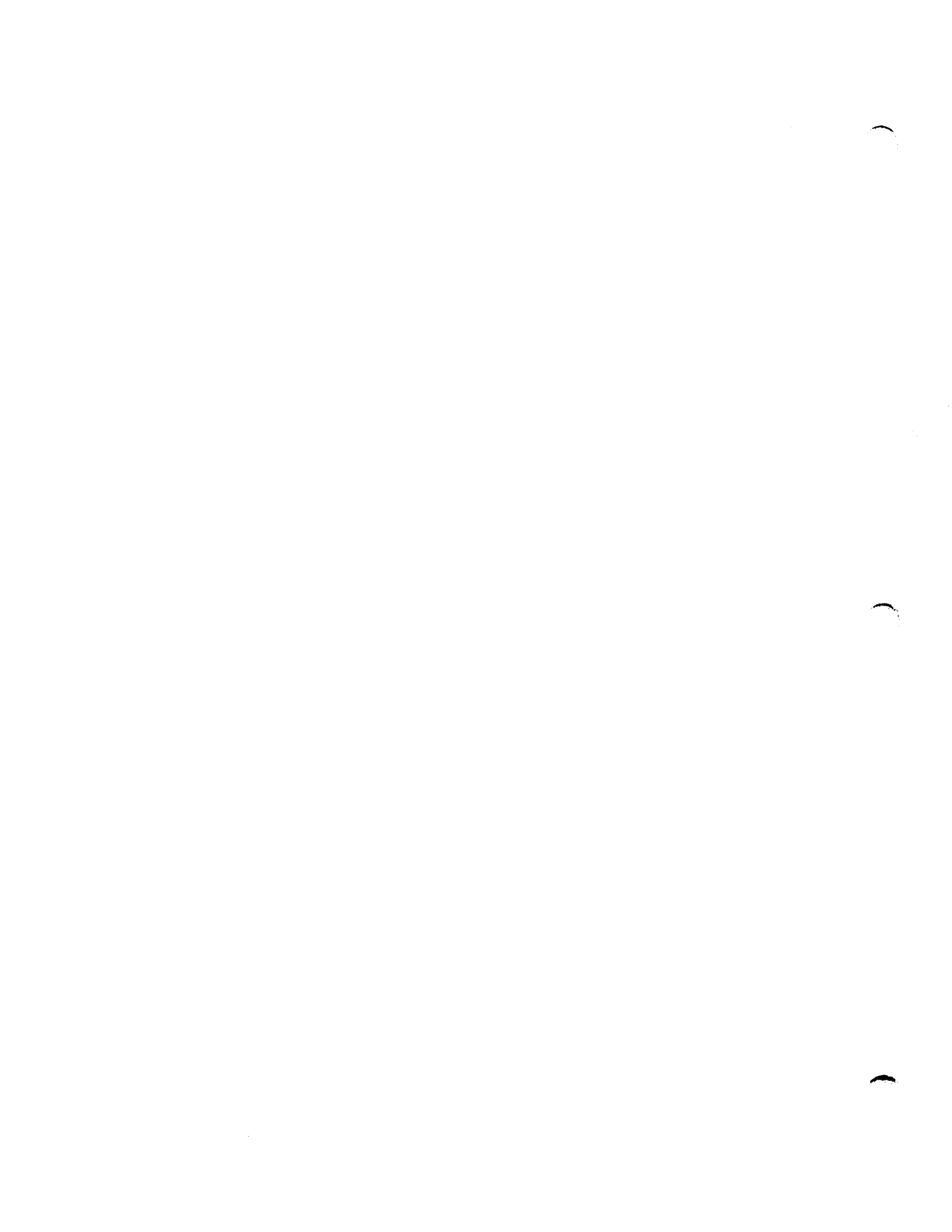
Set the FG 504 ATTENUATOR (dB) to -50 dB. Release all front panel push-buttons. Connect the FG 504 OUTPUT through a 50 Ω unterminated coaxial cable to either the oscilloscope vertical input or digital voltmeter input. Adjust R1140 (Offset Balance) on A1 MAIN board for a reading of zero volts ±100 mV on the oscilloscope or voltmeter.

11. Adjust Zero Input Offset (R1015)

Set the FG 504 ATTENUATOR (dB) to the 0 dB position. Adjust R1015 (Input Offset) on the A1 MAIN board for a reading of 0 V ±100 mV on the oscilloscope or voltmeter. Disconnect the 50 Ω cable.

12. Adjust Output Impedance (C1092)

Push the FG 504 square-wave pushbutton and the TRIGGER FREE RUN pushbutton in. Set the MULTIPLIER to 10<sup>5</sup> and the FREQUENCY Hz (START) dial to 40. Connect two unterminated 42-inch 50 Ω coaxial cables in series with a female-to-female bnc adapter; connect one end to the FG 504 OUTPUT and the other end to the oscilloscope vertical input. Adjust the oscilloscope vertical sensitivity, triggering, (Mode to Auto) and sweep speed to display at least one complete square wave cycle approximately 6-divisions in amplitude. Adjust C1092 (Output Impedance)



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oscilloscope trigger slope from + to - while adjusting R52 (Top Dial Sym Cal) on the A3 LOOP board so the halves of the square-wave are exactly equal in time (R52 only affects the positive half). Set the oscilloscope trigger slope to +.

7. Adjust Minimum Dial Waveform Symmetry (R155)

Change the FG 504 FREQUENCY Hz (START) dial setting to a position approximately half way between a .1 and 1 on the dial and set the MULTIPLIER to  $10^4$ . Adjust the oscilloscope sweep speed so the positive half of the waveform cycle just fills the graticule horizontally.

Switch the oscilloscope trigger slope from + to - while adjusting R155 (Min Dial Sym Cal) on the A3 LOOP board so the halves of the square-wave are exactly equal in time (R155 only affects the negative half of the waveform).

8. Adjust Low Dial Waveform Symmetry (R215)

Set the FG 504 FREQUENCY Hz (START) dial to 1 and the MULTIPLIER to 10. Set the oscilloscope for dc coupled normal triggering and adjust sweep speed and trigger level so one waveform cycle just fills the graticule horizontally. Adjust R215 (LF Sym Cal) on the A3 LOOP board so that the halves of the square-wave are exactly equal in time. Disconnect the 50  $\Omega$  cables and termination from the FG 504 and oscilloscope.

9. Check Dial Calibration (R115, R145) and Adjust Mechanical Alignment

a. Connect the FG 504 TRIG OUTPUT through a 50  $\Omega$  coaxial cable to a 50  $\Omega$  termination at the frequency counter input. Set the FG 504 MULTIPLIER to  $10^3$  and the FREQUENCY Hz (START) dial to .1 (fully cw). Adjust R115 (Min Dial Cal) on A3 LOOP board for a reading of 150 Hz to 200 Hz on the counter. Set the FREQUENCY Hz (START) dial to 40 and adjust R145 (X40 Cal) on A3 LOOP board for a counter display of 40.0 kHz. Set the FREQUENCY Hz (START) dial to 1; the counter display should be 1.0 kHz. If the reading is correct, skip part b and proceed to part c; if not correct, perform part b.

CAUTION

The mechanical dial adjustment in part b must be performed with the instrument operating. Exercise caution to avoid shorting out circuitry with Allen wrench or pliers.



# ADJUSTMENT PROCEDURE

## Services Available

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

## Checking Transformer Phasing

If the FG 504 is used in early models of the TM 500-Series Power Modules, ripple on the output waveform can be excessive in some cases. The ripple results from Power Module transformer phasing that is incompatible with FG 504 operation; however, the problem is easily cured.

To determine if your Power Module is properly phased, place the FG 504 in operation on two extender cables (Tektronix Part No. 067-0645-03). Make certain both extender cables are firmly connected (do not attempt to operate the FG 504 with only one extender cable).

Turn to the Rear Interface Connector Assignments pullout at the rear of this manual. Locate pin 13A on the Main board (left board when viewing the rear of the instrument). Using an ac voltmeter, measure the voltage from pin 13A to chassis ground (pin 9A or 9B). The normal voltage is about 35 V rms. If the voltage is about 15 V rms, the phasing is incorrect. Correct the phasing by interchanging the wires to pins 13A and 13B in the Power Module. Measure the voltage from pin 1B to chassis ground and interchange the Power Module wires to pins 1A and 1B if indicated. Check all compartments of the Power Module for proper phasing.

## Maintenance

Refer to the TM 500-Series Power Module manuals for complete maintenance information. When replacing cam switch contacts, order High Frequency Cam Switch Repair Kit, Tektronix Part No. 003-0708-00.

### NOTE

*Do not attempt to operate the instrument unless BOTH plug in cards are connected to the mainframe.*

## Circuit Board Removal

To remove the Main board (right side board), remove the four screws holding the back panel to the instrument frame. Remove the back panel. Remove the SWEEP DURATION, RISE and FALLTIME and ATTENUATOR (dB) knobs. Disconnect all cable plugs connected to the board. Remove the four screws attaching the board to the plug-in frame and remove the board by sliding the board backwards until the switch shafts clear the front panel holes.

To remove the Function board (center board), first remove all cable plugs attached to the board. Then remove the four screws attaching the board to the spacers. Slide the board to the rear of the instrument until the pushbuttons clear the front panel and remove the board.

To remove the Loop board (left side board), disconnect cable connections to the board. Remove the MULTIPLIER knob. Unsolder the wire from the AM INPUT connector on the front panel to the board. Next remove the four screws attaching the Loop board to the plug-in frame and slide the board to the rear of the plug-in unit until the HOLD pushbutton clears the front panel. Remove the board from the plug-in.

## Test Equipment

For complete calibration, the following equipment is suggested:

- a. Digital voltmeter with ranges greater than  $\pm 20$  Vdc, Tektronix DM 502 or equivalent.
- b. Digital counter capable of reading to 40 MHz, Tektronix DC 504 or equivalent.
- c. Triangle generator capable of producing 10 V peak-to-peak waveforms at 1 kHz, Tektronix FG 503 or equivalent.

CHANGE:	DESCRIPTION
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4. Check Power Supply Ripple and Noise

Set the Differential oscilloscope Trigger to Line, Vertical Input Coupling to ac, and Vertical Sensitivity as required. Connect a 1X probe to each differential input. Connect the - (minus) input probe tip to the FG 504 chassis ground. Connect the + input probe tip to the appropriate test points on the A1 MAIN board. Check ripple and noise according to the following table.

SUPPLY	TOLERANCE
+15 V	Less than 500 $\mu$ V p-p
-15 V	Less than 500 $\mu$ V p-p
+25 V	Less than 5 mV p-p
-25 V	Less than 5 mV p-p
+5 V	Less than 100 mV p-p

Disconnect the probes.

5. Adjust Triangle DC Level (R360)

Set the Real-Time oscilloscope vertical input coupling to dc, Volts/div to 20 mV, variable volts/div as required, time base to 0.5 ms/div, trigger source to external, and trigger mode to auto. Connect a 10X probe to the oscilloscope vertical input, the probe ground clip to the FG 504 chassis ground and the probe tip to TP1 on the FG 504 A3 LOOP board. Connect a 50  $\Omega$  coaxial cable from the FG 504 TRIG OUTPUT to the oscilloscope external trigger input connector. Push the TRIGGER FREE RUN and triangle pushbuttons in. Release the HOLD/RUN button to RUN (out) and set the MULTIPLIER to  $10^3$ . Adjust the oscilloscope for an externally triggered 6-division display. Set the oscilloscope vertical input coupling to ground and position the trace vertically to the exact graticule center. Set the vertical input coupling to dc and adjust R360 (Triangle dc Level) on the A8 LOOP board for triangle peaks equidistant above and below graticule center. Disconnect the 10X probe.

6. Adjust Top Dial Waveform Symmetry (R52)

Connect a 50  $\Omega$  coaxial cable from the FG 504 OUTPUT terminal to a 50  $\Omega$  termination connected to the real-time oscilloscope vertical input. Change the following FG 504 control settings: Push the square-wave pushbutton in and set the FREQUENCY Hz (START) dial to 40 (40 kHz square-wave). Set the oscilloscope vertical for a 5 V/div display; set time/div, variable, and triggering (source to Internal; level as required) so the negative-going half-cycle of the square-wave just fills the graticule area horizontally. Switch the

**Adjustment Procedure—FG 504**

d. A 60 MHz real-time oscilloscope system with sampling and high gain differential plug-in. Tektronix 5403 mainframe, 5A48 vertical plug-in, 5A22N differential plug-in, 5B40 time base and 5S14N sampling plug-in or equivalent.

e. One Tektronix P6065A 10X probe for the oscilloscope or equivalent.

f. Two Tektronix P6011 1X probes for the oscilloscope or equivalent.

g. Distortion analyzer or a 40 Hz and 4 kHz notch filter constructed as shown in Fig. 3-1.

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

i. One 10X 50 Ω attenuator, Tektronix Part No. 011-0059-02 or equivalent.

j. Three 50 Ω, 52 inch coaxial cables with bnc connectors, Tektronix Part No. 012-0057-01 or equivalent.

k. One bnc female to bnc female connector, Tektronix Part No. 103-0028-00 or equivalent.

l. Two flexible plug-in extender cables, Tektronix Part No. 067-0645-03.

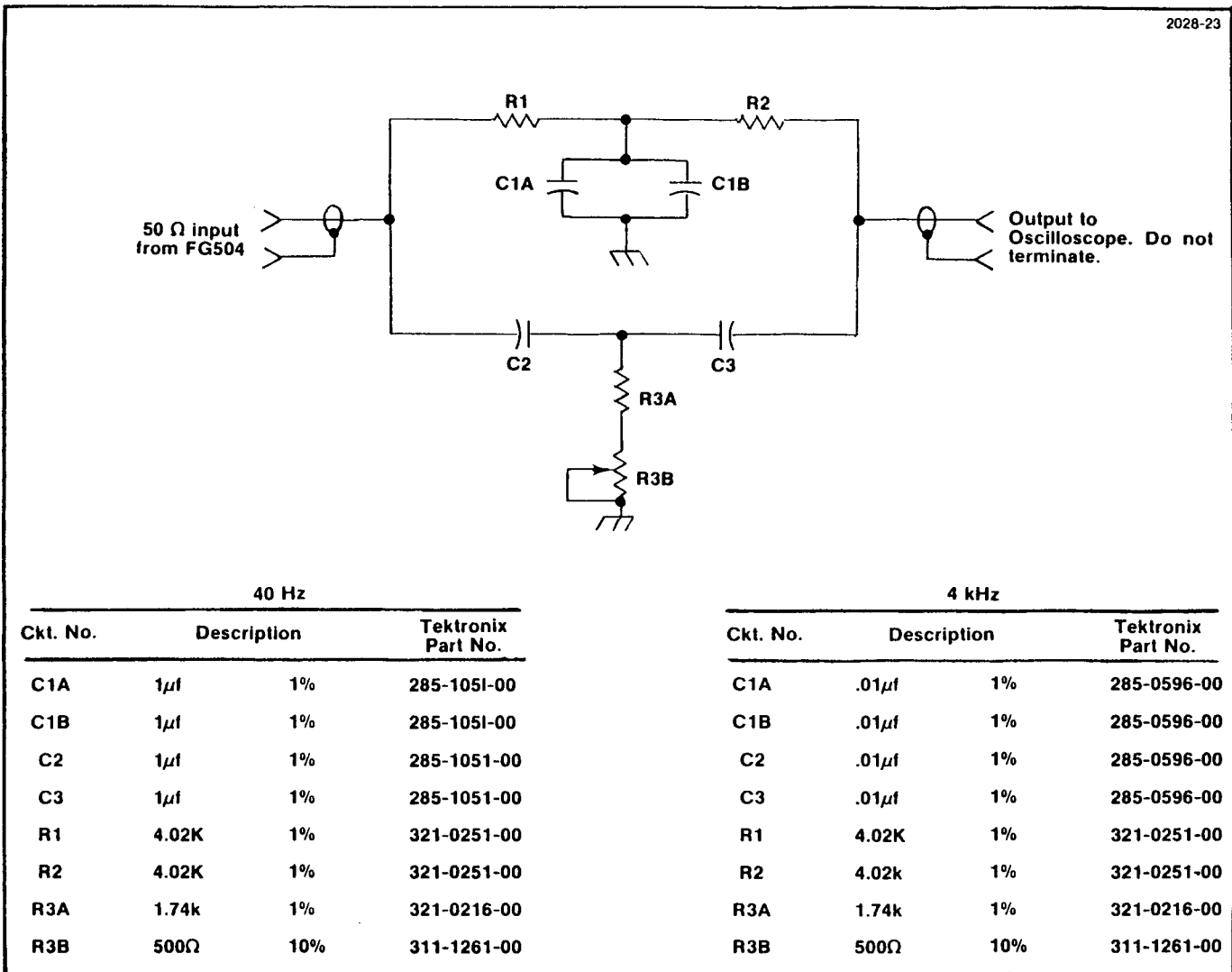


Fig. 3-1. 40 Hz and 4 kHz notch filters.

CHANGE:	DESCRIPTION
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PROCEDURE

NOTE

In the following procedure, the test oscilloscope vertical input requirements will be identified as Differential, Sampling, or Real Time. Differential indicates a system providing differential operation with at least 1 mV/div sensitivity. Sampling means a sampling or real-time system capable of at least 200 MHz bandwidth (the procedure is written for a sampling system, and if a real-time high-impedance input is employed, the input should be terminated with a 50Ω termination to simulate the loading presented by a sampling system). When real-time oscilloscope or test oscilloscope is mentioned, use a 60 mHz (or greater) system with 5 mV to 5 V/div sensitivity.

1. Set +15 V Supply (R1605)

Set the digital voltmeter range to 20 V dc. Connect the low level test lead to the ground test point on the A1 MAIN board. Connect the high input test lead to the +15 V test point on the A1 MAIN board. Check for a reading of +15 V ±30 mV. If outside of tolerance, adjust R1605 (+15 V Adj) for correct reading.

NOTE

If R1605 (Step 1) or R1705 (Step 2) settings require adjustment the entire adjustment procedure must be performed.

2. Set -15 V Supply (R1705)

Move the high input test lead to the -15 V test point on the A1 MAIN board. Check for a reading within ±10 mV of the absolute value of the +15 V supply reading in step 1. If reading is out of tolerance, adjust R1705 (-15 V Adj).

3. Check Power Supply Voltages

Move the high input test lead to the appropriate test points on the A1 MAIN board and set the voltmeter range switch as necessary while measuring the following supplies for listed tolerance limits:

<u>Supply</u>	<u>Tolerance</u>
+25 V	±0.5 V
-25 V	+0.5 V, -1.5 V
+5 V	±0.2 V

For easy access to all adjustments, calibrate the FG 504 using the extender cables. Make certain the cables and plug-in are properly connected (top of each end of the extender cables to top of power module to top of the FG 504). Turn the power module off when making connections. Adjustments are located on the top and both sides 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.

### 1. Set +15 V Supply

Connect the voltmeter to +15 V and chassis ground as shown in the illustration. Adjust R1605 (+15 V Adj) for +15 V  $\pm$ 50 mV.

### 2. Set -15 V Supply

Connect the voltmeter to -15 V and chassis ground as shown in the illustration. Adjust R1705 ( $\pm$ 15 V Bal) for a reading within  $\pm$ 10 mV of the absolute value of the +15 V supply.

### 3. Check Power Supply Voltages

Check the power supplies at the locations shown in the illustration according to the following table.

Supply	Tolerance
+25 V	$\pm$ 200 mV
-25 V	$\pm$ 200 mV
+5 V	+5.0 V $\pm$ 200 mV

### 4. Check Power Supply Ripple and Noise

Set the SWEEP DURATION to OFF and the MULTIPLIER to 10. Depress the HOLD button and release all other pushbuttons. Install the differential plug-in in the oscilloscope mainframe. Trigger the oscilloscope time base in the line trigger mode. Connect the 1X probes to both inputs of the plug-ins. Ac-couple the vertical plug-in inputs. Connect the - input to the chassis of the FG 504 and the + input to the locations shown in the illustration. Check the ripple and noise according to the following table.

Supply	Tolerance
+15 V	<500 $\mu$ V p-p
-15 V	<500 $\mu$ V p-p
+25 V	<5 mV p-p
-25 V	<5 mV p-p
+5 V	<100 mV p-p

Release the HOLD mode pushbutton.

### 5. Adjust Triangle DC Level

Install the higher bandwidth vertical plug-in in the oscilloscope and connect the 10X probe to the input. Connect the probe to TP1 located as shown in the illustration. Connect a coaxial cable from the TRIG OUTPUT to the oscilloscope external trigger input. Push the FREE RUN and the TRIANGLE buttons; all other buttons out with the SWEEP DURATION off. Set the MULTIPLIER at  $10^3$  and the FREQUENCY Hz (START) at 1 for a 1 kHz triangle waveform. Adjust the oscilloscope for an externally triggered display of 6 divisions. Now ground the oscilloscope vertical input and position the trace vertically to the exact graticule center. Remove the ground and adjust R360 (Triangle DC Level) for equidistant triangle peaks from the graticule center. Remove the probe from the oscilloscope. Leave this setup for the next step.

### 6. Adjust Top Dial Waveform Symmetry

Connect a coaxial cable from the OUTPUT terminal to a 50  $\Omega$  termination and then to the oscilloscope vertical plug-in input. Leave all controls as in the previous step with the following exceptions. Set the RISE and FALLTIME control to the FIXED  $\leq$ 6 ns position. Push the SQUAREWAVE button. Change the FREQUENCY Hz (START) dial to 40X (40 kHz square-wave). Adjust the sweep rate of the oscilloscope so that one half of the square-wave cycle just fills the graticule horizontally. While switching the oscilloscope triggering from + slope to - slope, adjust R52 (Top Dial Sym Cal) so that the halves of the square-wave are exactly equal in time.

### 7. Adjust Minimum Dial Waveform Symmetry

Change the FREQUENCY Hz (START) dial to a position approximately half-way between .1 and 1 on the dial and the MULTIPLIER to  $10^4$ . Adjust the oscilloscope sweep speed so that half of the cycle just fills the graticule horizontally. Leave the other controls as in the previous step. While switching the oscilloscope triggering from + slope to - slope, adjust R155 (Min Dial Sym Cal) so that the halves of the square-wave are exactly equal in time.

### 8. Adjust Low Dial Waveform Symmetry

Change the FREQUENCY Hz (START) dial to 1 and the MULTIPLIER to 10. Set the oscilloscope trigger for dc coupling. Leave the other controls as in the previous step. Adjust the oscilloscope sweep speed so that half of the cycle just fills the graticule horizontally. While switching the oscilloscope triggering from + slope to - slope, adjust R215 (Lf Sym Cal) so that the halves of the square-wave are exactly equal in time.

CHANGE:	DESCRIPTION
ADJUSTMENT LOCATIONS	
<p>Refer to pullout page 17 in this insert for location of all adjustable components and test points mentioned in this procedure. Adjustable components are located at the top and both sides of the FG 504. In the FG 504 with SN B042000-up, many of the components on the A1 MAIN circuit board have been relocated, and the Offset Balance adjustment R1140 has been relocated from the A2 FUNCTION board to the A1 MAIN board.</p>	
PRELIMINARY CONTROL SETTINGS	
FREQUENCY Hz (START	1
STOP FREQ	40
HOLD/RUN	HOLD (in)
MULTIPLIER	10
FREQUENCY VERNIER	Cal (cw)
TRIGGER	
FREE RUN	Out
TRIG	Out
GATE	Out
Ø LOCK	Out
MAN	Out
LEVEL	Midrange
STOP FREQ/SWEEP	SWEEP (out)
LOG SWP/LIN SWP	LIN SWP (out)
TRIG SWP/FREE RUN	TRIG SWP (out)
Square-wave pushbutton	Off (out)
Triangle pushbutton	Off (out)
Sine-wave pushbutton	Off (out)
OFFSET (PULL)	Off (in)
PHASE	Midrange
SWEEP DURATION	OFF
VAR	Cal (ccw)
RISE AND FALL TIME	FIXED ≤6 ns
VAR	Cal (ccw)
ATTENUATOR (dB)	0 dB
VAR	Cal (cw)
MAN TRIG	Out
TRIG LEVEL	Midrange
SYMMETRY (PULL)	Pushed in, variable at midrange

## 9. Check and Adjust Dial Mechanical Calibration

Connect the TRIG OUTPUT through a coaxial cable and termination to the digital counter. Change the MULTIPLIER to the  $10^3$  position. Make certain the variable is in the calibrated position. Set the FREQUENCY Hz (START) dial to 40. Make certain the counter reads 40 kHz within specifications. If not, mechanical dial adjustment is necessary as explained later in this step. Now switch the MULTIPLIER to the  $10^4$  range and check that the counter reads 400 kHz within specifications. If these frequencies are not within specifications, adjust R145 (X40 Cal) until both frequencies are within specifications.

Now set the FREQUENCY Hz (START) dial to the mechanical stop in the cw direction (lowest frequency). Change the MULTIPLIER variable to the full ccw position. Set the MULTIPLIER to the  $10^4$  position. Check that the counter reads between 200 Hz and 400 Hz. If not, adjust R115 (Dial Min Cal) for a counter reading between 200 Hz and 400 Hz. Now change the MULTIPLIER variable fully cw and the FREQUENCY Hz (START) dial to 1. Check that the counter reads 10 kHz within specifications. If not, remove the two set screws holding the STOP FREQ knob to the potentiometer shaft and remove the STOP FREQ knob. Loosen the two set screws holding the knob assembly to the potentiometer shaft. These set screws are located just inside the front panel. While holding the potentiometer shaft with pliers, adjust the FREQUENCY Hz (START) dial so that when the dial reads 1, the output frequency is 10 kHz within specifications. To replace the STOP FREQ dial, turn the STOP FREQ potentiometer shaft fully ccw. Place the STOP FREQ knob on the shaft and align the index mark on the knob with the index mark on the front panel. Tighten the two set screws.

## 10. Adjust Top Dial Calibration

Connect the FG 504 TRIG OUTPUT connector through a coaxial cable and termination to the digital counter. Set the FREQUENCY Hz (START) dial to 40 and the MULTIPLIER to  $10^3$ . Leave all other controls as they were for the previous step. Adjust R145 (X40 Cal) for a reading of 40 kHz within specification limits. Change the MULTIPLIER to the  $10^4$  position and check that the counter reads 400 kHz within specification limits. If not, compromise the adjustment of R145 until both frequencies are within specifications.

## 11. Adjust Bottom Dial Calibration

Use the same setup as in the previous step. Make certain the MULTIPLIER is on the  $10^3$  position. Set the FREQUENCY Hz (START) dial fully cw and the FREQUENCY VERNIER fully ccw. Adjust R115 (Dial Min Cal) for a frequency between 2 kHz and 4 kHz.

## 12. Adjust $10^5$ Range Timing

Use the same setup as in the previous step. Change the FREQUENCY Hz (START) dial to 40 and the MULTIPLIER to the  $10^5$  range. Adjust C242 (4 MHz Cal) for a frequency of 4 MHz within specification limits.

## 13. Adjust $10^6$ Range Timing

Use the same setup as in the previous step. Change the MULTIPLIER to  $10^6$ . Adjust C195 (40 MHz Cal) for a frequency of 40 MHz within specification limits.

## 14. Adjust 20 MHz Timing

Use the same setup as in the previous step. Change the FREQUENCY Hz (START) dial to 20. Adjust R128 (20 MHz Cal) for a frequency of 20 MHz within specification limits.

## 15. Check High Frequency Dial Tracking

Use the same setup as in the previous step. With the MULTIPLIER on the  $10^6$  range, check that the output frequency from 4 MHz to 40 MHz is within specification limits. If dial tracking is not within specification limits, it may be necessary to slightly readjust R128 (20 MHz Cal) and C195 (40 MHz Cal) to achieve proper tracking. If proper tracking is still unobtainable, perform the Amplitude Flatness step (23) and then redo this step.

## 16. Adjust Stop Frequency Dial Range

Place unit in the STOP FREQ mode and move the SWEEP DURATION control to the 10 s position. Set the FREQUENCY Hz (START) dial at 1. Move the STOP FREQ control so that the index mark points to 40 on the FREQUENCY Hz (START) dial. Change the MULTIPLIER to the  $10^3$  position and adjust R10 (Stop Freq Cal) for a Frequency of 40 kHz.

## 17. Adjust Residual Offset

Make certain the ATTENUATOR (dB) is in the -50 dB position with the VAR control fully cw. Release all front panel pushbuttons and turn the SWEEP DURATION to the OFF position. Connect the OUTPUT through a coaxial cable to the digital voltmeter or the oscilloscope vertical input. No termination is necessary for this step. Adjust R1140 (Offset Balance) for a reading of 0 V on the voltmeter.

## 18. Adjust Zero Input Offset

Using the same setup as in the previous step, change the ATTENUATOR (dB) to the 0 dB position. Adjust R1015 (Input Offset) for a reading of 0 V within 100 mV on the oscilloscope or voltmeter.

CHANGE:	DESCRIPTION
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8. Distortion Analyzer: Frequency range, 20 Hz to at least 40 kHz; Input impedance, one megohm; Distortion resolution <0.5%. Hewlett Packard Model 334A or equivalent (with bnc input, or use banana plug-to-bnc adapter).

9. 50Ω Termination: Connectors, bnc. Tektronix Part 011-0049-01 or equivalent.

10. 50Ω Attenuator: Ratio, 10X; Connectors, bnc. Tektronix Part 011-0059-02 or equivalent.

11. Cable (3): Length, 42"; Impedance, 50Ω; Connectors, bnc. Tektronix Part 012-0057-01 or equivalent.

12. Adapter: Connectors, bnc female to bnc female. Tektronix Part 103-0028-00 or equivalent.

13. Extender Cables (2): Connectors, to match TM 500-series power module interface connector and FG 504 rear interface connector; Cables, flexible. Tektronix Part 067-0645-02.

PREPARATION

Disconnect Power Module from power input source. For access to all adjustments, connect the FG 504 through extender cables to a TM 500-series Power Module (TM 503 or larger). Extender cable connectors must be oriented with top of one connector toward top of FG 504 and top of other connector toward top of power module (do not attempt to operate the FG 504 with only one extender cable).

NOTE

One end of R14 should be disconnected from the circuitry to prevent jitter at low frequencies when the FG 504 is operated with extender cables.

Install all required TM 500-series test equipment in power modules. Connect power modules and other powered test equipment to an appropriate power input source; turn them on and allow at least 30 minutes warmup before starting the adjustment procedure. All adjustments must be made at an ambient temperature between +20°C and +30°C.



### 19. Adjust Output Impedance

Push the SQUAREWAVE pushbutton and the FREE RUN pushbutton. Make certain the SWEEP DURATION is in the OFF position. Set the MULTIPLIER to the  $10^6$  range, the ATTENUATOR (dB) to 0, the attenuator variable fully cw, and the RISE and FALLTIME to the FIXED  $\leq 6$  ns position. Set the FREQUENCY Hz (START) dial to 10. Connect the TRIG OUTPUT through a coaxial cable to the external trigger input on the sampling oscilloscope. Connect the OUTPUT terminal through two 52-inch coaxial cables connected together, a  $50\ \Omega$  termination, and 10X attenuator, in that order, to the  $50\ \Omega$  input on the sampling unit. Adjust the vertical sensitivity of the oscilloscope for a display of about 6 divisions and the sweep speed for a display of at least one complete cycle of the square waveform. Adjust C1092 (Output Impedance) for the smoothest square-wave front corner and the most uniform, flattest top of the square-wave without sacrificing risetime.

### 20. Adjust Output Amplifier Response

Using the same setup as in the previous step, remove the  $50\ \Omega$  termination and adjust the vertical sensitivity of the oscilloscope for a display of about 6 divisions. Adjust C1090 (Sq Comp Short Term) for the best front corner, least risetime and minimum aberrations on the front corner and top of the square-wave. Change the MULTIPLIER to the  $10^5$  position and adjust C922 (Sq Comp Long Term) for the flattest top on the square waveform. Change the MULTIPLIER to the  $10^6$  position and adjust R1050 (Sq Comp Trailing Edge) for the same conditions on the falling transition and bottom of the square-wave. Now change the FREQUENCY Hz (START) dial to 1 and, with the top portion of the square-wave displayed, adjust R950 (Sq Comp Leading Edge) and R1050 (Sq Comp Trailing Edge) for the flattest top and bottom of the square waveform. Check that the risetime of the square-wave is within specifications.

### 21. Adjust Sine Flatness

Using the same setup as in the previous step, push the SINEWAVE button. Make certain the MULTIPLIER is in the  $10^6$  position and the FREQUENCY Hz (START) dial is at 40. Adjust C857 (Sine Flatness) for equal sine-wave amplitudes while switching the MULTIPLIER between the  $10^6$  and  $10^5$  positions.

### 22. Adjust Rise and Fall time Symmetry

Using the real time oscilloscope, change the RISE and FALLTIME control to the  $.1\ \mu\text{s}$  position. Change the MULTIPLIER to the  $10^4$  position and the FREQUENCY Hz (START) dial to 20. Place the MULTIPLIER variable control in the fully cw position. Obtain a convenient waveform display of several cycles on the oscilloscope. Adjust R610 (Rise and Fall Sym) so that the top and bottom of the waveforms are equal in time. Return the MULTIPLIER variable control to the calibrated position.

### 23. Adjust Linear and Logarithmic Sweep Amplitude

Using the real time oscilloscope, connect the 10X probe to the point marked Ramp in the illustration. Make certain the vertical plug-in is in the dc position. Change the SWEEP DURATION control to the 10 ms position. Release the FREE RUN pushbutton and make certain the SQUAREWAVE button is in. Place unit in the STOP FREQ mode. Note the voltage level displayed on the oscilloscope. Place the unit in the SWEEP mode and adjust R1460 (Ramp Peak) so that the peak or ramp is at the noted voltage level. Now place the unit in the LOG SWP mode and adjust R1475 (Log Peak) so that the peak of the logarithmic ramp is at the same amplitude as the noted voltage.

### 24. Adjust Amplitude Flatness

Set the FREQUENCY Hz (START) dial at 4 and the STOP FREQ dial at 40. Change the SWEEP DURATION control to the 10 ms position. Push the TRIANGLE pushbutton. Make certain the unit is in the SWEEP mode and the FREE RUN button is in. Set the MULTIPLIER at  $10^6$ . Connect a coaxial cable from the OUTPUT terminal to the vertical input of the real time oscilloscope through the 10X attenuator and  $50\ \Omega$  termination in that order. Connect a coaxial cable from the LIN SWEEP OUTPUT connector to the external trigger input of the oscilloscope sweep. Set the oscilloscope sweep rate at 1 ms/div and trigger the oscilloscope. Now adjust the variable sweep timing on the oscilloscope so only one envelope is visible across the entire graticule. Vertically center the left side of this envelope. Adjust R365 (Hf Loop DC Level) so that the right side of the envelope is also vertically centered in the graticule. Now adjust C325 and C340 (Hf Loop Comp) so that the rest of the waveform is most nearly symmetrical around the horizontal graticule line. Considerable interaction exists between C325 and C340. Readjust as necessary to obtain the best symmetry.

### 25. Adjust Sine Drive (Distortion)

Push the SINEWAVE button. Turn the SWEEP DURATION to the OFF position. Change the MULTIPLIER to the  $10^2$  position. Make certain the FREQUENCY Hz (START) dial is at 40. Leave all other controls as in the previous step.

Connect the distortion analyzer to the OUTPUT terminal or connect the 4 kHz notch filter constructed as shown in Fig. 3-1 between the OUTPUT terminal and the oscilloscope. If the notch filter is used, do not terminate the output coaxial cable at the oscilloscope input. Slightly adjust the FREQUENCY Hz (START) dial to obtain minimum display amplitude if using the notch filter. Now adjust R740 (Sine Drive) for minimum display amplitude on the oscilloscope or, if using the distortion analyzer, minimum distortion.

It may be necessary to slightly readjust R52 (Top Dial Sym Cal) in Step 6 and R360 (Triangle Dc Level) in Step 5 for minimum distortion. Now change the FREQUENCY Hz

CHANGE:	DESCRIPTION
	<p>Pages 3-1 through 3-6</p> <p>REPLACE: All of the text after the "Test Equipment" title, including Adjustment Procedure steps 1 through 29 with the following:</p> <p style="text-align: center;">ADJUSTMENT PROCEDURE FOR FG 504 SN B042000-UP</p> <p>RECALIBRATION INTERVAL</p> <p>Recommended recalibration interval is 2000 hours of operation or six months, whichever occurs first.</p> <p>TEXT EQUIPMENT REQUIRED</p> <ol style="list-style-type: none"> <li>1. TM 500-series Power Modules: Compartments to accommodate the FG 504 (2 compartments) and other items of TM 500-series equipment used for this procedure. Combinations of Tektronix TM 501, TM 503, TM 504, TM 506 or TM 515 as required.</li> <li>2. Digital Voltmeter (with banana plug-to-bnc adapter, or bnc input): Ranges, <math>\pm 25</math> Vdc or greater; Accuracy, within <math>\pm 1\%</math> of reading <math>\pm 1</math> count. Tektronix DM 502<sup>a</sup> or equivalent.</li> <li>3. Frequency Counter: Frequency range, 150 Hz to at least 40 MHz; Accuracy, within one part in <math>10^5 \pm 1</math> count. Tektronix DC 504<sup>a</sup> or equivalent.</li> <li>4. Triangle Generator: Output, triangle waveform; Frequency, 1 kHz; Amplitude, 10 V p-p into 50 <math>\Omega</math>. Tektronix FG 503<sup>a</sup> or equivalent.</li> <li>5. Test Oscilloscope System: Real time or combination real time and sampling. Bandwidth, dc to 200 MHz; Differential sensitivity, 1mV/div. at 60 Hz; Single ended sensitivity, 5 mV/div. to 5 V/div; sweep speed 10 ms/div. to 2 ns/div. Example 1: Tektronix 5403 mainframe, 5A48 vertical plug-in, 5A22N differential vertical plug-in, 5B40 time base, and 5S14N sampling plug-in. Example 2: Tektronix 7704A mainframe, 7A16A vertical plug-in, 7A13 differential plug-in, and 7B80 time base plug-in, or equivalent.</li> <li>6. 10X Low-capacitance Probe: Connectors and compensation range to match vertical input characteristics of test oscilloscope. Tektronix P6062B, P6106, or equivalent.</li> <li>7. 1X Probes (2): Connectors to match differential vertical input of test oscilloscope. Tektronix P6101 or equivalent (P6062B has selectable 1X/10X attenuation and may be used in this application).</li> </ol> <p><sup>a</sup>Requires a TM 500-series power module.</p>

## Adjustment Procedure—FG 504

(START) dial to 4 and the MULTIPLIER to  $10^3$ . Touch up R215 (Lf Sym Cal) in Step 8 and R740 (Sine Drive) for minimum distortion. Repeat this step if necessary for minimum distortion.

Now change the FREQUENCY Hz (START) dial to 4 and set the MULTIPLIER at 10. Replace the 4 kHz notch filter with the 40 Hz notch filter or use the distortion analyzer. Now touch up R215 (Lf Sym Cal) in Step 8 for least distortion.

### 26. Adjust Sine Gain

Set the MULTIPLIER to the  $10^3$  position and the FREQUENCY Hz (START) dial to the 10 position. Make certain the FREERUN and TRIANGLE pushbuttons are in. Leave all other controls as in the previous step. Obtain a convenient vertical display of at least four divisions on the oscilloscope. Now push the SINEWAVE pushbutton and adjust R855 (Sine Gain) so that the sine-wave amplitude exactly matches the triangle wave amplitude.

### 27. Adjust Sine Offset

Using the same setup as in the previous step, adjust R790 (Sine Offset) so that the sine-wave is symmetrical above and below the 0 V graticule line on the oscilloscope.

### 28. Adjust Squarewave Level

Using the same setup as in the previous step, push the SQUAREWAVE pushbutton and adjust R630 (Squarewave Level) so that the square-wave is symmetrical above and below the 0 V graticule line on the oscilloscope.

### 29. Adjust AM Balance

Connect a 1 kHz triangle waveform of 10 V peak-to-peak amplitude, produced from a generator external to the FG 504, to the AM INPUT of the FG 504. Externally trigger the oscilloscope from the triangle generator. Push the SINEWAVE and FREE RUN pushbuttons. Set the MULTIPLIER to the  $10^4$  position and the FREQUENCY Hz (START) dial to 30. Connect the OUTPUT terminal to the oscilloscope. Adjust the amplitude of the external triangle generator for approximately 100% modulation as viewed on the oscilloscope. Vertically center the valleys of the waveform envelope at the graticule center. Now adjust R870 (AM Bal) so that the positive and negative peaks of the envelope are equidistant from the valleys of the waveform envelope. Retouch R790 (Sine Offset) in Step 24 and redo this step if necessary for best calibration.

CHANGE:	DESCRIPTION
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the supply due to overvoltage, occurs at -18.7 V. The power module supplies -33.5 V dc through contacts 8A and 8B for this supply.

The two 25 V ac windings and the 17.5 V ac winding are each connected to full wave bridge rectifiers. The rectifier outputs are connected in series to provide approximately plus and minus 40 V. This dc output powers the +25 V and -25 V series regulator circuitry. Transistors Q1640 and Q1642 make up the differential amplifier for the +25 V supply. The +15 V reference is applied to the base of Q1640. The +25 V feedback for voltage sensing is connected through R1644 to the base of Q1642. The series pass transistor is driven by Q1642 through Q1650 and Q1660. The current limit sensing resistor is R1663. When the voltage across this resistor is high enough to turn on Q1652, base drive to the series pass transistor is reduced and current limiting occurs. If the output voltage drops approximately 27 V below the raw supply, VR1652 turns on Q1652, limiting the current. This is a foldback overload safety action. If the supply moves in the positive direction, the crowbar circuit Q1677, activates at +31.5 V disabling all positive supplies except the +5 V.

Transistors Q1742 and Q1740 form a differential amplifier for the -25 V supply. The -25 V is sensed through R1744 and referenced to the +15 V supply by R1742. The bases of the differential amplifier operate at a zero voltage level. Changes in the output level are amplified to drive Q1750 and Q1760 which control the power module series pass transistor. This provides -25 V supply regulation. Current limiting is achieved by the voltage drop across R1763. As the current increases beyond safe limits, Q1752 turns on, reducing drive to the series pass transistor. If the output voltage rises to approximately 27 V above the raw supply, VR1752 turns on Q1752, limiting the current. This provides foldback overload protection. Over voltage conditions occur at approximately -31.5 V when actuation of the crowbar circuit disables all negative supplies.

# 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

CHANGE:	DESCRIPTION
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Page 2-5 Power Supplies (Diagram 7)

REMOVE the title and all power supply text

SUBSTITUTE THIS TITLE AND TEXT:

Power Supply (Diagrams 7 and 8)

There are five regulated power supplies: +5 V, +15 V, -15 V, +25 V, and -25 V. The -15 V, +25 V, and -25 V supplies reference to the +15 V supply. The +5 V supply obtains its unregulated voltage from the +11.5 V ac supply in the power module. The +5 V supply is series regulated by U1690 which contains its own internal reference and provides short circuit current limiting at approximately 750 mA.

The +15 V supply is series regulated and referenced to a 6.2 V zener connected in the emitter of Q1610. Potentiometer R1605 adjusts the +15 V output. Resistor R1602 provides a voltage correction feedback path. Should the load on the +15 V supply increase, the voltage at the base of Q1610 will drop slightly. This causes the base of Q1620 to go slightly positive, reducing conduction. The base of Q1622 now goes slightly negative, thus increasing conduction in the series pass transistor located in the power module. This supplies more current for the +15 V load and restores the voltage to the preset level. The power module supplies +33.5 V dc through rear interface contacts 12A and 12B for the operation of this supply. The 0.75  $\Omega$  resistor in the emitter circuit of the series pass transistor senses an overload current. When enough current flows through this resistor to turn on Q1621, base drive to the series pass transistor is reduced. This sets an upper limit to the amount of current that can be drawn from this supply. If the +15 V supply is raised beyond about +19.5 V, for any reason, an scr crowbar circuit on the floating interface board shuts down all supplies except the +5 V.

The -15 V supply is referenced to the +15 V supply. Transistors Q1710 and Q1715 form a differential amplifier for this series regulating supply. Any change of output voltage level, due to a shift in load, is fed back to Q1710. Transistor Q1710 drives the series pass transistor through Q1720 and Q1722 so that the supply remains at -15 V over its range of current handling capability. The current sensing resistor for this supply is R1726. When the voltage across this resistor becomes high enough to turn on Q1721, base drive to the series pass transistor in the power module is reduced and the supply becomes current limited. Shutdown of

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01282	PARKER STEARNS AND CO., INC.	300 SHEFFIELD AVENUE	BROOKLYN, NY 11207
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY ROUTE 202	DALLAS, TX 75222 SOMERVILLE, NY 08876
02735	RCA CORPORATION, SOLID STATE DIVISION	ELECTRONICS PARK	SYRACUSE, NY 13201
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	P O BOX 867, 19TH AVE. SOUTH	MURTL BEACH, SC 29577
04222	AVX CERAMICS, DIVISION OF AVX CORP.	5005 E MCDOWELL RD, PO BOX 20923	PHOENIX, AZ 85036
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	343 SNYDER AVENUE	BERKELEY HEIGHTS, NJ 07922
05091	TRI-ORDINATE CORPORATION	12515 CHADRON AVE.	HAWTHORNE, CA 90250
07910	TELEDYNE SEMICONDUCTOR	LOWER WASHINGTON STREET	DOVER, NH 03820
12697	CLAROSTAT MFG. CO., INC.	1601 OLYMPIC BLVD.	SANTA MONICA, CA 90404
14193	CAL-R, INC.	3301 ELECTRONICS WAY	
14433	ITT SEMICONDUCTORS	P O BOX 3049 1710 S. DEL MAR AVE.	WEST PALM BEACH, FL 33402 SAN GABRIEL, CA 91776
14752	ELECTRO CUBE INC.		
16546	U.S. CAPACITOR CORP/CENTRALAB ELECTRONICS DIV.	4561 COLORADO	LOS ANGELES, CA 90039
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
21847	AERTECH INDUSTRIES	825 STEWART DR.	SUNNYVALE, CA 94086
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
28480	HEWLETT-PACKARD CO., CORPORATE HQ.	1501 PAGE MILL RD.	PALO ALTO, CA 94304
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50157	N. L. INDUSTRIES, INC., ELECTRONICS DEPT.	P. O. BOX 787 5 HEMLOCK STREET	MUSKEGON, MI 49445 LATHAM, NY 12110 NORTH ADAMS, MA 01247
53184	XCITON CORPORATION		
56289	SPRAGUE ELECTRIC CO.		
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
73899	JFD ELECTRONICS COMPONENTS CORP.	PINETREE ROAD	OXFORD, NC 27565
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST. 800 E. NORTHWEST HWY	PHILADELPHIA, PA 19108 DES PLAINES, IL 60016
75915	LITTELFUSE, INC.	P O BOX 500	BEAVERTON, OR 97077
80009	TEKTRONIX, INC.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
81483	INTERNATIONAL RECTIFIER CORP.		
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET P O BOX 372	INDIANAPOLIS, IN 46206 COLUMBUS, NE 68601
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	

**TEKTRONIX**committed to  
technical excellence**MANUAL CHANGE INFORMATION**PRODUCT FG 504CHANGE REFERENCE M31515070-2028-01DATE REVISED 1-26-79

CHANGE:

DESCRIPTION

THIS REVISED M31515 INSERT REPLACES ORIGINAL INSERT AND ADDENDUMS 1 THROUGH 3 AND INCLUDES A COMPLETE NEW ADJUSTMENT PROCEDURE FOR SN B042000-UP.

## TEXT CHANGES

Page 1-9 Fig. 1-16 and cutline

DELETE the readout from the waveform photograph ( $>200\text{mV}$   $>5\text{V}$   $>100\mu\text{s}$ )

CHANGE the third line of cutline to read:

-2.5 V on the modulating signal equals 0% modulation and

+2.5 V equals 100% modulation.

Page 2-1 Right column, after eighth line; ADD:

With switches S240-5, 6, and 7 closed, the positive timing current divides. Most of the current flows through R202, and the remaining current flows through R200, R204, and C210. One-tenth of the current flows through R200 and R204 to charge C210 because the combined resistance of R200 and R204 is ten times the resistance of R202.

Page 2-2 Right column, at end of bottom paragraph; ADD:

The sine shaper consists of four diode bridges, CR745-CR748, CR750-CR753, CR755-CR758 and CR762-CR765. These bridges are connected between the +15 V and -15 V supplies. The resistors from the common anodes and cathodes of each bridge are equal in value. The resistance values for each bridge are, however, different from the other bridges. This causes equal positive and negative break points for an individual bridge, but different amplitude voltage break points for the different bridges. As the triangle voltage rises to +1 V, it progressively exceeds the break point of each bridge. The non-linear characteristics of the diodes prevent sharp transitions at the break points. The opposite action occurs as the input triangle drives to -1 V. The output currents from the bridges are summed at the input to U770, and the result is a close approximation of a pure sine-wave.

Page 2-3 Output Amplifier (Diagram 4); change second sentence to read:

The input stage consists of pairs of differential amplifiers Q930 and Q940 complemented by Q1030 and Q1040.

Page 2-4 Logarithmic converter; change second sentence in second paragraph to read:

Operational amplifier U1480 is used as an inverter.



Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-3842-00	B010100	B029999	CKT BOARD ASSY:MAIN	80009	670-3842-00
A1	670-3842-01	B030000		CKT BOARD ASSY:MAIN	80009	670-3842-01
A2	670-3841-00	B010100	B029999	CKT BOARD ASSY:FUNCTION	80009	670-3841-00
A2	670-3841-01	B030000	B031354	CKT BOARD ASSY:FUNCTION	80009	670-3841-01
A2	670-3841-02	B031355		CKT BOARD ASSY:FUNCTION	80009	670-3841-02
A3	670-3840-00	B010100	B029999	CKT BOARD ASSY:LOOP	80009	670-3840-00
A3	670-3840-01	B030000		CKT BOARD ASSY:LOOP	80009	670-3840-01
A4	670-3797-00	B010100	B029999	CKT BOARD ASSY:FLOATING INTERFACE	80009	670-3797-00
A4	670-3797-01	B030000		CKT BOARD ASSY:FLOATING INTERFACE	80009	670-3797-01
C72	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C78	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C95	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C80	281-0599-00	XB030000		CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	374001-COKO-109C
C98	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C106	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C195	281-0123-00			CAP.,VAR,CER DI:5-25PF,100V	72982	518-000A5-25
C210	285-1068-00			CAP.,FXD,PLSTC:5UF,1%,200V	14752	230B1C505F
C240	283-0361-00			CAP.,FXD,CER DI:460PF,1%,50V	72982	A02C-2C0G-461F
C242	281-0158-00			CAP.,VAR,CER DI:7-45PF,50V	73899	DVJ-5006
C244	285-1066-00			CAP.,FXD,PLSTC:0.05UF,1%,200V	14752	230B1C503F
C246	285-1067-00			CAP.,FXD,PLSTC:0.5UF,1%,200V	14752	230B1C504F
C248	285-1050-00			CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C250	285-1062-00			CAP.,FXD,PLSTC:0.005UF,0.1%,200V	19396	70-27948
C255	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	81314147 C 104K
C275	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C290	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C300	281-0653-00			CAP.,FXD,CER DI:3.3PF,30%,200V	72982	374-001COK0109C
C315	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C325	281-0158-00			CAP.,VAR,CER DI:7-45PF,50V	73899	DVJ-5006
C327	281-0617-00			CAP.,FXD,CER DI:15PF,10%,200V	72982	374-001COG0150K
C329	283-0639-00			CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C331	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F201F0
C340	281-0158-00			CAP.,VAR,CER DI:7-45PF,50V	73899	DVJ-5006
C342	281-0617-00			CAP.,FXD,CER DI:15PF,10%,200V	72982	374-001COG0150K
C344	283-0639-00			CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C346	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F201F0
C380	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C387	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C475	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C480	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C495	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J
C510	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J
C534	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C550	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C570	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C576	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C588	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C592	283-0633-00			CAP.,FXD,MICA D:77PF,1%,100V	00853	D151E770F0
C594	283-0252-00			CAP.,FXD,CER DI:1000PF,10%,50V	72982	A01AL9A2LW5R102K
C596	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C598	283-0209-00	B010100	B029999	CAP.,FXD,CER DI:1UF,20%,50V	72982	8130M050Z5U0105M
C598	290-0522-00	B030000		CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C612	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P

# CALIBRATION TEST EQUIPMENT REPLACEMENT

## Calibration Test Equipment Chart

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

Comparison of Main Characteristics

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

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

Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C618	281-0510-00	XB010165		CAP., FXD, CER DI: 22PF, +/-4.4PF, 500V	72982	301-000COG0220M
C632	283-0005-00			CAP., FXD, CER DI: 0.01UF, +100-0%, 250V	72982	8131N300Z5U0103P
C638	283-0005-00			CAP., FXD, CER DI: 0.01UF, +100-0%, 250V	72982	8131N300Z5U0103P
C642	281-0613-00			CAP., FXD, CER DI: 10PF, +/-1PF, 200V	72982	374-001COG0100F
C712	283-0638-00			CAP., FXD, MICA D: 130PF, 1%, 100V	00853	D151E131F0
C745	281-0516-00	XB010165		CAP., FXD, CER DI: 39PF, +/-3.9PF, 500V	72982	301-000U2J0390K
C777	281-0615-00	B010100	B010164X	CAP., FXD, CER DI: 3.9PF, +/-0.5PF, 200V	72982	374-001C0J0399D
C784	283-0597-00			CAP., FXD, MICA D: 470PF, 10%, 300V	00853	D153E471K0
C790	290-0534-00			CAP., FXD, ELCTLT: 1UF, 20%, 35V	56289	196D105X0035HA1
C812	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C844	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C857	281-0093-00			CAP., VAR, CER DI: 5.5-18PF	72982	538-011A5.5-18
C880	290-0534-00			CAP., FXD, ELCTLT: 1UF, 20%, 35V	56289	196D105X0035HA1
C884	290-0534-00			CAP., FXD, ELCTLT: 1UF, 20%, 35V	56289	196D105X0035HA1
C914	283-0111-00			CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C922	281-0158-00			CAP., VAR, CER DI: 7-45PF, 50V	73899	DVJ-5006
C934	283-0005-00			CAP., FXD, CER DI: 0.01UF, +100-0%, 250V	72982	8131N300Z5U0103P
C936	283-0111-00	B010100	B010125X	CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C946	283-0353-00			CAP., FXD, CER DI: 0.1UF, 10%, 50V	16546	W050FH104KPSS
C947	283-0111-00			CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C950	283-0620-00			CAP., FXD, MICA D: 470PF, 1%, 300V	00853	D153F471F0
C955	283-0005-00			CAP., FXD, CER DI: 0.01UF, +100-0%, 250V	72982	8131N300Z5U0103P
C958	283-0005-00			CAP., FXD, CER DI: 0.01UF, +100-0%, 250V	72982	8131N300Z5U0103P
C965	283-0005-00			CAP., FXD, CER DI: 0.01UF, +100-0%, 250V	72982	8131N300Z5U0103P
C972	283-0353-00			CAP., FXD, CER DI: 0.1UF, 10%, 50V	16546	W050FH104KPSS
C975	290-0525-00			CAP., FXD, ELCTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C976	283-0353-00			CAP., FXD, CER DI: 0.1UF, 10%, 50V	16546	W050FH104KPSS
C978	283-0353-00			CAP., FXD, CER DI: 0.1UF, 10%, 50V	16546	W050FH104KPSS
C1028	283-0111-00	B010100	B010125X	CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C1046	283-0353-00			CAP., FXD, CER DI: 0.1UF, 10%, 50V	16546	W050FH104KPSS
C1047	283-0111-00			CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C1050	283-0620-00			CAP., FXD, MICA D: 470PF, 1%, 300V	00853	D153F471F0
C1072	283-0353-00			CAP., FXD, CER DI: 0.1UF, 10%, 50V	16546	W050FH104KPSS
C1075	290-0525-00			CAP., FXD, ELCTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C1076	283-0353-00			CAP., FXD, CER DI: 0.1UF, 10%, 50V	16546	W050FH104KPSS
C1078	283-0353-00			CAP., FXD, CER DI: 0.1UF, 10%, 50V	16546	W050FH104KPSS
C1090	281-0138-00			CAP., VAR, PLSTC: 0.4-1.2PF, 600V	74970	273-0051-001
C1092	281-0123-00			CAP., VAR, CER DI: 5-25PF, 100V	72982	518-000A5-25
C1110	283-0600-00	B010100	B010164X	CAP., FXD, MICA D: 43PF, 5%, 500V	00853	D105E430J0
C1146	283-0000-00			CAP., FXD, CER DI: 0.001UF, +100-0%, 500V	72982	831-516E102P
C1154	290-0525-00			CAP., FXD, ELCTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C1156	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1174	290-0525-00			CAP., FXD, ELCTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C1176	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1200	281-0662-00			CAP., FXD, CER DI: 10PF, +/-0.5PF, 500V	72982	301-000H3M0100D
C1204	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1215	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1217	290-0527-00			CAP., FXD, ELCTLT: 15UF, 20%, 20V	90201	TDC156M020FL
C1258	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1284	290-0525-00			CAP., FXD, ELCTLT: 4.7UF, 20%, 50V	56289	196D475X0050KA1
C1295	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1322	283-0180-00			CAP., FXD, CER DI: 5600PF, 20%, 200V	72982	8121N204 E 562M
C1330	283-0167-00			CAP., FXD, CER DI: 0.1UF, 10%, 100V	72982	81314147 C 104K

## **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.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1340	283-0167-00			CAP., FXD, CER DI:0.1UF, 10%, 100V	72982	81314147 C 104K
C1380	283-0110-00			CAP., FXD, CER DI:0.005UF, +80-20%, 150V	56289	19C242B
C1392	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1394	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1438	290-0536-00			CAP., FXD, ELCTLT:10UF, 20%, 25V	90201	TDC106M025FL
C1440	285-0808-00			CAP., FXD, PLSTC:0.1UF, 10%, 50V	56289	LP66A1A104K004
C1442	285-0862-00			CAP., FXD, PLSTC:0.001, 10%, 100V	56289	410P10291
C1445	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1462	281-0523-00			CAP., FXD, CER DI:100PF, +/-20PF, 500V	72982	301-000U2M0101M
C1468	283-0054-00	B010100	B029999	CAP., FXD, CER DI:150PF, 5%, 200V	72982	855-535U2J151J
C1468	281-0524-00	B030000		CAP., FXD, CER DI:150PF, +/-30PF, 500V	04222	7001-1381
C1478	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1488	283-0191-00			CAP., FXD, CER DI:0.022UF, 20%, 50V	72982	8121N075Z5U0223M
C1492	283-0054-00	B010100	B029999	CAP., FXD, CER DI:150PF, 5%, 200V	72982	855-535U2J151J
C1492	281-0524-00	B030000		CAP., FXD, CER DI:150PF, +/-30PF, 500V	04222	7001-1381
C1494	283-0047-00	B010100	B029999	CAP., FXD, CER DI:270PF, 5%, 500V	72982	861-518B271J
C1494	281-0543-00	B030000		CAP., FXD, CER DI:270PF, 10%, 500V	72982	301055X5P271K
C1504	281-0662-00			CAP., FXD, CER DI:10PF, +/-0.5PF, 500V	72982	301-000H3M0100D
C1520	283-0065-00			CAP., FXD, CER DI:0.001UF, 5%, 100V	72982	805-505B102J
C1608	283-0005-00			CAP., FXD, CER DI:0.01UF, +100-0%, 250V	72982	8131N300Z5U0103P
C1612	283-0001-00			CAP., FXD, CER DI:0.005UF, +100-0%, 500V	72982	831-559E502P
C1630	290-0117-00			CAP., FXD, ELCTLT:50UF, +75-10%, 50V	56289	30D506G050DD9
C1650	283-0001-00			CAP., FXD, CER DI:0.005UF, +100-0%, 500V	72982	831-559E502P
C1665	290-0117-00			CAP., FXD, ELCTLT:50UF, +75-10%, 50V	56289	30D506G050DD9
C1670	290-0519-00			CAP., FXD, ELCTLT:100UF, 20%, 20V	56289	196D107X0020MA3
C1671	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1672	290-0519-00			CAP., FXD, ELCTLT:100UF, 20%, 20V	56289	196D107X0020MA3
C1673	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C1680	290-0786-00			CAP., FXD, ELCTLT:1500UF, +50-10%, 75VDC	80031	39CS75JL152
C1682	290-0786-00			CAP., FXD, ELCTLT:1500UF, +50-10%, 75VDC	80031	39CS75JL152
C1690	290-0415-00			CAP., FXD, ELCTLT:5.6UF, 10%, 35V	56289	150D565X9035B2
C1691	285-1101-00			CAP., FXD, PLSTC:0.022UF, 10%, 200V	19396	223K02PT485
C1694	290-0415-00			CAP., FXD, ELCTLT:5.6UF, 10%, 35V	56289	150D565X9035B2
C1720	283-0001-00			CAP., FXD, CER DI:0.005UF, +100-0%, 500V	72982	831-559E502P
C1730	290-0117-00			CAP., FXD, ELCTLT:50UF, +75-10%, 50V	56289	30D506G050DD9
C1750	283-0001-00			CAP., FXD, CER DI:0.005UF, +100-0%, 500V	72982	831-559E502P
C1765	290-0117-00			CAP., FXD, ELCTLT:50UF, +75-10%, 50V	56289	30D506G050DD9
C1770	290-0525-00			CAP., FXD, ELCTLT:4.7UF, 20%, 50V	56289	196D475X0050KA1
C1774	290-0525-00			CAP., FXD, ELCTLT:4.7UF, 20%, 50V	56289	196D475X0050KA1
C1778	290-0525-00			CAP., FXD, ELCTLT:4.7UF, 20%, 50V	56289	196D475X0050KA1
C1800	290-0525-00			CAP., FXD, ELCTLT:4.7UF, 20%, 50V	56289	196D475X0050KA1
CR20	152-0141-02			SEMICOND DEVICE:SILICON, 30V, 150MA	07910	1N4152
CR21	152-0141-02			SEMICOND DEVICE:SILICON, 30V, 150MA	07910	1N4152
CR85	152-0141-02			SEMICOND DEVICE:SILICON, 30V, 150MA	07910	1N4152
CR108	152-0141-02			SEMICOND DEVICE:SILICON, 30V, 150MA	07910	1N4152
CR180	152-0322-00			SEMICOND DEVICE:SILICON, 15V, HOT CARRIER	28480	5082-2672
CR182	152-0322-00			SEMICOND DEVICE:SILICON, 15V, HOT CARRIER	28480	5082-2672
CR184	152-0322-00			SEMICOND DEVICE:SILICON, 15V, HOT CARRIER	28480	5082-2672
CR186	152-0322-00			SEMICOND DEVICE:SILICON, 15V, HOT CARRIER	28480	5082-2672
CR188	152-0322-00			SEMICOND DEVICE:SILICON, 15V, HOT CARRIER	28480	5082-2672
CR190	152-0322-00			SEMICOND DEVICE:SILICON, 15V, HOT CARRIER	28480	5082-2672
CR218	152-0141-02			SEMICOND DEVICE:SILICON, 30V, 150MA	07910	1N4152



Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR220	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR352	152-0322-00			SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR356	152-0322-00			SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR462	152-0322-00			SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR470	152-0322-00			SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR556	152-0322-00			SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR558	152-0322-00			SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR560	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR562	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR564	152-0322-00			SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR566	152-0322-00			SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR632	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR745	152-0646-01	B010100	B020287	SEMICON D DEVICE:CHECKED	80009	152-0646-01
CR745	152-0322-00	B020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR745	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR746	152-0646-01	B010100	B020287	SEMICON D DEVICE:CHECKED	80009	152-0646-01
CR746	152-0322-00	B020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR746	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR747	152-0322-00	XB020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR747	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR748	152-0322-00	XB020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR748	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR750	152-0322-00	XB020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR750	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR751	152-0646-01	B010100	B020287	SEMICON D DEVICE:CHECKED	80009	152-0646-01
CR751	152-0322-00	B020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR751	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR752	152-0646-01	B010100	B020287	SEMICON D DEVICE:CHECKED	80009	152-0646-01
CR752	152-0322-00	B020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR752	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR753	152-0322-00	XB020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR753	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR755	152-0322-00	XB020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR755	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR756	152-0322-00	XB020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR756	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR757	152-0646-01	B010100	B020287	SEMICON D DEVICE:CHECKED	80009	152-0646-01
CR757	152-0322-00	B020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR757	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR758	152-0646-01	B010100	B020287	SEMICON D DEVICE:CHECKED	80009	152-0646-01
CR758	152-0322-00	B020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR758	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR762	152-0322-00	XB020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR762	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR763	152-0646-01	B010100	B020287	SEMICON D DEVICE:CHECKED	80009	152-0646-01
CR763	152-0322-00	B020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR763	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR764	152-0646-01	B010100	B020287	SEMICON D DEVICE:CHECKED	80009	152-0646-01
CR764	152-0322-00	B020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR764	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR765	152-0322-00	XB020288	B031354	SEMICON D DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR765	152-0322-01	B031355		SEMICON D DEVICE:SET OF 16,MATCHED FOR VF	21847	A2X600A
CR825	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152

STANDARD ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff      Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
	070-2028-01		1						MANUAL, TECH: INSTRUCTION	80009	070-2028-01

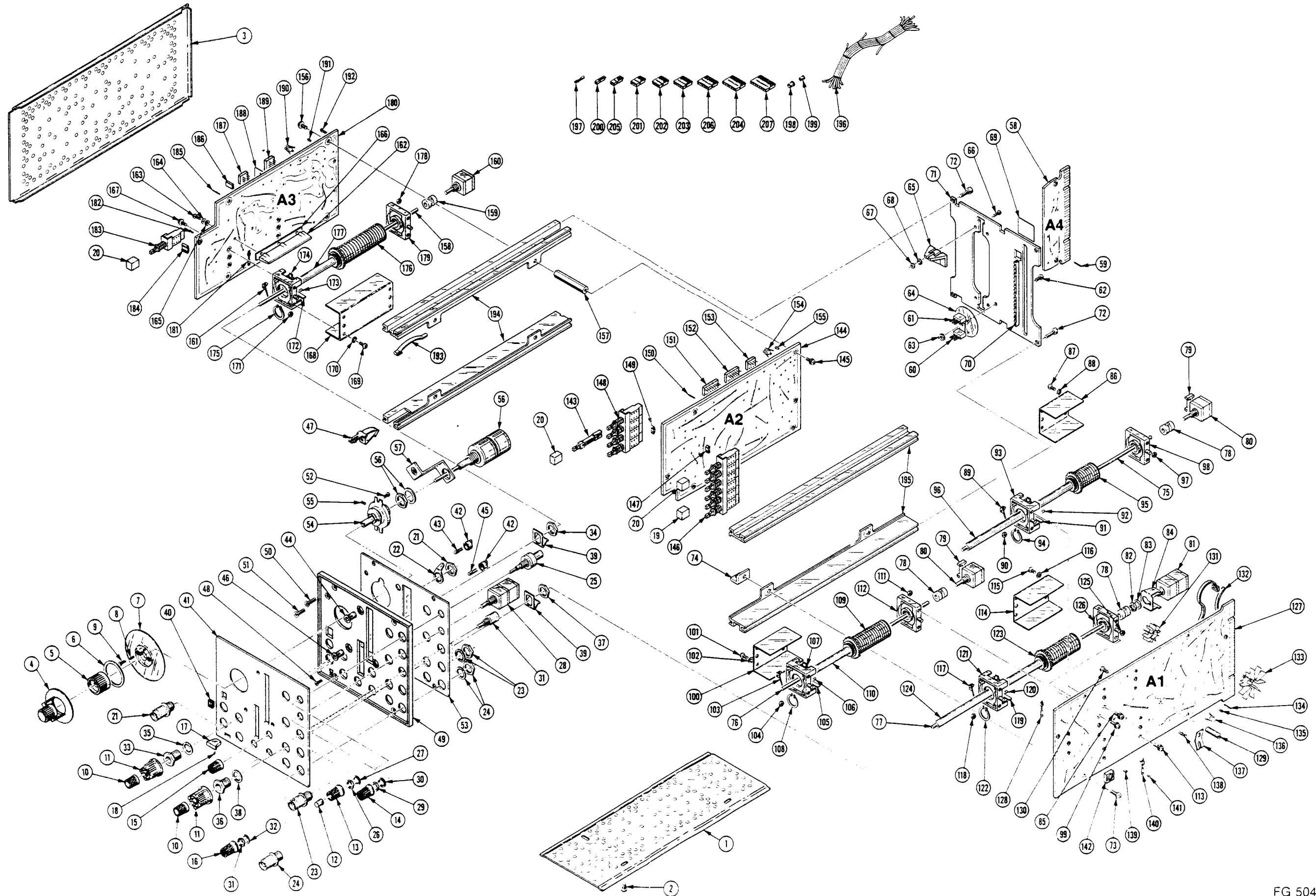


Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR826	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR842	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR942	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR943	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR960	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR962	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1042	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1043	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1212	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1225	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1226	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1235	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1285	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1286	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1312	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1370	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1372	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1470	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1608	152-0061-00			SEMICON D DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1622	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1630	152-0066-00	XB010125		SEMICON D DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1665	152-0061-00	B010100	B030719	SEMICON D DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1665	152-0066-00	B030720		SEMICON D DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1680	152-0488-00			SEMICON D DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR1682	152-0066-00			SEMICON D DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1711	152-0141-02			SEMICON D DEVICE:SILICON,30V,150MA	07910	1N4152
CR1722	152-0061-00			SEMICON D DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1730	152-0061-00	B010100	B010124	SEMICON D DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1730	152-0066-00	B010125		SEMICON D DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR1765	152-0061-00	B010100	B030719	SEMICON D DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1765	152-0066-00	B030720		SEMICON D DEVICE:SILICON,400V,750MA	80009	152-0066-00
DS50	150-1031-00	B010100	B010125	LAMP,LED:RED,20V	53184	XC209R
DS50	150-1033-00	B010126		LAMP,LED:YELLOW,2.2V	80009	150-1033-00
DS720	150-1031-00	B010100	B010125	LAMP,LED:RED,20V	53184	XC209R
DS720	150-1033-00	B010126		LAMP,LED:YELLOW,2.2V	80009	150-1033-00
DS1675	150-1029-00			LAMP,LED:2.0V,GREEN	53184	XC209G
F1120	159-0140-00			FUSE,WIRE LEAD:0.3A,125V,5 SEC	80009	159-0140-00
F1615	159-0116-00			FUSE,CARTRIDGE:1A,125V,0.4 SEC,0.17 LEADS	75915	273001
F1715	159-0116-00			FUSE,CARTRIDGE:1A,125V,0.4 SEC,0.17 LEADS	75915	273001
J20	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	05091	31-279
J300	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J406	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J418	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J420	131-1315-00			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR235-1
J485	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J640	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J700	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	05091	31-279
J730	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J732	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J735	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J900	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
J1120	131-1003-00			CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00



Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
J1125	131-1315-00			CONNECTOR, RCPT, :BNC, FEMALE	24931	28JR235-1
J1200	131-1315-00			CONNECTOR, RCPT, :BNC, FEMALE	24931	28JR235-1
J1201	131-1003-00			CONNECTOR BODY, :CKT CD MT, 3 PRONG	80009	131-1003-00
J1295	131-1003-00			CONNECTOR BODY, :CKT CD MT, 3 PRONG	80009	131-1003-00
J1370	131-0955-00			CONNECTOR, RCPT, :BNC, FEMALE, W/HARDWARE	05091	31-279
J1520	131-0955-00			CONNECTOR, RCPT, :BNC, FEMALE, W/HARDWARE	05091	31-279
L515	108-0733-00			COIL, RF:113NH	80009	108-0733-00
L646	108-0733-00			COIL, RF:113NH	80009	108-0733-00
L945	108-0181-01			COIL, RF:0.2UH	80009	108-0181-01
L1045	108-0550-00			COIL, RF:110NH	80009	108-0550-00
L1120	108-0237-00			COIL, RF:80UH	80009	108-0237-00
LR880	108-0520-00			COIL, RF:2.2UH (WOUND ON A 10 OHM RES)	80009	108-0520-00
LR884	108-0520-00			COIL, RF:2.2UH (WOUND ON A 10 OHM RES)	80009	108-0520-00
LR977	108-0520-00			COIL, RF:2.2UH (WOUND ON A 10 OHM RES)	80009	108-0520-00
LR1077	108-0520-00			COIL, RF:2.2UH (WOUND ON A 10 OHM RES)	80009	108-0520-00
Q55	151-0188-00			TRANSISTOR: SILICON, PNP	01295	2N3906
Q65	151-0438-00			TRANSISTOR: SILICON, PNP, SEL FROM SPS6927	80009	151-0438-00
Q80	151-0438-00			TRANSISTOR: SILICON, PNP, SEL FROM SPS6927	80009	151-0438-00
Q90	151-0438-00			TRANSISTOR: SILICON, PNP, SEL FROM SPS6927	80009	151-0438-00
Q100	151-0367-00			TRANSISTOR: SILICON, NPN, SEL FROM 3571TP	80009	151-0367-00
Q165	151-0188-00			TRANSISTOR: SILICON, PNP	01295	2N3906
Q170A, B	151-0232-00			TRANSISTOR: SILICON, NPN, DUAL	80009	151-0232-00
Q175	151-0190-00			TRANSISTOR: SILICON, NPN	80009	151-0190-00
Q225	151-0188-00			TRANSISTOR: SILICON, PNP	01295	2N3906
Q230	151-0190-00			TRANSISTOR: SILICON, NPN	80009	151-0190-00
Q255A, B	151-1032-00			TRANSISTOR: SILICON, FET, DUAL	80009	151-1032-00
Q270	151-0438-00			TRANSISTOR: SILICON, PNP, SEL FROM SPS6927	80009	151-0438-00
Q280	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q285	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q295	151-0438-00			TRANSISTOR: SILICON, PNP, SEL FROM SPS6927	80009	151-0438-00
Q310	151-0447-00			TRANSISTOR: SILICON, NPN	80009	151-0447-00
Q395	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q406	151-0199-00			TRANSISTOR: SILICON, PNP	27014	ST65038
Q410	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q415	151-0199-00			TRANSISTOR: SILICON, PNP	27014	ST65038
Q450	151-0438-00			TRANSISTOR: SILICON, PNP, SEL FROM SPS6927	80009	151-0438-00
Q456	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q462	151-0199-00			TRANSISTOR: SILICON, PNP	27014	ST65038
Q470	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q495	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q500	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q510	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q530	151-0435-00			TRANSISTOR: SILICON, PNP	04713	MPS-A65
Q540	151-0188-00			TRANSISTOR: SILICON, PNP	01295	2N3906
Q550	151-0221-00			TRANSISTOR: SILICON, PNP	80009	151-0221-00
Q570	151-0424-00			TRANSISTOR: SILICON, NPN	80009	151-0424-00
Q580	151-0190-00			TRANSISTOR: SILICON, NPN	80009	151-0190-00
Q600	151-1042-00			SEMICON DVC SE: MATCHED PAIR FET	80009	151-1042-00
Q610						
Q615	151-0427-00			TRANSISTOR: SILICON, NPN	80009	151-0427-00
Q620	151-0427-00			TRANSISTOR: SILICON, NPN	80009	151-0427-00
Q640	151-0199-00			TRANSISTOR: SILICON, PNP	27014	ST65038



Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q720	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q805	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q825	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q830	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q835	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q840	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	80009	151-0367-00
Q906	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q914	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q930	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q940	151-0424-00			TRANSISTOR:SILICON,NPN	80009	151-0424-00
Q950	151-0411-00			TRANSISTOR:SILICON,NPN	80009	151-0411-00
Q952	151-0285-00			TRANSISTOR:SILICON,PNP	80009	151-0285-00
Q970	151-0211-00			TRANSISTOR:SILICON,NPN	01282	2N3866
Q980	151-0211-00			TRANSISTOR:SILICON,NPN	01282	2N3866
Q1030	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS6927	80009	151-0438-00
Q1040	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS6927	80009	151-0438-00
Q1050	151-0450-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N5583	80009	151-0450-00
Q1052	151-0211-00			TRANSISTOR:SILICON,NPN	01282	2N3866
Q1070	151-0285-00			TRANSISTOR:SILICON,PNP	80009	151-0285-00
Q1080	151-0285-00			TRANSISTOR:SILICON,PNP	80009	151-0285-00
Q1150	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1160	151-0440-00			TRANSISTOR:SILICON,PNP	80009	151-0440-00
Q1170	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1180	151-0439-00			TRANSISTOR:SILICON,NPN	80009	151-0439-00
Q1220	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1245	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	80009	151-0367-00
Q1250	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	80009	151-0367-00
Q1254	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	80009	151-0367-00
Q1260	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q1262	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q1280	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q1400	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1410	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1420	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q1430	151-1021-00			TRANSISTOR:SILICON,JFE	80009	151-1021-00
Q1450	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1610	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1620	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1622	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1640	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1642	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1650	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1652	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1660	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1675	151-0506-00	XB010125		TRANSISTOR:SILICON,SCR	03508	C106B2
Q1710	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1715	151-0350-00	XB030000		TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1720	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1722	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1742	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q1750	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1752	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1760	151-0347-00	B010100	B030719	TRANSISTOR:SILICON,NPN	80009	151-0347-00

Replaceable Mechanical Parts—FG504

Fig. & Index No.	Tektronix Part No.	Serial/Model No Eff      Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-205	352-0169-00		2	.					HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
	352-0161-00		2	.					HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00
	352-0162-00		1	.					HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
	352-0163-00		2	.					CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
-206	352-0164-00		1	.					CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
-207	352-0166-00		1	.					CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0166-00

Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q1760	151-0439-00	B030720		TRANSISTOR:SILICON,NPN	80009	151-0439-00
R5 <sup>1</sup>	311-1799-00			RES.,VAR,WW:2 X 10K OHM,5%,1W	32997	3540S-591-103103
R8	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R10	311-1267-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
R12	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
R14	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R20	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R23	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R25	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R28	321-0276-00			RES.,FXD,FILM:7.32K OHM,1%,0.125W	91637	MFF1816G73200F
R30	321-0288-00			RES.,FXD,FILM:9.76K OHM,1%,0.125W	91637	MFF1816G97600F
R32	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R34	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R36	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R38	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R42	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R45	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R50 <sup>2</sup>	311-1851-00			RES.,VAR,NONWIR:15K OHM,1W	01121	14M212
R51	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R52	311-1567-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	73138	91A-100ROM
R54	321-0168-00			RES.,FXD,FILM:549 OHM,1%,0.125W	91637	MFF1816G549ROF
R58	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R65	321-0161-00			RES.,FXD,FILM:464 OHM,1%,0.125W	91637	MFF1816G464ROF
R68	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931ROF
R70	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R72	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R76	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931ROF
R78	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R80	321-0161-00			RES.,FXD,FILM:464 OHM,1%,0.125W	91637	MFF1816G464ROF
R85	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R88	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R90	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R92	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R95	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R98	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R100	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R102	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R104	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R108	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R114	307-0108-00			RES.,FXD,CMPSN:6.8 OHM,5%,0.25W	80009	307-0108-00
R115	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A R500
R120	311-1835-00			RES.,VAR,NONWIR:100 OHM,20%,1W	01121	13M972
R125 <sup>3</sup>	311-1799-00			RES.,VAR,WW:2 X 10K OHM,5%,1W	32997	3540S-591-103103
R128	311-1560-00			RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A-50000M
R130	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R134	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R136	315-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R138	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R140	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R143	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
R145	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A R2K
R147	321-0247-00			RES.,FXD,FILM:3.65K OHM,1%,0.125W	91637	MFF1816G36500F

<sup>1</sup>Furnished as a unit with R125.

<sup>2</sup>Furnished as a unit with S50.

<sup>3</sup>Furnished as a unit with R5.

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-	-----			-		ACTR ASSY INCLUDES:		
-168	200-1913-00			1		COVER,CAM SW: (ATTACHING PARTS)	80009	200-1913-00
-169	211-0008-00			4		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-170	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	000EX	OBD
-171	210-0406-00			2		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-172	214-1139-02			2		SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-173	214-1752-00			2		ROLLER,DETENT:	80009	214-1752-00
-174	401-0180-00			1		BEARING,CAM SW:FRONT (ATTACHING PARTS)	80009	401-0180-00
-175	354-0390-00			1		RING,RETAINING:0.338 ID X 0.025" THK,STL - - - * - - -	79136	5100-37MD
-176	105-0704-00			1		ACTUATOR,SWITCH:CAM SWITCH	80009	105-0704-00
-177	384-0878-09			1		SHAFT,CAM SW:OUTER CNCTRC,W/DRIVER,DELAY	80009	384-0878-09
-178	210-0406-00			4		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-179	401-0178-01			1		BEARING,CAM SW:CENTER/REAR	80009	401-0178-01
-180	-----			1		CKT BOARD ASSY:LOOP(SEE A3 EPL)		
-181	131-1031-00			16		CONTACT ASSY,EL:CAM SWITCH,TOP (ATTACHING PARTS FOR EACH)	80009	131-1031-00
-182	210-0779-00			16		RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG - - - * - - -	42838	RA-29952715
-183	-----			1		SWITCH,PUSH:(SEE S195 EPL)		
-184	361-0382-00			2		SPACER,PB SW:BROWN,0.275 INCH LONG	80009	361-0382-00
-185	131-0608-00			32		TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-186	131-0993-01			1		LINK,TERM.CONNE:2 WIRE BROWN	00779	530153-9
-187	136-0514-00			6		SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	CS9002-8
-188	337-2224-00			1		SHIELD,ELEC:CIRCUIT CARD	80009	337-2224-00
-189	136-0269-02			1		SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C95140
-190	131-1003-00			4		CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-191	136-0252-04			24		SOCKET,PIN TERM:0.188 INCH LONG	22526	75060-007
-192	214-0579-00	B010100	B010124	4		TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	214-0579-00	B010125		2		TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	131-0566-00			1		LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
	342-0324-00	XB010125		1		INSULATOR,DISC:TO-5 TRANSISTOR	13103	7717-5N-BLUE
-193	214-1061-00			1		SPRING,GROUND:FLAT	80009	214-1061-00
-194	426-1245-00	B010100	B042229	2		FR SECT,PLUG-IN:LEFT SIDE, TOP AND BOTTOM	80009	426-1245-00
	426-1245-00	B042230		1		FR SECT,PLUG-IN:LEFT SIDE, TOP AND BOTTOM	80009	426-1245-00
	426-1245-01	B042230		1		FR SECT,PLUG-IN:TOP LEFT	80009	426-1245-01
	386-3657-00	XB031205		1		SUPPORT,PLUG-IN:	80009	386-3657-00
-195	426-1246-02			2		FR SECT,PLUG-IN:RIGHT SIDE, TOP AND BOTTOM	80009	426-1246-02
	386-3657-00	XB031205		1		SUPPORT,PLUG-IN:	80009	386-3657-00
-196	179-2398-00	B010100	B029999	1		WIRING HARNESS:CHASSIS	80009	179-2398-00
	179-2398-01	B030000		1		WIRING HARNESS,:CHASSIS	80009	179-2398-01
-197	131-0707-00			39		CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-198	210-0775-00			12		EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
-199	210-0774-00			12		EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00
-200	352-0171-00			5		HLDR,TERM CONN:1 WIRE BLACK	80009	352-0171-00
-201	352-0161-03			1		CONN BODY,PL,EL:3 WIRE ORANGE	80009	352-0161-03
-202	352-0162-04			1		CONN BODY,PL,EL:4 WIRE YELLOW	80009	352-0162-04
-203	352-0163-01			1		CONN BODY,PL,EL:5 WIRE BROWN	80009	352-0163-01
-204	352-0165-06			1		CONN BODY,PL,EL:7 WIRE BLUE	80009	352-0165-06
	179-2416-00			1		WIRING HARNESS:POWER	80009	179-2416-00
	131-0707-00			18		CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	352-0162-00			2		HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
	352-0162-06			1		CONN BODY,PL,EL:4 WIRE BLUE	80009	352-0162-06
	352-0163-01			1		CONN BODY,PL,EL:5 WIRE BROWN	80009	352-0163-01
	352-0171-00			1		HLDR,TERM CONN:1 WIRE BLACK	80009	352-0171-00
	179-2399-00			1		WIRING HARNESS:FRONT PANEL	80009	179-2399-00
	131-0707-00			40		CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	210-0774-00			4		EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00
	210-0775-00			4		EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
	352-0171-00			4		HLDR,TERM CONN:1 WIRE BLACK	80009	352-0171-00



Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R150	321-0289-00			RES., FXD, FILM:10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R155	311-1559-00			RES., VAR, NONWIR:10K OHM, 20%, 0.50W	73138	91A-10001M
R158	321-0289-00			RES., FXD, FILM:10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R160	321-0289-00			RES., FXD, FILM:10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R162	321-0661-00			RES., FXD, FILM:600 OHM, 1%, 0.125W	91637	MFF1816G600ROF
R165	315-0151-00			RES., FXD, CMPSN:150 OHM, 5%, 0.25W	01121	CB1515
R170	321-0661-00			RES., FXD, FILM:600 OHM, 1%, 0.125W	91637	MFF1816G600ROF
R172	321-0661-00			RES., FXD, FILM:600 OHM, 1%, 0.125W	91637	MFF1816G600ROF
R175	317-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.125W	01121	BB1005
R195	315-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.25W	01121	CB1005
R200	307-0111-00			RES., FXD, CMPSN:3.6 OHM, 5%, 0.25W	01121	CB36G5
R202	321-0054-00			RES., FXD, FILM:35.7 OHM, 5%, 0.125W	91637	MFF1816G357ROF
R204	321-0150-00			RES., FXD, FILM:357 OHM, 1%, 0.125W	91637	MFF1816G357ROF
R206	321-0246-00			RES., FXD, FILM:3.57K OHM, 1%, 0.125W	91637	MFF1816G35700F
R208	321-0342-00			RES., FXD, FILM:35.7K OHM, 1%, 0.125W	91637	MFF1816G35701F
R210	321-0438-00			RES., FXD, FILM:357K OHM, 1%, 0.125W	91637	MFF1816G35702F
R212	315-0512-00			RES., FXD, CMPSN:5.1K OHM, 5%, 0.25W	01121	CB5125
R215	311-1559-00			RES., VAR, NONWIR:10K OHM, 20%, 0.50W	73138	91A-10001M
R220	315-0512-00			RES., FXD, CMPSN:5.1K OHM, 5%, 0.25W	01121	CB5125
R225	315-0150-00			RES., FXD, CMPSN:15 OHM, 5%, 0.25W	01121	CB1505
R228	315-0150-00			RES., FXD, CMPSN:15 OHM, 5%, 0.25W	01121	CB1505
R235	315-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.25W	01121	CB1005
R250	315-0200-00			RES., FXD, CMPSN:20 OHM, 5%, 0.25W	01121	CB2005
R252	315-0510-00			RES., FXD, CMPSN:51 OHM, 5%, 0.25W	01121	CB5105
R255	315-0431-00			RES., FXD, CMPSN:430 OHM, 5%, 0.25W	01121	CB4315
R258	315-0220-00			RES., FXD, CMPSN:22 OHM, 5%, 0.25W	01121	CB2205
R260	315-0220-00			RES., FXD, CMPSN:22 OHM, 5%, 0.25W	01121	CB2205
R262	315-0431-00			RES., FXD, CMPSN:430 OHM, 5%, 0.25W	01121	CB4315
R265	315-0120-00			RES., FXD, CMPSN:12 OHM, 5%, 0.25W	01121	CB1205
R270	315-0511-00			RES., FXD, CMPSN:510 OHM, 5%, 0.25W	01121	CB5115
R271	317-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.125W	01121	BB1005
R272	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R275	315-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.25W	01121	CB1005
R280	307-0107-00			RES., FXD, CMPSN:5.6 OHM, 5%, 0.25W	01121	CB56G5
R285	315-0511-00			RES., FXD, CMPSN:510 OHM, 5%, 0.25W	01121	CB5115
R287	317-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.125W	01121	BB1005
R288	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R290	315-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.25W	01121	CB1005
R295	307-0107-00			RES., FXD, CMPSN:5.6 OHM, 5%, 0.25W	01121	CB56G5
R300	307-0093-00			RES., FXD, CMPSN:1.2 OHM, 5%, 0.50W	01121	EB12G5
R315	301-0122-00			RES., FXD, CMPSN:1.2K OHM, 5%, 0.50W	01121	EB1225
R317	315-0200-00			RES., FXD, CMPSN:20 OHM, 5%, 0.25W	01121	CB2005
R322	321-0145-00			RES., FXD, FILM:316 OHM, 1%, 0.125W	91637	MFF1816G316ROF
R325	315-0470-00			RES., FXD, CMPSN:47 OHM, 5%, 0.25W	01121	CB4705
R327	315-0101-00			RES., FXD, CMPSN:100 OHM, 5%, 0.25W	01121	CB1015
R329	315-0122-00			RES., FXD, CMPSN:1.2K OHM, 5%, 0.25W	01121	CB1225
R331	315-0513-00			RES., FXD, CMPSN:51K OHM, 5%, 0.25W	01121	CB5135
R336	321-0145-00			RES., FXD, FILM:316 OHM, 1%, 0.125W	91637	MFF1816G316ROF
R340	315-0470-00			RES., FXD, CMPSN:47 OHM, 5%, 0.25W	01121	CB4705
R342	315-0101-00			RES., FXD, CMPSN:100 OHM, 5%, 0.25W	01121	CB1015
R344	315-0122-00			RES., FXD, CMPSN:1.2K OHM, 5%, 0.25W	01121	CB1225
R346	315-0513-00			RES., FXD, CMPSN:51K OHM, 5%, 0.25W	01121	CB5135
R350	321-0249-00			RES., FXD, FILM:3.83K OHM, 1%, 0.125W	91637	MFF1816G38300F

Replaceable Mechanical Parts—FG504

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-123	105-0701-00		1	.	ACTUATOR, SWITCH: CAM SWITCH	80009	105-0701-00
-124	384-0878-14		1	.	SHAFT, CAM SW: OUTER CONCENTRIC, W/DRIVER	80009	384-0878-14
-125	210-0406-00		4	.	NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS	73743	2X12161-402
-126	401-0178-01		1	.	BEARING, CAM SW: CENTER/REAR	80009	401-0178-01
-127	-----		1	.	CKT BOARD ASSY: MAIN(SEE A1 EPL)		
-128	131-1030-00		7	.	CONT ASSY, ELEC: CAM SWITCH, BOTTOM	80009	131-1030-00
-129	384-0531-00		1	.	ROD, SPACER: 0.25 OD X 0.656 INCH LONG (ATTACHING PARTS)	80009	384-0531-00
-130	211-0008-00		1	.	SCREW, MACHINE: 4-40 X 0.25 INCH, PNH STL - - - * - - -	83385	OBD
	342-0324-00	XB010125	8	.	INSULATOR, DISC: TO-5 TRANSISTOR	13103	7717-5N-BLUE
-131	214-1291-00		2	.	HEAT SINK, ELEC: XSTR, 0.72 OD X 0.375"H	05820	207-AB
-132	343-0149-00		1	.	CLAMP, LOOP: NYLON	80009	343-0149-00
-133	214-1254-00		4	.	HEAT SINK, ELEC: 0.422 H X 1.240 INCH OD	05820	209-AB
	214-0693-00	XB010175	2	.	HEAT SINK, ELEC: 0.25 ID X 0.75 INCH LONG	98978	TXD017-075
-134	131-0608-00		31	.	TERMINAL, PIN: 0.365 L X 0.25 PH, BRZ, GOLD PL	22526	47357
-135	136-0252-04		9	.	SOCKET, PIN TERM: 0.188 INCH LONG	22526	75060-007
-136	131-1003-00		3	.	CONN, RCPT, ELEC: CKT BD MT, 3 PRONG	80009	131-1003-00
-137	344-0248-00		3	.	CLIP, ATTENUATOR:	80009	344-0248-00
-138	214-1797-00		6	.	PIN, ATTEN CLIP:	80009	214-1797-00
-139	136-0261-00		6	.	SOCKET, PIN TERM: FOR 0.22 INCH PIN	00779	1-331677-6
-140	131-1031-00		22	.	CONTACT ASSY, EL: CAM SWITCH, TOP (ATTACHING PARTS FOR EACH)	80009	131-1031-00
-141	210-0779-00		1	.	RIVET, TUBULAR: 0.051 OD X 0.115 INCH LONG - - - * - - -	42838	RA-29952715
-142	136-0514-00		1	.	SOCKET, PLUG IN: MICROCIRCUIT, 8 CONTACT	73803	CS9002-8
	131-0566-00		1	.	LINK, TERM. CONNE: 0.086 DIA X 2.375 INCH L	55210	L-2007-1
-143	384-1099-00		4	.	EXTENSION SHAFT: PUSH BUTTON, 1.54 INCH LONG	80009	384-1099-00
-144	-----		1	.	CKT BOARD ASSY: FUNCTION(SEE A2 EPL) (ATTACHING PARTS)		
-145	211-0116-00		4	.	SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS - - - * - - -	83385	OBD
-146	-----		-	.	CKT BOARD ASSY INCLUDES:		
			1	.	SWITCH, PUSH: (SEE S730 EPL)		
-147	361-0384-00		6	.	SPACER, PB SW: 0.133 INCH LONG	80009	361-0384-00
-148	-----		1	.	SWITCH, PUSH: (SEE S1235 EPL)		
-149	361-0385-00		4	.	SPACER, PB SW: 0.164 INCH LONG	80009	361-0385-00
-150	131-0608-00		38	.	TERMINAL, PIN: 0.365 L X 0.25 PH, BRZ, GOLD PL	22526	47357
-151	136-0260-02		4	.	SOCKET, PLUG-IN: 16 CONTACT, LOW CLEARANCE	82647	C9316-18
-152	136-0269-02		1	.	SOCKET, PLUG-IN: 14 CONTACT, LOW CLEARANCE	01295	C95140
-153	136-0514-00		7	.	SOCKET, PLUG IN: MICROCIRCUIT, 8 CONTACT	73803	CS9002-8
-154	131-1003-00		5	.	CONN, RCPT, ELEC: CKT BD MT, 3 PRONG	80009	131-1003-00
-155	136-0252-04		5	.	SOCKET, PIN TERM: 0.188 INCH LONG	22526	75060-007
	672-0552-00		1	.	CKT BOARD ASSY: W/CAM SWITCH (ATTACHING PARTS)	80009	672-0552-00
-156	211-0601-00		4	.	SCR, ASSEM WSHR: 6-32 X 0.312 INCH, PNH BRS - - - * - - -	80009	211-0601-00
-157	129-0388-00		4	.	POST, ELEC-MECH: 1.673 INCH LONG	80009	129-0388-00
-158	384-0442-00		-	.	CKT BOARD ASSEMBLY INCLUDES:		
			1	.	EXTENSION SHAFT: 0.125 OD X 8.452 INCH LONG	80009	384-0442-00
-159	376-0051-01		1	.	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
-160	-----		1	.	RESISTOR, VAR: (SEE R120 EPL)		
-161	131-0963-00		1	.	CONTACT, ELEC: GROUNDING	000EX	OBD
-162	337-1418-01		1	.	SHIELD, ELEC: CAM SWITCH (ATTACHING PARTS)	80009	337-1418-01
-163	211-0001-00		3	.	SCREW, MACHINE: 2-56 X 0.25 INCH, PNH STL	83385	OBD
-164	210-0001-00		3	.	WASHER, LOCK: INTL, 0.092 ID X 0.18"OD, STL	78189	1202-00-00-0541C
-165	210-1008-00		3	.	WASHER, FLAT: 0.09 ID X 0.188" OD, BRS - - - * - - -	12360	OBD
-166	342-0167-00		1	.	INSULATOR, PLATE: 2.45 INCH LONG	80009	342-0167-00
	-----		1	.	ACTR ASSY, CAM S: FREQUENCY(SEE S240 EPL) (ATTACHING PARTS)		
-167	211-0116-00		4	.	SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS - - - * - - -	83385	OBD

Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R352	321-0145-00			RES.,FXD,FILM:316 OHM,1%,0.125W	91637	MFF1816G316ROF
R356	321-0145-00			RES.,FXD,FILM:316 OHM,1%,0.125W	91637	MFF1816G316ROF
R358	321-0248-00	B010100	B029999	RES.,FXD,FILM:3.74K OHM,1%,0.125W	91637	MFF1816G37400F
R358	321-0248-00	B030000		RES.,FXD,FILM:3.74K OHM,(NOM VALUE),SEL	91637	MFF1816G37400F
R360	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A R500
R363	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R365	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A R500
R367	321-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.125W	91637	MFF1816G15800F
R370	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R372	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R375	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R380	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R382	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R385	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R387	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R390	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R395	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R397	315-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R398	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R400	301-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.50W	01121	EB1315
R402	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R406	315-0910-00			RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
R409	315-0240-00			RES.,FXD,CMPSN:24 OHM,5%,0.25W	01121	CB2405
R410	315-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R412	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R415	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R417	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R419	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R420	315-0511-00	B010100	B029999	RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R420	315-0101-00	B030000		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R450	315-0240-00			RES.,FXD,CMPSN:24 OHM,5%,0.25W	01121	CB2405
R452	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R454	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R456	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R458	301-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.50W	01121	EB3625
R462	323-0172-00			RES.,FXD,FILM:604 OHM,1%,0.50W	91637	MFF1226G604ROF
R465	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R470	323-0172-00			RES.,FXD,FILM:604 OHM,1%,0.50W	91637	MFF1226G604ROF
R475	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R480	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R490	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R492	317-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.125W	01121	BB2005
R494	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R496	301-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
R498	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R500	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R512	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R515	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R520	311-1373-00			RES.,VAR,NONWIR:5K OHM,20%,1W	01121	16M188
R522	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R524	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	MFF1816G39200F
R526	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R528	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-84	407-0553-00			1	.	.	.	.	.	BRACKET, CMPNT: BRASS ALBALOYPL	80009	407-0553-00
	131-0963-00			3	.	.	.	.	.	CONTACT, ELEC: GROUNDING	000EX	OBD
	-----			1	.	.	.	.	.	ACTR ASSY, CAM S: AMPLITUDE(SEE S590 EPL)		
-85	211-0116-00			4	.	.	.	.	.	SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	-----			-	.	.	.	.	.	ACTUATOR ASSEMBLY INCLUDES:		
-86	200-1910-00			1	.	.	.	.	.	COVER, CONTACT: 9 ELEMENTS (ATTACHING PARTS)	80009	200-1910-00
-87	211-0008-00			4	.	.	.	.	.	SCREW, MACHINE: 4-40 X 0.25 INCH, PNH STL	83385	OBD
-88	210-0004-00			4	.	.	.	.	.	WASHER, LOCK: #4 INTL, 0.015THK, STL CD PL	78189	1204-00-00-0541C
	-----			1	.	.	.	.	.	CONTACT, ELEC: GROUNDING	000EX	OBD
-90	210-0406-00			2	.	.	.	.	.	NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS	73743	2X12161-402
-91	214-1139-02			2	.	.	.	.	.	SPRING, FLAT: GREEN COLORED	80009	214-1139-02
-92	214-1752-00			2	.	.	.	.	.	ROLLER, DETENT:	80009	214-1752-00
-93	401-0180-00			1	.	.	.	.	.	BEARING, CAM SW: FRONT (ATTACHING PARTS)	80009	401-0180-00
-94	354-0390-00			1	.	.	.	.	.	RING, RETAINING: 0.338 ID X 0.025" THK, STL	79136	5100-37MD
	-----			1	.	.	.	.	.	ACTUATOR, SWITCH: CAM SWITCH	80009	105-0702-00
-96	384-0878-14			1	.	.	.	.	.	SHAFT, CAM SW: OUTER CONCENTRIC, W/DRIVER	80009	384-0878-14
-97	210-0406-00			4	.	.	.	.	.	NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS	73743	2X12161-402
-98	401-0178-01			1	.	.	.	.	.	BEARING, CAM SW: CENTER/REAR	80009	401-0178-01
	-----			1	.	.	.	.	.	ACTR ASSY CAM S: VARIABLE(SEE S1100 EPL) (ATTACHING PARTS)		
-99	211-0116-00			4	.	.	.	.	.	SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	-----			-	.	.	.	.	.	ACTR ASSEMBLY INCLUDES:		
-100	200-1911-00			1	.	.	.	.	.	COVER, CAM SW: 1.925 L X 0.876 H, AL (ATTACHING PARTS)	80009	200-1911-00
-101	211-0008-00			4	.	.	.	.	.	SCREW, MACHINE: 4-40 X 0.25 INCH, PNH STL	83385	OBD
-102	210-0004-00			4	.	.	.	.	.	WASHER, LOCK: #4 INTL, 0.015THK, STL CD PL	78189	1204-00-00-0541C
	-----			1	.	.	.	.	.	CONTACT, ELEC: GROUNDING	000EX	OBD
-104	210-0406-00	B010100 B029999		2	.	.	.	.	.	NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS	73743	2X12161-402
	210-0406-00	B010100 B029999		3	.	.	.	.	.	NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS	73743	2X12161-402
	214-1139-00	B030000		1	.	.	.	.	.	SPRING, FLAT: 0.885 X 0.156CU BE GLD CLR	80009	214-1139-00
-105	214-1139-02			1	.	.	.	.	.	SPRING, FLAT: GREEN COLORED	80009	214-1139-02
-106	214-1752-00			2	.	.	.	.	.	ROLLER, DETENT:	80009	214-1752-00
-107	401-0180-00			1	.	.	.	.	.	BEARING, CAM SW: FRONT (ATTACHING PARTS)	80009	401-0180-00
-108	354-0390-00			1	.	.	.	.	.	RING, RETAINING: 0.338 ID X 0.025" THK, STL	79136	5100-37MD
-109	105-0703-00			1	.	.	.	.	.	ACTUATOR, SWITCH: CAM SWITCH	80009	105-0703-00
-110	384-0878-13			1	.	.	.	.	.	SHAFT, CAM SW: OUTER CONCENTRIC, W/DRIVER	80009	384-0878-13
-111	210-0406-00			4	.	.	.	.	.	NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS	73743	2X12161-402
-112	401-0178-01			1	.	.	.	.	.	BEARING, CAM SW: CENTER/REAR	80009	401-0178-01
	-----			-	.	.	.	.	.	ACTR ASSY, CAM S: SWEEP(SEE S1435 EPL) (ATTACHING PARTS)		
-113	211-0116-00			4	.	.	.	.	.	SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	-----			-	.	.	.	.	.	ACTUATOR ASSEMBLY INCLUDES:		
-114	200-1911-00			1	.	.	.	.	.	COVER, CAM SW: 1.925 L X 0.876 H, AL (ATTACHING PARTS)	80009	200-1911-00
-115	211-0008-00			4	.	.	.	.	.	SCREW, MACHINE: 4-40 X 0.25 INCH, PNH STL	83385	OBD
-116	210-0004-00			4	.	.	.	.	.	WASHER, LOCK: #4 INTL, 0.015THK, STL CD PL	78189	1204-00-00-0541C
	-----			1	.	.	.	.	.	CONTACT, ELEC: GROUNDING	000EX	OBD
-118	210-0406-00			2	.	.	.	.	.	NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS	73743	2X12161-402
-119	214-1139-02			2	.	.	.	.	.	SPRING, FLAT: GREEN COLORED	80009	214-1139-02
-120	214-1752-00			2	.	.	.	.	.	ROLLER, DETENT:	80009	214-1752-00
-121	401-0180-00			1	.	.	.	.	.	BEARING, CAM SW: FRONT (ATTACHING PARTS)	80009	401-0180-00
-122	354-0390-00			1	.	.	.	.	.	RING, RETAINING: 0.338 ID X 0.025" THK, STL	79136	5100-37MD

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R530	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R536	321-0371-00			RES.,FXD,FILM:71.5K OHM,1%,0.125W	91637	MFF1816G71501F
R538	321-0276-00			RES.,FXD,FILM:7.32K OHM,1%,0.125W	91637	MFF1816G73200F
R540	321-0184-00			RES.,FXD,FILM:806 OHM,1%,0.125W	91637	MFF1816G806ROF
R544	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R548	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R552	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R572	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R574	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R576	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R580	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R582	321-0184-00			RES.,FXD,FILM:806 OHM,1%,0.125W	91637	MFF1816G806ROF
R584	321-0276-00			RES.,FXD,FILM:7.32K OHM,1%,0.125W	91637	MFF1816G73200F
R586	321-0371-00			RES.,FXD,FILM:71.5K OHM,1%,0.125W	91637	MFF1816G71501F
R592	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R604	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R606	315-0200-00	B010100	B010174	RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R606	307-0106-00	B010175		RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R610	311-1258-00			RES.,VAR,NONWIR:50 OHM,10%,0.50W	32997	3329P-L58-500
R612	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R615	321-0208-00			RES.,FXD,FILM:1.43K OHM,1%,0.125W	91637	MFF1816G14300F
R616	317-0510-00	XB030000		RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R618	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R620	321-0208-00			RES.,FXD,FILM:1.43K OHM,1%,0.125W	91637	MFF1816G14300F
R622	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R625	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R630	311-1568-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	73138	91A R50
R632	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R640	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R642	317-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.125W	01121	BB2005
R646	323-0177-00			RES.,FXD,FILM:680 OHM,1%,0.50W	91637	MFF1226G681ROF
R700	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R704	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R706	315-0395-00			RES.,FXD,CMPSN:3.9M OHM,5%,0.25W	01121	CB3955
R708	321-0371-00			RES.,FXD,FILM:71.5K OHM,1%,0.125W	91637	MFF1816G71501F
R710	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R716	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R717	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R720	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R730	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R735	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R736	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R738	315-0750-00	B010100	B010164	RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R738	315-0620-00	B010165		RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R740	311-1568-00	B010100	B010174	RES.,VAR,NONWIR:50 OHM,20%,0.50W	73138	91A R50
R740	311-1567-00	B010175		RES.,VAR,NONWIR:100 OHM,20%,0.50W	73138	91A-100ROM
R742	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R745	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R746	315-0470-00	XB010165		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R747	321-0110-00			RES.,FXD,FILM:137 OHM,1%,0.125W	91637	MFF1816G137ROF
R749	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R751	321-0307-00			RES.,FXD,FILM:15.4K OHM,1%,0.125W	91637	MFF1816G15401F
R753	321-0067-00			RES.,FXD,FILM:48.7 OHM,1%,0.125W	91637	MFF1816G48R70F

Replaceable Mechanical Parts—FG504

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-39	344-0195-01			4						CLIP, ELECTRICAL: CAM SHAFT	80009	344-0195-01
-40	426-1072-00			11						FRAME, PUSH BTN: PLASTIC	80009	426-1072-00
-41	333-1820-00			1						PANEL, FRONT: FG504	80009	333-1820-00
-42	200-0935-00			3						BASE, LAMPHOLDER: 0.29 OD X 0.19 CASE	80009	200-0935-00
-43	-----			1						LAMP, LED: (SEE DS1675 EPL)		
-44	352-0157-00			1						LAMPHOLDER: WHITE PLASTIC	80009	352-0157-00
-45	-----			2						LAMP, LED: (SEE DS50 AND DS720)		
-46	352-0157-00			2						LAMPHOLDER: WHITE PLASTIC	80009	352-0157-00
-47	214-1513-01	B010100	B031174	1						LCH, PLUG-IN RET:	80009	214-1513-01
	105-0719-00	B031175		1						LATCH, RETAINING: PLUG-IN (ATTACHING PARTS)	80009	105-0719-00
-48	213-0113-00			1						SCR, TPG, THD FOR: 2-32 X 0.312 INCH, PNH STL	93907	OBD
	105-0718-00	XB031175		1						BAR, LATCH RLSE:	80009	105-0718-00
-49	386-2795-00			1						SUBPANEL, FRONT: (ATTACHING PARTS)	80009	386-2795-00
-50	213-0229-00			4						SCR, TPG, THD FOR: 6-20 X 0.375" 100 DEG, FLH STL	93907	OBD
-51	211-0559-00			1						SCREW, MACHINE: 6-32 X 0.375" 100 DEG, FLH STL	83385	OBD
-52	213-0138-00			2						SCR, TPG, THD FOR: 4-40 X 0.188 INCH, PNH STL	83385	OBD
	210-0978-00			1						WASHER, FLAT: 0.375 ID X 0.50 INCH OD, STL	78471	OBD
-53	337-1967-00			1						SHIELD, ELEC: REAR SUBPANEL	80009	337-1967-00
-54	401-0331-00			1						DR, TURNS RDCN: 6 TO 1 RATIO, 0.025 X 1.156 SFT	0000Y	4511-DAF/MOD
-55	213-0020-00			2						SETSCREW: 6-32 X 0.125 INCH, HEX. SOC STL	70276	OBD
-56	-----			1						RES., VAR, WW: (SEE R5 AND 125 EPL)		
-57	407-1274-00			1						BRACKET, VAR RES: ALUMINUM	80009	407-1274-00
-58	-----			1						CKT BOARD ASSY: FLOATING INTFC (SEE A4 EPL)		
-59	131-0608-00			14						TERMINAL, PIN: 0.365 L X 0.25 PH, BRZ, GOLD PL	22526	47357
-60	-----			1						TRANSISTOR: (SEE Q1180 EPL)		
-61	-----			1						TRANSISTOR: (SEE Q1160 EPL) (ATTACHING PARTS)		
-62	211-0040-00			1						SCREW, MACHINE: 4-40 X 0.25", BDGH PLSTC	26365	OBD
-63	210-0586-00			1						NUT, PLAIN, EXT W: 4-40 X 0.25 INCH, STL	78189	211-041800-00
-64	210-0921-00			1						WASHER, MICA: 0.50 X 0.141 X 0.005 INCH THK	80009	210-0921-00
-65	351-0449-00			2						GUIDE, CKT BOARD: (ATTACHING PARTS FOR EACH)	80009	351-0449-00
-66	211-0062-00			2						SCREW, MACHINE: 2-56 X 0.312 INCH, RDH STL	83385	OBD
-67	210-0405-00			2						NUT, PLAIN, HEX.: 2-56 X 0.188 INCH, BRS	73743	2X12157-402
-68	210-0001-00			2						WASHER, LOCK: INTL, 0.092 ID X 0.18" OD, STL	78189	1202-00-00-0541C
-69	334-2208-00			1						MARKER, IDENT: WARNING	80009	334-2208-00
-70	255-0334-00			FT						PLASTIC CHANNEL: 12.75 X 0.175 X 0.155, NYL	11897	122-37-2500
-71	386-3356-00			1						PANEL, REAR: (ATTACHING PARTS)	80009	386-3356-00
-72	213-0192-00			4						SCR, TPG, THD FOR: 6-32 X 0.50 INCH, PNH STL	87308	OBD
	672-0550-00			1						CKT BOARD ASSY: MAIN W/3 CAM SWITCHES (ATTACHING PARTS)	80009	672-0550-00
-73	211-0602-00			4						SCR, ASSEM WSHR: 6-32 X 0.438 INCH, PNH BRS	80009	211-0602-00
-74	407-1693-00			4						BRACKET, COVER: ALUMINUM	80009	407-1693-00
-75	384-0282-00			1						EXTENSION SHAFT: 0.125 OD X 0.625 INCH LONG	80009	384-0282-00
-76	384-1407-00			1						EXTENSION SHAFT: 4.55 L X 0.125 OD, AL, CRM	80009	384-1407-00
-77	384-1406-00			1						EXTENSION SHAFT: 6.64 L X 0.125 OD, AL, CRM	80009	384-1406-00
-78	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
-79	361-0515-00			2						SPACER, SWITCH: PLASTIC	80009	361-0515-00
-80	-----			2						RESISTOR, VAR: (SEE R520 AND R1435 EPL)		
-81	-----			1						RESISTOR, VAR: (SEE R1100A, B EPL) (ATTACHING PARTS)		
-82	210-0583-00			1						NUT, PLAIN, HEX.: 0.25-32 X 0.312 INCH, BRS	73743	2X20224-402
-83	210-0046-00			1						WASHER, LOCK: INTL, 0.26 ID X 0.40" OD, STL	78189	1214-05-00-0541C

Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R755	321-0307-00			RES.,FXD,FILM:15.4K OHM,1%,0.125W	91637	MFF1816G15401F
R757	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R759	321-0153-00			RES.,FXD,FILM:383 OHM,1%,0.125W	91637	MFF1816G383ROF
R761	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R763	321-0354-00			RES.,FXD,FILM:47.5K OHM,1%,0.125W	91637	MFF1816G47501F
R765	321-0117-00			RES.,FXD,FILM:162 OHM,1%,0.125W	91637	MFF1816G162ROF
R767	321-0354-00			RES.,FXD,FILM:47.5K OHM,1%,0.125W	91637	MFF1816G47501F
R770	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R775	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R777	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R780	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R784	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	MFF1816G24301F
R787	315-0272-00	B010100	B029999	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R787	315-0100-00	B030000		RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R790	311-1565-00	B010100	B029999	RES.,VAR,NONWIR:250 OHM,20%,0.50W	73138	91A-250ROM
R790	311-1555-00	B030000		RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91A R100K
R793	315-0272-00	B010100	B029999	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R793	315-0100-00	B030000		RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R795	321-0756-00	XB030000		RES.,FXD,FILM:50K OHM,1%,0.125W	91637	MFF1816G5001F
R798	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249ROF
R800	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499ROF
R802	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R805	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750ROF
R807	315-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R810	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750ROF
R818	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249ROF
R820	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499ROF
R822	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R830	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R835	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R840	321-0106-00			RES.,FXD,FILM:124 OHM,1%,0.125W	91637	MFF1816G124ROF
R842	321-0106-00			RES.,FXD,FILM:124 OHM,1%,0.125W	91637	MFF1816G124ROF
R850	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R852	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R855	311-1568-00	B010100	B010174	RES.,VAR,NONWIR:50 OHM,20%,0.50W	73138	91A R50
R855	311-1567-00	B010175		RES.,VAR,NONWIR:100 OHM,20%,0.50W	73138	91A-100ROM
R857	315-0271-00	B010100	B010174	RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R857	315-0241-00	B010175		RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R868	321-0235-00			RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R870	311-1571-00			RES.,VAR,NONWIR:500 OHM,0.50W	73138	91W-500ROM
R872	321-0235-00			RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R900	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R902	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R904	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R906	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R910	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R914	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R916	301-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
R920	321-0103-00			RES.,FXD,FILM:115 OHM,1%,0.125W	91637	MFF1816G115ROF
R922	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R924	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R928	301-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
R930	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105

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	200-1837-00			2						COVER, PLUG-IN: TOP AND BOTTOM (ATTACHING PARTS FOR EACH)	80009	200-1837-00
-2	211-0504-00			2						SCREW, MACHINE: 6-32 X 0.25 INCH, PNH STL - - - * - - -	83385	OBD
-3	337-1399-04			2						SHIELD, ELEC: SIDE	80009	337-1399-04
-4	366-1609-00			1						KNOB: 0.08 ID, 0.415 OD	80009	366-1609-00
	213-0022-00			2						. SETSCREW: 4-40 X 0.188 INCH, HEX SOC STL	74445	OBD
-5	366-1651-00			1						KNOB: GRAY, FCTN FREQSTOP, 0.252 ID, 0.705 OD	80009	366-1651-00
	213-0153-00			2						. SETSCREW: 5-40 X 0.125, STL BK OXD, HEX	000CY	OBD
-6	210-1239-00			1						WSHR, SPR, TNSN: 0.96 ID X 0.012, CU BE	86928	5806-42-1
-7	354-0557-01			1						RING, KNOB SKIRT: CLEAR, 1.875 OD (ATTACHING PARTS)	80009	354-0557-01
-8	214-2201-00			1						PIN, SPRING: 0.066 OD X 0.187 INCH L, STL	80009	214-2201-00
-9	211-0088-00			2						SCREW, MACHINE: 2-56 X 0.281"82 DEG, FLH STL - - - * - - -	77250	OBD
-10	366-1031-06			4						KNOB: GRAY--VAR - . EACH KNOB INCLUDES:	80009	366-1031-06
	213-0153-00			1						. SETSCREW: 5-40 X 0.125, STL BK OXD, HEX	000CY	OBD
-11	366-1170-03			4						KNOB: GRAY, 0.25 ID X 0.706 OD, 0.6H - . EACH KNOB INCLUDES:	80009	366-1170-03
	213-0153-00			2						. SETSCREW: 5-40 X 0.125, STL BK OXD, HEX	000CY	OBD
-12	366-1059-02			2						PUSH BUTTON: GRAY, 3.0 H X 0.277 OD	80009	366-1059-02
-13	366-1077-01			2						KNOB: GRAY, 0.127 ID, 0.5 OD, 0.531H - . EACH KNOB INCLUDES:	80009	366-1077-01
	213-0153-00			1						. SETSCREW: 5-40 X 0.125, STL BK OXD, HEX	000CY	OBD
-14	366-0494-07			1						KNOB: GRAY--PULL	80009	366-0494-07
	213-0246-00			1						. SETSCREW: 5-40 X 0.093 INCH L, HEX SOC	71159	OBD
-15	366-1023-08			1						KNOB: GRAY--PULL	80009	366-1023-08
	213-0153-00			1						. SETSCREW: 5-40 X 0.125, STL BK OXD, HEX	000CY	OBD
-16	366-1023-07			1						KNOB: GRAY, 0.127 ID, 0.392 OD, 0.466	80009	366-1023-07
	213-0246-00			1						. SETSCREW: 5-40 X 0.093 INCH L, HEX SOC	71159	OBD
-17	366-1520-02	B010100	B031174	1						KNOB: GRAY	80009	366-1520-02
	366-1690-00	B031175		1						KNOB, LATCH: (ATTACHING PARTS)	80009	366-1690-00
-18	214-1840-00	B010100	B031174X	1						PIN, KNOB SECRG: 0.094 OD X 0.120 INCH LONG - - - * - - -	80009	214-1840-00
-19	366-1559-01			3						PUSH BUTTON: GRAY, 0.43 L X 0.18 W X 0.18 H	80009	366-1559-01
-20	366-1559-00			8						PUSH BUTTON: GRAY	80009	366-1559-00
-21	-----			2						CONNECTOR, RCPT: (SEE J700 AND J1520 EPL)		
-22	210-0255-00			2						TERMINAL, LUG: 0.391" ID INT TOOTH	80009	210-0255-00
-23	-----			2						CONNECTOR, RCPT: (SEE J20 AND J1370 EPL)		
-24	-----			3						CONNECTOR, RCPT: (SEE J420, J1125 AND J1200 EPL)		
-25	-----			2						RESISTOR, VAR: (SEE R1210 AND R1375 EPL) (ATTACHING PARTS FOR EACH)		
-26	210-0583-00			1						NUT, PLAIN, HEX.: 0.25-32 X 0.312 INCH, BRS	73743	2X20224-402
-27	210-0940-00			1						WASHER, FLAT: 0.25 ID X 0.375 INCH OD, STL - - - * - - -	79807	OBD
-28	-----			2						RESISTOR, VAR: (SEE R50 AND R1130 EPL) (ATTACHING PARTS FOR EACH)		
-29	210-0583-00			1						NUT, PLAIN, HEX.: 0.25-32 X 0.312 INCH, BRS	73743	2X20224-402
-30	210-0940-00			1						WASHER, FLAT: 0.25 ID X 0.375 INCH OD, STL - - - * - - -	79807	OBD
-31	-----			1						RESISTOR, VAR: (SEE R1270 EPL)		
-32	210-0940-00			1						WASHER, FLAT: 0.25 ID X 0.375 INCH OD, STL	79807	OBD
-33	358-0029-00			1						BSHG, MACH. THD: HEX, 0.375-32 X 0.438" LONG (ATTACHING PARTS)	80009	358-0029-00
-34	210-0590-00			1						NUT, PLAIN, HEX.: 0.375 X 0.438 INCH, STL	73743	2X28269-402
-35	210-0012-00			1						WASHER, LOCK: INTL, 0.375 ID X 0.50" OD STL - - - * - - -	78189	1220-02-00-0541C
-36	358-0029-00			3						BSHG, MACH. THD: HEX, 0.375-32 X 0.438" LONG (ATTACHING PARTS FOR EACH)	80009	358-0029-00
-37	210-0590-00			1						NUT, PLAIN, HEX.: 0.375 X 0.438 INCH, STL	73743	2X28269-402
-38	210-0978-00			1						WASHER, FLAT: 0.375 ID X 0.50 INCH OD, STL - - - * - - -	78471	OBD



Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R936	301-0681-00			RES., FXD, CMPSN:680 OHM, 5%, 0.50W	01121	EB6815
R938	317-0510-00			RES., FXD, CMPSN:51 OHM, 5%, 0.125W	01121	BB5105
R942	321-0097-00			RES., FXD, FILM:100 OHM, 1%, 0.125W	91637	MFF1816G100ROF
R945	321-0087-00	B010100	B030719	RES., FXD, FILM:78.7 OHM, 1%, 0.125W	91637	MFF1816G78R70F
R945	321-0090-00	B030720		RES., FXD, FILM:84.5 OHM, 1%, 0.125W	91637	MFF1816G84R50F
R947	315-0360-00			RES., FXD, CMPSN:36 OHM, 5%, 0.25W	01121	CB3605
R950	311-1260-00			RES., VAR, NONWIR:250 OHM, 10%, 0.50W	32997	3329P-L58-251
R952	321-0030-00			RES., FXD, FILM:20 OHM, 1%, 0.125W	91637	MFF1816G20R00F
R958	315-0273-00	B010100	B030719	RES., FXD, CMPSN:27K OHM, 5%, 0.25W	01121	CB2735
R958	SELECTED	B030720				
R960	315-0150-00			RES., FXD, CMPSN:15 OHM, 5%, 0.25W	01121	CB1505
R965	317-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.125W	01121	BB1005
R970	315-0200-00			RES., FXD, CMPSN:20 OHM, 5%, 0.25W	01121	CB2005
R974	308-0297-00			RES., FXD, WW:24.7 OHM, 1%, 3W	91637	RS2B-K24R70F
R980	315-0200-00			RES., FXD, CMPSN:20 OHM, 5%, 0.25W	01121	CB2005
R982	301-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.50W	01121	EB1005
R983	315-0103-00	XB030000		RES., FXD, CMPSN:10K OHM, 5%, 0.25W	01121	CB1035
R984	301-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.50W	01121	EB1005
R1015	311-1558-00			RES., VAR, NONWIR:20K OHM, 20%, 0.50W	73138	91A R20K
R1016	315-0682-00			RES., FXD, CMPSN:6.8K OHM, 5%, 0.25W	01121	CB6825
R1024	317-0510-00			RES., FXD, CMPSN:51 OHM, 5%, 0.125W	01121	BB5105
R1028	301-0681-00			RES., FXD, CMPSN:680 OHM, 5%, 0.50W	01121	EB6815
R1030	317-0510-00			RES., FXD, CMPSN:51 OHM, 5%, 0.125W	01121	BB5105
R1036	301-0681-00			RES., FXD, CMPSN:680 OHM, 5%, 0.50W	01121	EB6815
R1038	317-0510-00			RES., FXD, CMPSN:51 OHM, 5%, 0.125W	01121	BB5105
R1042	321-0097-00			RES., FXD, FILM:100 OHM, 1%, 0.125W	91637	MFF1816G100ROF
R1045	321-0087-00	B010100	B030719	RES., FXD, FILM:78.7 OHM, 1%, 0.125W	91637	MFF1816G78R70F
R1045	321-0090-00	B030720		RES., FXD, FILM:84.5 OHM, 1%, 0.125W	91637	MFF1816G84R50F
R1047	315-0360-00			RES., FXD, CMPSN:36 OHM, 5%, 0.25W	01121	CB3605
R1050	311-1260-00			RES., VAR, NONWIR:250 OHM, 10%, 0.50W	32997	3329P-L58-251
R1052	321-0030-00			RES., FXD, FILM:20 OHM, 1%, 0.125W	91637	MFF1816G20R00F
R1070	315-0200-00			RES., FXD, CMPSN:20 OHM, 5%, 0.25W	01121	CB2005
R1074	308-0297-00			RES., FXD, WW:24.7 OHM, 1%, 3W	91637	RS2B-K24R70F
R1080	315-0200-00			RES., FXD, CMPSN:20 OHM, 5%, 0.25W	01121	CB2005
R1082	301-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.50W	01121	EB1005
R1083	315-0103-00	XB030000		RES., FXD, CMPSN:10K OHM, 5%, 0.25W	01121	CB1035
R1084	301-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.50W	01121	EB1005
R1090	321-0220-00			RES., FXD, FILM:1.91K OHM, 1%, 0.125W	91637	MFF1816G19100F
R1092	315-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.25W	01121	CB1005
R1096	305-0101-00			RES., FXD, CMPSN:100 OHM, 5%, 2W	01121	HB1015
R1098	305-0101-00			RES., FXD, CMPSN:100 OHM, 5%, 2W	01121	HB1015
R1100A,B	311-1775-00			RES., VAR, NONWIR:1.6K X 2.5K OHM, 15%, 0.50W	01121	13M814
R1102	323-0068-00			RES., FXD, FILM:49.9 OHM, 1%, 0.50W	75042	CECT0-49R90F
R1104	323-0068-00			RES., FXD, FILM:49.9 OHM, 1%, 0.50W	75042	CECT0-49R90F
R1110	307-1024-00			ATTENUATOR, FXD:	80009	307-1024-00
R1112	307-1024-00			ATTENUATOR, FXD:	80009	307-1024-00
R1114	307-1037-00			ATTENUATOR, FXD:50 OHM, 10 DB	80009	307-1037-00
R1120	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1122	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1130 <sup>1</sup>	311-1851-00			RES., VAR, NONWIR:15K OHM, 1W	01121	14M212
R1132	315-0273-00	B010100	B010163	RES., FXD, CMPSN:27K OHM, 5%, 0.25W	01121	CB2735
R1132	321-0341-00	B010164	B010174	RES., FXD, FILM:34.8K OHM, 1%, 0.125W	91637	MFF1816G34801F
R1132	321-0336-00	B010175		RES., FXD, FILM:30.9 OHM, 1%, 0.125W	91637	MFF1816G30901F

<sup>1</sup> Furnished as a unit with S1130.

## 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
000EX	O'HARA METAL PRODUCT COMPANY	542 BRANNAN STREET	SAN FRANCISCO, CA 94107
0000Y	PLASTOCK, INC.	380 CHESTNUT STREET	NORWOOD, NJ 07648
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
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12360	ALBANY PRODUCTS CO., DIV. OF PNEUMO DYNAMICS CORPORATION	145 WOODWARD AVENUE	SOUTH NORWALK, CT 06586
13103	THERMALLOY COMPANY, INC.	2021 W VALLEY VIEW LANE P O BOX 34829	DALLAS, TEXAS 75234
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
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
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
71159	BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC.	P O BOX 2244, 40 BRISTOL ST.	WATERBURY, CT 06720
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
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
98978	INTERNATIONAL ELECTRONIC RESEARCH CORP.	135 W. MAGNOLIA BLVD.	BURBANK, CA 91502

Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1134	315-0103-00	B010100	B010163	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1134	321-0289-00	B010164		RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1136	315-0103-00	B010100	B010163	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1136	321-0289-00	B010164		RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1138	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1140	311-1757-00			RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	32997	3326H-GA8-252
R1142	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1146	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R1150	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1154	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1156	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1160	303-0390-00	B010100	B029999	RES.,FXD,CMPSN:39 OHM,5%,1W	01121	GB3905
R1160	306-0390-00	B030000		RES.,FXD,CMPSN:39 OHM,10%,2W	01121	HB3901
R1164	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R1174	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1176	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1180	303-0390-00	B010100	B029999	RES.,FXD,CMPSN:39 OHM,5%,1W	01121	GB3905
R1180	306-0390-00	B030000		RES.,FXD,CMPSN:39 OHM,10%,2W	01121	HB3901
R1190	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R1200	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1202	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1204	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1210 <sup>1</sup>	311-1320-00			RES.,VAR,NONWIR:5K OHM,1W,W/SW	12697	381CM-39700
R1215	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1217	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1220	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1222	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1228	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1230	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1234	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1240	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1242	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1245	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1250	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R1254	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R1256	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1258	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R1264	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1270	311-1712-00			RES.,VAR,NONWIR:20K OHM,10%,1W	01121	SPSG040S203UA
R1274	321-0394-00			RES.,FXD,FILM:124K OHM,1%,0.125W	91637	MFF1816G12402F
R1276	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1278	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R1282	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1284	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1295	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210ROF
R1298	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1300	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1302	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1305	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1308	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1310	321-0079-00			RES.,FXD,FILM:64.9 OHM,1%,0.125W	91637	MFF1816G64R90F
R1316	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1320	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

<sup>1</sup>Furnished as a unit with S1210.

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

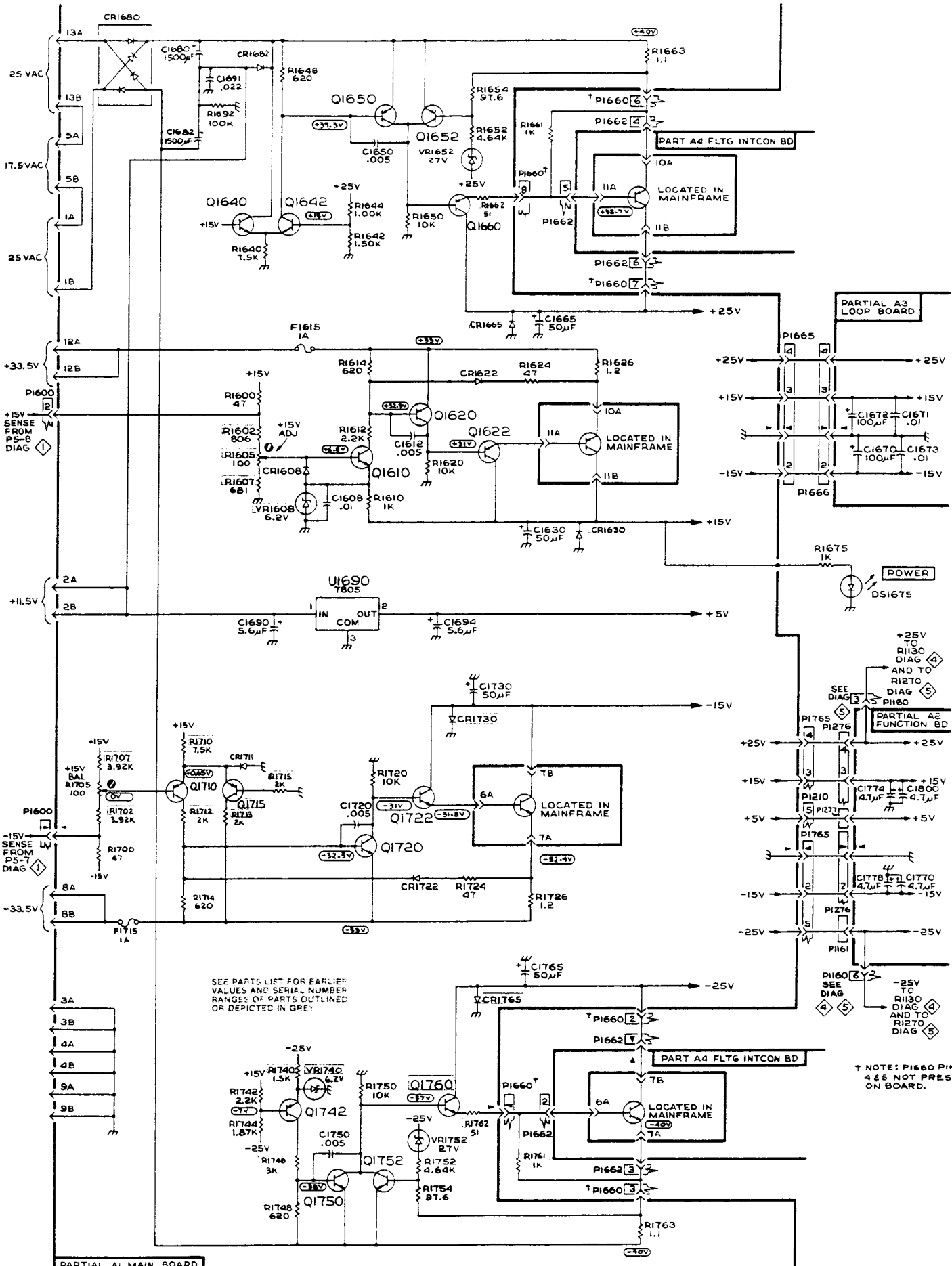
Kct No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1324	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1328	315-0752-00			RES., FXD, CMPSN:7.5K OHM, 5%, 0.25W	01121	CB7525
R1330	315-0752-00			RES., FXD, CMPSN:7.5K OHM, 5%, 0.25W	01121	CB7525
R1331	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R1332	315-0514-00			RES., FXD, CMPSN:510K OHM, 5%, 0.25W	01121	CB5145
R1334	321-0396-00			RES., FXD, FILM:130K OHM, 1%, 0.125W	91637	MFF1816G13002F
R1340	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R1345	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1370	315-0103-00			RES., FXD, CMPSN:10K OHM, 5%, 0.25W	01121	CB1035
R1372	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R1375 <sup>1</sup>	311-1320-00			RES., VAR, NONWIR:5K OHM, 1W, W/SW	12697	381CM-39700
R1376	315-0332-00			RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W	01121	CB3325
R1380	315-0106-00			RES., FXD, CMPSN:10M OHM, 5%, 0.25W	01121	CB1065
R1384	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1386	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1390	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1392	315-0511-00			RES., FXD, CMPSN:510 OHM, 5%, 0.25W	01121	CB5115
R1394	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1400	321-0272-00			RES., FXD, FILM:6.65K OHM, 1%, 0.125W	91637	MFF1816G66500F
R1402	321-0287-00			RES., FXD, FILM:9.53K OHM, 1%, 0.125W	91637	MFF1816G95300F
R1406	321-0193-00			RES., FXD, FILM:1K OHM, 1%, 0.125W	91637	MFF1816G10000F
R1408	321-0289-00			RES., FXD, FILM:10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R1410	321-0314-00			RES., FXD, FILM:18.2K OHM, 1%, 0.125W	91637	MFF1816G18201F
R1412	321-0227-00			RES., FXD, FILM:2.26K OHM, 1%, 0.125W	91637	MFF1816G22600F
R1416	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025
R1418	315-0272-00			RES., FXD, CMPSN:2.7K OHM, 5%, 0.25W	01121	CB2725
R1425	315-0103-00			RES., FXD, CMPSN:10K OHM, 5%, 0.25W	01121	CB1035
R1435	311-1373-00			RES., VAR, NONWIR:5K OHM, 20%, 1W	01121	16M188
R1436	315-0361-00			RES., FXD, CMPSN:360 OHM, 5%, 0.25W	01121	CB3615
R1438	315-0134-00			RES., FXD, CMPSN:130K OHM, 5%, 0.25W	01121	CB1345
R1440	315-0155-00			RES., FXD, CMPSN:1.5M OHM, 5%, 0.25W	01121	CB1555
R1442	315-0134-00			RES., FXD, CMPSN:130K OHM, 5%, 0.25W	01121	CB1345
R1444	315-0101-00			RES., FXD, CMPSN:100 OHM, 5%, 0.25W	01121	CB1015
R1448	315-0101-00	B010100	B029999	RES., FXD, CMPSN:100 OHM, 5%, 0.25W	01121	CB1015
R1448	315-0202-00	B030000		RES., FXD, CMPSN:2K OHM, 5%, 0.25W	01121	CB2025
R1450	315-0101-00			RES., FXD, CMPSN:100 OHM, 5%, 0.25W	01121	CB1015
R1452	315-0202-00			RES., FXD, CMPSN:2K OHM, 5%, 0.25W	01121	CB2025
R1456	321-0210-00			RES., FXD, FILM:1.5K OHM, 1%, 0.125W	91637	MFF1816G15000F
R1458	321-0222-00			RES., FXD, FILM:2K OHM, 1%, 0.125W	91637	MFF1816G20000F
R1460	311-1562-00			RES., VAR, NONWIR:2K OHM, 20%, 0.50W	73138	91A R2K
R1462	315-0682-00			RES., FXD, CMPSN:6.8K OHM, 5%, 0.25W	01121	CB6825
R1466	315-0432-00			RES., FXD, CMPSN:4.3K OHM, 5%, 0.25W	01121	CB4325
R1467	315-0225-00			RES., FXD, CMPSN:2.2M OHM, 5%, 0.25W	01121	CB2255
R1470	315-0103-00			RES., FXD, CMPSN:10K OHM, 5%, 0.25W	01121	CB1035
R1475	311-1558-00			RES., VAR, NONWIR:20K OHM, 20%, 0.50W	73138	91A R20K
R1476	321-0412-00			RES., FXD, FILM:191K OHM, 1%, 0.125W	91637	MFF1816G19102F
R1478	321-0222-00			RES., FXD, FILM:2K OHM, 1%, 0.125W	91637	MFF1816G20000F
R1480	321-0357-00			RES., FXD, FILM:51.1K OHM, 1%, 0.125W	91637	MFF1816G51101F
R1484	321-0223-00			RES., FXD, FILM:2.05K OHM, 1%, 0.125W	91637	MFF1816G20500F
R1486	315-0201-00			RES., FXD, CMPSN:200 OHM, 5%, 0.25W	01121	CB2015
R1490	315-0184-00			RES., FXD, CMPSN:180K OHM, 5%, 0.25W	01121	CB1845
R1495	315-0202-00			RES., FXD, CMPSN:2K OHM, 5%, 0.25W	01121	CB2025
R1496	321-0408-00			RES., FXD, FILM:174K OHM, 1%, 0.125W	91637	MFF1816G17402F

<sup>1</sup> Furnished as a unit with S1375.



Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Discont	Name & Description	Mfr Code	Mfr Part Number
R1500	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1504	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1508	321-0253-00			RES.,FXD,FILM:4.22K OHM,1%,0.125W	91637	MFF1816G42200F
R1510	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1512	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1514	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1520	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1525	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1600	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1602	321-0182-00	B010100	B029999	RES.,FXD,FILM:768 OHM,1%,0.125W	91637	MFF1816G768R0F
R1602	321-0184-00	B030000		RES.,FXD,FILM:806 OHM,1%,0.125W	91637	MFF1816G806R0F
R1605	311-1566-00	B010100	B029999	RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91A-200R0M
R1605	311-1567-00	B030000		RES.,VAR,NONWIR:100 OHM,20%,0.50W	73138	91A-100R0M
R1607	321-0175-00	B010100	B029999	RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R1607	321-0177-00	B030000		RES.,FXD,FILM:681 OHM,1%,0.125W	91637	MFF1816G681R0F
R1610	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1612	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1614	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R1620	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1624	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1626	307-0093-00			RES.,FXD,CMPSN:1.2 OHM,5%,0.50W	01121	EB12G5
R1640	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1642	323-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.50W	75042	CECT0-1501F
R1644	323-0193-00			RES.,FXD,FILM:1K OHM,1%,0.50W	75042	CECT0-1001F
R1648	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R1650	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1652	321-0257-00			RES.,FXD,FILM:4.64K OHM,1%,0.125W	91637	MFF1816G46400F
R1654	321-0096-00			RES.,FXD,FILM:97.6 OHM,1%,0.125W	91637	MFF1816G97R60F
R1661	315-0102-00	XB030000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1662	315-0510-00	XB030000		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R1663	308-0767-00			RES.,FXD,WW:1.1 OHM,5%,1W	75042	BW20-1R100J
R1674	315-0102-00	XB010125		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1675	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1692	304-0104-00			RES.,FXD,CMPSN:100K OHM,10%,1W	01121	GB1041
R1700	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1702	315-0202-00	B010100	B029999	RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1702	321-0250-00	B030000		RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	MFF1816G39200F
R1705	311-1567-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	73138	91A-100R0M
R1707	315-0202-00	B010100	B029999	RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1707	321-0250-00	B030000		RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	MFF1816G39200F
R1710	315-0472-00	B010100	B029999	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1710	315-0752-00	B030000		RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1712	315-0202-00	XB030000		RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1713	315-0202-00	XB030000		RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1714	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R1715	315-0202-00	XB030000		RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1720	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1724	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1726	307-0093-00			RES.,FXD,CMPSN:1.2 OHM,5%,0.50W	01121	EB12G5
R1740	315-0472-00	B010100	B010124	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1740	315-0152-00	B010125		RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1742	323-0226-00			RES.,FXD,FILM:2.21K OHM,1%,0.50W	75042	CECT0-2211F
R1744	323-0219-00			RES.,FXD,FILM:1.87K OHM,1%,0.50W	75042	CECT0-1871F



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

T NOTE: PI660 PINS 4 & 5 NOT PRESENT ON BOARD.



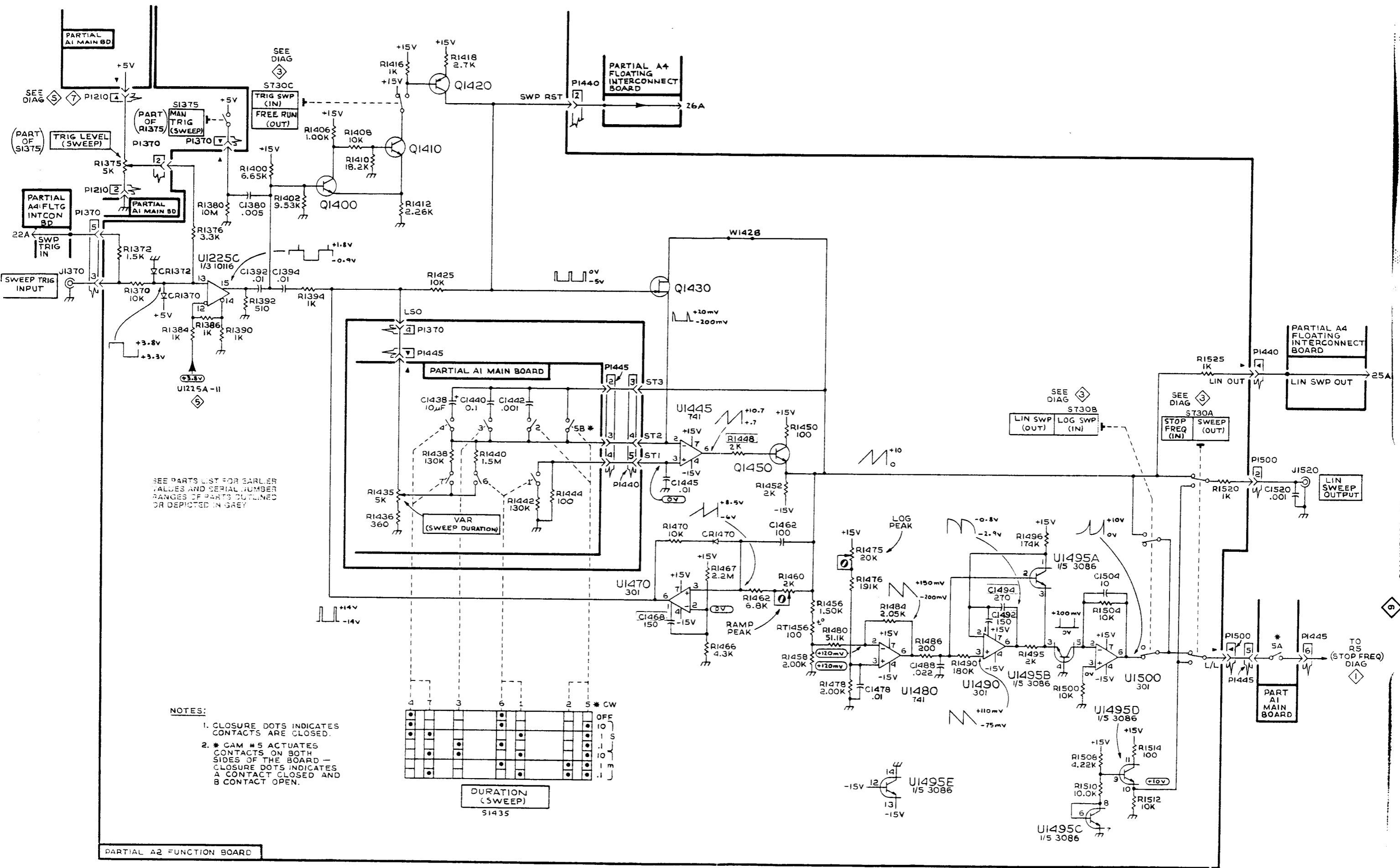
Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
RI746	315-0302-00	XB030000		RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
RI748	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
RI750	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
RI752	321-0257-00			RES.,FXD,FILM:4.64K OHM,1%,0.125W	91637	MFF1816G46400F
RI754	321-0096-00			RES.,FXD,FILM:97.6 OHM,1%,0.125W	91637	MFF1816G97R60F
RI761	315-0102-00	XB030000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
RI762	315-0510-00	XB030000		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
RI763	308-0767-00			RES.,FXD,WW:1.1 OHM,5%,1W	75042	BW20-1R100J
RT317	307-0122-00			RES.,THERMAL:50 OHM,10%	50157	3D1515
RT318	307-0122-00			RES.,THERMAL:50 OHM,10%	50157	3D1515
RT748	307-0122-00	XB010165		RES.,THERMAL:50 OHM,10%	50157	3D1515
RT1456	307-0126-00			RES.,THERMAL:100 OHM,10%	14193	2D21-101K
S50 <sup>1</sup>	311-1851-00			RES.,VAR,NONWIR:15K OHM,1W	01121	14M212
S195	260-1208-00			SWITCH,PUSH:DPDT	80009	260-1208-00
S240	263-1140-00			ACTR ASSY,CAM S:	80009	263-1140-00
S590	263-1139-00			ACTR ASSY,CAM S:	80009	263-1139-00
S730A-F	260-1803-00			SWITCH,PUSH:6 BTN,2 POLE,3 IL,3PP,10MM	71590	2KBM060000-974
S1100	263-1138-00	B010100	B029999	ACTR ASSY,CAM S:	80009	263-1138-00
S1100 <sup>2</sup>	263-1138-01	B030000		DRUM ASSY,CAM S:AMPLITUDE DRUM TYPE	80009	263-1138-01
S1130 <sup>2</sup>	311-1851-00			RES.,VAR,NONWIR:15K OHM,1W	01121	14M212
S1210 <sup>3</sup>	311-1320-00			RES.,VAR,NONWIR:5K OHM,1W,W/SW	12697	381CM-39700
S1235A-D	260-1802-00			SWITCH,PUSH:4 BTN,2 POLE,INTERLOCK	80009	260-1802-00
S1375 <sup>4</sup>	311-1320-00			RES.,VAR,NONWIR:5K OHM,1W,W/SW	12697	381CM-39700
S1435	263-1137-00			ACTR ASSY,CAM S:	80009	263-1137-00
U5	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U25	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U30	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U45	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U155	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U215	156-0335-00	B010100	B020287	MICROCIRCUIT,DI:OP AMPL,FET INPUT	27014	LH0042CH
U215	156-0484-00	B020288		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0484-00
U375	156-0534-00			MICROCIRCUIT,LI:DUAL DIFF AMPL,14 LD DIP	02735	CA3102E
U530	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U710	156-0511-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	18324	NE513V
U770	155-0032-00			MICROCIRCUIT,LI:ML,PRE-AMPLIFIER	80009	155-0032-00
U1145	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U1215	156-0230-00			MICROCIRCUIT,DI:DUAL D MA-SLAVE FLIP-FLOP	80009	156-0230-00
U1225	156-0369-00			MICROCIRCUIT,LI:TRIPLE LINE RE	80009	156-0369-00
U1295	156-0230-00			MICROCIRCUIT,DI:DUAL D MA-SLAVE FLIP-FLOP	80009	156-0230-00
U1340	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U1445	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U1470	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U1480	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U1490	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U1495	156-0197-00			MICROCIRCUIT,LI:5 TRANSISTOR ARRAY	80009	156-0197-00
U1500	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U1690	156-0277-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	27014	LM340T-5
VR23	152-0279-00			SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0279-00
VR275	152-0306-00			SEMICONV DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B
VR295	152-0306-00			SEMICONV DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B
VR310	152-0326-00			SEMICONV DEVICE:ZENER,0.4W,7.5V,5%	80009	152-0326-00
VR380	152-0280-00			SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00

<sup>1</sup>Furnished as a unit with R50.  
<sup>2</sup>Furnished as a unit with R1130.  
<sup>3</sup>Furnished as a unit with R1210.  
<sup>4</sup>Furnished as a unit with R1375.



Replaceable Electrical Parts—FG 504

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
VR462	152-0306-00			SEMICON D DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B
VR470	152-0306-00			SEMICON D DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B
VR550	152-0280-00			SEMICON D DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR570	152-0280-00			SEMICON D DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR775	152-0306-00			SEMICON D DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B
VR805	152-0508-00			SEMICON D DEVICE:ZENER,0.4W,12.6V,5%	80009	152-0508-00
VR932	152-0405-00			SEMICON D DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
VR940	152-0520-00			SEMICON D DEVICE:ZENER,1W,12V,5%	14433	1N4742A
VR1032	152-0405-00			SEMICON D DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
VR1040	152-0520-00			SEMICON D DEVICE:ZENER,1W,12V,5%	14433	1N4742A
VR1608	152-0280-00	B010100	B029999	SEMICON D DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR1608	152-0227-00	B030000		SEMICON D DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0227-00
VR1652	152-0147-00			SEMICON D DEVICE:ZENER,0.4W,27V,5%	81483	1N971B
VR1675	152-0241-00	XB010125		SEMICON D DEVICE:ZENER,0.4W,33V,5%	04713	1N973B
VR1740	152-0280-00	B010100	B029999	SEMICON D DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR1740	152-0227-00	B030000		SEMICON D DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0227-00
VR1752	152-0147-00			SEMICON D DEVICE:ZENER,0.4W,27V,5%	81483	1N971B



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

- NOTES:
1. CLOSURE DOTS INDICATES CONTACTS ARE CLOSED.
  2. \* CAM #5 ACTUATES CONTACTS ON BOTH SIDES OF THE BOARD - CLOSURE DOTS INDICATES A CONTACT CLOSED AND B CONTACT OPEN.

CONTACT	STATE
1	OFF
2	OFF
3	OFF
4	OFF
5	CW
6	OFF
7	OFF
8	OFF
9	OFF
10	OFF
11	OFF
12	OFF
13	OFF
14	OFF
15	OFF
16	OFF
17	OFF
18	OFF
19	OFF
20	OFF
21	OFF
22	OFF
23	OFF
24	OFF
25	OFF
26	OFF
27	OFF
28	OFF
29	OFF
30	OFF
31	OFF
32	OFF
33	OFF
34	OFF
35	OFF
36	OFF
37	OFF
38	OFF
39	OFF
40	OFF
41	OFF
42	OFF
43	OFF
44	OFF
45	OFF
46	OFF
47	OFF
48	OFF
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54	OFF
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56	OFF
57	OFF
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66	OFF
67	OFF
68	OFF
69	OFF
70	OFF
71	OFF
72	OFF
73	OFF
74	OFF
75	OFF
76	OFF
77	OFF
78	OFF
79	OFF
80	OFF
81	OFF
82	OFF
83	OFF
84	OFF
85	OFF
86	OFF
87	OFF
88	OFF
89	OFF
90	OFF
91	OFF
92	OFF
93	OFF
94	OFF
95	OFF
96	OFF
97	OFF
98	OFF
99	OFF
100	OFF

SWEEP SCHEMATIC





# 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 ( $\mu$ F).
- Resistors = Ohms ( $\Omega$ ).

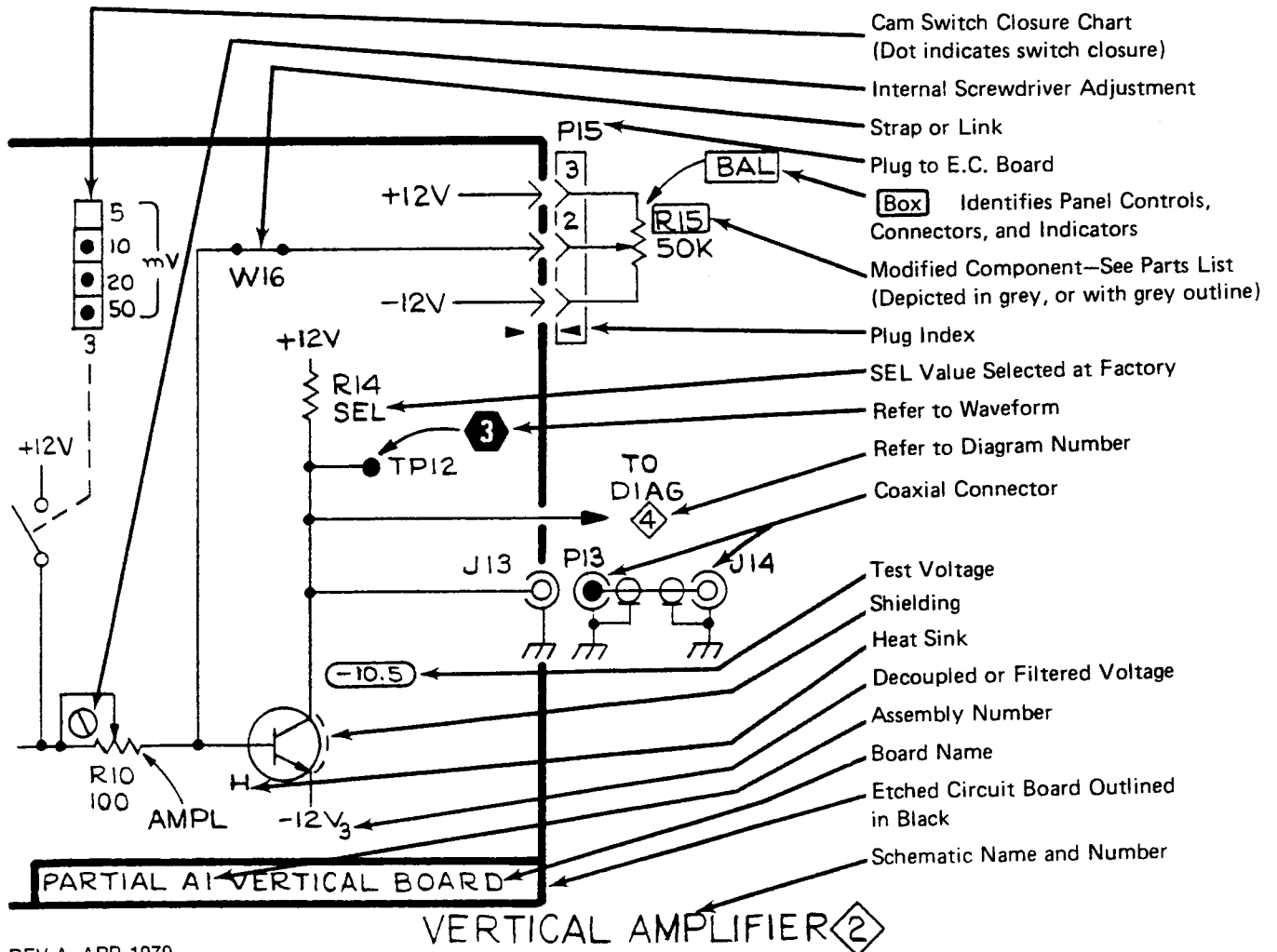
Symbols used on the diagrams are based on ANSI Standard Y32.2-1975.

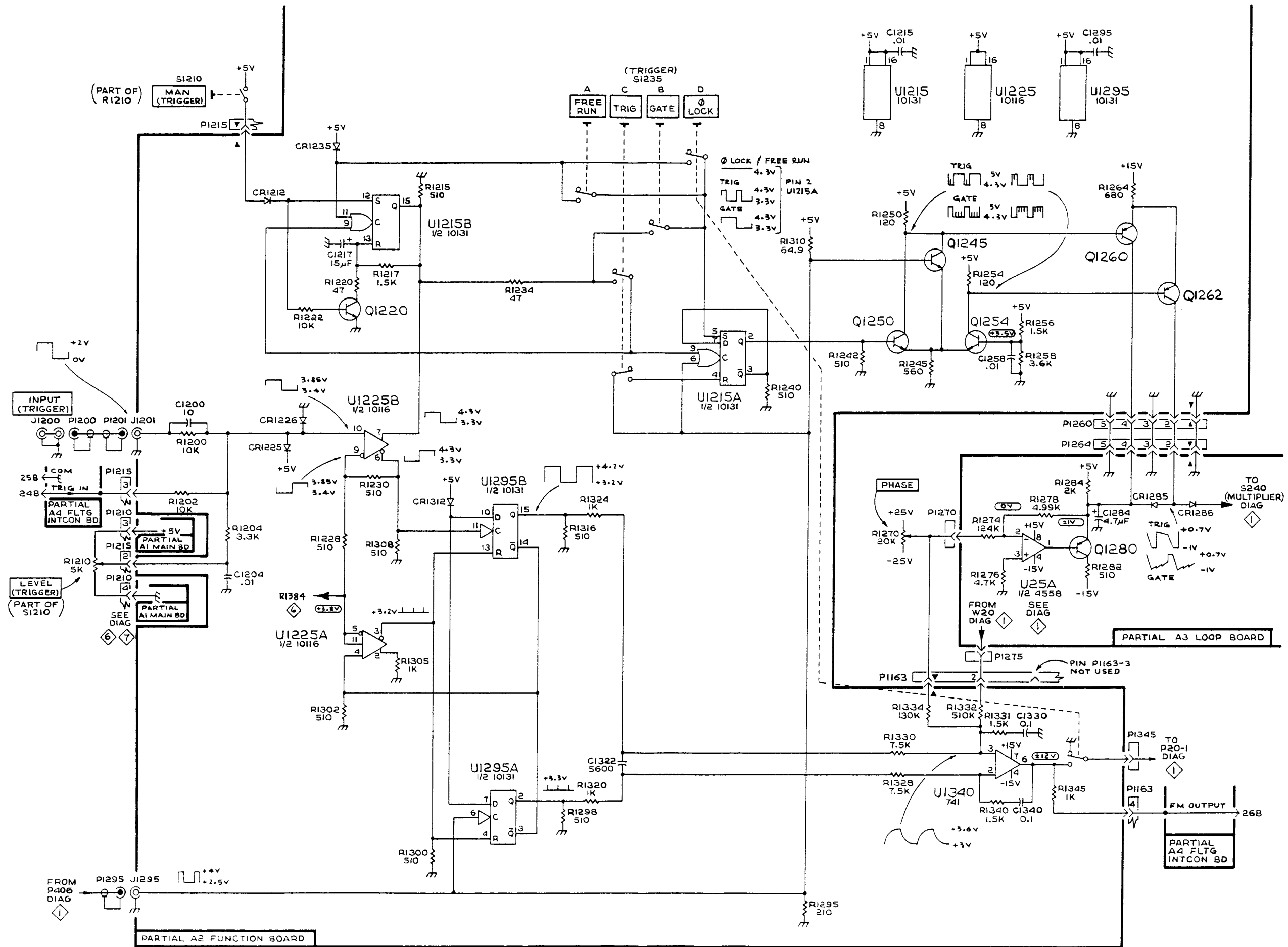
Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

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

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

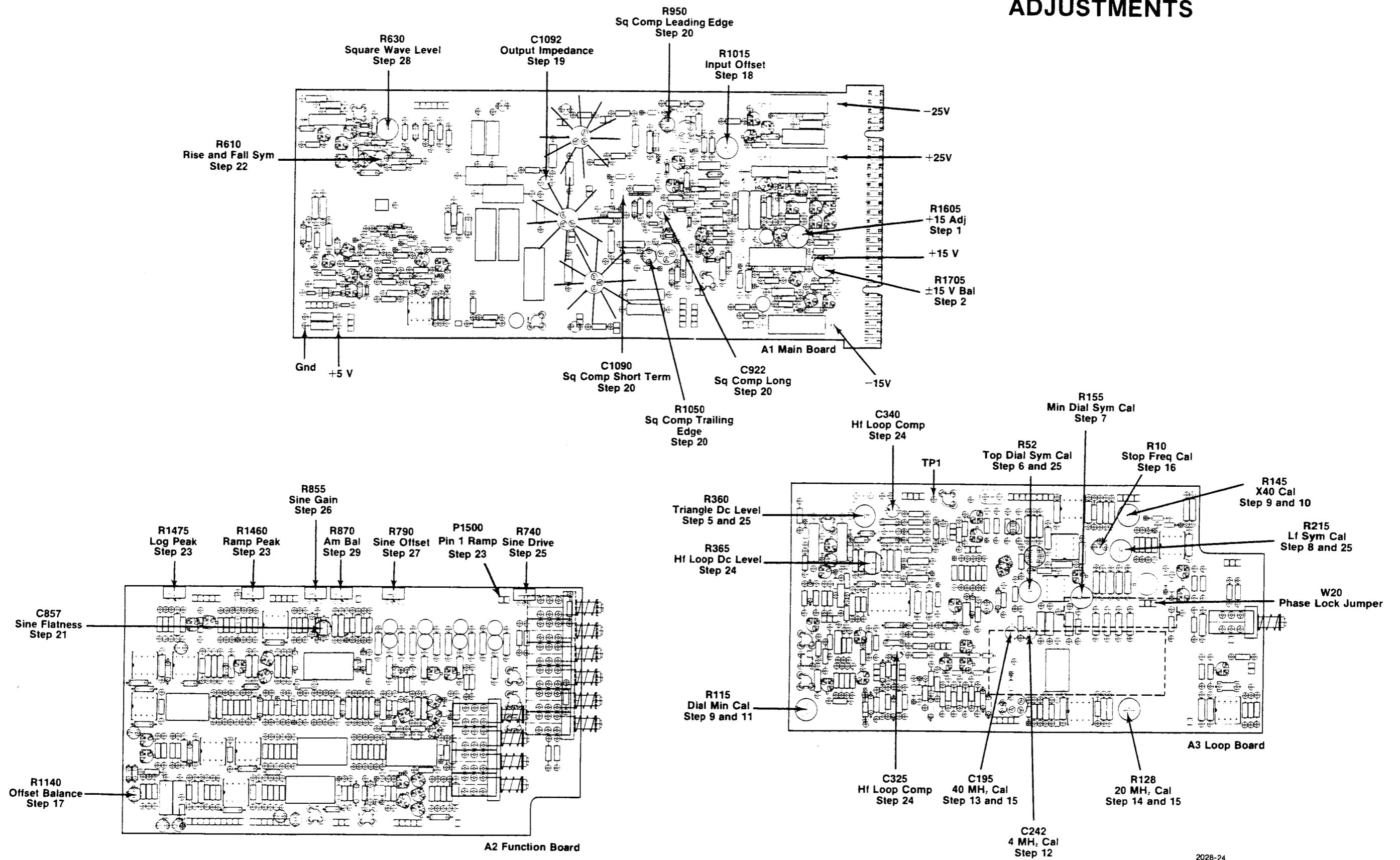
The following special symbols are used on the diagrams:





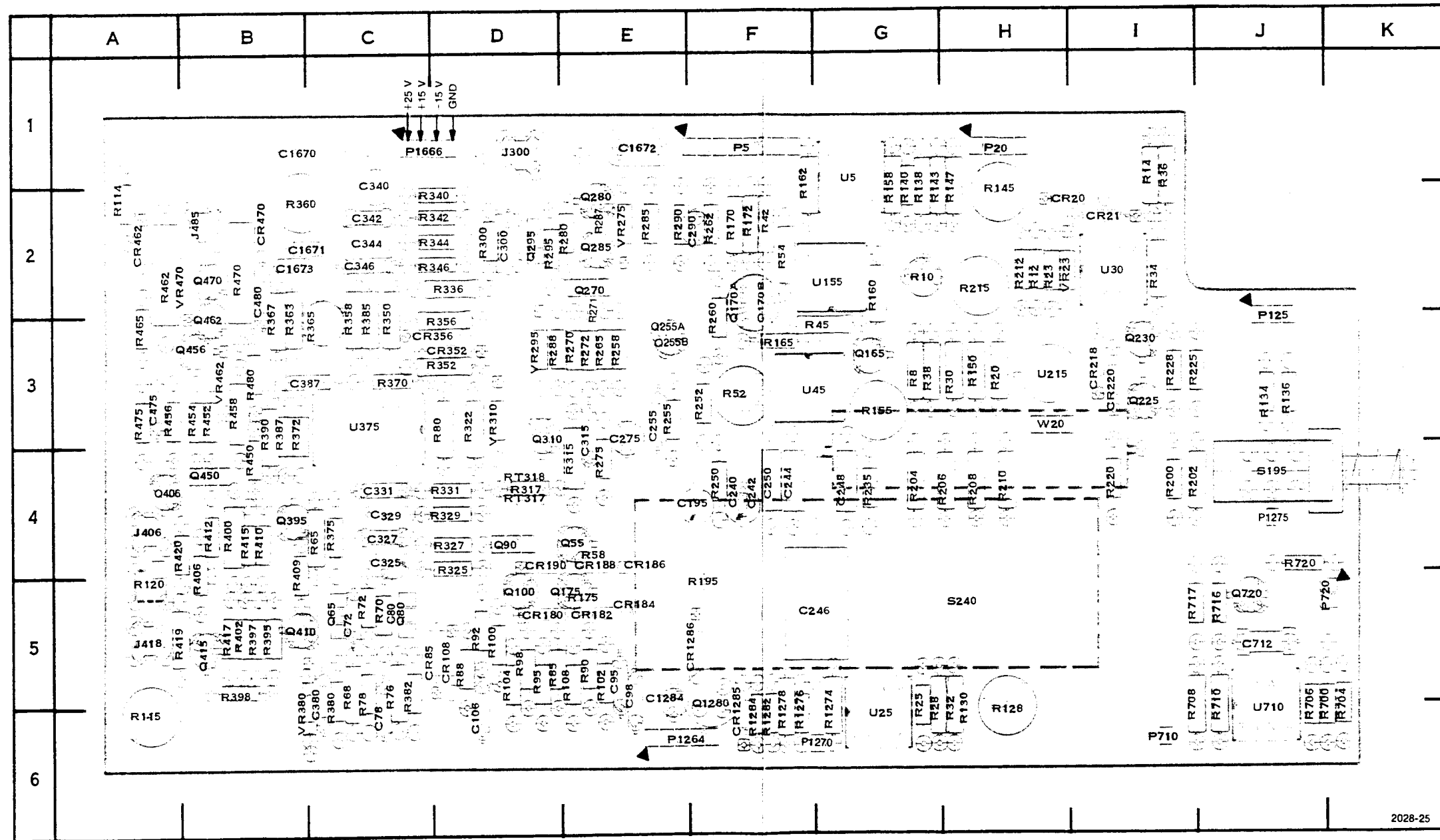


# ADJUSTMENTS





### A3 LOOP BOARD COMPONENT LOCATIONS

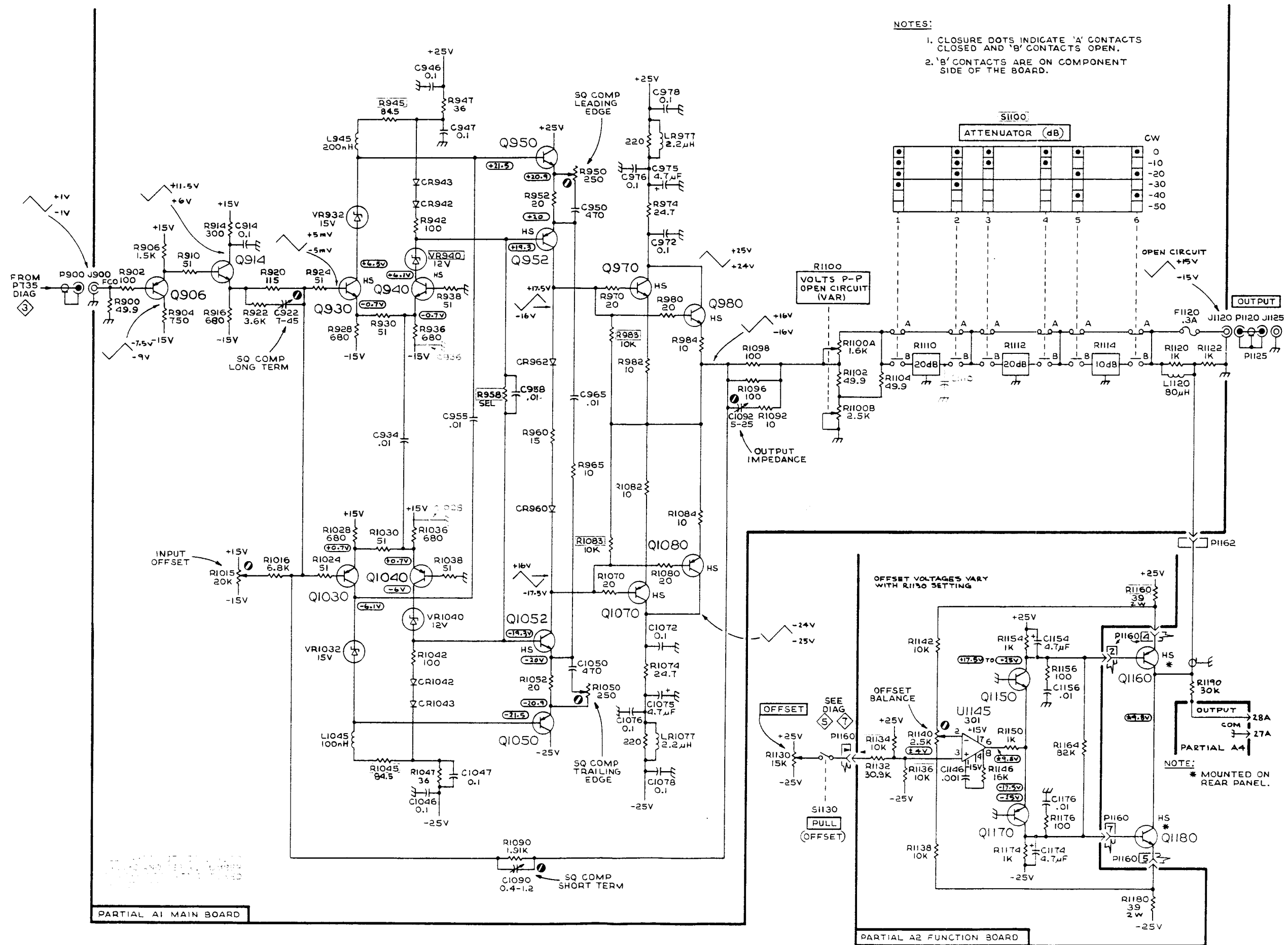


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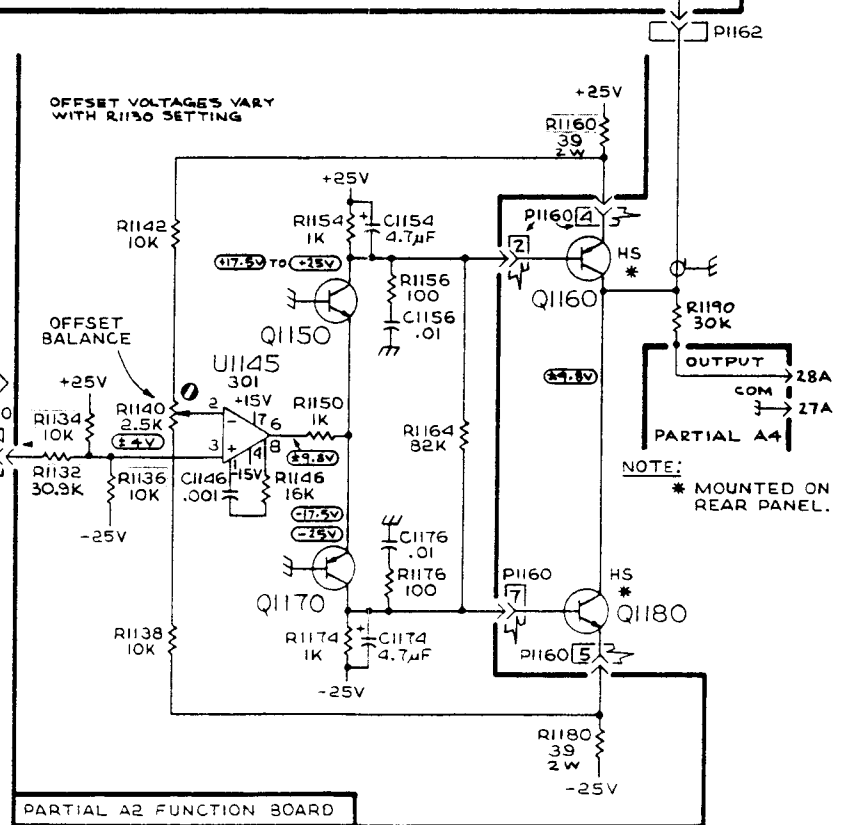
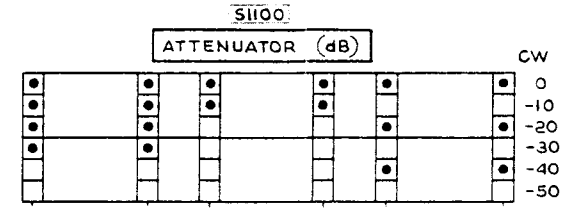
REV A, APR 1979

\*See Parts List for serial number ranges.

† Located on back of board.



NOTES:  
 1. CLOSURE DOTS INDICATE 'A' CONTACTS CLOSED AND 'B' CONTACTS OPEN.  
 2. 'B' CONTACTS ARE ON COMPONENT SIDE OF THE BOARD.



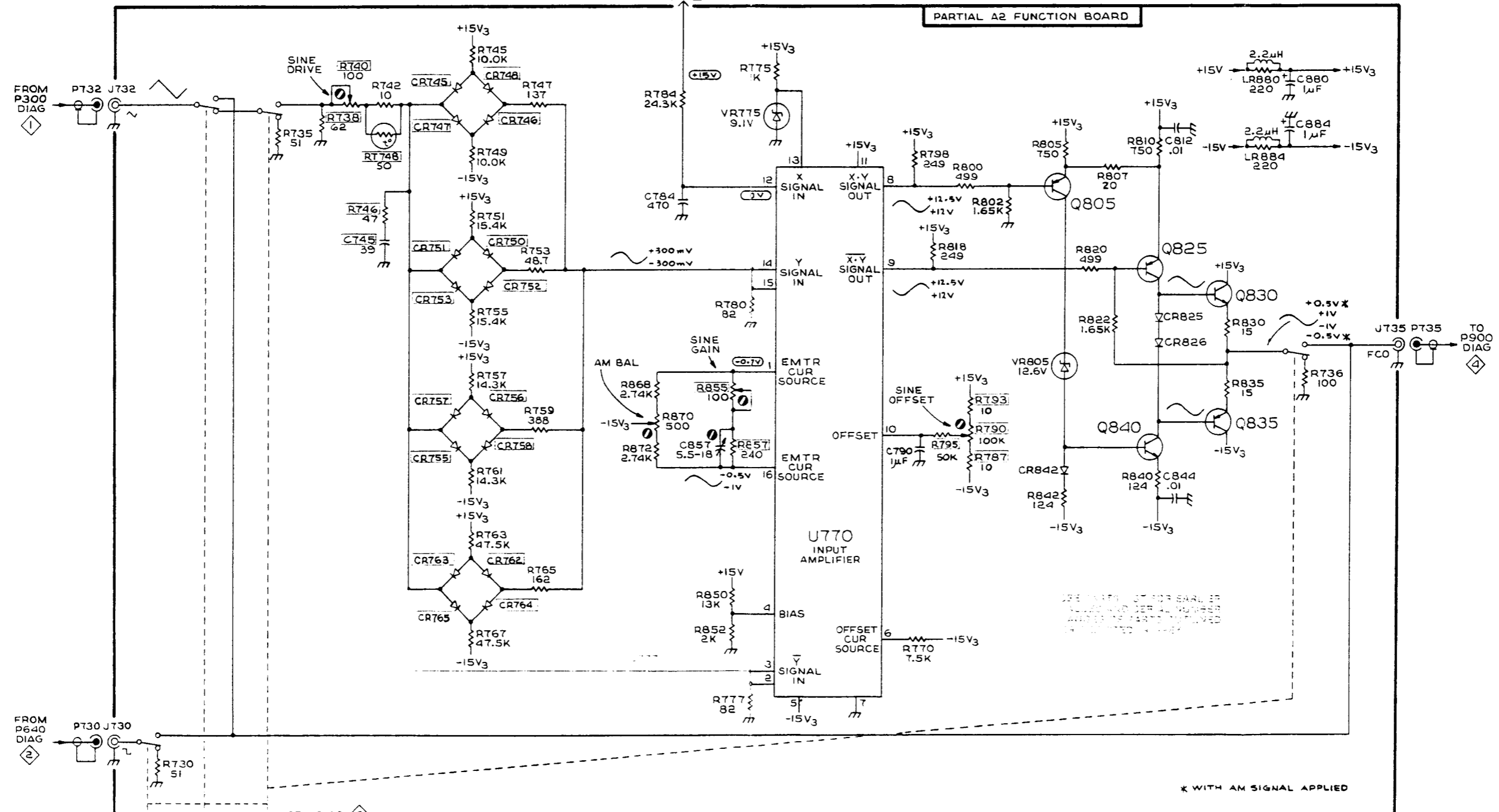
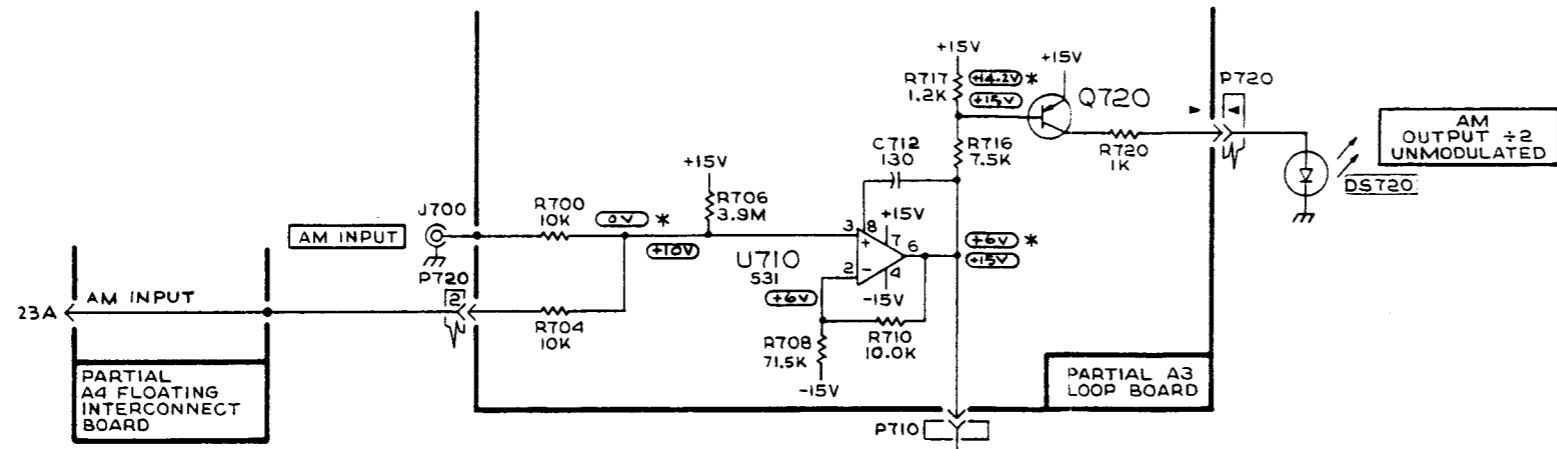
PARTIAL A1 MAIN BOARD

PARTIAL A2 FUNCTION BOARD

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C72	C5	P5	F1	R80	D3	R295	D2	R1274	G6
C78	C6	P20	H1	R85	D5	R300	D2	R1276	F6
C80*	C5	P125	J3	R88	D5	R315	E4	R1278	F6
C95	E5	P710	I6	R90	E5	R317	D4	R1282	F6
C98	E5	P720	J5	R92	D5	R322	D3	R1284	F6
C106	D6	P1264	E6	R95	D5	R325	D4	R1674*	†
C195	F4	P1270	G6	R98	D5	R327	D4		
C210	†	P1275	J4	R100	D5	R329	D4	RT317	D4
C240	F4	P1666	C1	R102	E5	R331	D4	RT318	D4
C242	F4	Q55	E4	R104	D5	R336	D2		
C244	F4	Q65	C5	R108	E5	R340	D2	S195	J4
C246	F5	Q80	C5	R114	A2	R342	D2	S240	H5
C248	G4	Q90	D4	R115	A6	R344	D2		
C250	F4	Q100	D5	R120	A5	R346	D2	U5	G1
C255	E3	Q165	G3	R128	H6	R350	C3	U25	G6
C275	E3	Q170	F2	R130	H6	R352	D3	U30	I2
C290	F2	Q175	E5	R134	J3	R356	D3	U45	G3
C300	D2	Q225	I3	R136	J3	R358	C3	U155	G2
C315	E3	Q230	I3	R138	G2	R360	B2	U215	H3
C325	C4	Q255A	E3	R140	G2	R363	B3	U375	C3
C327	C4	Q255B	E3	R143	G2	R365	C3	U710	J6
C329	C4	Q270	E2	R145	H2	R367	B3		
C331	C4	Q280	E2	R147	H2	R370	C3	VR23	H2
C340	C1	Q285	E2	R150	H3	R372	B3	VR275	E2
C342	C2	Q295	D2	R155	G3	R375	C4	VR295	D3
C344	C2	Q310	D3	R158	G2	R380	C5	VR310	D3
C346	C2	Q395	B4	R160	G2	R382	C5	VR380	B6
C380	C5	Q406	A4	R162	F2	R385	C3	VR462	B3
C387	B3	Q410	B5	R165	F3	R387	B3	VR470	B2
C475	A3	Q415	B5	R170	F2	R390	B3	VR1675*	†
C480	B2	Q450	B4	R172	F2	R395	B5		
C712	J5	Q456	B3	R175	E5	R397	B5	W20	H33
C1284	E5	Q462	B3	R195	F5	R398	B5		
C1670	B1	Q470	B2	R200	I4	R400	B4		
C1671	B2	Q720	J5	R202	I4	R402	B5		
C1672	E1	Q1280	F5	R204	G4	R406	B4		
C1673	B2	Q1675*	†	R206	H4	R409	B4		
				R208	H4	R410	B4		
				R210	H4	R412	B4		
CR20	I2	R8	G3	R212	H2	R415	B4		
CR21	I2	R10	G2	R212	H2	R415	B4		
CR85	C5	R12	H2	R215	H2	R417	B5		
CR108	D5	R14	I2	R220	I4	R419	A5		
CR180	D5	R20	H3	R225	I3	R420	A4		
CR182	E5	R23	H2	R228	I3	R450	B4		
CR184	E5	R25	G6	R235	G4	R452	B3		
CR186	E4	R28	G6	R250	F4	R454	B3		
CR188	E4	R30	H3	R252	F3	R456	A3		
CR190	D4	R32	H6	R255	E3	R458	B3		
CR218	I3	R34	I2	R258	E3	R462	A2		
CR220	I3	R36	I4	R260	F3	R465	A3		
CR352	D3	R38	G3	R262	F2	R470	B2		
CR356	D3	R42	F2	R265	E3	R475	A3		
CR462	A2	R45	G3	R270	E3	R480	B3		
CR470	B2	R52	F3	R271	E2	R700	J6		
CR1285	F6	R54	F2	R272	E3	R704	K6		
CR1286	F5	R58	E4	R275	E4	R706	J6		
		R65	C4	R280	E2	R708	I6		
		R68	C5	R285	E2	R710	J6		
J300	D1	R70	C5	R287	E2	R716	J5		
J406	A4	R72	C5	R288	D3	R717	I5		
J418	A5	R76	C5	R290	E2	R720	J4		
J485	B2	R78	C5						

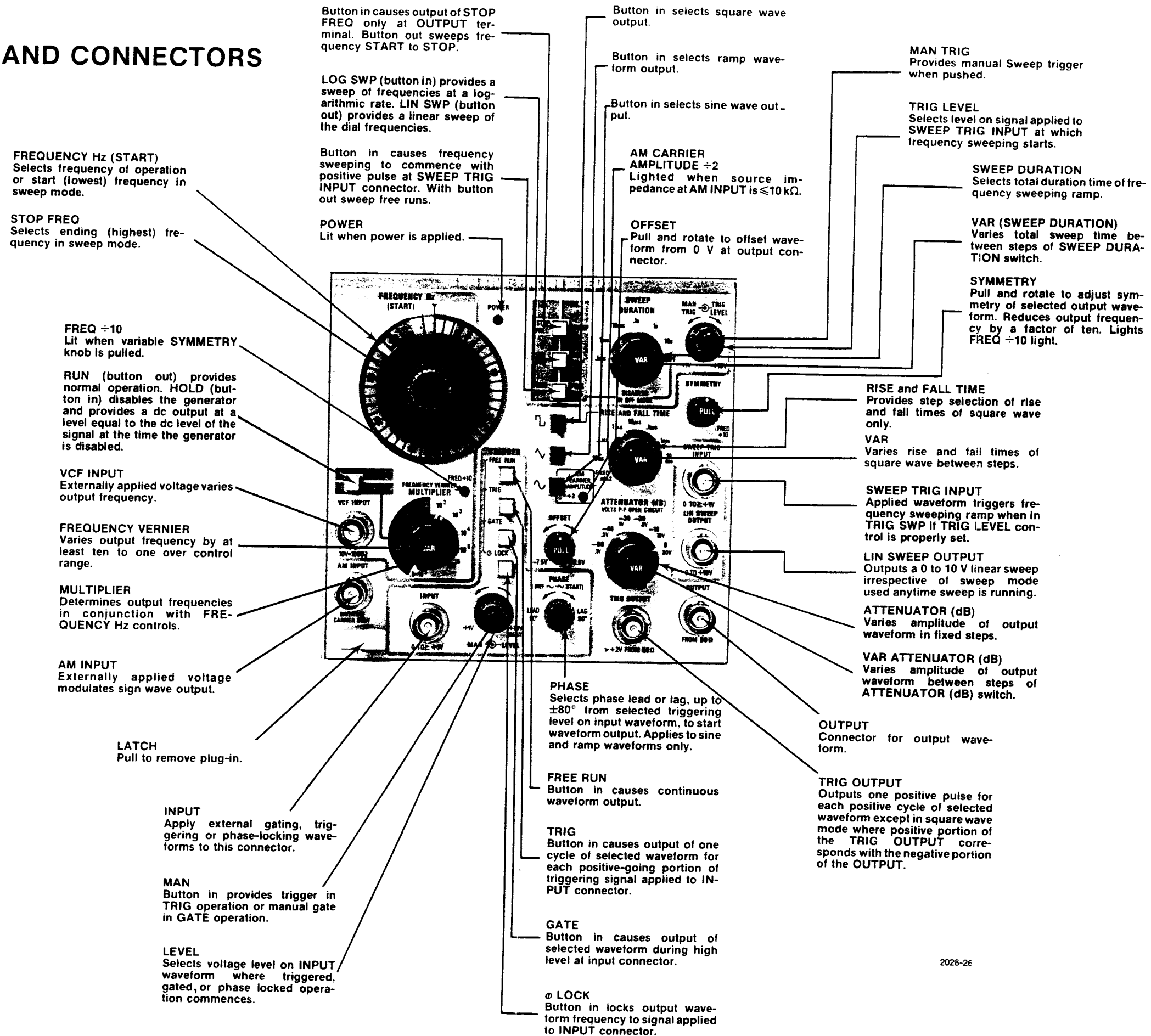








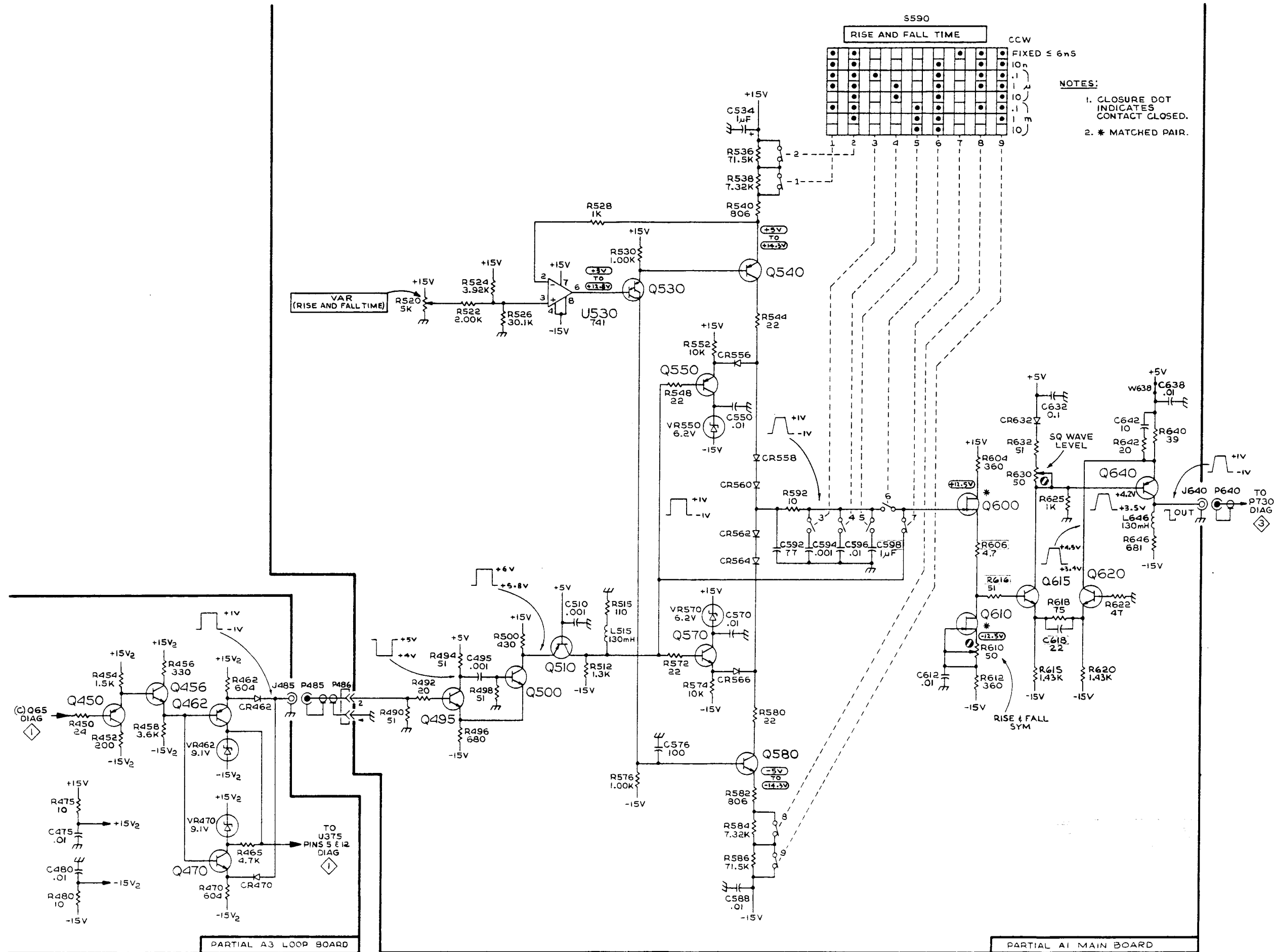
# CONTROLS AND CONNECTORS



2028-26







S590

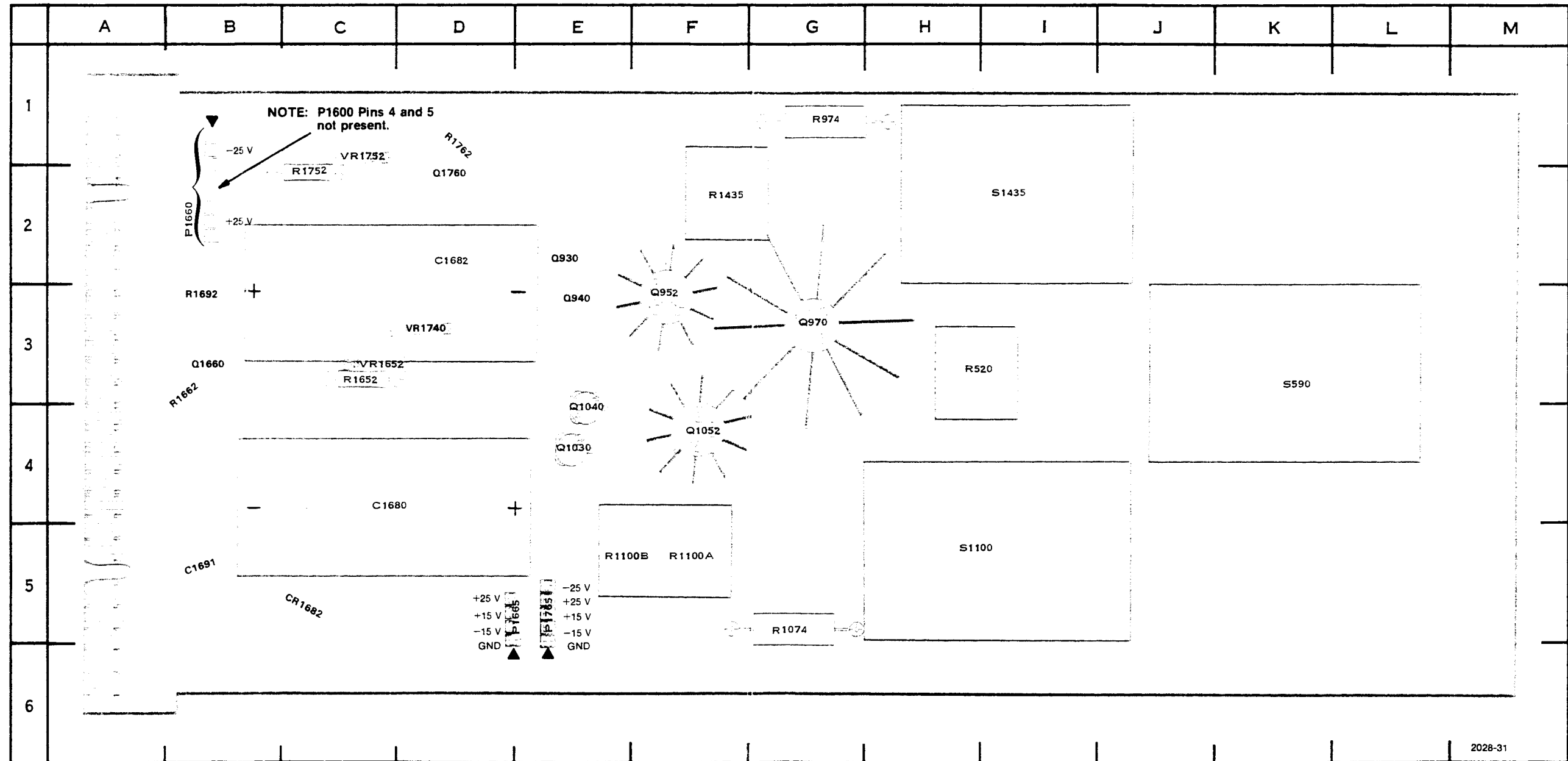
RISE AND FALL TIME


CCW  
FIXED ≤ 6ns  
10n  
1μ  
10μ  
100μ

NOTES:  
1. CLOSURE DOT INDICATES CONTACT CLOSED.  
2. \* MATCHED PAIR.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C745*	I3	J730	I3	R777	E3	R1305	D4	S730A	J1
C777*	E3	J732	I3	R780	F2	R1308	F4	S730B	J2
C784	F2	J735	I4	R784	F2	R1310	H4	S730C	J2
C790	F2	J1201	F5	R787	F2	R1316	D5	S730D	J3
C812	F3	J1295	E5	R790	G1	R1320	D5	S730E	J3
C844	F3			R793	F2	R1324	D5	S730F	J3
C857	E1	LR880	G3	R795*	G1	R1328	D4		
C880	G2	LR884	G3	R798	E3	R1330	D4	S1235A	H3
C884	G2			R800	F3	R1331	D4	S1235B	H4
C1146	C5			R802	F3	R1332	D5	S1235C	H4
C1154	B6	P712	F1	R805	G3	R1334	D5	S1235D	H5
C1156	A5	P1160	C6	R807	G3	R1340	D4		
C1174	B6	P1161	C6	R810	G3	R1345	C4		
C1176	A5	P1163	D6	R818	F3	R1370	D3	U770	E2
C1200	F5	P1215	F6	R820	F3	R1372	E2	U1145	C5
C1204	F5	P1260	G6	R822	H3	R1376	D3	U1215	G4
C1215	G4	P1276	D6	R830	H3	R1380	D3	U1225	E4
C1217	G4	P1277	D6	R835	H3	R1384	E3	U1295	E5
C1258	H5	P1345	H6	R840	F3	R1386	E3	U1340	D4
C1295	E5	P1370	D1	R842	F3	R1390	D3	U1445	B2
C1322	D5	P1440	C1	R850	E3	R1392	D3	U1470	D2
C1330	D4	P1500	I1	R852	E3	R1394	E2	U1480	B2
C1340	D4			R855	E1	R1400	D2	U1490	B2
C1380	D3	Q805	G3	R857	E2	R1402	D3	U1495	B3
C1392	D3	Q825	G3	R868	E2	R1406	D2	U1500	C4
C1394	E2	Q830	H3	R870	F1	R1408	D2		
C1445	A3	Q835	G3	R872	F2	R1410	D2	VR775	F2
C1462	C1	Q840	G3	R1132	C5	R1412	D2	VR805	G3
C1468	D2	Q1150	B4	R1134	C5	R1416	D3		
C1478	B3	Q1170	B4	R1136	B5	R1418	C3		
C1488	B3	Q1220	G4	R1138	C5	R1425	C2	W1428	C2
C1492	A3	Q1245	G5	R1140	A5	R1448	B2		
C1494	A3	Q1250	G5	R1142	C5	R1450	B2		
C1504	B4	Q1254	G5	R1146	C5	R1452	B2		
C1770	D5	Q1260	G5	R1150	B4	R1456	C2		
C1774	E6	Q1262	G5	R1154	B5	R1458	C2		
C1778	B2	Q1400	D3	R1156	A5	R1460	D1		
C1800	A4	Q1410	D2	R1160	B5	R1462	C2		
		Q1420	C2	R1164	B5	R1466	D2		
CR745	I2	Q1430	C2	R1174	B5	R1467	D2		
CR746	I2	Q1450	B2	R1176	B4	R1470	C2		
CR747*	I2			R1180	B5	R1475	B1		
CR748*	I2			R1200	F5	R1476	B2		
CR750*	H2	R730	J3	R1202	F5	R1478	B2		
CR751	H2	R735	J4	R1204	F5	R1480	C2		
CR752	H2	R736	J4	R1215	F4	R1484	C2		
CR753*	H2	R738	I2	R1217	G4	R1486	C2		
CR755*	G2	R740	I1	R1220	G4	R1490	B4		
CR756*	G2	R742	I2	R1222	G4	R1495	B3		
CR757	G2	R745	H2	R1228	F4	R1496	B4		
CR758	G2	R746*	I2	R1230	F4	R1500	B4		
CR762*	G2	R747	I2	R1234	F4	R1504	C4		
CR763	G2	R749	I2	R1240	H5	R1508	C3		
CR764	G2	R751	H2	R1242	G5	R1510	C3		
CR765*	G2	R753	H2	R1245	H5	R1512	C3		
CR825	H3	R755	H2	R1250	F4	R1514	C3		
CR826	H3	R757	G2	R1254	G5	R1520	J1		
CR842	G3	R759	G2	R1256	H4	R1525	B2		
CR1212	G5	R761	H2	R1258	H5				
CR1225	F5	R763	F2	R1264	G5				
CR1226	F5	R765	G2	R1295	H5				
CR1235	H4	R767	G2	R1298	D5				
CR1312	F5	R770	E3	R1300	D4				
CR1370	D3	R775	F2	R1302	D4				
CR1372	E3					RT748*	I2		
CR1470	C2					RT1456	C2		

## A1 MAIN BOARD (BACK) COMPONENT LOCATIONS



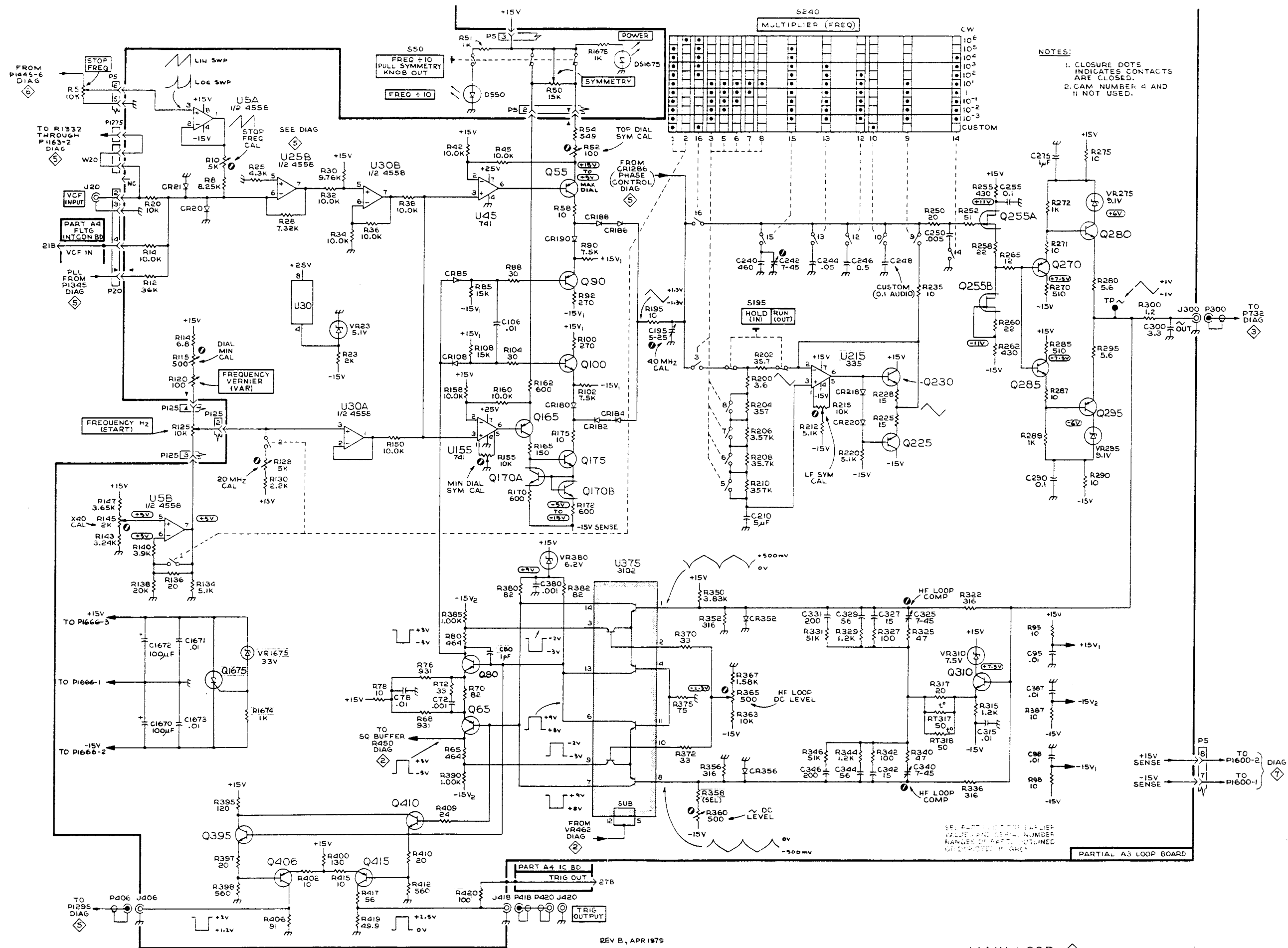
2028-31

\*See Parts List for serial number ranges.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C1680	C4	Q952	F3	R520	H3	S590	K3
C1682	D2	Q930	E2	R974	G1	S1100	H5
C1691	B5	Q940	E3	R1074	G5	S1435	I2
		Q970	G3	R1100	F5		
		Q1030	E4	R1435	F2		
CR1682	C5	Q1040	E4	R1652	C3	VR1652	C3
		Q1052	F4	R1662*	B3	VR1740	D3
P1660	B2	Q1660	B3	R1692*	B3	VR1752	C1
P1665	E5	Q1760*	D2	R1752	C2		
P1765	E5			R1762*	D1		

REV A, APR 1979







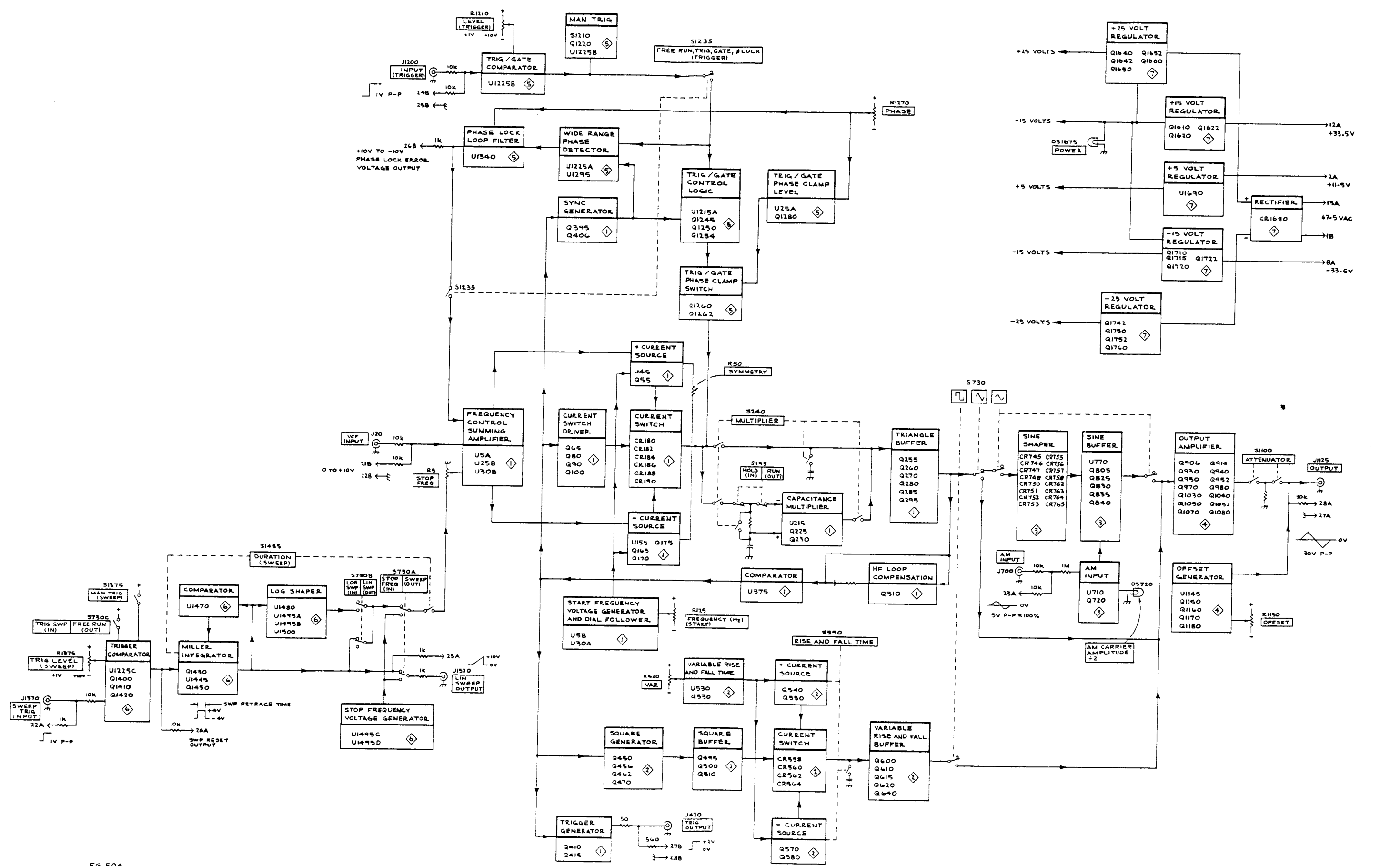


FIG 504

REV B, APR 1979  
2028-17

BLOCK DIAGRAM

DEM  
0176





CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C495	B5	CR1043	H4	Q1722	L5	R952	H2	R1714	K5
C510	C5	CR1608	K4	Q1742	K3	R958	H3	R1715*	K5
C534	A4	CR1622	K4	Q1750	J2	R960	G3	R1720	L5
C550	B4	CR1630*	J3	Q1752	K2	R965	H4	R1724	K5
C570	C5	CR1665	L2			R970	G2	R1726	K5
C576	D5	CR1680	K2			R980	H2	R1740	J3
C588	A2	CR1711	K5	R490	A5	R982	G3	R1742	J3
C592	C4	CR1722	K5	R492	B5	R983*	G3	R1744	J3
C594	B4	CR1730	L5	R494	B5	R984	F2	R1746*	K3
C596	C4	CR1765	K1	R496	A5	R1015	J2	R1748	J2
C598	C3			R498	B5	R1016	I2	R1750	J1
C612	C2	F1120	E5	R500	B5	R1024	I4	R1754	L1
C618*	B1	F1615	K4	R512	C5	R1028	J3	R1763	L1
C632	C2	F1715	K5	R515	C4	R1030	I3		
C638	A4			R522	D5	R1036	I3		
C642	B2	J640	B1	R524	D5	R1038	I3		
C914	J4	J900	I5	R526	D5	R1042	G4		
C922	H3	J1120	F5	R528	C5	R1045	I4	U530	C5
C934	I3			R530	C5	R1047	I5	U1690	B6
C936*	J2	L515	C4	R536	A3	R1050	H4		
C946	I1	L646	B2	R538	A3	R1052	H4	VR550	B4
C947	I1	L945	I2	R540	B4	R1070	G3	VR570	D5
C950	H2	L1045	I4	R544	B4	R1080	G3	VR932	I2
C955	I2	L1120	E6	R548	B4	R1082	F5	VR940	H2
C958	H3			R552	A4	R1083*	G4	VR1032	I4
C965	H3			R572	C4	R1084	F3	VR1040	H4
C972	G3	LR977	G1	R574	D4	R1090	H3	VR1608	J5
C975	F1	LR1077	G6	R576	C5	R1092	F2		
C976	F1			R580	C4	R1096	E3		
C978	G1	P486	A5	R582	D4	R1098	E3	W638	A4
C1028*	J3	P1162	D6	R584	D3	R1102	H5		
C1046	I5	P1210	A5	R586	D4	R1104	H5		
C1047	I5	P1445	D1	R592	C4	R1110	E4		
C1050	H4	P1600	J6	R604	C2	R1112	E4		
C1072	G4			R606	B2	R1114	F5		
C1075	G6	Q495	B5	R610	C2	R1120	E5		
C1076	G5	Q500	B5	R612	C2	R1122	E5		
C1078	G6	Q510	B5	R615	B1	R1436	H1		
C1090	H3	Q530	C5	R616*	B2	R1438	D2		
C1092	F3	Q540	B4	R618	B1	R1440	D2		
C1110*	D4	Q550	B4	R620	A1	R1442	D2		
C1438	E1	Q570	C4	R622	A2	R1444	D2		
C1440	E2	Q580	D4	R625	B2	R1600	J5		
C1442	E2	Q600	B2	R630	C2	R1602	L4		
C1608	K4	Q610	B2	R632	C2	R1605	K4		
C1612	L4	Q615	B2	R640	C2	R1607	J5		
C1630	K4	Q620	A2	R642	B2	R1610	K5		
C1650	L3	Q640	B2	R646	A1	R1612	L4		
C1665	K2	Q906	I4	R900	J4	R1614	K3		
C1690	A5	Q914	I4	R902	I4	R1620	L4		
C1694	A6	Q950	I2	R904	J4	R1624	K3		
C1720	L5	Q980	G2	R906	J4	R1626	K3		
C1730	K6	Q1050	I4	R910	I4	R1640	L3		
C1750	K2	Q1070	G5	R914	J4	R1642	K3		
C1765	K1	Q1080	G3	R916	I3	R1644	K2		
CR556	B4	Q1610	K4	R920	I3	R1648	K3		
CR558	B4	Q1620	L3	R922	I3	R1650	L3		
CR560	B4	Q1622	L3	R924	I2	R1654	K3		
CR562	C4	Q1640	K3	R928	I2	R1663	K3		
CR566	C4	Q1642	K3	R930	I3	R1700	J5		
CR632	C2	Q1650	L3	R936	I3	R1702	L5		
CR942	H1	Q1652	K3	R938	I3	R1705	L4		
CR943	I1	Q1710	K5	R942	H2	R1707	K4		
CR960	G3	Q1715*	K5	R945	I2	R1710	K5		
CR962	H3	Q1720	L5	R947	I1	R1712*	K5		
CR1042	H4			R950	I2	R1713*	K5		

## Using the Rear Interface Connectors

### Output

This terminal is connected to the front panel OUTPUT connector through a 30 kΩ resistor. The common terminal for this output is pin 27A.

### Sweep Reset Output

A positive-going pulse from about -13 V to about +9 V occurs at this connection at the time the sweep resets. This output is designed to drive at least 10 kΩ. The pulse can be used to raise the pen on a chart recorder when doing sweep frequency tests on filters or other devices or as end-of-sweep trigger for an external device. Connect the return line to chassis ground.

### Linear Sweep Output

This terminal is connected to the output of the sweep generator through a 1 kΩ resistor. The waveform at this terminal is identical with the waveform at the front panel LIN SWEEP OUTPUT terminal except in the STOP FREQ mode. In the STOP FREQ mode this rear connection continues to output the linear sweep ramp while the front panel connection outputs a dc voltage equivalent to the peak ramp voltage. To make the output at the rear terminal the same as the LIN SWEEP OUTPUT terminal, remove the lower end of R1525 from the Function board. Connect an eight inch wire from the lower end of R1525 to the lower end of R1520 also located on the Function board. The exact location of these resistors can be found from the Parts Location Grid. Use chassis ground as the return circuit.

### AM Input

This input has the same input characteristics as the AM INPUT connection on the front panel. Use chassis ground for the circuit return.

### Sweep Trigger Input

This terminal is connected to the front panel SWP TRIG INPUT connector through a 1.5 kΩ resistor. Use chassis ground for the return circuit.

### Trigger Output

This connection is made through a 510 Ω resistor to the front panel TRIG OUTPUT connector. Use connection 27B for the return circuit.

### Phase Lock Error Voltage

The signal at this terminal is the output of the phase locked loop filter. An output of 0 V indicates the reference frequency is the same as the free-run frequency. A voltage of +10 V (open circuit) indicates a generator output frequency of about 10 dial divisions higher than free-run frequency, and -10 V (open circuit) indicates a generator frequency about 10 dial divisions lower than the free-run frequency. The output impedance is 1 KΩ. Use the chassis ground as the return circuit.

### Trigger Input

This connection has the same dc input characteristics as the front panel TRIGGER INPUT connector. Use the chassis as the return circuit.

### VCF Input

This connection has the same input characteristics as the front panel VCF INPUT connector. Use contact 22B as the return circuit.

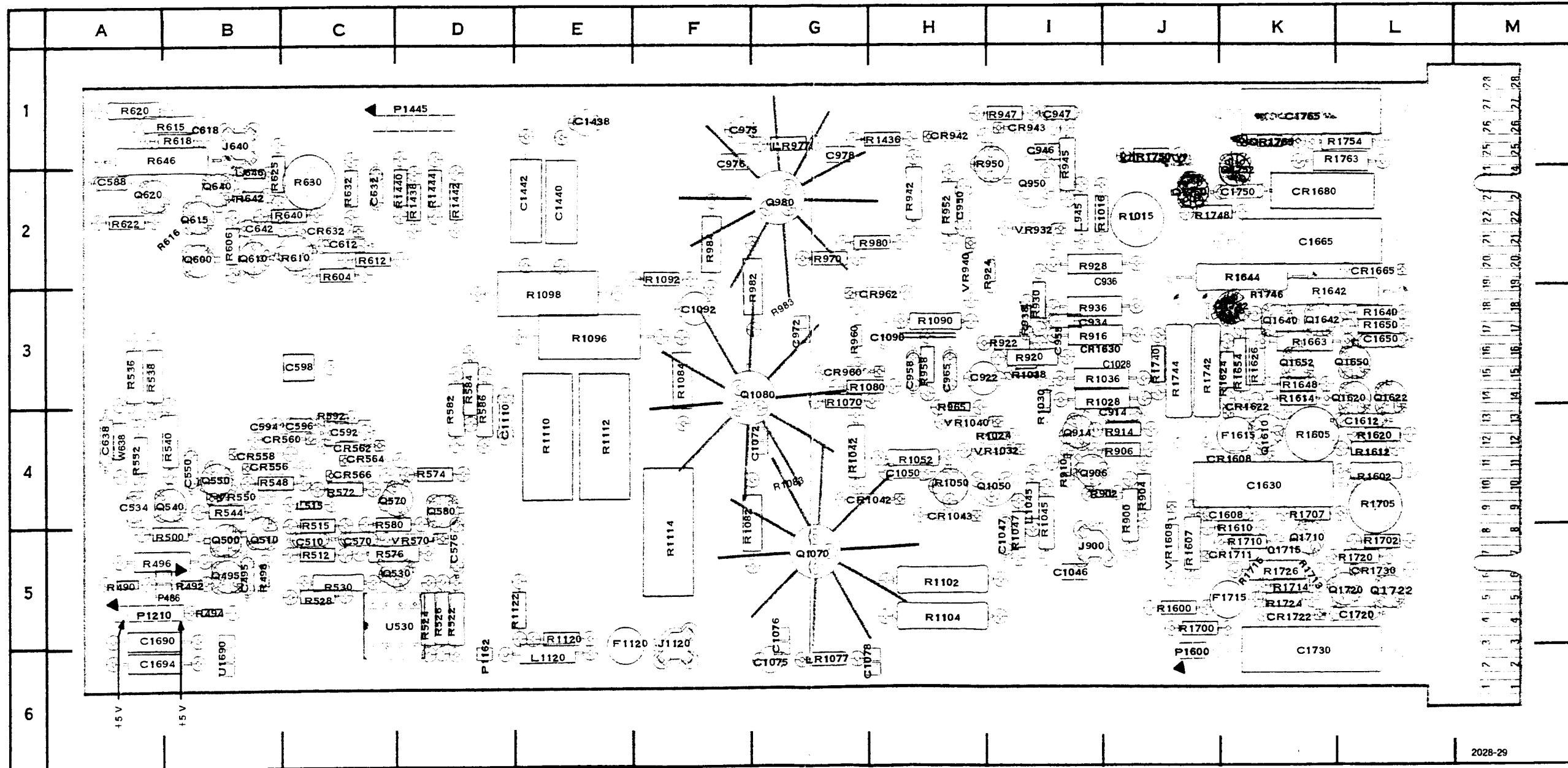
## REAR INTERFACE CONNECTOR ASSIGNMENTS

Output or Input	Pin B	Pin A	Output or Input
Trig Output Common	28	28	Output
Trig Output	27	27	Output Common
Phase Lock Error Voltage	26	26	Sweep Reset Output
Trigger/Gate Input Common	25	25	Linear Sweep Output
Trigger/Gate Input	24	24	AM Input
	23	23	Sweep Trigger Input
VCF Input Common	22	22	
VCF Input	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	*9	±33.5 V common return
-33.5 V filtered dc	*8	*8	-33.5 V filtered dc
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	17.5 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 boards

Assignments listed for pins 1A-13A and 1B-13B are available in all power modules. Pins marked with an asterisk (\*) are used on the Main board. Pins marked with a dagger (†) are used on the Floating board. Pins 14 through 28 are not used on the Main board. All connections shown for pins 21 through 28 are on the Floating board.

### A1 MAIN BOARD (FRONT) COMPONENT LOCATIONS



1 25 26 27 28  
 2 21 22 23  
 3 17 18 19 20  
 4 13 14 15 16  
 5 9 10 11 12  
 6 5 6 7 8

2028-29

\*See Parts List for serial number ranges.