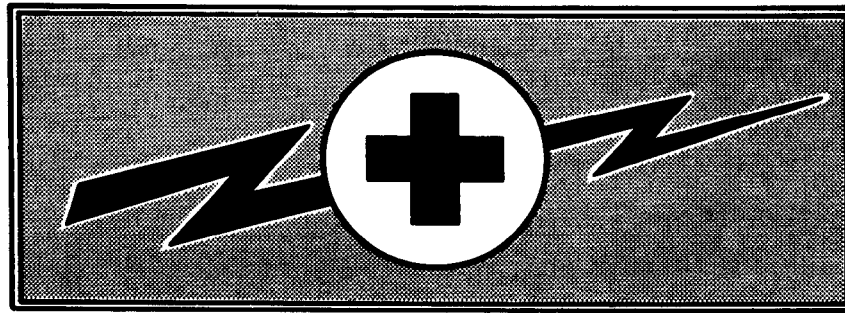


**TECHNICAL MANUAL**

**OPERATOR, ORGANIZATIONAL,  
DIRECT SUPPORT, AND GENERAL SUPPORT  
MAINTENANCE MANUAL  
(INCLUDING REPAIR PARTS)  
FOR**

**FUNCTION GENERATOR  
TEKTRONIX, MODEL FG 501A  
(6625-01-106-9873)**

## WARNING



RA PD 404264

### DANGEROUS VOLTAGE

is used in the operation of this equipment

### DEATH ON CONTACT

may result if personnel fail to observe safety precautions

---

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the technician is aided by operators, he must warn them about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after the power has been turned off, always ground every part before touching it.

Be careful not to contact high-voltage connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

## WARNING

Do not be misled by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.

**COMMON** and probe ground straps are electrically connected. Herefore, an elevated reference applied to any is present on each - as indicated by the yellow warning bands under the probe retractable hook tips.

For Artificial Respiration, refer to FM 21-11,

### Power Source

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

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TECHNICAL MANUAL )  
)  
No. 9-6625-474-14&P-2 )

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
Washington, D.C., 27 December 1984

**OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT,  
AND GENERAL SUPPORT MAINTENANCE MANUAL  
(INCLUDING REPAIR PARTS)  
FOR  
FUNCTION GENERATOR  
TEKTRONIX, MODEL FG 501A  
(6625-01-106-9873)**

**REPORTING OF ERRORS**

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), direct to: Commander, US Army Missile Command, ATTN: DRSMI-SNPM, Redstone Arsenal, AL 35898-5238. A reply will be furnished to you.

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This manual is, in part, authenticated manufacturer's commercial literature. Recommended Spare Parts List has been added to supplement the commercial literature. The format of this manual has not been structured to consider levels of maintenance.

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## SECTION 0

GENERAL INFORMATION

---

**0-1. Scope.** This manual contains instructions for the operator, organizational, direct support, and general support maintenance of and calibration procedures for Tektronix Function Generator, Model FG 501A. Throughout this manual, Tektronix Function Generator, Model FG 501A is referred to as the FG 501A.

**0-2. Indexes of publications.** *a. DA Pam 310-4.* Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to Tektronix Function Generator, Model FG 501A.

*b. DA Pam 310-7.* Refer to the latest issue of DA Pam 310-7 to determine whether there are modification work orders (MWO'S) pertaining to Tektronix Function Generator, Model FG 501A.

**0-3. Forms, Records, and Reports.** Department of Army forms and procedures used for equipment maintenance and calibration are those prescribed by TM 38-750, The Army Maintenance Management System. Accidents involving injury to personnel or damage to materiel will be reported on DA Form 285, Accident Report, in accordance with AR 385-40.

**0-4. Reporting Equipment Improvement Recommendations (EIR).** If your FG 501A needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, U.S. Army Missile Command, ATTN: DRSM1-CIMD, Redstone Arsenal, AL 35898-5290. We'll send you a reply.

**0-5. Administrative Storage.** To prepare the Tektronix Function Generator, Model FG 501A for placement into and removal from administrative storage, refer to Section 3, Chapter 4, AR 750-25-1, Maintenance of Equipment and Supplies. Temporary storage should be accomplished in accordance with TB 750-25-1, Section 2, Maintenance of Supplies and Equipment.

**0-6. Destruction of Army Electronics Materiel.** Destruction of Tektronix Function Generator, Model FG 501A to prevent enemy use shall be in accordance with TM 750-244-2.

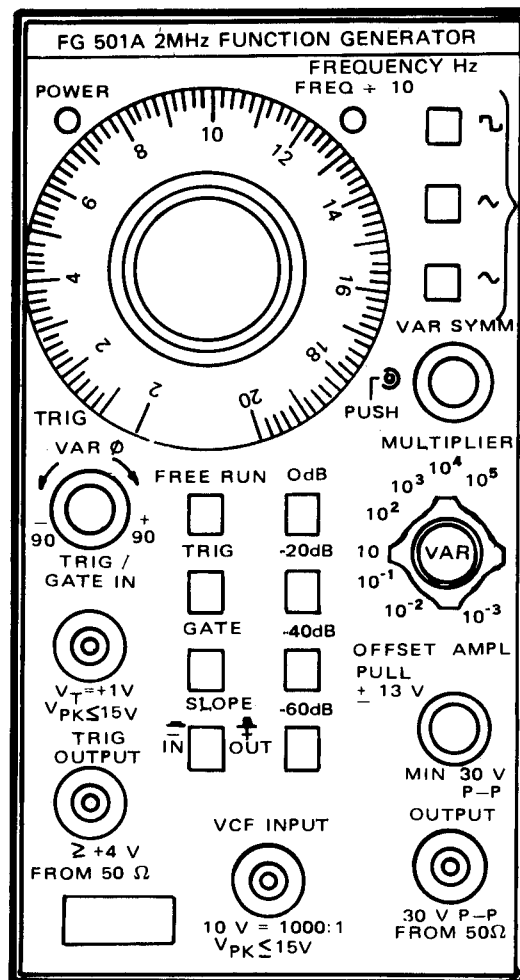


FIG.0-1. FG 501A 2MHz FUNCTION GENERATOR



## SECTION 1

# SPECIFICATION

## INTRODUCTION

This section of the manual contains a general description of the FG 501A and complete electrical, environmental, and physical specifications. Standard accessories are also listed. Instrument option information is located in the back of this manual in a separate section.

## INSTRUMENT DESCRIPTION

The FG 501A Function Generator provides low distortion sine, square, triangle, ramp, and pulse waveforms over the frequency range 0.002 Hz to 2 MHz in eight decade steps. Dc offset up to  $\pm 13$  V is available. Waveform triggering and gating functions, in addition to being slope (+ or -) selectable, are provided with variable phase control capable of up to  $\pm 90^\circ$  phase shift. The symmetry of the output waveform may also be varied from 5 to 95%. Step attenuators provide up to 60 dB of attenuation in 20 dB steps. A variable amplitude control provides an additional 20 dB attenuation.

A voltage-controlled frequency (VCF) input is provided to control the output frequency from an external voltage source. The output frequency can be swept above and below the selected frequency to a maximum of 1000:1 depending on the polarity and amplitude of the VCF input signal and the selected output frequency.

## ACCESSORIES

The only accessory shipped with the FG 501A is the Instruction Manual.

## PERFORMANCE CONDITIONS

The electrical characteristics are valid with the following conditions:

1. The instrument must have been adjusted at an ambient temperature between  $+20^\circ$  C and  $+30^\circ$  C and operating at an ambient temperature between  $0^\circ$  C and  $+50^\circ$  C.
2. The instrument must be in a non-condensing environment whose limits are described under Environmental.
3. Allow twenty minutes warm-up time for operation to specified accuracy; sixty minutes after exposure to or storage in high humidity (condensing) environment.

Items listed in the Performance Requirements column of the Electrical Characteristics are verified by completing the Performance Check in this manual. Items listed in the Supplemental Information column may not be verified in this manual; they are either explanatory notes or performance characteristics for which no limits are specified.

Table 1-1  
ELECTRICAL CHARACTERISTICS

| Characteristics                                               | Performance Requirements                                                                                                                                                                                                                            | Supplemental Information                                                                                                                                                                                                                                    |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frequency<br>Range<br>Sine-wave, square-wave,<br>and triangle | .002 Hz to 2 MHz                                                                                                                                                                                                                                    | Provided in eight decade steps plus variable, with overlap on all ranges.<br><br>Calibrated portion of dial extends from 20 to 2. Portion of dial from 2 to .2 is uncalibrated<br><br>.0002 Hz to .002 Hz uncalibrated portion of dial.                     |
| Ramp and Pulse                                                | .002 Hz to 200 kHz $\pm$ 10% calibrated portion of dial.                                                                                                                                                                                            | Measured at 50% duty cycle.<br><br>.0002 Hz to .002 Hz uncalibrated portion of dial.                                                                                                                                                                        |
| Variable Symmetry<br>Duty Cycle                               | $\leq 5\%$ to $\geq 95\%$ .                                                                                                                                                                                                                         | Activation of Symmetry control divides output frequency by $\approx 10$ .                                                                                                                                                                                   |
| Output Amplitude                                              | At least 30 V P-P into an open circuit, at least 15 V p-p into 50 $\Omega$ . (Front panel only.)                                                                                                                                                    | Offset control off.                                                                                                                                                                                                                                         |
| Output Impedance                                              |                                                                                                                                                                                                                                                     | Front panel $z_o = 50 \Omega \pm 10\%$<br>ATTEN in 0 dB position.<br>Rear interface $z_o = 600 \Omega -10\%$ .                                                                                                                                              |
| Offset Range                                                  | At least $\pm 13$ V into open circuit, at least $\pm 6.5$ V into 50 $\Omega$ .<br>Maximum peak signal plus offset cannot exceed $\pm 15$ V into an open circuit, or $\pm 7.5$ into 50 $\Omega$ . (Front panel only.) Offset reduced by attenuators. |                                                                                                                                                                                                                                                             |
| Frequency Resolution                                          |                                                                                                                                                                                                                                                     | 1 part in $10^4$ of full scale with frequency vernier control.                                                                                                                                                                                              |
| Stability (Frequency)<br>Time                                 |                                                                                                                                                                                                                                                     | $\leq 0.1\%$ for 1 hour,<br>$\leq 0.5\%$ for 24 hours.                                                                                                                                                                                                      |
| Temperature                                                   |                                                                                                                                                                                                                                                     | Within 2% from .2 Hz to 2 MHz, and within 10% from .002 Hz to .2 Hz. The FREQUENCY Hz dial must be on the calibrated portion. The instrument must be in a temperature between 0° C and +50° C and checked after a 1 hour warmup. VAR SYMM control disabled, |

Table 1-1 (cont)

| Characteristics                                                 | Performance Requirements                                                                                                                                                             | Supplemental Information                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Amplitude Flatness                                              | Measured with 0 dB ATTEN button "IN" and output driving 50 $\Omega$ load. (Front panel only.)                                                                                        |                                                                                                                                                                                                                                                                                                |
| Sinewave<br>(10 kHz Sinewave Ref)                               | $\pm 0.1$ dB 20 Hz to 20 kHz<br>$\pm 0.5$ dB 20 kHz to 1 MHz<br>$\pm 1$ dB 1 MHz to 2 MHz                                                                                            | Typically $\pm 5$ dB .002 Hz to 20 Hz                                                                                                                                                                                                                                                          |
| Squarewave<br>(10 kHz Squarewave Ref)                           | Peak to peak amplitude within $\pm 0.5$ dB of squarewave reference amplitude 20 Hz to 2 MHz.                                                                                         | Typically within $\pm 5$ dB .002 Hz to 20 Hz.                                                                                                                                                                                                                                                  |
| Triangle<br>(10 kHz Triangle Ref)                               | Peak to peak amplitude within $\pm 0.5$ dB of triangle wave reference amplitude 20 Hz to 200 kHz. Within 2 dB 200 kHz to 2 MHz.                                                      | Typically within $\pm 5$ dB .002 Hz to 20 Hz.                                                                                                                                                                                                                                                  |
| Sinewave Distortion                                             | $\leq 0.25\%$ 20 Hz to 20 kHz on 10 <sup>3</sup> range and below.<br><br>$\leq 0.5\%$ 20 kHz to 100 kHz.<br><br>All harmonics at least 30 dB below fundamental from 100 kHz to 2 MHz | 20° to 30° C. Measured with with average responding THD meter.<br>Measurement bandwidth limited to approximately 300 kHz.<br>Verified at 15 V p-p into 50 $\Omega$ load. Must be on calibrated portion of dial. VAR SYMM control off, Offset control off.<br>Trig output driving open circuit. |
| Squarewave Output<br>Risetime and Falltime<br>Aberrations (p-p) | Step ATTEN in 0 dB position.<br>$\leq 25$ ns at 15 V p-p into 50 $\Omega$ .<br>$\leq 3\%$ (Front panel only. )                                                                       |                                                                                                                                                                                                                                                                                                |
| Pulse Output<br>Risetime and Falltime<br>Aberrations (p-p)      | Step ATTEN in 0 dB position.<br>$\leq 25$ ns at 15 V p-p into 50 $\Omega$ .<br>$\leq 3\%$ (Front panel only.)                                                                        |                                                                                                                                                                                                                                                                                                |
| VCF Input                                                       | 10 V $\geq 1000:1$                                                                                                                                                                   | Positive going voltage increases frequency. Maximum Slew Rate = 0.5 V/ $\mu$ s. VCF must not exceed range limits, Maximum input $\leq 15$ V pk.                                                                                                                                                |
| Ext Trig/Gate Input<br>Impedance                                |                                                                                                                                                                                      | $\approx 2$ k $\Omega$                                                                                                                                                                                                                                                                         |
| Threshold Level                                                 | +1 V $\pm 20\%$ .                                                                                                                                                                    | Maximum input $\leq 15$ V pk.                                                                                                                                                                                                                                                                  |
| Trigger Output                                                  | $\geq +4$ V into open circuit<br>$\geq +2$ V into 50 $\Omega$ .                                                                                                                      |                                                                                                                                                                                                                                                                                                |
| Variable Phase Range                                            | At least $\pm 90^\circ$                                                                                                                                                              | Sine and Triangle only.                                                                                                                                                                                                                                                                        |

Table 1-1 (cont)

| Characteristics | Performance Requirements                                              | Supplemental Information                                                                                                |
|-----------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Attenuators     |                                                                       | 60 dB in 20 dB steps. >20 dB additional attenuation with amplitude control.                                             |
| Accuracy        | ±1 dB.                                                                | Verified at 20 kHz.                                                                                                     |
| Dial Accuracy   | Within 3% of full scale 20 to 2.                                      | 2 to .2 Uncal.                                                                                                          |
| Triangle        |                                                                       |                                                                                                                         |
| Linearity       |                                                                       | Greater than or equal to 99% 20 Hz to 200 kHz. 97% 200 kHz to 2 MHz (calibrated). Measured from 10% to 90% of waveform. |
| Time Symmetry   | Better than 1% 20 Hz to 200 kHz.<br>5% 200 kHz to 2 MHz (calibrated). |                                                                                                                         |

Table 1-2  
MISCELLANEOUS

| Characteristics                 | Description                                     |
|---------------------------------|-------------------------------------------------|
| Power Consumption               | 12 W or less. (plug-in only)                    |
| Recommended Adjustment Interval | 1000 hours or 6 months, whichever occurs first. |
| Warm-up Time                    | 20 minutes.                                     |

Table 1-3  
ENVIRONMENTAL

| Characteristics | Description                                                                                  |
|-----------------|----------------------------------------------------------------------------------------------|
| Temperature     | Meets MIL-T-28800B, class 5.                                                                 |
| Operating       | 0° C to +50° C                                                                               |
| Non-operating   | -55° C to +75° C                                                                             |
| Humidity        | 95% RH, 0° C to 30° C<br>75% RH to 40° C<br>45% RH to 50° C                                  |
| Altitude        | Exceeds MIL-T-28800B, class 5.                                                               |
| Operating       | 4.6 Km (15,000 ft)                                                                           |
| Non-operating   | 15 Km (50,000 ft)                                                                            |
| Vibration       | 0.38 mm (0.015") peak to peak,<br>5 Hz to 55 Hz, 75 minutes.                                 |
|                 | Exceeds MIL-T-28800B, class 5,<br>when installed in qualified<br>power modules. <sup>b</sup> |

Table 1-3 (cont)

| Characteristics             | Description                                                                                                                                                                             |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shock                       | 30 G's (1/2 sine), 11 ms duration, 3 shocks in each direction along 3 major axes, 18 total shocks. Meets MIL-T-28800B, class 5, when installed in qualified power modules. <sup>b</sup> |
| Bench Handling <sup>c</sup> | 12 drops from 45°, 4" or equilibrium, whichever occurs first. Meets MIL-T-28800B, class 5.                                                                                              |
| Transportation <sup>c</sup> | Qualified under National Safe Transit Association Preshipment Test Procedures 1A-B-1, and 1A-B-2.                                                                                       |
| EMC                         | Within limits of MIL-461A, and F.C.C. Regulations, Part 15, Subpart J, Class A.                                                                                                         |
| Electrical Discharge        | 20 kV maximum charge applied to instrument case.                                                                                                                                        |

<sup>a</sup>With power module.<sup>b</sup>Refer to TM 500 power module specifications.<sup>c</sup>Without power module.

Table 1-4

## PHYSICAL CHARACTERISTICS

| Characteristics    | Description                                                          |
|--------------------|----------------------------------------------------------------------|
| Finish             | Plastic/aluminum laminate front panel. Anodized aluminum chassis.    |
| Net Weight         | 1.88 lbs (.85 kg)                                                    |
| Overall Dimensions | Height 5 in (126mm)<br>Width 2.6 in (67mm)<br>Length 11.9 in (303mm) |

## SECTION 2

# OPERATING INSTRUCTIONS

## INTRODUCTION

This section of the manual provides operating information required to obtain the most effective performance from the FG 501A. Included are installation and removal instructions, a functional description of the front panel controls, and a general description of the operating modes. Some basic applications of the instrument are also briefly discussed.

## INSTALLATION AND REMOVAL

The FG 501A is calibrated and ready to use when received. It operates in one compartment of any TM 500-series power module. Refer to the power module instruction manual for line voltage requirements and power module operation.

### CAUTION

*To prevent damage to the FG 501A, turn the power module off before installation or removal of the instrument from the mainframe. Do not use excessive force to install or remove.*

Check to see that the plastic barriers on the interconnecting jack of the selected power module compartment match the cutouts in the FG 501 A circuit board edge connector. If they do not match, do not insert the instrument until the reason is found. When the units are properly matched, align the FG 501A chassis with the upper and lower guides of the selected compartment (see Fig. 2-1). Insert the FG 501A into the compartment and press firmly to seat the circuit board edge connector in the power module interconnecting jack. Apply power to the FG 501A by operating the power switch on the power module.

To remove the FG 501A from the power module, pull the release latch (located in the lower left corner) until the interconnecting jack disengages. The FG 501A will now slide straight out.

## REPACKAGING FOR SHIPMENT

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag

showing: owner (with address) and the name of an individual at your firm that can be contacted. Include complete instrument serial number and a description of the service required.

If the original package is not fit for use or not available, repack the instrument as follows:

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

The carton test strength for your instrument is 200 pounds.

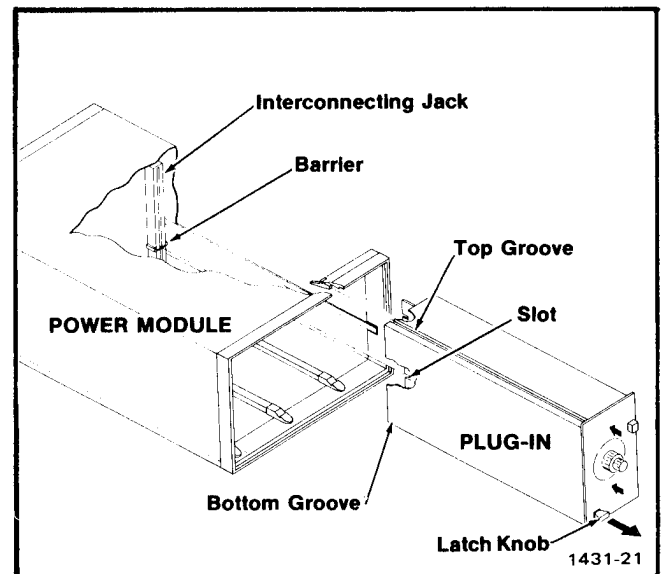


Fig. 2-1. Plug-in installation and removal.

## CONTROLS AND CONNECTORS

Although the FG 501A is calibrated and ready to use, the functions and actions of the controls and connectors should be reviewed before attempting to use it. All

controls necessary for operation of the instrument are located on the front panel. A brief description of these controls follows. Refer to Fig. 2-2.

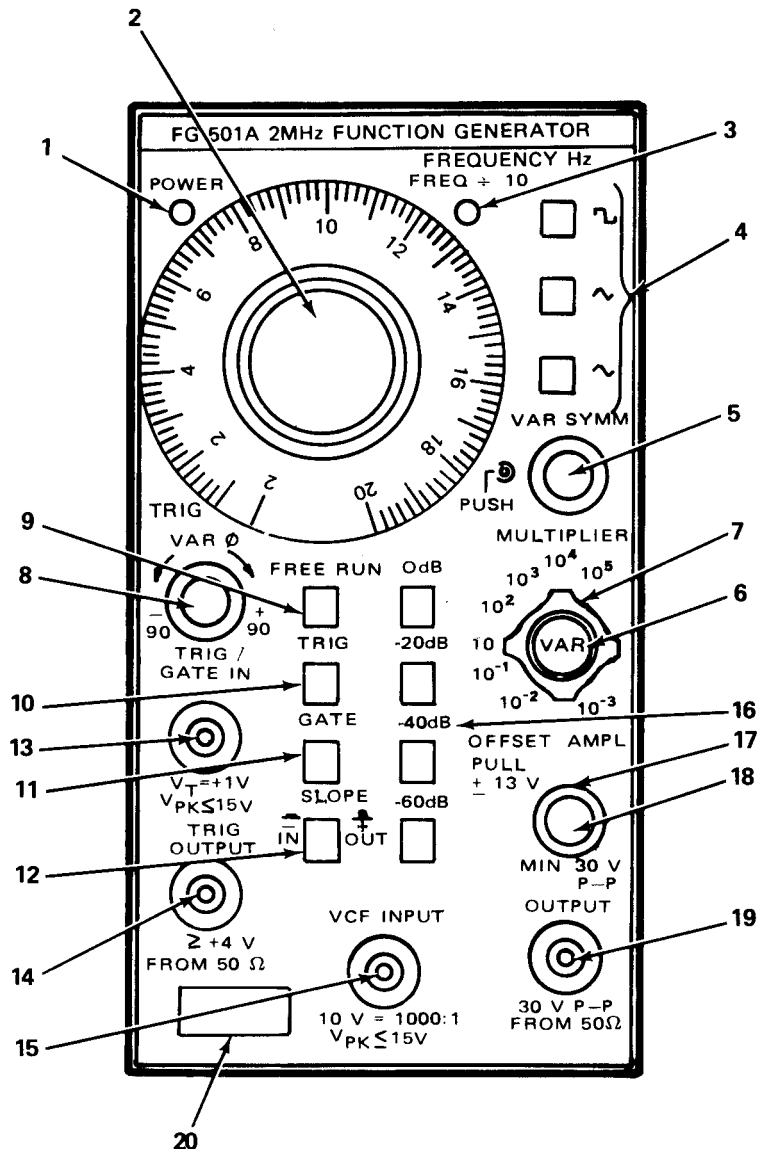


Fig. 2-2. Controls and connectors.

- ① **POWER** - Illuminated when power is applied to the FG 501A.

## FREQUENCY CONTROL AND FUNCTION SELECTION

- ② **FREQUENCY Hz** - Selects the frequency of the output waveform in conjunction with the MULTIPLIER control.
- ③ **FREQ + 10** - Illuminated when the variable symmetry function is activated.
- ④ **FUNCTION BUTTONS** - Select square, triangle, and sine waveforms.
- ⑤ **VAR SYMM** - (push to enable) adjusts time-based symmetry of the selected output waveform. Reduces the frequency of the output waveform by a factor = 10 and illuminates the FREQ + 10 indicator.
- ⑥ **FREQUENCY VERNIER** - For fine adjustment of output frequency to at least 1 part in  $10^4$  of full scale.
- ⑦ **MULTIPLIER** - Selects the output frequency in eight decade steps in conjunction with the FREQUENCY Hz control.

## TRIGGER AND GATE CONTROLS

- ⑧ **VAR  $\theta$ —Selects** - Selects phase lead or lag, up to  $\pm 90^\circ$ , relative to input trigger or gate waveform.
- ⑨ **FREE RUN** - When pressed causes continuous waveform output.
- ⑩ **TRIG** - When pressed causes output of one cycle of selected waveform for each trigger pulse applied to the TRIG/GATE IN connector.

- ⑪ **GATE** - When pressed causes continuous output of the selected waveform for the duration of the gating pulse.

- ⑫ **SLOPE** - Button selects, in TRIG mode, the slope of the input signal which will trigger the selected output waveform. In GATE mode, whether output gating will occur when the level of the input signal is above or below the threshold level of +1 V.

- ⑬ **TRIG/GATE IN** - Bnc connector used to apply the external trigger or gating signal.

- ⑭ **VCF INPUT** - Bnc connector for applying an external voltage for controlling the output frequency of the generator.

- ⑮ **TRIGGER OUTPUT** - Bnc connector which outputs one positive pulse for each cycle of the selected output waveform.

## OUTPUT CONTROLS

- ⑯ **ATTENUATOR BUTTONS** - Attenuate the amplitude of the selected output waveform in 20 dB steps to a maximum of 60 dB when pressed.
- ⑰ **AMPL** - Varies the amplitude of the selected output waveform, between steps of the attenuator buttons.
- ⑱ **OFFSET** - Pull and turn control, concentric with the AMPL control, provides up to  $\pm 13$  V dc offset of the output waveform.
- ⑲ **OUTPUT** - Bnc connector for output of the selected waveform.
- ⑳ **RELEASE LATCH** - Pull to disengage the FG 501A from the power module.



# OPERATING CONSIDERATIONS

## OUTPUT CONNECTIONS

The output of the FG 501A 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 aberrations on the output waveform. 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 square 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 applied to sensitive circuits.
4. Use terminations or impedance matching devices to avoid reflections when using long cables (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.

## RISETIME AND FALLTIME

If the FG 501A is used to measure the rise or falltime of a device, the risetime characteristics of associated equipment should be considered. If the risetime of the device under test is at least 10 times greater than the combined risetimes of the FG 501A and associated equipment, the error introduced will not exceed 1%, and generally can be ignored. When the rise or falltime of the test device is less than 10 times as long as the combined risetimes of the testing system, the actual risetime of the system must be calculated. The risetime of the device under test can be determined once the risetime of the system is known.

## IMPEDANCE MATCHING

If the FG 501A is driving a high impedance such as the 1 M $\Omega$  input impedance (paralleled by a stated

capacitance) of the vertical input of an oscilloscope, connect the transmission line to a 50  $\Omega$  attenuator, 50  $\Omega$  termination, and then to the oscilloscope input. The attenuator isolates the input capacitance of the device, and the FG 501A is properly terminated.

## FIRST TIME OPERATION

The Controls and Connectors pages give a description of the front panel controls and connectors. The waveform selection and frequency determining control sare outlined in blue, the trigger function controls and inputs are outlined in green, and the output controls are outlined in black.

The following exercise will familiarize the operator with most functions of the FG 501A.

### NOTE

*If any discrepancies are encountered during the exercise, refer the condition to qualified service personnel,*

Preset the controls as follows:

#### Blue section:

|                   |          |
|-------------------|----------|
| FREQUENCY Hz      | 10       |
| MULTIPLIER        | 10       |
| FREQUENCY VERNIER | Fully cw |
| WAVEFORM—SINE     | in       |
| VAR SYMM          | off      |

#### Green section:

|          |    |
|----------|----|
| FREE RUN | in |
|----------|----|

#### Black section:

|                 |          |
|-----------------|----------|
| ATTENUATOR      | -20 dB   |
| AMPL (variable) | Centered |
| OFFSET          | off      |

Connect a 50  $\Omega$  bnc coaxial cable terminated in 50  $\Omega$  to the vertical input of an oscilloscope. Set the oscilloscope controls to:

|                        |                    |
|------------------------|--------------------|
| Vertical               | 1 V/Div DC Coupled |
| Horizontal (Time Base) | 1 ms/Div           |

The oscilloscope should display 1 complete cycle per division of the sine waveform ( approximately 10 cycles across the graticule),

1. Alternately press the square, triangle and sine buttons and observe the different waveshapes. Return to the preset condition.

2. Alternately press the four attenuator buttons and rotate the AMPL (variable) control to verify that the waveform amplitude changes. Return these controls to the preset condition.

3. Pull the OFFSET knob out and rotate it. Notice the change in dc level of the displayed waveform. Return the OFFSET knob to the in position.

4. Push the VAR SYMM button to release it to the out position. Observe that the  $FREQ \div 10$  indicator is illuminated and only one cycle of the output waveform is displayed. Rotate the VAR SYMM control through its range and notice the change in shape of the square, triangle, and sine waveforms (with the appropriate buttons pushed in). Return the controls to the preset condition.

5. Rotate the FREQUENCY control and the MULTIPLIER switch while observing the change in frequency of the displayed waveform. Return these controls to the preset condition.

## OPERATING MODES

### FREE-RUNNING OUTPUT

The following procedure will provide a free-running output with variable frequency and amplitude.

1. Select the desired waveform.
2. Set the AMPL control fully counterclockwise. Check that the VAR SYMM and OFFSET controls are in the off (in) position.
3. Select the desired frequency with the FREQUENCY Hz dial and MULTIPLIER switch. Frequency equals dial setting times multiplier setting.
4. Connect the load to the FG 501A output connector and adjust the AMPL control for the desired output amplitude.

### TRIGGERED OR GATED (BURST) OPERATION

With the FG 501A set for free-running operation, as described in previous paragraphs, apply the triggering or gating signal to the TRIG/GATE IN connector.

If only one cycle of the output waveform per trigger is desired, push the TRIG button and select + or – slope. One output cycle will now be generated for each input trigger cycle.

If more than one cycle of the output waveform is desired, push the GATE button. The output will now be continuous for the duration of the gating waveform. The number of cycles per burst can be approximated by dividing the gating signal duration by the period of FG 501A output frequency.

In triggered or gated operation the PHASE control varies the start of the output waveform by  $\pm 90^\circ$ . This phase change is measured from the 0 V,  $0^\circ$  point on the output waveform.

### VOLTAGE CONTROLLED FREQUENCY (VCF) OPERATION

The output frequency of any selected waveform can be swept within a range of 1000:1 by applying an external voltage to the VCF INPUT connector. The polarity of the VCF input signal determines which direction the output frequency sweeps from the selected frequency. A positive (+) going signal increases the frequency while a negative (–) going signal decreases the frequency. The amplitude and polarity of the input voltage can be selected within a range of  $\pm 10$  V depending on the FREQUENCY Hz dial setting.

The maximum swept frequency range of 1000:1 encompasses the uncalibrated portion of the FREQUENCY Hz dial ( $<.2$  to  $2$ ). To ensure that the frequency does sweep at least a range of 1000:1, it is recommended that the FREQUENCY Hz dial be set at  $.2$  and a 0 to +10 V signal be applied to the VCF INPUT connector. It may be necessary

to vary the FREQUENCY VERNIER control to obtain the full 1000:1 swept range or the lowest swept frequency desired.

Since the VCF input amplitude is a linear relationship, the frequency output range can be determined from the VCF input amplitude.

## TRIGGER OUTPUT

A +4 V square wave is available from the TRIG OUTPUT connector. The frequency of the trigger output is determined by the frequency of the selected output waveform. One trigger pulse is generated for each positive cycle of the output signal except when square waves are selected. When generating square waves, one trigger pulse is generated for each negative cycle of the output signal. Trigger output impedance is 50  $\Omega$ .

## BASIC WAVEFORM CAPABILITIES

The following photographs illustrate the basic waveform capabilities of the FG 501A.

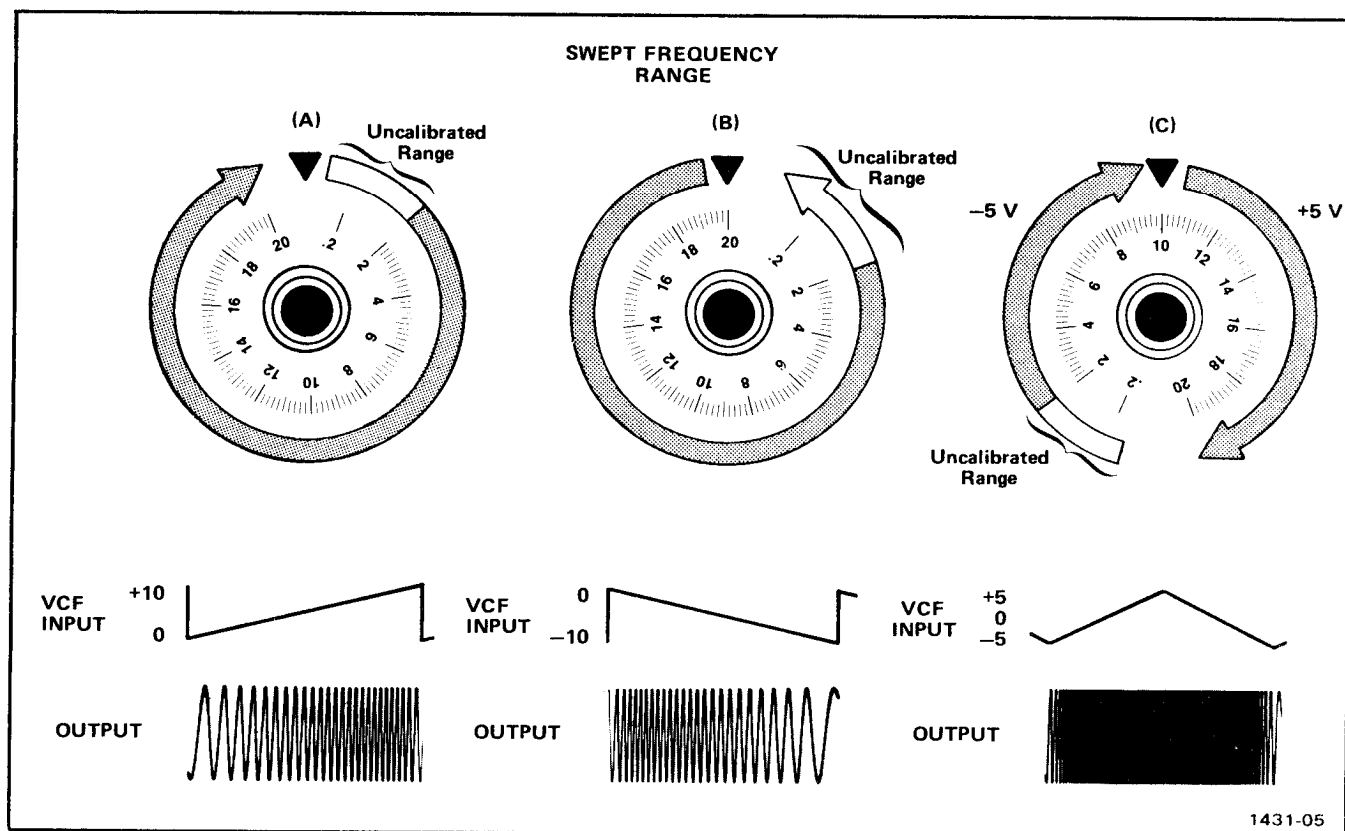


Fig. 2-3. Swept Frequency range with 10 V signals applied to VCF IN connector.

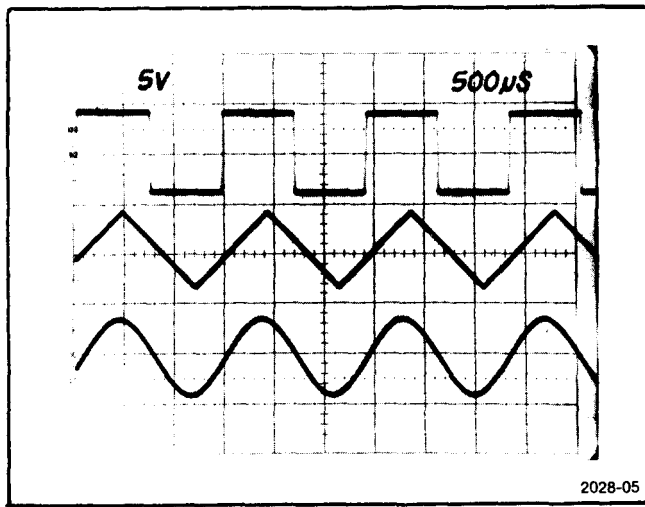


Fig. 2-4. BASIC FUNCTIONS. Square, triangle, and sine waveforms selected by front panel pushbuttons.

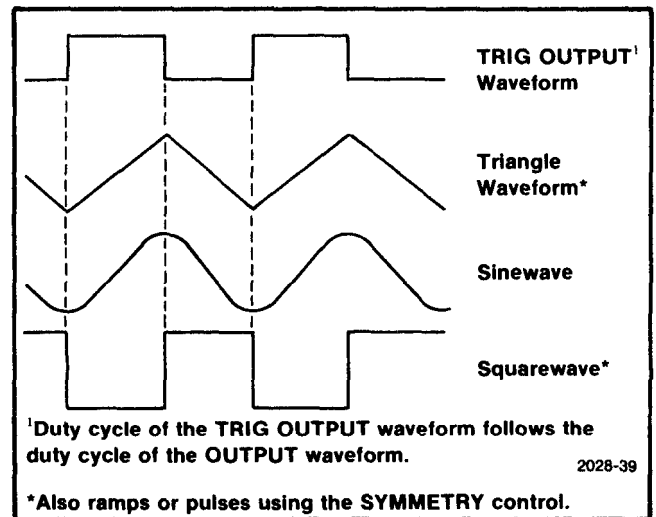


Fig. 2-6. Phase relationships between OUTPUT waveforms and the TRIG OUT waveform.

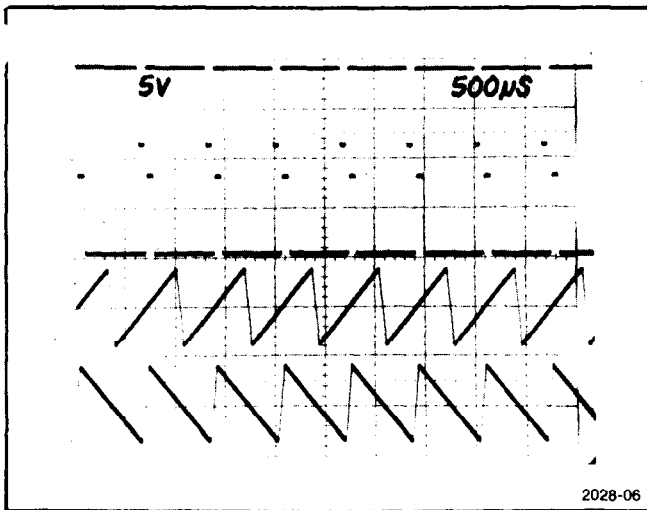


Fig. 2-5. RAMPS AND PULSES. These are obtained from the basic waveforms by using the SYMMETRY control.

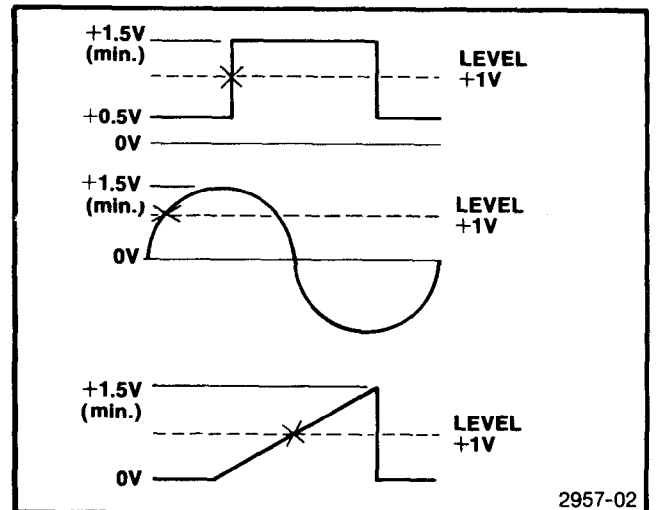


Fig. 2-7. Trigger Signal amplitude requirements and triggering points.

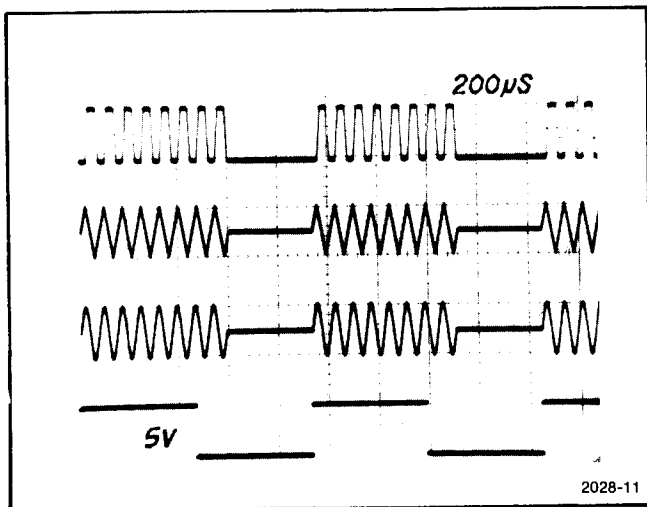


Fig. 2-8. GATED OPERATION. The top three traces are various output waveforms and the bottom trace is the gating waveform applied to the trigger INPUT connector with the GATE pushbutton pressed in. Note the additional cycle completed after the waveforms are gated off.

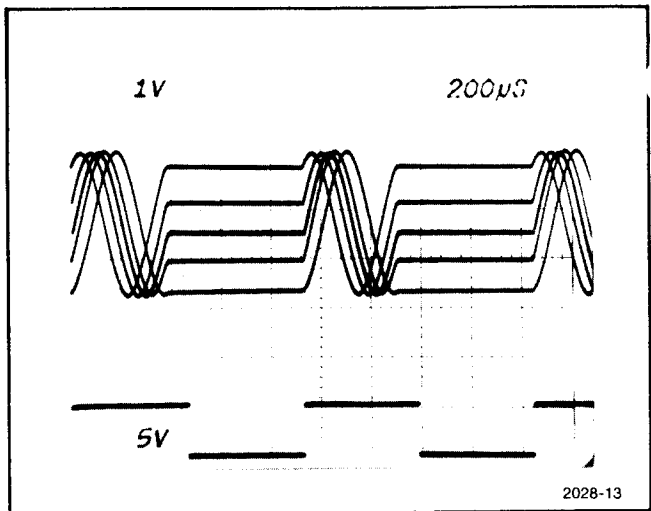


Fig. 2-10. PHASE CONTROL OPERATION. This photograph illustrates PHASE control usage in the triggered mode. The five super-imposed traces illustrate the effect of the phase control. This control provides  $\pm 90^\circ$  of shift. The bottom trace is the triggering waveform.

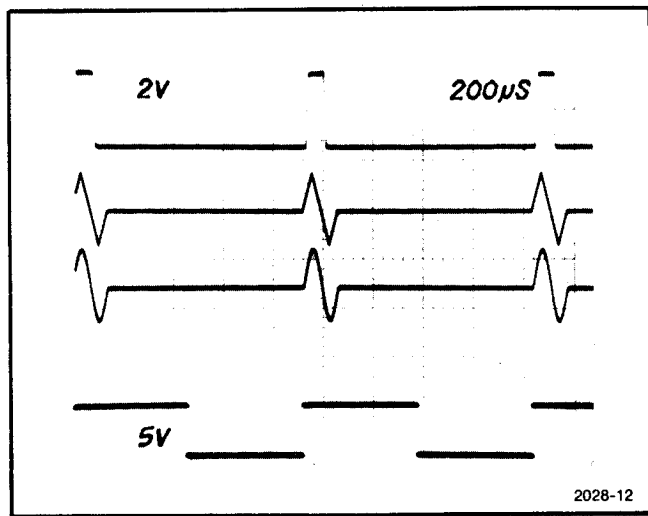


Fig. 2-9. TRIGGERED OPERATION. The top three traces are the various out put traces selected. The bottom trace is the triggering waveform applied to the trigger INPUT connector with the TRIG mode selected. Note that only one cycle of the output waveforms is completed.

# APPLICATIONS

## RESPONSE ANALYSIS

The FG 501A is particularly suited for determining response characteristics of circuits or systems. This application utilizes the VCF input of the FG 501A to sweep the generator over a range of frequencies. Refer to the Voltage Controlled Frequency (VCF) Operation discussion under Operating Modes for additional information.

1. Connect the equipment as shown in Fig. 2-11.
2. Set the MULTIPLIER selector and FREQUENCY Hz dial for the desired upper or lower frequency limit (depending on the direction you wish to sweep).
3. Apply the desired waveform to the VCF INPUT connector. (A positive-going waveform will increase the frequency while a negative-going waveform will decrease it.)
4. Adjust the amplitude of the VCF input waveform for the desired output frequency range.

5. Observe the response characteristics on the monitoring oscilloscope.

The frequency at which a displayed response characteristic occurs can be determined by first removing the VCF input waveform, then manually adjusting the FREQUENCY Hz dial to again obtain the particular characteristic observed in the swept display and reading that frequency on the FREQUENCY Hz dial.

## TONE-BURST GENERATION OR STEPPED FREQUENCY MULTIPLICATION

The FG 501A can be used as a tone-burst generator or frequency multiplier for checking tone-controlled devices. This application utilizes a ramp generator, such as the TEKTRONIX RG 501, as a VCF signal source and a pulse generator, such as the TEKTRONIX PG 501, as a gating signal source.

The following procedure describes a technique for obtaining a tone-burst or frequency multiplied output

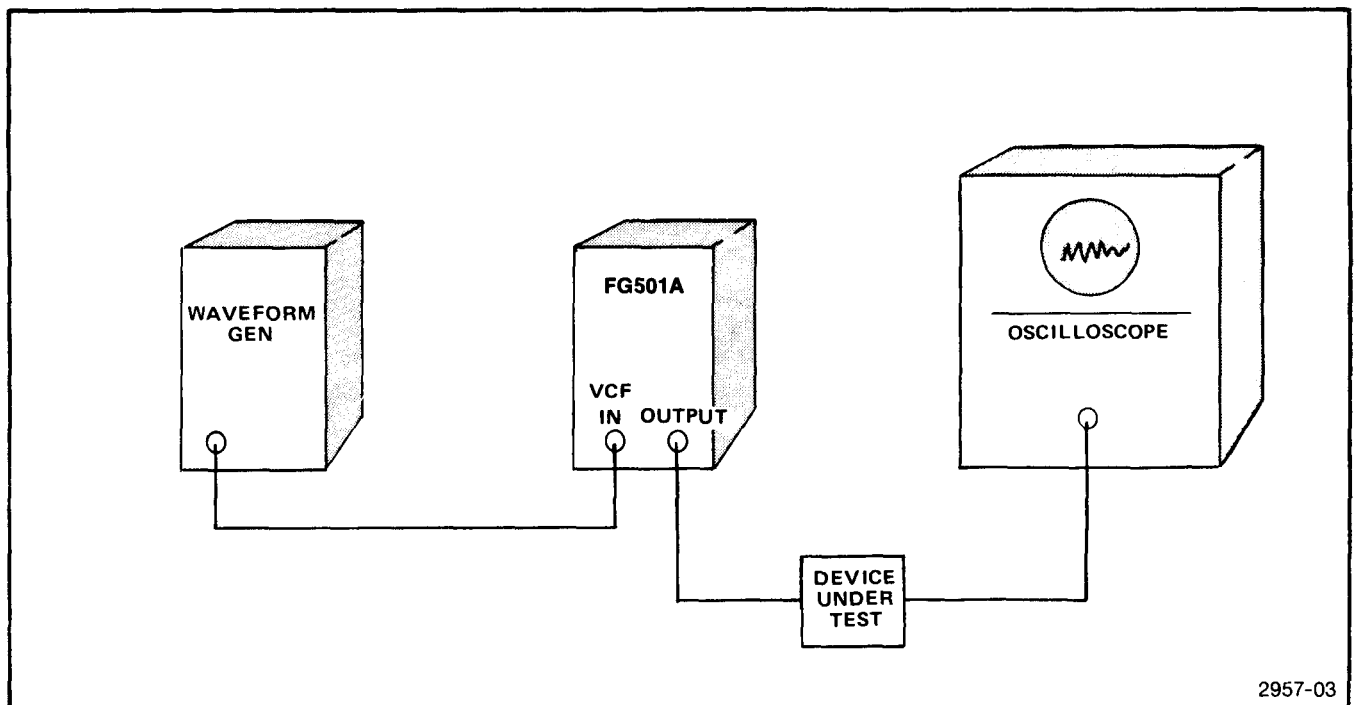


Fig. 2-11. Analyzing circuit or system response.

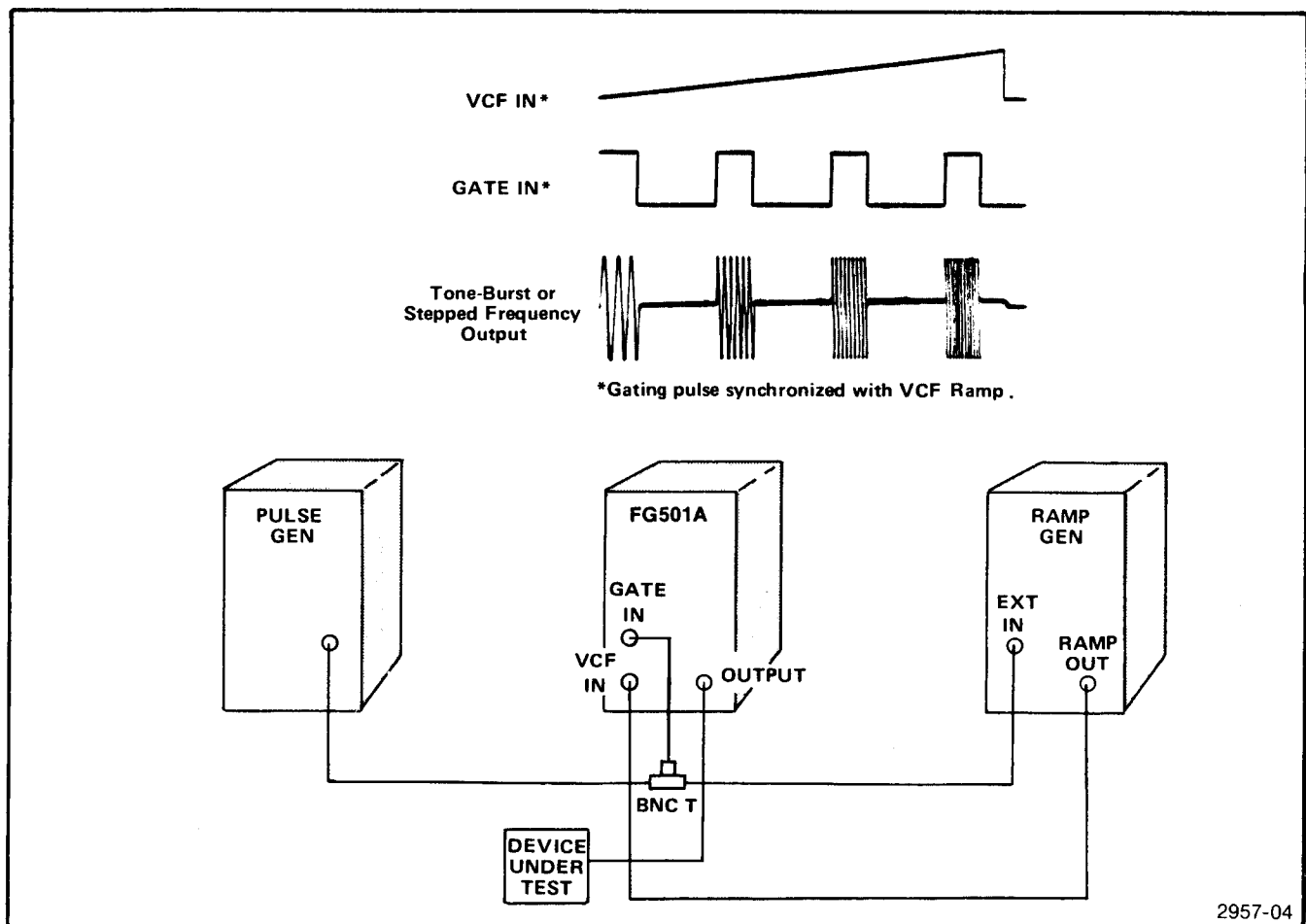
from the FG 501A. Refer to the Gated (burst) Output and Variable Phase and the Voltage-controlled Frequency (VCF) Output discussions under Operation for additional information.

Adjust the pulse generator duration for the desired burst width.

1. Connect the equipment as shown in Fig. 2-12.
2. Push the GATE button in and set the PHASE control to the desired phase.
3. Set the ramp generator for the desired ramp duration and polarity.
4. Adjust the pulse generator period for the desired number of bursts within the selected ramp duration.

5. Select the sweep frequency range by adjusting the FREQUENCY Hz dial for one end of the sweep range (upper or lower limit depending on the polarity of the ramp). Then, adjust the ramp generator amplitude for the other swept frequency limit.

Various other tone-burst or frequency multiplied characteristics can be obtained by using different gating input waveforms, i.e., triangle, sine, square, etc.



**Fig. 2-12. Tone-burst generation or stepped frequency multiplication.**

## SECTION 3

## THEORY OF OPERATION

## INTRODUCTION

This section of the manual contains a description of the electrical circuits in the FG 501A. Refer to the block diagram and schematic diagrams on the fold out pages in the back of the manual to aid in understanding this

description. Diamond enclosed numbers appearing throughout this section refer to the schematic diagram on which the circuit being discussed is located.

LOOP 

## FREQUENCY CONTROL AND SUMMING AMPLIFIER

The voltage developed across the frequency control divider string, R1429, R1321, R500 and R510, is applied to pin 5 of operational amplifier U1540B. This voltage is buffered by the amplifier and a current is developed through R1551. This current is applied top in 2 of summing amplifier U1540A where it is summed with any currents developed by a voltage applied to the VCF inputs. The VCF inputs are J510 (front panel) through R1553, and pin 21B (rear interface) through R1103. These summed currents are buffered by Q1445 and flow through R1543. The voltage developed across R1543 is proportional to the frequency.

## CURRENT SOURCES AND SWITCH

The voltage developed across R1543 is buffered by U1440 and Q1541 which form the negative current source for the main loop timing circuitry. This same voltage is also buffered by U1540C and Q1543 which form a current source identical to U1440 and Q1541. The output current from Q1543 flows through Q1527, Q1525, and Q1421, which form a current mirror that inverts this current to provide the positive current source for the main loop timing circuitry. The current through R1521 is the timing capacitor charging current; the current through R1536 is the discharging current. The Top Dial Symmetry Cal, R1421, adjusts the balance between these two currents so they are equal in magnitude.

In the normal mode of operation (fixed symmetry) R520 and R540 are in the emitter circuit of Q1541 and Q1543. In this condition, equal amounts of current will flow in both the positive and negative current sources. When S500, VAR SYMM, is activated, R530 is switched into the current source emitter circuits. As R530 is varied from one end to the other, unequal amounts of current flow through the

positive and negative current sources. In this manner the symmetry of the waveform generated by the loop is varied. These currents are switched into the junction of CR1531 and CR1533 where they alternately charge and discharge the timing capacitor, producing a triangle waveform. The current switch is formed by Q1531, CR1531, Q1433 and CR1533.

TIMING CAPACITORS AND CAPACITANCE MULTIPLIER 

The timing capacitors provide for triangle generation in the five fastest MULTIPLIER ranges. They are switched into and out of the circuit in decade steps from  $10^5$  (C1631) down to  $10^1$  (C1741).

For the four lower MULTIPLIER ranges,  $10^0$  down to  $10^{-3}$ , C1741 is switched into the feedback loop of U1930 forming an integrator. Current from the current switch is applied to operational amplifier U1940. A voltage is developed at the output of this amplifier that is proportional to the applied current times the value of R1941 (1 k $\Omega$ ). This voltage is applied, across one of four resistors, to the input of U1930. These resistors, R1831, R1841, R1842, and R1843, are switched into and out of the circuit in decade steps with the MULTIPLIER switch S1731. This arrangement provides very large values of effective capacitance. The output of U1930 is now the triangle that is applied to the buffer stage.

TRIANGLE BUFFER 

The voltage developed by the timing capacitor or multiplier (U1930) is applied to the triangle buffer. Q1725 and Q1723 form the differential input stage of this circuit. Q1821 serves as a constant current source for the input differential pair. Q1721 and Q1712 complete the feedback for the amplifier such that the voltage at the emitter of Q1712 is equal to the voltage at the Gate of Q1725.



Loop delay compensation is provided by a network comprised of R1712, R1812, C1712, and C1714. The buffered timing capacitor voltage is applied through this network to the level comparators.

## LEVEL COMPARATORS

The level comparators detect upper and lower threshold levels. U1700A is the upper level detector and U1700B the lower. The reference level for these comparators is supplied by U1400B and C. As the threshold levels are detected, the respective comparator triggers U1600B.

## REFERENCE VOLTAGES

The reference voltage supplies are composed of U1400B (–) and U1400C (+) and associated components. The upper (positive) level threshold voltage is established by adjusting R1412. This resistor is in a voltage divider string from zener diode VR1413. The voltage developed across R1412 is buffered by U1400C and set to approximately +400 mV at the output. This voltage is applied to pin 5 of U1700A as the upper threshold level reference. This same voltage is also applied to pin 9 of inverter U1400B. R1511 is used to adjust the gain of this stage so that the output is nominally –400 mV. This voltage is applied to pin 13 of U1700B as the lower threshold level reference.

## LOOP LOGIC

When a rising voltage at pin 6 of U1700A passes through the threshold level set at pin 5, the output (pin 8) goes low pulling pin 10 of U1600B low. This action sets the flip-flop causing pin 9 (Q) to go high and pin 8 (Q) to go low. Pin 8 of U1600B is tied back, through R1403, to the junction of CR1431 and VR1532. VR1532 serves as a level shifter to change the TTL output gate to the correct level to drive the current switch (Q1531, CR1531, Q1433, CR1533).

As the voltage at the junction of R1532 and R1534 drops, it pulls the bases of Q1531 and Q1433 low. Q1531 is turned on and Q1433 is turned off. Any current from the positive current source, through R1521, now flows through Q1531 and is shunted to the –15 V supply. With Q1433 turned off, any current flow through the negative current source must come from the positively charged timing capacitor through CR1533.

The falling voltage on the timing capacitor is buffered through the triangle buffer and applied to the level comparators U1700A and U1700B. As the voltage at pin 12 of U1700B falls through the threshold level set at pin 13, the output (pin 1) goes low pulling pin 13 of U1600B low. This action resets the flip-flop causing pin 9 (Q) to now go

low and pin 8 ( $\bar{Q}$ ) to go high. Taking this high at pin 8 back to the current switch, Q1531 will be turned off and Q1433 turned on. This allows the timing capacitor to charge in the positive direction.

The action just described generates one entire cycle of a triangle wave.

## TRIGGER GENERATOR

The square wave output at pin 8 ( $\bar{Q}$ ) of U1600B also drives the trigger output amplifier. This circuit is composed of emitter follower Q1431 and associated components. Q1440, in conjunction with R1440, serves as output short circuit protection. The output of this circuit (at J2043) is a square wave 180° out of phase with the main loop signal. The output amplitude is greater than +4 V into an open circuit, and at least +2 V into a 50  $\Omega$  load.

## SQUARE WAVE GENERATOR

The output at pin 9 (Q) of U1600B is a square wave, but 180° out of phase with that at pin 8. This signal is used to drive the square wave generator composed of differential pair Q1801, Q1901, and associated components. The base of Q1901 is held at a constant voltage by divider network R1815 and R1818. R1728 and R1816 form a constant current source for the differential pair. The square wave from U1600B alternately switches this constant current to ground through Q1801 or through R1819 and Q1901. In this manner, a square wave voltage is developed with dc levels sufficient to drive the output amplifier for the square wave function.

## PHASE CLAMP THRESHOLD DETECTOR

The output of the triangle buffer, in addition to possibly being fed to the Output Amplifier through S1901B, is connected to the base of Q1711. Q1711 and Q1611 form a differential amplifier. Q1621 and associated components provide a constant current source for the differential pair. This amplifier senses the level of the triangle waveform and compares it to the output voltage of U1400A. The output voltage of U1400A is determined by the setting of the VAR 0 control, R550. The voltage range of R550 is established by reference voltage supplies U1400B (–) and U1400C (+). These are the same reference voltages supplied to the Level Comparators. This arrangement permits comparison of the triangle voltage with the maximum possible positive and negative levels, and all levels between.

When the triangle voltage exceeds the reference voltage set by the VAR 0 control, Q1711 turns off. Any current flowing through Q1621 now flows through Q1611.

## CURRENT AMPLIFIER

Current flowing through Q1611 also flows through R1622 and is amplified by Q1521. Temperature compensation for this amplifier is provided by CR1621. Differential pair Q1511 and Q1523 serve as a current switch. With Q1511 turned off, any current amplified by Q1521 passes through Q1523 to the junction of CR1531 and CR1533. When the timing capacitor voltage rises to the threshold

level set by the VAR 0 control, R550, it is clamped. Q1523 now draws exactly the amount of current that the positive current source supplies. Because the square wave at pin 5 (Q) of U1600A drives the base of Q1511, the clamping action only happens during the positive edge of the triangle wave. On the negative transition, Q1523 is shut off, and Q1511 is on. In this manner, the timing capacitor voltage can be clamped at any desired positive level.

## TRIG/GATE AMP AND SINE SHAPER

### TRIG/GATE AMP AND LOGIC

The input trigger amplifier consists of an emitter coupled differential pair (Q1320 and Q1322), current amplifier Q1324, and the required logic circuitry to control the operation of the main loop phase clamp. Input circuit protection is provided by R1203, R1204, CR1220 and CR1221. Triggering signals are applied either through front panel connector J520 or interface connections on the rear edge of the Main circuit board.

The differential pair, Q1320-Q1322, responds to the input signal when the voltage rises above (+ SLOPE) the reference voltage at the base of Q1320. This reference voltage is established by divider network R1312 and R1314. The position of S1400D, SLOPE switch, determines whether a positive or negative going input will cause the amplifier Q1324 to conduct. When the threshold level is exceeded and conduction starts, current flow through the circuit causes a voltage to be developed across R1322. This voltage is applied to the base of Q1324. The output at the collector of Q1324 is a TTL compatible waveform to drive the logic circuit, U1310. CR1320 provides temperature compensation for Q1324.

Three modes of operation are selectable with S1400; Triggered, Gated, and Free Running.

In the TRIG mode, S1400A and S1400C are positioned such that the output, pin 6, of U1310B is connected to pin 4, set input, of U1600A. In this mode, a very narrow, negative going voltage pulse is developed by U1310B each time the input waveform passes through the trigger threshold. This low sets U1600A, which deactivates the phase clamp until the triangle generator again starts in the positive direction, and allows the generator to complete one full cycle.

In the GATE mode, S1400A and S1400C are positioned such that the output, pin 3, of U1310A is connected to pin 4, set input, of U1600A. In this mode, a low level is produced whenever the input waveform exceeds the threshold if + SLOPE is selected. The generator free runs

as long as this condition exists. As soon as the level at the input connector drops below the threshold, the output voltage of U1310A rises. This high level causes the generator to again stop running when the phase clamp reaches its threshold level at the end of the last complete cycle.

In the FREE RUN mode, S1400A is positioned such that pin 4 of U1600A is held low. The generator now outputs continuous waveforms.

### SINE SHAPER

The Sine Shaper is composed of three separate circuit functions: a Transconductance Amplifier, the Shaper Circuitry, and an Output Buffer.

**Transconductance Amplifier.** Emitter coupled transistors Q1210 and Q1212 along with current source Q1200 form the Transconductance Amplifier. The amplifier converts the triangle voltage at the base of Q1212 to a differential current. This current flows through two sets of diode wired transistors, U1120C, U1120D, U1220C, and U1220D, to the input of the shaper.

**Shaper.** The active portion of the Shaper is formed by two sets of emitter coupled transistors U1220A, U1220B, U1120A and U1120B. These devices have their inputs wired in series and their outputs cross coupled. U1120E and U1220E are current sources for these devices. The circuit operates by generating a power series approximation to the sine function. The devices in U1120 generate the first order term while those in U1220 generate the second order term in the approximation.

**Output Buffer.** The Output Buffer is an operational amplifier that converts the differential current from Q1010 and U1020D to a single ended voltage that is applied, through the function switch, to the output amplifier. U1020E is a current source for the emitter coupled differential input pair U1020A and U1020B. Q1012 serves as a current mirror for U1020A and as an active load for U1020B. U1020C is the output emitter follower and R1020 is the feedback resistor.

## OUTPUT AMPLIFIER & ATTENUATORS

The output amplifier is basically a noninverting operational amplifier whose plus input is the base of Q2101 and minus input is the base of Q2113.

The three basic waveforms are selected by S1901 and applied across R560B and R2335 to the input stage of the amplifier. R560B varies the amplitude of the selected waveform. The feedback network consists of R2011 and R2012, connected from the output to the minus input of the amplifier. C2011 provides high frequency compensation for the feedback, and is used to adjust the squarewave front corner. The input pair, Q2101 and Q2113, amplify the difference between the input waveform and the feedback waveform.

An offset current is also summed with the feedback signal at the base of Q2113 when S510A is closed. This allows R560A to control the dc offset of the output signal.

The output of Q2101 is applied directly to Q2111 which is cascoded with Q2011. The output of Q2113 passes through an inverting amplifier, Q2211, before passing to Q2213 cascoded with Q2311. CR2111 provides temperature compensation for Q2211. The two cascodes form drivers for the amplifier output stage.

The output stage consists of Q2013 and Q2123 in parallel with Q2121 for amplification of positive going signals. Q2321 and Q2323 in parallel with Q2325 form the amplifier for negative going signals. The output is taken at the junction of R2026 and R2228. The 50  $\Omega$  output impedance is determined by parallel 100  $\Omega$  resistors R2033 and R2131. C2121 in this network provides high frequency compensation for the output impedance. The attenuator circuit is a constant impedance resistive divider network, switch selectable in 20 dB steps.

## POWER SUPPLY

The FG 501A receives its power from the power module via interface connections on the rear edge of the Main circuit board. The power module supplies plus (+) and minus (–) 33.5 Vdc (unregulated) from which the following regulated voltages are generated.

### +20 V SUPPLY

The +33.5 V from the power module is filtered and applied to voltage regulator U1210 (pins 11 and 12). This regulator contains its own reference, operational amplifier, and current limiting elements. The output of the regulator is applied to Q1231 which serves as a driver the the series pass transistor located in the power module. The +20 V output is applied across voltage divider R1201, R1301, and R1315. The output level of the supply is set by R1301 (+15 V Adj) which compares the supply output to the internal reference level of the regulator. This supply is current limited through the action of R1121 and the current limiting element in the regulator. When excessive amounts of current are drawn from the supply, the voltage developed across R1121 turns on the current limiting element in the regulator (U1210). This action reduces the base drive, through Q1231, to the series pass transistor causing the supply to reduce output. This supply is the reference for other supplies in the FG 501A.

### +15 V SUPPLY

The +15 V supply consists of U1230D and Q1221. U1230D serves as an error amplifier which compares the F15 Voutput of the supply to a +15 Preference developed by divider network R1231, R1232 and R1233 from the

+20 V supply. Since this supply is sourced from the +20 V, it is inherently current limited by the +20 V supply.

### +5 V SUPPLY

The +5 V supply consists of U1230C and Q1331. U1230C serves as an error amplifier which compares the +5 V output to a +5 V reference developed by divider network R1231, R1232 and R1233 from the +20 V supply. Since this supply is sourced from the +15 V and referenced to the +20 V supply, it is inherently current limited under the same conditions that limit those supplies.

### –20 V SUPPLY

The –20 V supply is derived from –33.5 V supplied by the power module. The output of operational amplifier U1230A is applied, through Q1245, to the base of Q1241, which serves as a driver for the series pass transistor located in the power module. This supply is also referenced to the +20 V. The supply is current limited through the action of R1141 and Q1243. When excessive amounts of current are drawn through R1141, a voltage sufficient to turn Q1243 on develops across R1141. This action reduces the base drive to the series pass transistor causing the supply to reduce output.

### –15 V SUPPLY

The –15 V supply consists of operational amplifier (U1230B) and a series pass feedback regulator (Q1345). The output of the supply is fed back through divider network R1247, R1341, and R1245. The output level is adjusted by R1341. Because this supply is sourced from the –20 V supply, it is current limited by the –20 V supply.

## SECTION 4

**CALIBRATION****PERFORMANCE CHECK****INTRODUCTION**

This procedure checks the Electrical Performance Requirements as listed in the Specification section in this manual. Perform the internal adjustment procedure if the instrument fails to meet these checks. If recalibration does not correct the discrepancy, circuit troubleshooting is indicated. Also, use this procedure to determine acceptability of performance in an incoming inspection facility. For convenience, many steps in this procedure check the performance of this instrument at only one value in the

specified performance range. Any value within the specified range, within appropriate limits, may be substituted.

**TEST EQUIPMENT REQUIRED**

The test equipment, or equivalent, listed in Table 4-1 is suggested to perform the performance check and the adjustment procedure.

Table 4-1

**TEST EQUIPMENT REQUIRED**

| Item | Description                       | Minimum Specifications                                                                   | Application |          | Example                      |
|------|-----------------------------------|------------------------------------------------------------------------------------------|-------------|----------|------------------------------|
|      |                                   |                                                                                          | Perf Check  | Adj Proc |                              |
| 1    | Power Module                      | Five compartments or more.                                                               | X           | X        | TEKTRONIX TM 515 or TM 506   |
| 2    | Oscilloscope System               | Minimum Vertical deflection<br>Sweep Rate .5 $\mu$ s.                                    | X           | X        | TEKTRONIX 7704/4/7A16A/7B50  |
| 3    | Differential Comparator Amplifier | Minimum Vertical deflection factor .1 V/div                                              | X           | X        | TEKTRONIX 7A13               |
| 4    | Sampling System                   |                                                                                          |             | X        | Tektronix 7704/7S11/7T11/S-1 |
| 5    | Spectrum Analyzer                 |                                                                                          | X           |          | TEKTRONIX 7L12               |
| 6    | Distortion Analyzer               | Frequency range from 20 Hz to at least 300 kHz. Distortion resolution <0.25%             | X           | X        | TEKTRONIX AA 501             |
| 7    | Frequency Counter                 | Frequency range 0.002 Hz to above 2 MHz. Accuracy within one part in $10^4 \pm 1$ count. | X           | X        | TEKTRONIX DC 504             |
| 8    | Digital Multi meter               | Range to $\pm 30$ V 5 1/2 digits Accuracy 0.1%.                                          | X           | X        | TEKTRONIX DM 501             |
| 9    | Pulse Generator                   | 0 to 2 V square wave output into 50 $\Omega$ load. Period 2 $\mu$ s; Duration .1 $\mu$ s | X           |          | TEKTRONIX PG 501             |
| 10   | Power Supply                      | 0 to 10 V range Accuracy $\pm 10\%$                                                      | X           |          | TEKTRONIX PS 501-1           |

Table 4-1 (cont)

| Item | Description             | Minimum Specifications                      | Application |          | Example                        |
|------|-------------------------|---------------------------------------------|-------------|----------|--------------------------------|
|      |                         |                                             | Perf Check  | Adj Proc |                                |
| 11   | Flexible Extender Cable | Compatible with TM 500-Series Power Modules |             | X        | Tektronix Part No. 067-0645-02 |
| 12   | Meter Lead              | Black                                       | X           | X        | Tektronix Part No. 012-0462-00 |
| 13   | Meter Lead              | Red                                         | X           | X        | Tektronix Part No. 012-0462-01 |
| 14   | Oscilloscope Probe      | X10 10 M $\Omega$                           | X           | X        | Tektronix Part No. 010-6053-13 |
| 15   | Coaxial Cable           | 50 $\Omega$ BNC Connectors                  | X           | X        | Tektronix Part No. 012-0057-01 |
| 16   | Termination             | 50 $\Omega$ BNC Connectors                  | X           | X        | Tektronix Part No. 011-0049-01 |
| 17   | X10 Attenuator          | 50 $\Omega$ (20 dB) BNC                     |             | X        | Tektronix Part No. 011-0059-02 |
| 18   | X5 Attenuator           | 50 $\Omega$ (14 dB) BNC                     |             | X        | Tektronix Part No. 011-0060-02 |
| 19   | Adapter                 | BNC Female to Dual Banana                   | X           | X        | Tektronix Part No. 103-0090-00 |

### 1. Check Frequency Range

a. Connect the OUTPUT connector of the FG 501 to the counter input.

b. Press the FEE RUN and 0 dB pushbuttons.

c. Press either the  $\sim$ ,  $\sqcap$  or  $\simeq$  pushbuttons.

d. Make certain the VAR SYMM and OFFSET controls are off.

e. Set the FREQUENCY Hz dial to 20 and the MULTIPLIER control to the 10<sup>5</sup> position.

f. Adjust the AMPLITUDE control for a stable counter display.

g. CHECK - that the counter reads  $\geq 2$  MHz.

h. Activate the VAR SYMM control.

i. Adjust the VAR SYMM control for a 50% duty cycle pulse waveform.

j. CHECK - that the counter reads from 180 kHz to 220 kHz.

k. Change the MULTIPLIER to 10<sup>3</sup>.

l. CHECK - for an output frequency of between 0.0019 Hz and 0.0021 Hz.

m. Disable the VAR SYMM control.

n. Change the FREQUENCY Hz dial to 2.

o. CHECK - that the FREQUENCY Hz dial can be adjusted to obtain 0.0002 Hz.

p. Disconnect the counter for the next step

## 2. Check Variable Symmetry Duty Cycle

- a. Press the FREE RUN, 0 dB and  $\square$  pushbuttons.
- b. Release the VAR SYMM pushbutton.
- c. Connect the OUTPUT connector through a 50  $\Omega$  coaxial cable to the oscilloscope vertical input:
- d. Adjust the START, MULTIPLIER, AMPLITUDE, and oscilloscope controls to display a squarewave that occupies exactly 10 major divisions for one cycle.
- e. Rotate the VAR SYMM control from fully cw to fully CCW.
- f. CHECK - that the oscilloscope display varies each squarewave half cycle from  $\leq 1/2$  major division to  $\geq 9.5$  major divisions.
- g. Leave these connections for the next step.

## 3. Check Output Amplitude

- a. Using the same setup as in the previous step, turn the AMPLITUDE control fully cw.
- b. CHECK - that the waveform on the oscilloscope display is  $\geq 30$  V peak to peak.
- c. Remove the coaxial cable from the oscilloscope vertical input and connect a 50  $\Omega$  termination in series with the cable.
- d. CHECK - that the oscilloscope display is  $\geq 15$  V peak to peak.
- e. Disconnect the 50  $\Omega$  cable and remove the 50  $\Omega$  termination from the oscilloscope for the next step.

## 4. Check Offset Range

- a. Press the TRIG 0 dB, and  $\curvearrowright$  pushbuttons.
- b. Make certain the VAR SYMM pushbutton is in.
- c. Connect a dmm set to read  $\pm 15$  V to the output connector.

- d. Adjust the VAR  $\emptyset$  control for a 0 V reading on the dmm.
- e. Pull and turn the OFFSET control fully cw to fully CCW.
- f. CHECK - that the dmm reads  $\geq \pm 13$  V at the appropriate stops for the OFFSET control.
- g. Remove the coaxial cable from the dmm and insert a 50  $\Omega$  termination.
- h. CHECK - that the dmm reads at least  $\pm 6.5$  V at the appropriate stops of the OFFSET control.
- i. Remove the connections from the dmm for the next step.

## 5. Check Amplitude Flatness

- a. Press the FREE RUN, 0 dB and  $\curvearrowright$  pushbuttons.
- b. Make certain the OFFSET is off.
- c. Set the FREQUENCY Hz dial to 10 and the MULTIPLIER to  $10^3$ .
- d. Connect the OUTPUT connector through a 50  $\Omega$  cable and 50  $\Omega$  termination to the vertical input of the differential oscilloscope plug-in.
- e. Adjust the AMPLITUDE control and the gain of the vertical amplifier for an 8 major division peak to peak display.
- f. Increase the vertical amplifier gain by a factor of 10.
- g. Adjust the vertical amplifier plug-in offset voltage so that the waveform peaks are on the oscilloscope graticule center line.
- h. Change the output to any frequency from 20 Hz to 20 kHz.
- i. CHECK - that the display is within 0.46 major divisions from graticule center.

## TM 9-6625-474-14&P-2

- j. Change the output to any frequency from 20 kHz to 1 MHz.
  - k. CHECK - that the display is within 2.37 major divisions from graticule center.
  - l. Decrease the vertical gain of the oscilloscope by a factor of 10 and adjust the offset voltage to 0.
  - m. Adjust the output frequency to 10 kHz.
  - n. Adjust the oscilloscope vertical gain and the AMPLITUDE control for a 6 major division peak to peak display.
  - o. Change the output to any frequency from 1 MHz to 2 MHz.
  - p. CHECK - that the peak to peak display amplitude is from 5.36 to 6.73 major divisions.
  - q. Press the  pushbutton.
  - r. Set the output frequency to 10 kHz.
  - s. Adjust the AMPLITUDE control and the vertical comparator oscilloscope plug-in for an 8 major division peak to peak display.
  - t. Increase the oscilloscope vertical plug-in gain by a factor of 10.
  - u. Adjust the vertical plug-in offset voltage so that the positive peaks of the squarewaves are at graticule center.
  - v. Change the output to any frequency from 20 Hz to 2 MHz.
  - w. CHECK—that the positive squarewave peaks are within  $\pm 2.37$  major divisions from graticule center.
  - x. Press the  pushbutton.
  - y. Change the output frequency to 10 kHz.
  - z. Decrease the oscilloscope vertical plug-in gain by a factor of 10.
  - aa. Adjust the vertical plug-in offset voltage to 0.
  - bb. Adjust the AMPLITUDE control and the vertical plug-in gain for an 8 major division oscilloscope display of the triangle waveform.
  - cc. Increase the plug-in gain by a factor of 10.
  - dd. Adjust the offset voltage so that the positive peak of the triangle waveform is at graticule center.
  - ee. Change the output to any frequency from 20 Hz to 200 kHz.
  - ff. CHECK - that the positive peak of the triangle waveform is 2.37 major divisions or less from the graticule center.
  - gg. Decrease the vertical amplifier gain by a factor of 10.
  - hh. Remove the comparison voltage from the vertical plug-in.
  - ii. Adjust the AMPLITUDE control and the vertical plug-in gain for a peak to peak triangle waveform display of 6 major divisions.
  - jj. Change the output to any frequency from 200 kHz to 2 MHz.
  - kk. CHECK - that the peak to peak display reads from 4.4 major divisions to 7.6 major divisions in amplitude.
  - ll. Disconnect the oscilloscope for the next step.
- ### 6. Check Sinewave Distortion
- a. Press the FREE RUN, 0 dB, and  pushbuttons. The VAR SYMM, and OFFSET controls must be off (in).
  - b. Connect the OUTPUT connector through a 50  $\Omega$  coaxial cable and 50  $\Omega$  termination to the distortion analyzer.
  - c. Set the distortion analyzer to measure total harmonic distortion plus noise with average response.

d. Make certain the function generator is in an ambient temperature from 20° C to 30° C.

e. Select any frequency from 20 Hz to 20 kHz with the FREQUENCY Hz and MULTIPLIER controls. The FREQUENCY Hz control must be on the calibrated portion of the dial and the MULTIPLIER control must be on the 10<sup>3</sup> range or below.

f. Adjust the AMPLITUDE control for a 15 V peak to peak signal at the input of the distortion analyzer.

g. CHECK - that the distortion is  $\leq 0.25\%$ .

h. Select any frequency from 20 kHz to 100 kHz. The FREQUENCY Hz control must be on the calibrated portion of the dial.

i. CHECK - that the distortion is  $\leq 0.5\%$ .

j. Disconnect the distortion analyzer and the 50  $\Omega$  termination from the coaxial cable.

k. Connect the coaxial cable to the input of the spectrum analyzer.

l. Set the FREQUENCY Hz dial at 10 and the MULTIPLIER at 10<sup>4</sup>.

m. Adjust the AMPLITUDE control and the spectrum analyzer controls so that amplitudes 30 dB or greater below the fundamental amplitude are easily viewed on the spectrum analyzer.

n. Rotate the FREQUENCY Hz dial to 20, change the MULTIPLIER to 10<sup>5</sup>, and rotate the FREQUENCY Hz dial from 20 to 2.

o. CHECK - that all harmonics from 100 kHz to 2 MHz are at least 30 dB below the fundamental amplitude.

p. Remove the connections to the spectrum analyzer for the next step.

## 7. Check Squarewave and Pulse Output

a. Press the FREE RUN, 0 dB and  pushbuttons. All other pushbuttons out.

b. Set the FREQUENCY Hz dial and the MULTIPLIER control for any calibrated frequency. (For ease, the FREQUENCY Hz dial at 20 and the MULTIPLIER at 10<sup>5</sup> are recommended. )

c. Turn the AMPLITUDE control fully cw.

d. Connect the OUTPUT connector through a 50  $\Omega$  coaxial cable and the necessary attenuators to obtain a 5 division display to the 50  $\Omega$  vertical input of the sampling oscilloscope.

e. Connect the TRIG OUTPUT connector through a 50  $\Omega$  coaxial cable and the necessary attenuators to the external trigger input on the sampling oscilloscope.

f. Obtain a stable rise and fall time display on the oscilloscope.

g. CHECK - that the rise time and fall time is  $\leq 25$  ns from the 10% to the 90% amplitude points.

h. CHECK - that the peak to peak amplitude of the front corner ringing does not exceed 3% of the total squarewave amplitude. (If the squarewave amplitude is 8 major divisions, maximum aberrations allowed are 0.24 major divisions. )

i. Release the VAR SYMM pushbutton.

j. Adjust the VAR SYMM control for a pulse waveform.

k. Repeat steps f and g.

l. Remove all connections for the next step.

## 8. Check VCF Input

a. Press the FREE RUN, 0 dB and  pushbuttons. The VAR SYMM and OFFSET pushbuttons should be in. Set the FREQUENCY Hz dial to 20 and the MULTIPLIER to 10<sup>5</sup>.

b. Connect the OUTPUT connector through a 50  $\Omega$  coaxial cable to the input of the frequency counter.

c. Obtain a stable counter display.

d. Apply -10 Vdc to the VCF INPUT connector.



CHECK - that the frequency decreases by a factor of  $\geq 1000$ .

f. Remove all connections for the next step.

**9. Check External Trigger/Gate Input**

a. Press the TRIG, 0 dB, and  $\curvearrowright$  pushbuttons.

b. Connect the OUTPUT connector to the vertical input of the oscilloscope.

c. Connect the pulse generator through a 50  $\Omega$  coaxial cable and 50  $\Omega$  termination to the TRIG/GATE IN connector.

d. Set the pulse generator for a 0 to 1.2 V positive going 50% duty cycle pulse at 1/2 the frequency of the FG 501A.

e. CHECK - for one cycle of a sine waveform for each trigger pulse.

f. Press the GATE pushbutton.

g. CHECK - for an output waveform that lasts for the duration of the gating waveform.

h. Remove all connections for the next step.

**10. Check Trigger Output**

a. Press the FREE RUN pushbutton.

b. Connect the TRIG OUTPUT connector through a 50  $\Omega$  coaxial cable to the vertical input of the oscilloscope.

c. CHECK - for a  $\geq +4$  V waveform on the oscilloscope display.

d. Insert a 50  $\Omega$  termination from the coaxial cable to the oscilloscope vertical input.

e. CHECK - for a  $\geq +2$  V waveform on the oscilloscope display.

f. Remove all connections for the next step.

**11. Check Variable Phase Range**

a. Press the FREE RUN, 0 dB, and  $\curvearrowright$  pushbuttons.

b. Connect the OUTPUT connector to the vertical input of the oscilloscope. Set the oscilloscope for automatic triggering.

c. Obtain a sine waveform on the oscilloscope centered around 0 V. Determine the peak-to-peak amplitude of the waveform.

d. Press the TRIG pushbutton.

e. Rotate the VAR 0 from stop to stop and observe the position of the free running trace on the oscilloscope display.

f. CHECK - that the straight line can be positioned at the peak amplitudes of the sine waveform.

g. Remove all connections for the next step.

**12. Check Attenuator Accuracy**

a. Press the FREE RUN, 0 dB and  $\curvearrowright$  pushbuttons.

b. Set the FREQUENCY Hz dial to 20.

c. Set the MULTIPLIER to the  $10^3$  position.

d. Set the AMPLITUDE control fully cw.

e. Connect the OUTPUT connector through a 50  $\Omega$  coaxial cable and 50  $\Omega$  termination to the input of the dB ratio meter (AA 501).

f. Set the AA 501 for automatic level ranging.

g. Push the 0 dB REF button on the AA 501.

h. Push the -20 dB pushbutton.

i. CHECK - that the ratio meter reads from -19 dB to -21 dB.

j. Push the -40 dB pushbutton.

k. CHECK-that the display reads from -39 dB to -41 dB.

l. Push the -60 dB pushbutton.

m. CHECK-that the display reads from -59 dB to -61 dB.

n. Remove all connections for the next step.

#### 12A. Alternate Procedure for Checking Attenuator Accuracy

a. Press the FREE RUN, 0 dB, and  $\sqrt{}$  pushbuttons.

b. Set the FREQUENCY Hz dial to 20.

c. Set the MULTIPLIER to  $10^3$  position. Connect the output through a coaxial cable to the oscilloscope vertical input.

d. Adjust the AMPLITUDE control for exactly a 30 V peak to peak sinewave.

e. Push the -20 dB pushbutton.

f. CHECK-for a waveform amplitude from 2.67 V to 3.37 v.

g. Press the -40 dB pushbutton.

h. CHECK-for a waveform amplitude from 0.267 V to 0.337 V.

i. Press the -60 dB pushbutton.

j. CHECK-for a waveform amplitude from 0.0267 V to 0.0337 v.

k. Remove all connections for the next step.

#### 13. Check Triangle Time Symmetry

a. Press the FREE RUN pushbutton.

b. Set the FREQUENCY Hz and MULTIPLIER control for any frequency from 20 Hz to 200 kHz in the calibrated portion of the dial. Connect the counter through a coaxial cable to the TRIG OUTPUT connector.

c. Trigger the counter to read the time of the positive-going half cycle of the trigger waveform (+ slope).

d. Record this reading.

e. Trigger the counter to read the negative-going half cycle of the triggering waveform (- slope).

f. Record this reading.

g. CHECK-that the time difference of both readings is  $\leq 1$

h. Set the FREQUENCY Hz and MULTIPLIER controls for a frequency from 200 kHz to 2 MHz in the calibrated portion of the FREQUENCY Hz dial.

i. Repeat steps c through f.

j. CHECK-that the time difference is  $\leq 5\%$ .

k. Remove all connections.

# ADJUSTMENT PROCEDURE

## INTRODUCTION

Use this Adjustment Procedure to restore the FG 501A to original performance requirements. This Adjustment Procedure need not be performed unless the instrument fails to meet the Performance Requirements of the Electrical Characteristics listed in the Specification section, or if the Performance Check procedure cannot be completed satisfactorily. If the instrument has undergone repairs, the Adjustment Procedure is recommended.

Satisfactory completion of all adjustment steps in this procedure assures that the instrument will meet the performance requirements.

## SERVICES AVAILABLE

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

## RECALIBRATION INTERVAL

Recommended recalibration interval is 2000 hours of operation or six months, whichever occurs first.

## TEST EQUIPMENT REQUIRED

The test equipment (or equivalent) listed in Table 4-1 is required for adjustment of the FG 501A. Specifications given for the test equipment are the minimum necessary for accurate adjustment. All test equipment is assumed to be correctly calibrated and operating within specifications.

If other test equipment is used, calibration setup may need to be altered to meet the requirements of the equipment used.

## PREPARATION

Access to the internal adjustments is achieved most easily when the FG 501A is connected to the power module with a flexible extender (see equipment list). Removal of the left side cover provides access to all internal adjustments. Refer to the Adjustment Locations in the pullout pages at the rear of the manual.

Make adjustments at an ambient temperature between +20°C and +25°C.

## PRELIMINARY SETTINGS

Preset the FG 501A and test equipment controls as follows:



*To prevent damage to equipment, be sure the power module and oscilloscope mainframe power is off before inserting or removing plug-in units.*

### Power Module

|                                                                                                |                |
|------------------------------------------------------------------------------------------------|----------------|
| LINE SELECTOR                                                                                  | HI             |
|                                                                                                | FG 501A        |
|  (pushbutton) | in             |
| FREE RUN (pushbutton)                                                                          | in             |
| 0 dB (pushbutton)                                                                              | in             |
| FREQUENCY Hz dial                                                                              | 20             |
| VAR SYMM                                                                                       | Mid-range & in |
| VAR 0                                                                                          | Mid-range      |
| MULTIPLIER                                                                                     | 103            |
| VAR (frequency)                                                                                | cw             |
| OFFSET                                                                                         | Mid-range & in |
| AMPL                                                                                           | cw             |

### Digital Multimeter (DM 501)

|                |             |
|----------------|-------------|
| RANGE/FUNCTION | 20 DC VOLTS |
| INPUT          | EXT         |

## POWER SUPPLIES

### 1. Adjust the +15 V ADJ (R1301), $\pm 0.1\%$

a. Insert the FG 501A and digital multi meter into the power module.

b. Connect the power module power cord to 117 Vac source and turn on the power module.

c. Connect the test leads to the digital multi meter HI and LO INPUTS.

d. Connect the digital multi meter LO test lead to the FG 501A chassis ground. Connect the HI test lead to the FG 501A test point, TP1323 located on the Main board.

e. ADJUST-potentiometer R1301 located on the Main board until the digital multi meter readout indicates between +14.985 and +15.015.

**2. Adjust the -15 V ADJ (R1341),  $\pm 0.1\%$**

a. Remove the digital multi meter HI test lead from TP1323 and connect to test point, TP1451 (also located on the Main board).

b. ADJUST-potentiometer R1341 located on the Main board until the digital multi meter readout indicates between -14.985 and -15.015.

**3. Check the +5 V Supply Accuracy,  $\pm 0.5\%$**

a. Remove the digital multi meter HI test lead from TP1451 and connect to test point, TP1331 located on the Main board.

b. The digital multi meter must indicate a readout between +4.975 and +5.025.

**4. Check the +20 V Supply Accuracy,  $\pm 0.5\%$**

a. Change the digital multimeter RANGE/FUNCTION switch to 200 DC VOLTS.

b. Remove the digital multimeter HI test lead from TP 1331 and connect to test point, TP1321 located on the Main board.

c. The digital multi meter must indicate a readout between +19.90 and +20.10.

**5. Check the -20 V Supply Accuracy,  $\pm 0.5\%$**

a. Remove the digital multi meter HI test lead from TP1321 and connect to test point, TP1241 located on the Main board.

b. The digital multi meter must indicate a readout between -19.90 and -20.10.

c. Remove all connections

**DIAL ALIGNMENT**

Refer to Fig. 4-1 test setup and preliminary control settings with the following exceptions.

**7000 Series Oscilloscope**

|                  |                    |
|------------------|--------------------|
| POWER            | on                 |
| FOCUS            | } as desired for a |
| INTENSITY        |                    |
| VERTICAL MODE    | LEFT               |
| HORIZONTAL MODE  | B                  |
| B TRIGGER SOURCE | VERT MODE          |

**Vertical Plug-in**

|           |                  |
|-----------|------------------|
| VOLTS/DIV | 5                |
| VARIABLE  | in               |
| BANDWIDTH | FULL             |
| POLARITY  | + (UP)           |
| AC-GND-DC | DC               |
| POSITION  | centered display |

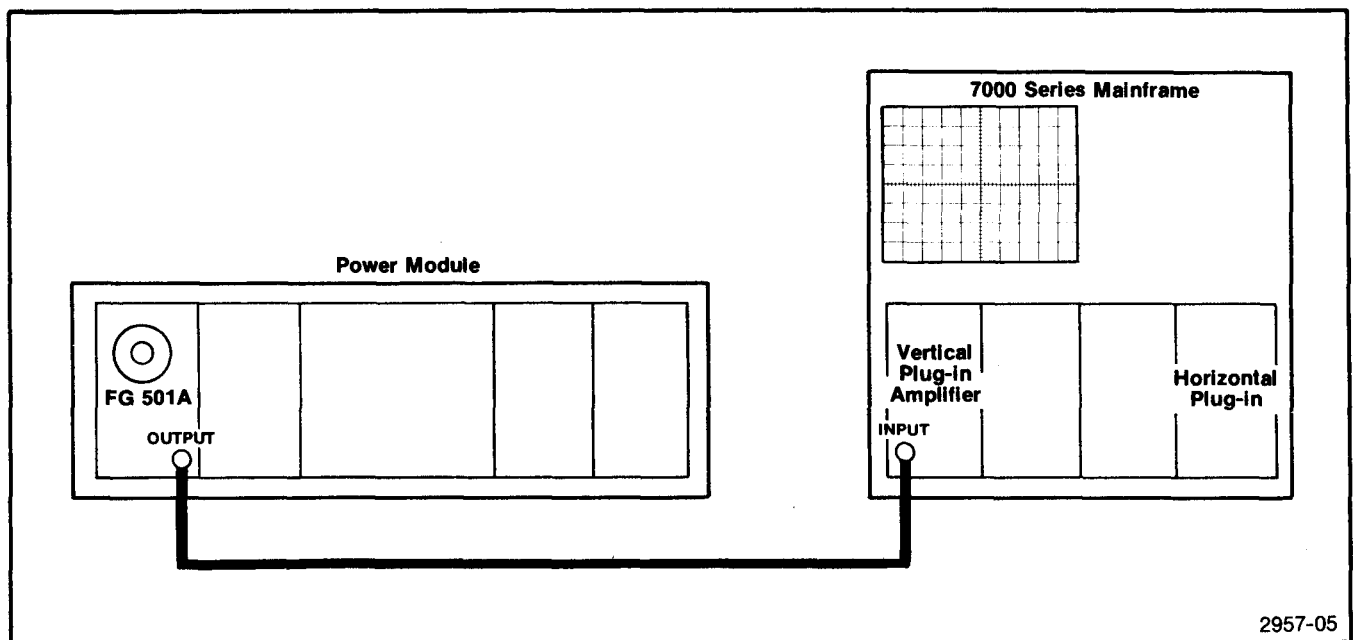


Fig. 4-1. Test setup for DIAL ALIGNMENT and OFFSET adjustment.

### Horizontal Plug-in

|              |                                                                                   |
|--------------|-----------------------------------------------------------------------------------|
| DISPLAY MODE | TIME BASE                                                                         |
| TIME/DIV     | 50 $\mu$ s                                                                        |
| VARIABLE     | in                                                                                |
| LEVEL/SLOPE  |  |
| MODE         | AUTO                                                                              |
| COUPLING     | AC                                                                                |
| SOURCE       | INT                                                                               |
| MAGNIFIER    | X1                                                                                |

### 6. Frequency Hz Dial Alignment

a. Connect the coaxial cable from the FG 501A OUTPUT to the vertical plug-in INPUT.

b. Adjust the horizontal plug-in LEVEL control for a stable squarewave display on the crt.

c. Locate the coupler holding the FREQUENCY Hz potentiometer extension shaft and loosen the coupler set screw.

d. ADJUST-the FREQUENCY Hz potentiometer counterclockwise until the displayed waveform just stops moving.

e. While holding the potentiometer (coupler), adjust the FREQUENCY Hz dial to 20 (exact).

f. Tighten the coupler set screw (snug only).

g. Adjust the FREQUENCY Hz dial to 18. Then rotate dial slowly counterclockwise until the display crt waveform just stops moving.

h. Check that the FREQUENCY Hz dial is on 20 ( $\pm 5$  minor graticule division).

i. Tighten the coupler set screw.

### ADJUST OFFSET

Refer to Fig. 4-1 test setup and preliminary control settings with the following exceptions.

#### FG 501A

|                                                                                                  |     |
|--------------------------------------------------------------------------------------------------|-----|
| AMPLITUDE                                                                                        | Ccw |
|  (pushbutton) | in  |
| FREQUENCY Hz                                                                                     | 20  |
| MULTIPLIER                                                                                       | 102 |

### Vertical Plug-in

|           |   |
|-----------|---|
| VOLTS/DIV | 2 |
|-----------|---|

### 7. Adjust the OUTPUT OFFSET (R2201) and SINE OFFSET (R1104)

a. The oscilloscope crt display is a triangle.

b. ADJUST-potentiometer R2201 located on the Main board until the displayed waveform is centered on the vertical graticule line.

c. Press the  (pushbutton) in.

d. The oscilloscope crt display is a sinewave.

e. ADJUST-potentiometer R1104 located on the Aux board until the displayed waveform is centered on the vertical graticule line.

### ADJUST SINE DISTORTION

### 8. Adjust the TRIANGLE AM PLADJ (R1412), TRIANGLE OFFSET (R1511), and TOP DIAL SYMM CAL (R1421)

Refer to Fig. 4-2 check setup and preliminary control settings with the following exceptions.

#### FG 501A

|           |    |
|-----------|----|
| AMPLITUDE | cw |
|-----------|----|

#### Audio Analyzer

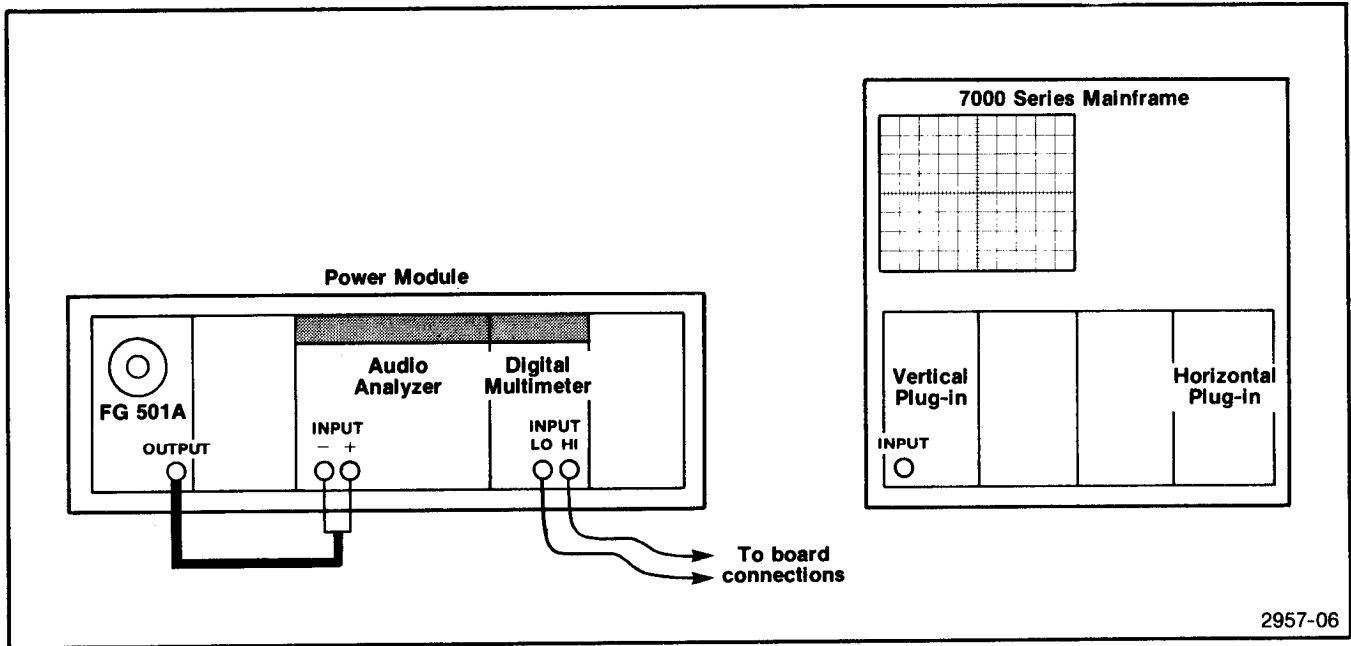
|                    |       |
|--------------------|-------|
| INPUT LEVEL RANGE  | 20 V  |
| FUNCTION           | THD+N |
| PERCENT DISTORTION | AUTO  |
| FILTERS            | OUT   |
| RESPONSE           | AWE   |

a. Remove the vertical plug-in INPUT connection and re-connect to the audio analyzer using a bnc to banana plug adapter.

b. ADJUST-potentiometers R1412, R1511, and R1421 all located on the Main board for a minimum reading on the audio analyzer. Repeat these adjustments until no further improvement is noted.

### 9. Adjust the "C" MULT ADJ (R1951)

Refer to Fig. 4-2 test setup and preliminary control settings with the following exceptions.



**Fig. 4-2. Test setup for SINE DISTORTION adjustment.**

## Digital Multimeter

|                |            |
|----------------|------------|
| RANGE/FUNCTION | 2 DC Volts |
|----------------|------------|

**FG 501A**

MULTIPLIER 1

- a. Connect the digital mult meter LO INPUT test lead to pin 2 of IC, U1930 located on the Main board.
- b. Connect the HI INPUT test lead to pin 2 of IC, U1940 also located on the Main board.
- c. ADJUST-potentiometer R1951 located on the Main board for a .0000 digital multimeter readout.
- d. Remove digital multimeter test leads.

### 10. Adjust the BOTTOM DIAL SYMM CAL (R1441)

Refer to Fig. 4-2 test setup.

- a. Adjust the FG 501A FREQUENCY Hz dial to 1 and change the MULTIPLIER to  $10^2$ .
- b. ADJUST-potentiometer R1441 for a minimum reading on the audio analyzer.

## OFFSET ADJUSTS

Refer to Fig. 4-3 test setup and preliminary control settings with the following exceptions:

FG 501A

|                |     |
|----------------|-----|
| ⌘ (pushbutton) | in  |
| MULTIPLIER     | 102 |
| OUTPUT         | ccw |

## Vertical Plug-in

|                  |     |
|------------------|-----|
| VOLTS Polarity   | +   |
| + INPUT Coupling | GND |
| - INPUT Coupling | GND |
| VOLTS/DIV        | .1  |

## 11. Adjust OUTPUT OFFSET (R2201)

- a. Connect a coaxial cable with 50  $\Omega$  termination from the FG 501A OUTPUT to the vertical plug-in + INPUT.
- b. Adjust the vertical plug-in POSITION control until the trace lines up on the center horizontal graticule line.
- c. Change the vertical plug-in + INPUT coupling to DC.
- d. Adjust the vertical plug-in COMPARISON control until the positive peak of the displayed waveform appears as graticule center.

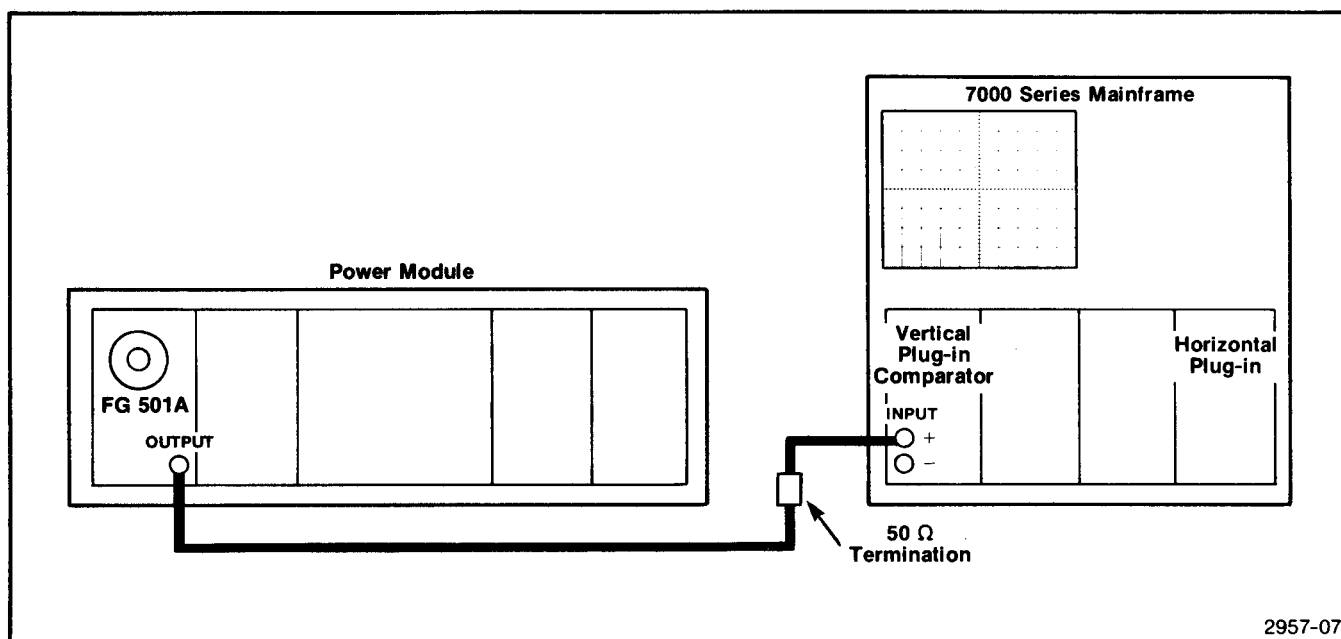


Fig. 4-3. Test setup for OFFSET and SINE/SQUARE AMPLITUDE adjustments.

e. Change the vertical plug-in VOLTS polarity to -.

f. Adjust the vertical plug-in COMPARISON VOLTAGE control until the negative peak of the displayed waveform moves half-way between its present position and the center horizontal graticule line.

g. ADJUST-potentiometer R2201 located on the Main board until the negative peak of the displayed waveform is on the center horizontal graticule line.

#### 12. Adjust the SINE OFFSET (R1104)

a. Change the vertical plug-in VOLTS polarity to + and press the  $\sim$  pushbutton (in).

b. Adjust the vertical plug-in COMPARISON VOLTAGE control until the positive peak of the displayed waveform appears at graticule center.

c. Change the vertical plug-in VOLTS polarity to -.

d. Adjust the vertical plug-in COMPARISON VOLTAGE control until the negative peak of the displayed waveform moves half-way between its present position and the center horizontal graticule line.

e. ADJUST-potentiometer R1104 located on the Aux board until the negative peak of the displayed waveform is on the center horizontal graticule line.

### SINE/SQUARE AMPLITUDE ADJUSTS

Refer to Fig. 4-3 test setup and the preliminary controls settings with the following exceptions:

#### FG 501A

|                     |    |
|---------------------|----|
| $\sim$ (pushbutton) | in |
| AMPLITUDE           | cw |

#### Vertical Plug-in

|                 |     |
|-----------------|-----|
| VOLTS/DIV       | .2  |
| +INPUT Coupling | GND |
| -INPUT Coupling | GND |

#### 13. Adjust the SINE AMPL (R1106)

a. Adjust the vertical plug-in POSITION control until the trace lines up on the center horizontal graticule line.

b. Change the vertical plug-in VOLTS polarity to -.

c. Change the vertical plug-in + INPUT coupling to DC and the - INPUT coupling to VC.

d. Adjust the vertical plug-in COMPARISON VOLTAGE control until the negative peak of the displayed waveform appears at graticule center.

e. Press the FG 501A  pushbutton (in).

f. ADJUST-potentiometer R1106 located on the Aux board until the negative peak of the displayed waveform is on the center horizontal graticule line.

#### 14. Adjust the SQ WAVE AMPL (R1728)

a. Press the FG 501A  pushbutton (in).

b. Note the position of the negative level of the displayed squarewave.

c. Press the FG 501A  pushbutton (in).

d. Change the vertical plug-in VOLTS polarity to +.

e. Adjust the vertical plug-in COMPARISON VOLTAGE control until the positive peak of the displayed waveform is on the center horizontal graticule line.

f. Press the FG 501A  pushbutton (in).

g. ADJUST-potentiometer R1728 located on the Main board until the positive level of the displayed squarewave is off of the center graticule line in the same direction and same amount as the negative level squarewave noted in step 29b.

### SQUAREWAVE COMP/RISE AND FALLTIME ADJUSTS

Refer to Fig. 4-4 test setup and the preliminary control settings with the following exceptions.

#### FG 501A

|              |     |
|--------------|-----|
| FREQUENCY Hz | 20  |
| MULTIPLIER   | 105 |
| AMPLITUDE    | CCW |

#### Sampling Vertical Plug-in

|            |     |
|------------|-----|
| mVOLTS/DIV | 200 |
|------------|-----|

#### Sampling Horizontal Plug-in

|             |            |
|-------------|------------|
| SWEEP RANGE | 5 $\mu$ s  |
| TIME/DIV    | .1 $\mu$ s |

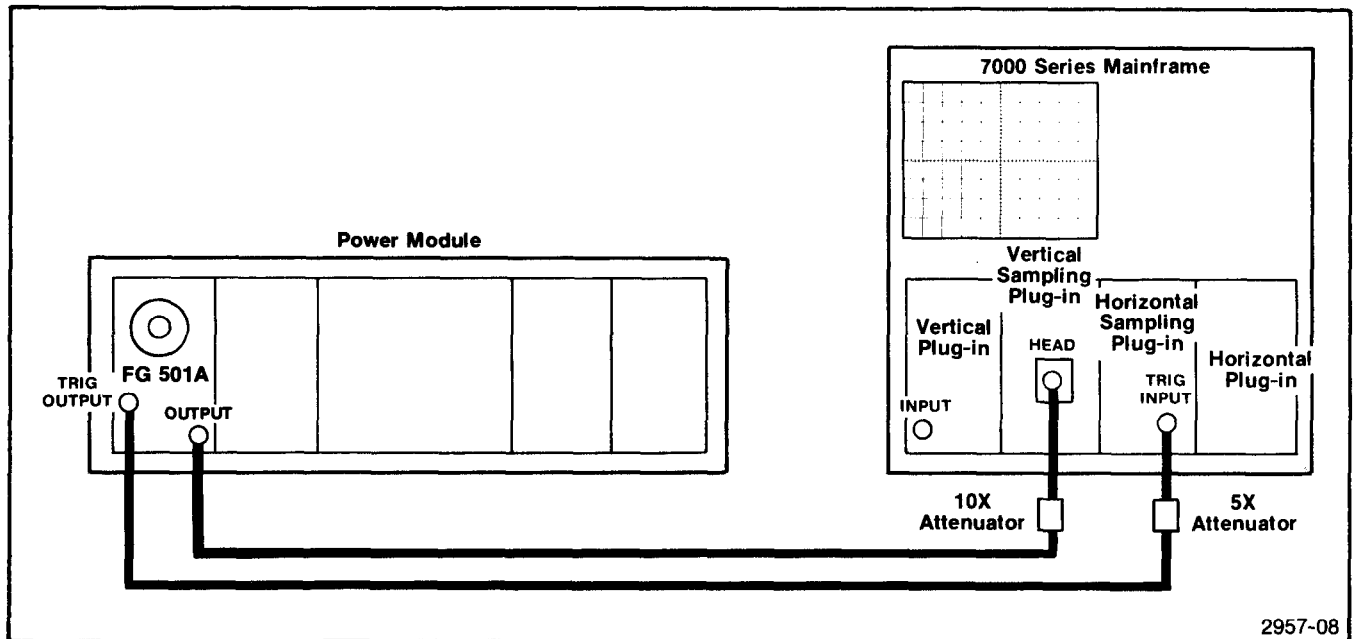


Fig. 4-4. Test setup for SQUAREWAVE COMP/RISE and FALL TIME adjustments.



### 15. Adjust the SQ WV COMP (C2011)

a. Connect a coaxial cable with a 10X attenuator from the FG 501A OUTPUT to the vertical plug-in sampling head input.

b. Connect a coaxial cable with a 5X attenuator from the FG 501A TRIG OUTPUT to the sampling horizontal plug-in TRIG INPUT.

c. Set the sampling vertical plug-in VARIABLE out and adjust for a displayed waveform amplitude of five major graticule divisions.

d. Change the sampling vertical plug-in mVOLTS/DIV switch to 20.

e. ADJUST-variable capacitor C2011 located on the Main board for a peak-to-peak aberration of 1 major graticule division on the displayed waveform. This aberration will appear at both the top and bottom of the waveform.

## DIAL CAL/LOOP DELAY

Refer to Fig. 4-5 test setup and preliminary control setti rigs.

### 16. Adjust the DIAL CAL (R1321)

a. Connect a 50 $\Omega$  coaxial cable and terminator from the FG 501A output to the counter input.

b. ADJUST-potentiometer R1321 located on the main board for a counter display of 20.00.

### 17. Adjust LOOP DELAY (C1714)

a. Change the FG 501A MULTIPLIER to 10<sup>5</sup> and the digital counter FUNCTION to FREQUENCY/.1 kHz.

b. ADJUST-variable capacitor C1714 located on Main board for a digital counter readout of 2.000.

c. Remove all cables and connections.

This completes the Adjustment Procedure for the FG 501A.

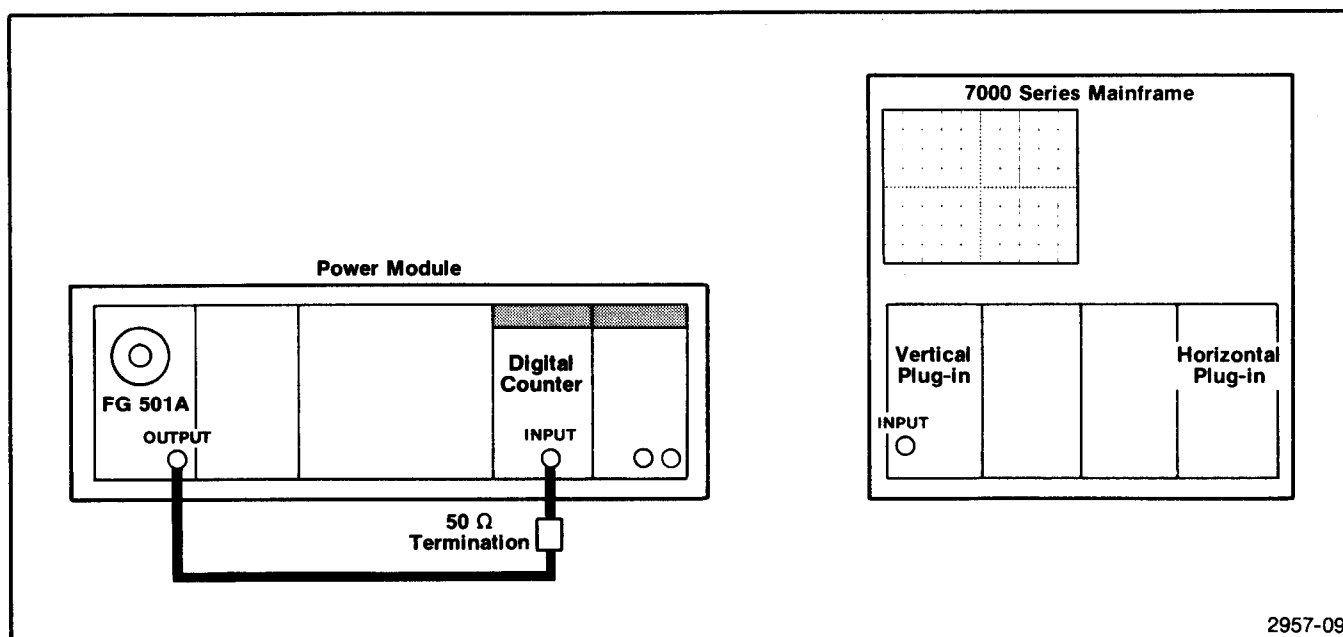


Fig. 4-5. Test setup for DIAL CAL and LOOP DELAY adjustments.

## SECTION 5

# MAINTENANCE

## GENERAL MAINTENANCE INFORMATION

### STATIC-SENSITIVE COMPONENTS



*Static discharge can damage any semiconductor component in this instrument.*

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

Observe the following precautions to avoid damage:

1. Minimize handling of static sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.
3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Keep the component leads shorted together whenever possible.
6. Pick up components by the body, never by the leads.
7. Do not slide the components over any surface.
8. Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge.
9. Use a soldering iron that is connected to earth ground.
10. Use only special antistatic suction type or wick type resoldering tools.

Table 5-1

#### RELATIVE SUSCEPTIBILITY TO STATIC DISCHARGE DAMAGE

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

<sup>a</sup>Voltage equivalent for levels:

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

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

### CLEANING

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



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

The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (approximately 5 lb/in<sup>2</sup>) or use a soft brush or cloth dampened with a mild detergent and water solution.

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



*Circuit boards and components must be dry before applying power.*

## **OBTAINING REPLACEMENT PARTS**

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

### **NOTE**

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

Some parts are manufactured or selected by Tektronix, Inc., to satisfy particular requirements or are manufactured for Tektronix, Inc., to our specifications. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. To determine the manufacturer, refer to the Replaceable Parts list and the Cross Reference index, Mfr. Code Number to Manufacturer.

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

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

## **SOLDERING TECHNIQUES**

### **WARNING**

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

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

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

## **SEMICONDUCTORS**

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

## **INTERCONNECTING PINS**

Several methods of interconnection including multi pin and coaxial cable, are used to electrically connect the circuit boards with other boards and components.

## **COAXIAL CABLES**

Replacement of coaxial end lead connectors requires special tools. Damaged cables should be replaced as a unit. For cable part numbers see the Replaceable Mechanical Parts list. Fig. 5-1 shows a coaxial connector assembly.

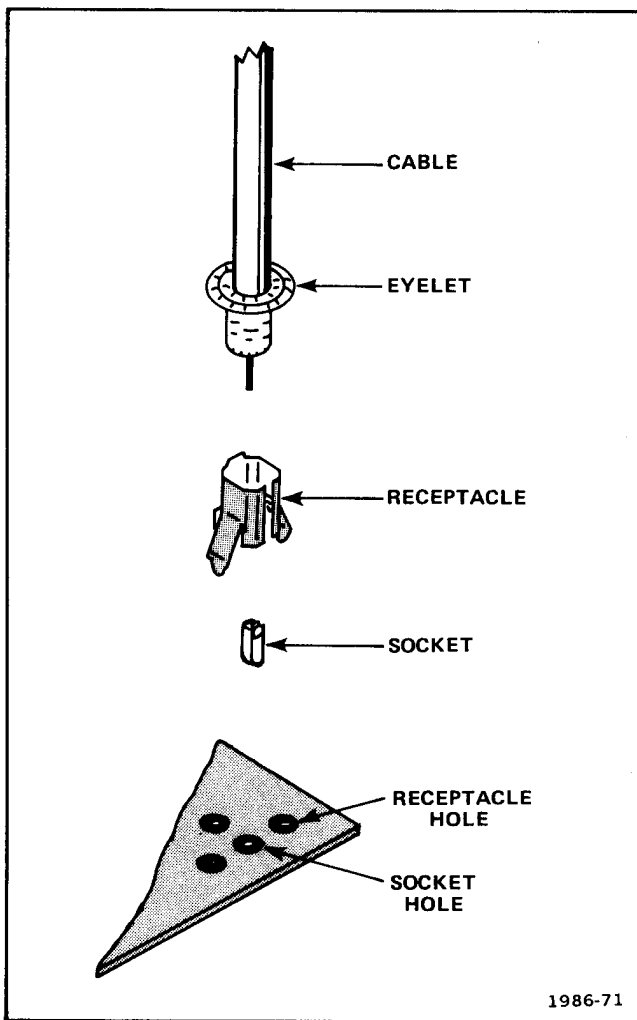


Fig. 5-1. Coaxial end lead connector assembly.

## MULTIPIN CONNECTORS

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

If the individual end lead pin connectors are removed from the plastic holder, note the order of the individual wires for correct replacement in the holder. For proper replacement see Fig. 5-2.

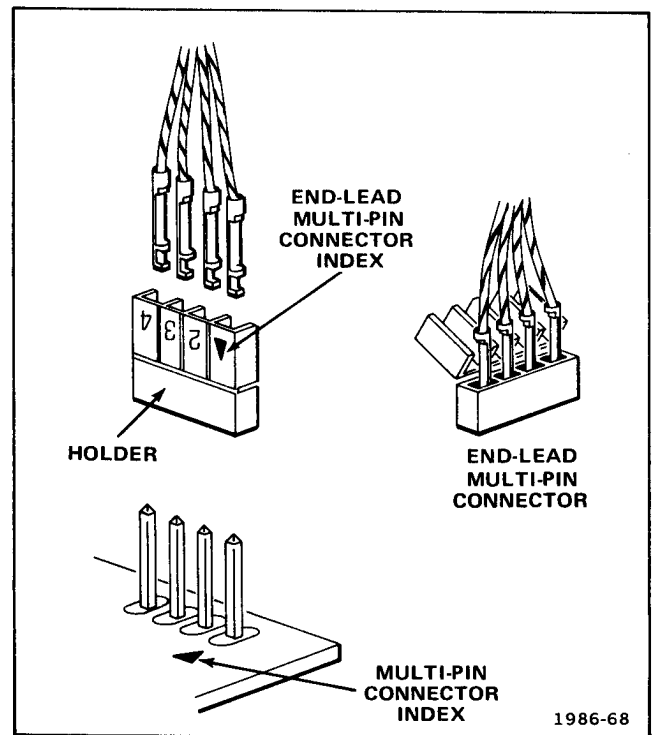


Fig. 5-2. Orientation and disassembly of multipin connectors.

## CAM SWITCHES

Use care when cleaning or repairing cam switches. Shaft alignment and spring tension of the contacts must be carefully maintained for proper operation of the switch. For assistance, contact your local Tektronix Field Office or representative.

### NOTE

*A cam-type switch repair kit including necessary tools, instructions, and replacement contacts is available from Tektronix, Inc. Order Tektronix Part No. 040-0541-00.*

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

1. Pull the metal cover off the switch. The switch is now open for inspection or cleaning.

2. To completely remove a switch from the circuit board, first remove any knobs or shaft extensions. Loosen the coupling at the potentiometer at the rear of the switch, and pull the long shaft out of the switch assembly.
3. Remove the screws (from the opposite side of the circuit board) that hold the cam drum to the board.
4. To remove the cam drum from the front support block, remove the retaining ring from the shaft on the front of the switch and slide the cam drum out of the support block. Be careful not to lose the small detent roller.
5. To replace defective switch contacts, follow the instructions given in the switch repair kit.
6. To reinstall the switch assembly, reverse the above procedure.

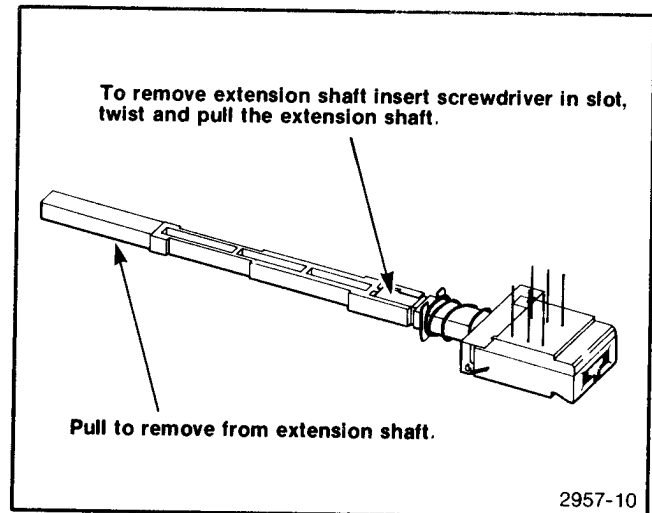


Fig. 5-3. Extension shaft and pushbutton removal.

## PUSHBUTTON SWITCHES

See Fig. 5-3 for pushbutton switch disassembly instructions.

## FRONT PANEL LATCH REMOVAL

To disassemble the latch, pry up on the pull tab bar attached to the latch assembly. The latch components can now be removed from the instrument.

# REAR INTERFACE INFORMATION

## FUNCTIONS AVAILABLE AT REAR CONNECTOR

A slot exists between pins 23 and 24 on the rear connector. Insert a barrier in the corresponding position of the power module jack to prevent noncompatible plug-ins from being using in that compartment. Consult the power module manual for further information. Signals for other specialized connections may be made to the rear interface connectors as shown in Fig. 5-4. A description of these connections follows.

### Output (From 600 $\Omega$ ) 28A

The output can be obtained at this terminal by connecting a coax cable from J2141 to J1204 on the A10 Main Board assembly. A 560  $\Omega$  resistor is in series with J2141.

### Output Common 27A

This is the return connection for the output.

### Trigger Output (50 $\Omega$ ) 27B

This terminal is connected via an internal jumper to the front panel trigger output connector. See the adjustment location illustration for the location of this jumper.

### Trigger Out Common 28B

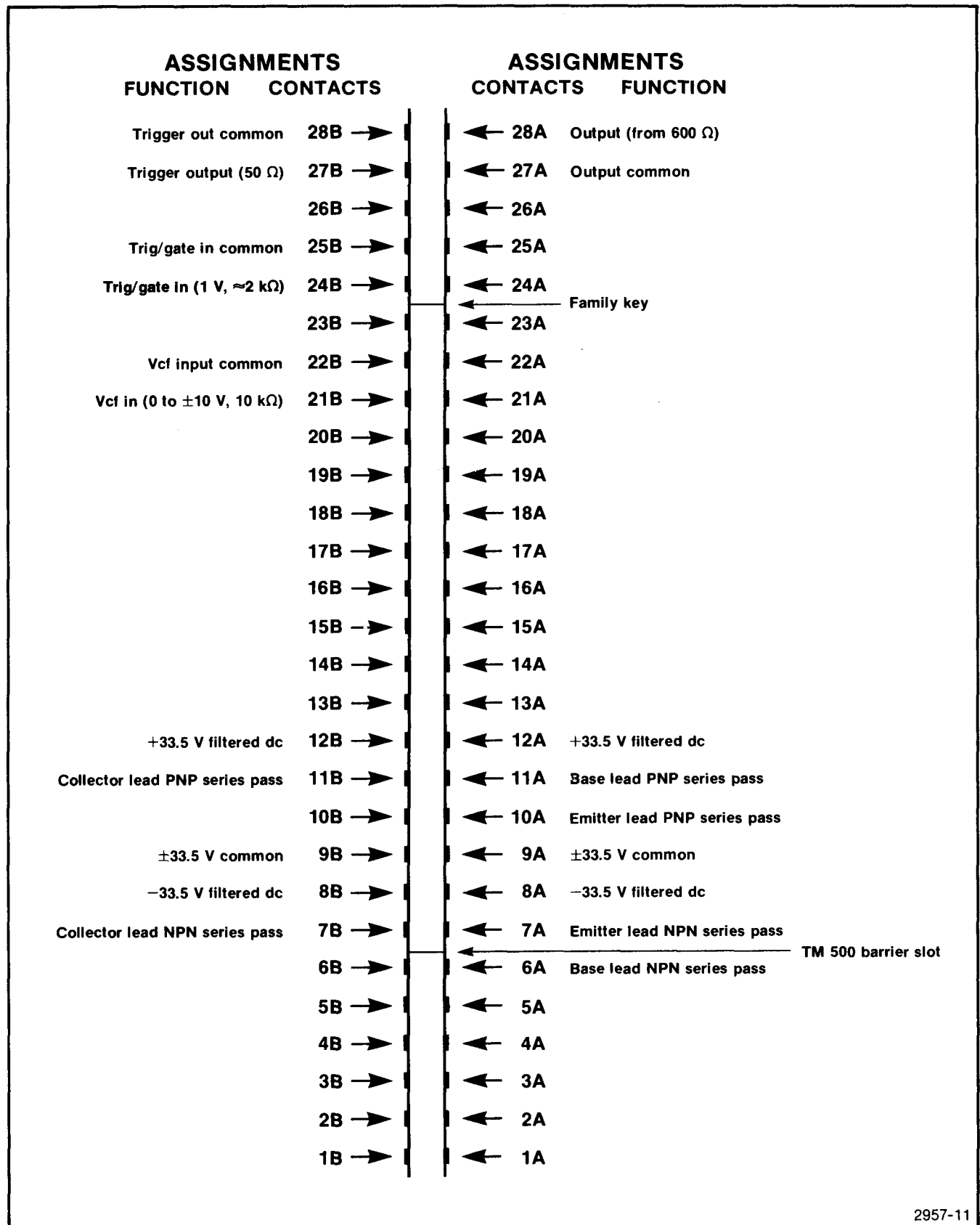
This is the return connection for the trigger output.

### Trig/Gate In 24B

This terminal is connected to the trigger amplifier through a 1 K $\Omega$  resistor. The output signal is 1 V with an impedance of  $\leq 10$  K $\Omega$ .

### Trig/Gate In Common 25B

This is the return connection for the trig/gate in.



2957-11

Fig. 5-4. Rear interface connector assignments.

**VCF In 21B**

This terminal is connected through a  $10K\Omega$  resistor via an internal jumper to the virtual ground summing node of operational amplifier U1540A (pin 2). See the Adjustment Location illustration for the location of this jumper.

**VCF In Common 22B**

This connection is the ground return for the VCF In.

SECTION 6

# OPTIONS

There are no options for the FG 501A at the time of this printing.



# 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, aerial number, and modification number if applicable.

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

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

### LIST OF ASSEMBLIES

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

### CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

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

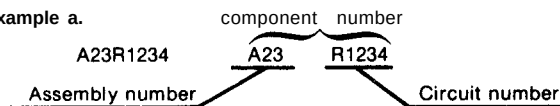
### ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

### COMPONENT NUMBER (column one of the Electrical Parts List)

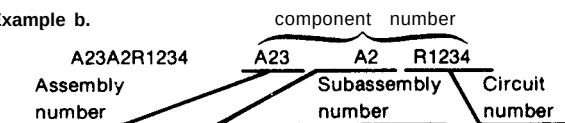
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

Example a.



Read Resistor 1234 of Assembly 23

Example b.



Read: Resistor 1234 of Subassembly 2 of Assembly 23

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

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

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

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

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

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

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

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

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

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

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

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

Indicates actual manufacturers part number.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

| Mfr. Code | Manufacturer                                                             | Address                                  | City, State, Zip           |
|-----------|--------------------------------------------------------------------------|------------------------------------------|----------------------------|
| 01121     | ALLEN-BRADLEY COMPANY                                                    | 1201 2ND STREET SOUTH                    | MILWAUKEE, WI 53204        |
| 01295     | TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP                             | P O BOX 5012, 13500 N CENTRAL EXPRESSWAY | DALLAS, TX 75222           |
| 02111     | SPECTROL ELECTRONICS CORPORATION                                         | 17070 EAST GALE AVENUE                   | CITY OF INDUSTRY, CA 91745 |
| 02735     | RCA CORPORATION, SOLID STATE DIVISION                                    | ROUTE 202                                | SOMERVILLE, NY 08876       |
| 03508     | GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT             | ELECTRONICS PARK                         | SYRACUSE, NY 13201         |
| 03888     | KDI PYROFILM CORPORATION                                                 | 60 S JEFFERSON ROAD                      | WHIPPANY, NJ 07981         |
| 04222     | AVX CERAMICS, DIVISION OF AVX CORP.                                      | P O BOX 867, 19TH AVE. SOUTH             | MYRTLE BEACH, SC 29577     |
| 04713     | MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.                                 | 5005 E MCDOWELL RD,PO BOX 20923          | PHOENIX, AZ 85036          |
| 07263     | FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP. | 464 ELLIS STREET                         | MOUNTAIN VIEW, CA 94042    |
| 12697     | CLAROSTAT MFG. CO., INC.                                                 | LOWER WASHINGTON STREET                  | DOVER, NH 03820            |
| 12969     | UNITRODE CORPORATION                                                     | 580 PLEASANT STREET                      | WATERTOWN, MA 02172        |
| 13511     | AMPHENOL CARDRE DIV., BUNKER RAMO CORP.                                  |                                          | LOS GATOS, CA 95030        |
| 19701     | ELECTRA-MIDLAND CORP., MEPCO ELECTRA INC.                                | P O BOX 760                              | MINERAL WELLS, TX 76067    |
| 22526     | BERG ELECTRONICS, INC.                                                   | YOUR EXPRESSWAY                          | NEW CUMBERLAND, PA 17070   |
| 27014     | NATIONAL SEMICONDUCTOR CORP.                                             | 2900 SEMICONDUCTOR DR.                   | SANTA CLARA, CA 95051      |
| 32997     | BOURNS, INC., TRIMPOT PRODUCTS DIV.                                      | 1200 COLUMBIA AVE.                       | RIVERSIDE, CA 92507        |
| 50434     | HEWLETT-PACKARD COMPANY                                                  | 640 PAGE MILL ROAD                       | PALO ALTO, CA 94304        |
| 53184     | XCITON CORPORATION                                                       | 5 HEMLOCK STREET                         | LATHAM, NY 12110           |
| 55210     | GETTIG ENG. AND MFG. COMPANY                                             | PO BOX 85, OFF ROUTE 45                  | SPRING MILLS, PA 16875     |
| 56289     | SPRAGUE ELECTRIC CO.                                                     | 87 MARSHALL ST.                          | NORTH ADAMS, MA 01247      |
| 71400     | BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.                              | 2536 W. UNIVERSITY ST.                   | ST. LOUIS, MO 63107        |
| 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.                         | PHILADELPHIA, PA 19108     |
| 80009     | TEKTRONIX, INC.                                                          | P O BOX 500                              | BEAVERTON, OR 97077        |
| 91637     | DALE ELECTRONICS, INC.                                                   | P. O. BOX 609                            | COLUMBUS, NE 68601         |

| COMPONENT NO. | TEKTRONIX<br>PART NO. | SERIAL/MODEL NO.<br>EFF DSCONT | NAME & DESCRIPTION                                                 | MFR<br>CODE | PART NUMBER      |
|---------------|-----------------------|--------------------------------|--------------------------------------------------------------------|-------------|------------------|
| A10           |                       |                                | CKT BOARD ASSY:FUNCTION GEN<br>(NOT REPLACEABLE ORDER 672-0924-01) |             |                  |
| A12           | 670-6694-00           | B010100                        | CKT BOARD ASSY:AUXILIARY                                           | 80009       | 670-6694-00      |
| A12           | 670-6694-01           | B020350                        | CKT BOARD ASSY:AUXILIARY                                           | 80009       | 670-6694-01      |
| A10           |                       |                                | CKT BOARD ASSY:FUNCTION GEN                                        |             |                  |
| A10C1115      | 290-0779-00           |                                | CAP., FXD, ELCTLT:10UF, +50-10%, 50VDC                             | 56289       | 502D237          |
| A10C1201      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C1203      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C1224      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C1235      | 281-0763-00           |                                | CAP., FXD, CER DI:47PF, 10%, 100V                                  | 72982       | 8035D9AADC1G470K |
| A10C1251      | 290-0779-00           |                                | CAP., FXD, ELCTLT:10UF, +50-10%, 50VDC                             | 56289       | 502D237          |
| A10C1253      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C1313      | 281-0820-00           |                                | CAP., FXD, CER DI:680PF, 10%, 50V                                  | 12969       | CGB681KDX        |
| A10C1321      | 290-0745-00           |                                | CAP., FXD, ELCTLT:2UF, +50-10%, 25V                                | 56289       | 502D225          |
| A10C1323      | 290-0745-00           |                                | CAP., FXD, ELCTLT:22UF, +50-10%, 25V                               | 56289       | 502D225          |
| A10C1325      | 290-0745-00           |                                | CAP., FXD, ELCTLT:22UF, +50-10%, 25V                               | 56289       | 502D225          |
| A10C1341      | 290-0745-00           |                                | CAP., FXD, ELCTLT:22UF, +50-10%, 25V                               | 56289       | 502D225          |
| A10C1431      | 283-0203-00           |                                | CAP., FXD, CER DI:0.47UF, 20%, 50V                                 | 72982       | 8131N075E474M    |
| A10C13434     | 283-0203-00           |                                | CAP., FXD, CER DI:0.47UF, 20%, 50V                                 | 72982       | 8131N075E474M    |
| A10C1451      | 290-0745-00           |                                | CAP., FXD, ELCTLT:22UF, +50-10%, 25V                               | 56289       | 502D225          |
| A10C1516      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C1532      | 281-0762-00           |                                | CAP., FXD, CER DI:27PF, 20%, 100V                                  | 72982       | 8035D9AADC0G270M |
| A10C1543      | 281-0823-00           | XB020350                       | CAP., FXD, CER DI:470PF, 10%, 50V                                  | 12969       | CGB471KDN        |
| A10C1601      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C1603      | 281-0773-00           |                                | CAP, FXD, CER DI:0.01UF, 10%, 100V                                 | 04222       | GC70-1C103K      |
| A10C1611      | 281-0759-00           |                                | CAP., FXD, CER DI:22PF, 10%, 100V                                  | 72982       | 8035D9AADC1G220K |
| A10C1613      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C1631      | 295-0164-00           |                                | CAP.SET, MTCHD:10, 1, 0.1, 0.01UF, 950PF                           | 80009       | 295-0164-00      |
| A10C1633      |                       |                                |                                                                    |             |                  |
| A10C1641      |                       |                                |                                                                    |             |                  |
| A10C1711      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C1712      | 281-0763-00           |                                | CAP., FXD, CER DI:47PF, 10%, 100V                                  | 72982       | 8035D9AADC1G470K |
| A10C1714      | 281-0158-00           |                                | CAP., VAR, CER DI:7-45PF, 50V                                      | 73899       | DVJ-5006         |
| A10C1723      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C1724      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C1725      | 281-0810-00           |                                | CAP., FXD, CER DI:5.6PF, 0.5%, 100V                                | 04222       | GC10-1A5R6D      |
| A10C1726      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C1741      |                       |                                | (PART OF A10C1631)                                                 |             |                  |
| A10C1751      |                       |                                |                                                                    |             |                  |
| A10C1811      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C1812      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C1813      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C1814      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C2006      | 281-0812-00           |                                | CAP., FXD, CER DI:1000PF, 10%, 100V                                | 72982       | 8035D9AADX7R102K |
| A10C2007      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C2011      | 281-0064-00           |                                | CAP., VAR, PLSTC:0.25-1.5PF, 600V                                  | 74970       | 273-0001-301     |
| A10C2013      | 290-0517-00           |                                | CAP., FXD, ELCTLT:6.8UF, 20%, 35V                                  | 56289       | 196D685X0035KA1  |
| A10C2020      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C2031      | 281-0773-00           |                                | CAP., FXD, CER DI:0.01UF, 10%, 100V                                | 04222       | GC70-1C103K      |
| A10C2121      | 281-0764-00           |                                | CAP., FXD, CER DI:82PF, 5%, 100V                                   | 72982       | 8035D9AADC1G802J |
| A10C2204      | 281-0775-00           |                                | CAP., FXD, CER DI:0.1UF, 20%, 50V                                  | 72982       | 8005D9AABZ5U104M |
| A10C2217      | 290-0517-00           |                                | CAP., FXD, ELCTLT:6.8UF, 20%, 35V                                  | 56289       | 196D685X0035KA1  |
| A10C2221      | 281-0812-00           |                                | CAP., FXD, CER DI:1000PF, 10%, 100V                                | 72982       | 8035D9AADX7R102K |
| A10C2224      | 290-0517-00           |                                | CAP, FXD, ELCTLT:6.8UF, 20%, 35V                                   | 56289       | 196D685X0035KA1  |

| COMPONENT NO. | TEKTRONIX<br>PART NO. | SERIAL/MODEL NO.<br>EFF DSCONT | NAME & DESCRIPTION                                                                  | MFR<br>CODE | MFR PART NUMBER  |
|---------------|-----------------------|--------------------------------|-------------------------------------------------------------------------------------|-------------|------------------|
| A10C2228      | 281-0773-00           |                                | CAP.,FXD,CER DI:0.01UF,10%,100V                                                     | 04222       | GC70-1C103K      |
| A10C2229      | 290-0517-00           |                                | CAP.,FXD,ELCTLT:6.8UF,20%,35V                                                       | 56289       | 196D685X0035KA1  |
| A10C2301      | 281-0773-00           |                                | CAP.,FXD,CER DI:0.01UF,10%,100V                                                     | 04222       | GC70-1C103K      |
| A10C2302      | 281-0812-00           |                                | CAP.,FXD,CER DI:1000PF,10%,100V                                                     | 72982       | 8035D9AADX7R102K |
| A10CR1431     | 152-0141-02           |                                | SEMICON D DEVICE:SILICON,30V,150MA                                                  | 01295       | 1N4152R          |
| A10CR1531     | 152-0322-00           |                                | SEMICON D DEVICE:SILICON,15V,HOT CARRIER                                            | 50434       | 5082-2672        |
| A10CR1533     | 152-0322-00           |                                | SEMICON D DEVICE:SILICON,15V,HOT CARRIER                                            | 50434       | 5082-2672        |
| A10CR1621     | 152-0141-02           |                                | SEMICON D DEVICE:SILICON,30V,150MA                                                  | 01295       | 1N4152R          |
| A10CR2111     | 152-0141-02           |                                | SEMICON D DEVICE:SILICON,30V,150MA                                                  | 01295       | 1N4152R          |
| A10CR2113     | 152-0141-02           |                                | SEMICON D DEVICE:SILICON,30V,150MA                                                  | 01295       | 1N4152R          |
| A10CR2213     | 152-0141-02           |                                | SEMICON D DEVICE:SILICON,30V,150MA                                                  | 01295       | 1N4152R          |
| A10CR2221     | 152-0141-02           |                                | SEMICON D DEVICE:SILICON,30V,150MA                                                  | 01295       | 1N4152R          |
| A10CR2222     | 152-0141-02           |                                | SEMICON D DEVICE:SILICON,30V,150MA                                                  | 01295       | 1N4152R          |
| A10F1111      | 159-0019-00           |                                | FUSE,CARTRIDGE:3AG,1A,250V,SLOW BLOW                                                | 71400       | MDL1             |
| A10F1131      | 159-0019-00           |                                | FUSE,CARTRIDGE:3AG,1A,250V,SLOW BLOW                                                | 71400       | MDL1             |
| A10J1100      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 2)                              | 22526       | 47357            |
| A10J1121      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD                                            | 22526       | 47357            |
| A10J1202      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 3)                              | 22526       | 47357            |
| A10J1203      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 3)                              | 22526       | 47357            |
| A10J1301      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 3)                              | 22526       | 47357            |
| A10J1541      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 4)                              | 22526       | 47357            |
| A10J1611      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 3)                              | 22526       | 47357            |
| A10J1641      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 2)                              | 22526       | 47357            |
| A10J1651      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 4)                              | 22526       | 47357            |
| A10J1801      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG                                                    | 80009       | 131-1003-00      |
| A10J1921      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG                                                    | 80009       | 131-1003-00      |
| A10J1923      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG                                                    | 80009       | 131-1003-00      |
| A10J2011      | 131-0608-00           |                                | TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD<br>(QTY OF 4)                              | 22526       | 47357            |
| A10J2021      | 131-0608-00           |                                | TERMINAL,PIN:0.365 LM X 0.025 PH BRZ GOLD<br>(QTY OF 2)                             | 22526       | 47357            |
| A10J2041      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG                                                    | 80009       | 131-1003-00      |
| A10J2043      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG                                                    | 80009       | 131-1003-00      |
| A10L1111      | 108-0020-00           |                                | COIL,RF:7.1UH                                                                       | 80009       | 108-0020-00      |
| A10L1251      | 108-0020-00           |                                | COIL,RF:7.1UH                                                                       | 80009       | 108-0020-00      |
| A10Q1221      | 151-0606-00           |                                | TRANSISTOR:SILICON,NPN                                                              | 04713       | SJE375           |
| A10Q1231      | 151-0464-00           |                                | TRANSISTOR:SILICON,NPN                                                              | 04713       | SJE412           |
| A10Q1241      | 151-0464-00           |                                | TRANSISTOR:SILICON,NPN                                                              | 04713       | SJE412           |
| A10Q1243      | 151-0190-00           |                                | TRANSISTOR:SILICON,NPN                                                              | 07263       | S032677          |
| A10Q1245      | 151-0350-00           |                                | TRANSISTOR:SILICON,PNP                                                              | 04713       | SPS6700          |
| A10Q1331      | 151-0190-00           |                                | TRANSISTOR:SILICON,NPN                                                              | 07263       | S032677          |
| A10Q1335      | 151-0188-00           |                                | TRANSISTOR:SILICON,PNP                                                              | 04713       | SPS6868K         |
| A10Q1345      | 151-0607-00           |                                | TRANSISTOR:SILICON,PNP                                                              | 04713       | SJE376           |
| A10Q1421      | 153-0586-00           |                                | SEMICON D DVD SE:2N3906,MATCHED PAIR<br>(FURNISHED AS A MATCHED PAIR WITH A10Q1527) | 80009       | 153-0586-00      |
| A10Q1431      | 151-0190-00           |                                | TRANSISTOR:SILICON,NPN                                                              | 07263       | S032677          |
| A10Q1433      | 151-0367-00           |                                | TRANSISTOR:SILICON,NPN,SEL FROM 3471TP                                              | 01295       | SKA6516          |
| A10Q1440      | 151-0190-00           |                                | TRANSISTOR:SILICON,NPN                                                              | 07263       | S032677          |
| A10Q1445      | 151-0435-00           |                                | TRANSISTOR:SILICON,PNP                                                              | 04713       | SPS8335          |

| COMPONENT NO. | TEKTRONIX PART NO. | SERIAL/MODEL NO. EFF DSCONT | NAME & DESCRIPTION                      | MFR CODE | MFR PART NUMBER |
|---------------|--------------------|-----------------------------|-----------------------------------------|----------|-----------------|
| A10Q1511      | 151-0190-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S032677         |
| A10Q1521      | 151-0427-00        |                             | TRANSISTOR:SILICON,NPN                  | 80009    | 151-0427-00     |
| A10Q1523      | 151-0190-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S032677         |
| A10Q1525      | 151-0188-00        |                             | TRANSISTOR:SILICON,PNP                  | 04713    | SPS6868K        |
| A10Q1527      |                    |                             | (PART OF A10Q1421)                      |          |                 |
| A10Q1531      | 151-0438-00        |                             | TRANSISTOR:SILICON,PNP,SEL FROM SPS6927 | 80009    | 151-0438-00     |
| A10Q1541      | 151-0341-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S040065         |
| A10Q1543      | 151-0341-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S040065         |
| A10Q1611      | 151-0188-00        |                             | TRANSISTOR:SILICON,PNP                  | 04713    | SPS6868K        |
| A10Q1621      | 151-0188-00        |                             | TRANSISTOR:SILICON,PNP                  | 04713    | SPS6868K        |
| A10Q1711      | 151-0188-00        |                             | TRANSISTOR:SILICON,PNP                  | 04713    | SPS6868K        |
| A10Q1712      | 151-0190-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S032677         |
| A10Q1721      | 151-0220-00        |                             | TRANSISTOR:SILICON,PNP                  | 07263    | S036228         |
| A10Q1723      | 151-1042-00        |                             | SEMICON DVC SE:MATCHED PAIR FET         | 01295    | SKA5390         |
| A10Q1725      |                    |                             |                                         |          |                 |
| A10Q1801      | 151-0220-00        |                             | TRANSISTOR:SILICON,PNP                  | 07263    | S036228         |
| A10Q1821      | 151-0190-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S032677         |
| A10Q1901      | 151-0220-00        |                             | TRANSISTOR:SILICON,PNP                  | 07263    | S036228         |
| A10Q2011      | 151-0220-00        |                             | TRANSISTOR:SILICON,PNP                  | 07263    | S036228         |
| A10Q2013      | 151-0190-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S032677         |
| A10Q2101      | 151-0190-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S032677         |
| A10Q2111      | 151-0221-00        |                             | TRANSISTOR:SILICON,PNP                  | 04713    | SPS246          |
| A10Q2113      | 151-0190-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S032677         |
| A10Q2121      | 151-0440-00        |                             | TRANSISTOR:SILICON,PNP                  | 03508    | X41E603         |
| A10Q2123      | 151-0440-00        |                             | TRANSISTOR:SILICON,PNP                  | 03508    | X41E603         |
| A10Q2211      | 151-0220-00        |                             | TRANSISTOR:SILICON,PNP                  | 07263    | S036228         |
| A10Q2213      | 151-0427-00        |                             | TRANSISTOR:SILICON,NPN                  | 80009    | 151-0427-00     |
| A10Q2311      | 151-0190-00        |                             | TRANSISTOR:SILICON,NPN                  | 07263    | S032677         |
| A10Q2321      | 151-0220-00        |                             | TRANSISTOR:SILICON,PNP                  | 07263    | S036228         |
| A10Q2323      | 151-0439-00        |                             | TRANSISTOR:SILICON,NPN                  | 80009    | 151-0439-00     |
| A10Q2325      | 151-0439-00        |                             | TRANSISTOR:SILICON,NPN                  | 80009    | 151-0439-00     |
| A10R500       | 311-1392-00        |                             | RES.,VAR,WM:PNL,10K OHM,2W              | 02111    | 140-9504        |
| A10R1103      | 321-0289-00        |                             | RES.,FXD,FILM:10K OHM,1%,0.125W         | 91637    | MFF1816G10001F  |
| A10R1113      | 315-0202-00        |                             | RES.,FXD,CMPSN:2K OHM,5%,0.25W          | 01121    | CB2025          |
| A10R1121      | 307-0093-00        |                             | RES.,FXD,CMPSN:1.2 OHM,5%,0.50W         | 01121    | EB1265          |
| A10R1131      | 315-0203-00        |                             | RES.,FXD,CMPSN:20K OHM,5%,0.25W         | 01121    | CB2035          |
| A10R1133      | 321-0318-00        |                             | RES.,FXD,FILM:20K OHM,1%,0.125W         | 91637    | MFF1816G20001F  |
| A10R1135      | 321-0318-00        |                             | RES.,FXD,FILM:20K OHM,1%,0.125W         | 91637    | MFF1816G20001F  |
| A10R1141      | 307-0093-00        |                             | RES.,FXD,CMPSN:1.2 OHM,5%,0.50W         | 01121    | EB1265          |
| A10R1143      | 315-0202-00        |                             | RES.,FXD,CMPSN:2K OHM,5%,0.025W         | 01121    | CB2025          |
| A10R1201      | 321-0337-00        |                             | RES.,FXD,FILM:31.6K OHM,1%,0.125W       | 91637    | MFF1816G31601F  |
| A10R1203      | 315-0202-00        |                             | RES.,FXD,CMPSN:2K OHM,5%,0.25W          | 01121    | CB2025          |
| A10R1225      | 315-0151-00        |                             | RES.,FXD,CMPSN:150 OHM,5%,0.25W         | 01121    | CB1515          |
| A10R1226      | 315-0682-00        |                             | RES.,FXD,CMPSN:6.8K OHM,5%,0.25W        | 01121    | CB6825          |
| A10R1227      | 307-0051-00        |                             | RES.,FXD,CMPSN:2.7 OHM,5%,0.50W         | 01121    | EB2765          |
| A10R1228      | 301-0201-00        |                             | RES.,FXD,CMPSN:200 OHM,5%,0.50W         | 01121    | EB2015          |
| A10R1229      | 315-0101-00        |                             | RES.,FXD,CMPSN:100 OHM,5%,0.25W         | 01121    | CB1015          |
| A10R1231      | 321-0289-00        |                             | RES.,FXD,FILM:10K OHM,1%,0.125W         | 91637    | MFF1816G10001F  |
| A10R1232      | 321-0318-00        |                             | RES.,FXD,FILM:20K OHM,1%,0.125W         | 91637    | MFF1816G20001F  |
| A10R1233      | 321-0289-00        |                             | RES.,FXD,FILM:10K OHM,1%,0.125W         | 91637    | MFF1816G10001F  |
| A10R1235      | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W         | 01121    | CB1035          |
| A10R1241      | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W         | 01121    | CB1035          |
| A10R1242      | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W         | 01121    | CB1035          |
| A10R1243      | 315-0302-00        |                             | RES.,FXD,CMPSN:3K OHM,5%,0.25W          | 01121    | CB3025          |
| A10R1245      | 321-0347-00        |                             | RES.,FXD,FILM:40.2K OHM,1%,0.125W       | 91637    | MFF1816G40201F  |
| A10R1247      | 321-0335-00        |                             | RES.,FXD,FILM:30.1K OHM,1%,0.125W       | 91637    | MFF1816G30101F  |
| A10R1301      | 311-1562-00        |                             | RES.,VAR,NONWIR:2K OHM,20%,0.50W        | 73138    | 91-84-0         |

| COMPONENT NO. | TEKTRONIX PART NO. | SERIAL/MODEL NO. EFF | DSCONT  | NAME & DESCRIPTION                     | MFR CODE | MFR PART NUMBER |
|---------------|--------------------|----------------------|---------|----------------------------------------|----------|-----------------|
| A10R1311      | 315-0103-00        |                      |         | RES., FXD, CMPSN:10K OHM, 5%, 0.25W    | 01121    | CB1035          |
| A10R1315      | 321-0311-00        |                      |         | RES., FXD, FILM:16.9K OHM, 1%, 0.125W  | 91637    | MFF1816G16901F  |
| A10R1321      | 311-1561-00        |                      |         | RES., VAR, NONWIR:2.5K OHM, 20%, 0.50W | 73138    | 91-83-0         |
| A10R1331      | 315-0682-00        |                      |         | RES., FXD, CMPSN:6.8K OHM, 5%, 0.25W   | 01121    | CB6825          |
| A10R1333      | 315-0103-00        |                      |         | RES., FXD, CMPSN:10K OHM, 5%, 0.25W    | 01121    | CB1035          |
| A10R1341      | 311-1563-00        |                      |         | RES., VAR, NONWIR:1K OHM, 20%, 0.50W   | 73138    | 91-85-0         |
| A10R1346      | 315-0512-00        |                      |         | RES., FXD, CMPSN:5.1K OHM, 5%, 0.25W   | 01121    | CB5125          |
| A10R1401      | 321-0193-03        | B010100              | B020339 | RES., FXD, FILM:1K OHM, 0.25%, 0.125W  | 91637    | MFF1816D10000C  |
| A10R1401      | 321-0222-00        | B020340              |         | RES., FXD, FILM:2K OHM, 1%, 0.125W     | 91637    | MFF1816G20000F  |
| A10R1403      | 315-0101-00        |                      |         | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121    | CB1015          |
| A10R1411      | 321-0258-09        |                      |         | RES., FXD, FILM:4.75K OHM, 1%, 0.125W  | 91637    | MFF1816C47500F  |
| A10R1412      | 311-1567-00        | B010100              | B020339 | RES., VAR, NONWIR:TRMR, 100 OHM, 0.50W | 73138    | 91-89-0         |
| A10R1412      | 311-1175-00        | B020340              |         | RES., VAR, NONWIR:100 OHM, 10%, 0.50W  | 73138    | 68WR100         |
| A10R1413      | 321-0916-03        |                      |         | RES., FXD, FILM:289 OHM, 0.25%, 0.125W | 91637    | MFF1816D289R0C  |
| A10R1421      | 311-0605-00        |                      |         | RES., VAR, NONWIR:TRMR, 200 OHM, 0.5W  | 73138    | 82-23-2         |
| A10R1423      | 321-0193-00        |                      |         | RES., FXD, FILM:1K OHM, 1%, 0.125W     | 91637    | MFF1816G10000F  |
| A10R1425      | 321-0193-00        |                      |         | RES., FXD, FILM:1K OHM, 1%, 0.125W     | 91637    | MFF1816G10000F  |
| A10R1429      | 315-0392-00        |                      |         | RES., FXD, CMPSN:3.9K OHM, 5%, 0.25W   | 01121    | CB3925          |
| A10R1431      | 315-0242-00        |                      |         | RES., FXD, CMPSN:2.4K OHM, 5%, 0.25W   | 01121    | CB2425          |
| A10R1432      | 315-0102-00        |                      |         | RES., FXD, CMPSN:1K OHM, 5%, 0.25W     | 01121    | CB1025          |
| A10R1433      | 315-0152-00        |                      |         | RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W   | 01121    | CB1525          |
| A10R1434      | 315-0750-00        |                      |         | RES., FXD, CMPSN:75 OHM, 5%, 0.25W     | 01121    | CB7505          |
| A10R1435      | 315-0300-00        |                      |         | RES., FXD, CMPSN:30 OHM, 5%, 0.25W     | 01121    | CB3005          |
| A10R1436      | 315-0241-00        |                      |         | RES., FXD, CMPSN:240 OHM, 5%, 0.25W    | 01121    | CB2415          |
| A10R1440      | 315-0100-00        |                      |         | RES., FXD, CMPSN:10 OHM, 5%, 0.25W     | 01121    | CB1005          |
| A10R1441      | 311-1559-00        |                      |         | RES., VAR, NONWIR:10K OHM, 20%, 0.50W  | 73138    | 91-81-0         |
| A10R1451      | 307-0051-00        |                      |         | RES., FXD, CMPSN:2.7 OHM, 5%, 0.50W    | 01121    | EB2765          |
| A10R1501      | 321-0754-07        | B010100              | B020339 | RES., FXD, FILM:900 OHM, 0.1%, 0.125W  | 91637    | MFF1816C900R0B  |
| A10R1501      | 321-0641-00        | B020340              |         | RES., FXD, FILM:1.8K OHM, 1%, 0.125W   | 91637    | MFF1816G18000F  |
| A10R1511      | 311-1565-00        | B010100              | B020339 | RES., VAR, NONWIR:250 OHM, 20%, 0.50W  | 73138    | 91-87-0         |
| A10R1511      | 311-1307-00        | B020340              |         | RES., VAR, NONWIR:500 OHM, 0.50W       | 32997    | 3299W-R27-501   |
| A10R1512      | 321-0222-00        |                      |         | RES., FXD, FILM:2K OHM, 1%, 0.125W     | 91637    | MFF1816G20000F  |
| A10R1513      | 321-0245-00        |                      |         | RES., FXD, FILM:3.48K OHM, 1%, 0.125W  | 91637    | MFF1816G34800F  |
| A10R1514      | 315-0202-00        |                      |         | RES., FXD, CMPSN:2K OHM, 5%, 0.25W     | 01121    | CB2025          |
| A10R1515      | 315-0512-00        |                      |         | RES., FXD, CMPSN:5.1K OHM, 5%, 0.25W   | 01121    | CB5125          |
| A10R1517      | 315-0103-00        |                      |         | RES., FXD, CMPSN:10K OHM, 5%, 0.25W    | 01121    | CB1035          |
| A10R1518      | 315-0101-00        |                      |         | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121    | CB1015          |
| A10R1521      | 315-0201-00        |                      |         | RES., FXD, CMPSN:200 OHM, 5%, 0.25W    | 01121    | CB2015          |
| A10R1532      | 315-0511-00        |                      |         | RES., FXD, CMPSN:510 OHM, 5%, 0.25W    | 01121    | CB5115          |
| A10R1533      | 315-0302-00        |                      |         | RES., FXD, CMPSN:3K OHM, 5%, 0.25W     | 01121    | CB3025          |
| A10R1534      | 315-0511-00        |                      |         | RES., FXD, CMPSN:510 OHM, 5%, 0.25W    | 01121    | CB5115          |
| A10R1536      | 315-0201-00        |                      |         | RES., FXD, CMPSN:200 OHM, 5%, 0.25W    | 01121    | CB2015          |
| A10R1541      | 321-0181-00        |                      |         | RES., FXD, FILM:750 OHM, 1%, 0.125W    | 91637    | MFF1816G750R0F  |
| A10R1543      | 321-0272-00        |                      |         | RES., FXD, FILM:6.65K OHM, 1%, 0.125W  | 91637    | MFF1816G66500F  |
| A10R1545      | 321-0181-00        |                      |         | RES., FXD, FILM:750 OHM, 1%, 0.125W    | 91637    | MFF1816G750R0F  |
| A10R1551      | 321-0289-00        |                      |         | RES., FXD, FILM:10K OHM, 1%, 0.125W    | 91637    | MFF1816G10001F  |
| A10R1553      | 321-0289-00        |                      |         | RES., FXD, FILM:10K OHM, 1%, 0.125W    | 91637    | MFF1816G10001F  |
| A10R1603      | 315-0101-00        |                      |         | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121    | CB1015          |
| A10R1611      | 315-0222-00        |                      |         | RES., FXD, CMPSN:2.2K OHM, 5%, 0.25W   | 01121    | CB2225          |
| A10R1613      | 315-0101-00        |                      |         | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121    | CB1015          |
| A10R1615      | 315-0101-00        |                      |         | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121    | CB1015          |
| A10R1621      | 315-0332-00        |                      |         | RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W   | 01121    | CB3325          |
| A10R1622      | 315-0221-00        |                      |         | RES., FXD, CMPSN:220 OHM, 5%, 0.25W    | 01121    | CB2215          |
| A10R1623      | 315-0510-00        |                      |         | RES., FXD, CMPSN:51 OHM, 5%, 0.25W     | 01121    | CB5105          |
| A10R1624      | 315-0101-00        |                      |         | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121    | CB1015          |
| A10R1625      | 315-0332-00        |                      |         | RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W   | 01121    | CB3325          |
| A10R1641      | 321-0222-00        |                      |         | RES., FXD, FILM:2K OHM, 1%, 0.125W     | 91637    | MFF1816G20000F  |

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| A10R1711      | 315-0101-00           | B010100 B020349                | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121       | CB1015          |
| A10R1711      | 315-0361-00           |                                | RES., FXD, CMPSN:360 OHM, 5%, 0.25W    | 01121       | CB3615          |
| A10R1712      | 321-0172-00           | XB020350 XB020350              | RES., FXD, FILM:604 OHM, 1%, 0.125W    | 91637       | MFF1816G604R0F  |
| A10R1713      | 315-0102-00           |                                | RES., FXD, CMPSN:1K OHM, 5%, 0.25W     | 01121       | CB1025          |
| A10R1714      | 315-0472-00           |                                | RES., FXD, CMPSN:4.7K OHM, 5%, 0.25W   | 01121       | CB4725          |
| A10R1715      | 315-0472-00           |                                | RES., FXD, CMPSN:4.7K OHM, 5%, 0.25W   | 01121       | CB4725          |
| A10R1721      | 315-0512-00           |                                | RES., FXD, CMPSN:5.1K OHM, 5%, 0.25W   | 01121       | CB5125          |
| A10R1723      | 315-0103-00           |                                | RES., FXD, CMPSN:10K OHM, 5%, 0.25W    | 01121       | CB1035          |
| A10R1724      | 315-0751-00           |                                | RES., FXD, CMPSN:750 OHM, 5%, 0.25W    | 01121       | CB7515          |
| A10R1725      | 315-0471-00           |                                | RES., FXD, CMPSN:470 OHM, 5%, 0.25W    | 01121       | CB4715          |
| A10R1727      | 315-0752-00           |                                | RES., FXD, CMPSN:7.5K OHM, 5%, 0.25W   | 01121       | CB7525          |
| A10R1728      | 311-1566-00           |                                | RES., VAR, NONWIR:200 OHM, 20%, 0.50W  | 73138       | 91-88-0         |
| A10R1801      | 315-0101-00           |                                | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121       | CB1015          |
| A10R1812      | 321-0155-00           |                                | RES., FXD, FILM:402 OHM, 1%, 0.125W    | 91637       | MFF1816G402R0F  |
| A10R1814      | 315-0153-00           |                                | RES., FXD, CMPSN:15K OHM, 5%, 0.25W    | 01121       | CB1535          |
| A10R1815      | 321-0222-00           |                                | RES., FXD, FILM:2K OHM, 1%, 0.125W     | 91637       | MFF1816G20000F  |
| A10R1816      | 321-0196-00           |                                | RES., FXD, FILM:1.07K OHM, 1%, 0.125W  | 91637       | MFF1816G10700F  |
| A10R1817      | 315-0101-00           |                                | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121       | CB1015          |
| A10R1818      | 321-0313-00           |                                | RES., FXD, FILM:17.8K OHM, 1%, 0.125W  | 91637       | MFF1816G17801F  |
| A10R1819      | 321-0236-00           |                                | RES., FXD, FILM:2.8K OHM, 1%, 0.125W   | 91637       | MFF1816G28000F  |
| A10R1831      | 321-0289-03           |                                | RES., FXD, FILM:10K OHM, 0.25%, 0.125W | 91637       | MFF1816D10001C  |
| A10R1841      | 321-0645-00           |                                | RES., FXD, FILM:100K OHM, 0.5%, 0.125W | 91637       | MFF1816D10002D  |
| A10R1842      | 307-0465-00           |                                | RES., FXD, FILM:10M OHM, 1%, 0.5W      | 03888       | FL1/2-105F      |
| A10R1843      | 321-0481-01           |                                | RES., FXD, FILM:1M OHM, 0.5%, 0.125W   | 91637       | MFF1816G10003D  |
| A10R1941      | 321-0193-03           |                                | RES., FXD, FILM:1K OHM, 0.25%, 0.125W  | 91637       | MFF1816D10000C  |
| A10R1950      | 315-0102-00           |                                | RES., FXD, CMPSN:1K OHM, 5%, 0.25W     | 01121       | CB1025          |
| A10R1951      | 311-1559-00           |                                | RES., CAR, NONWIR:10K OHM, 20%, 0.50W  | 73138       | 91-81-0         |
| A10R2001      | 315-0201-00           |                                | RES., FXD, CMPSN:200 OHM, 5%, 0.25W    | 01121       | CB2015          |
| A10R2003      | 315-0101-00           |                                | RES., FXD, CMPSN:100 OHM, 5%, 0.25W    | 01121       | CB1015          |
| A10R2004      | 315-0183-00           |                                | RES., FXD, CMPSN:18K OHM, 5%, 0.25W    | 01121       | CB1835          |
| A10R2005      | 315-0330-00           |                                | RES., FXD, CMPSN:33 OHM, 5%, 0.25W     | 01121       | CB3305          |
| A10R2006      | 315-0302-00           |                                | RES., FXD, CMPSN:3K OHM, 5%, 0.25W     | 01121       | CB3025          |
| A10R2011      | 321-0253-00           |                                | RES., FXD, FILM:4.22K OHM, 1%, 0.125W  | 91637       | MFF1816G42200F  |
| A10R2012      | 321-0143-00           |                                | RES., FXD, FILM:301 OHM, 1%, 0.125W    | 91637       | MFF1816G301R0F  |
| A10R2013      | 321-0268-00           |                                | RES., FXD, FILM:6.04K OHM, 1%, 0.125W  | 91637       | MFF1816G60400F  |
| A10R2024      | 321-0134-00           |                                | RES., FXD, FILM:243 OHM, 1%, 0.125W    | 91637       | MFF1816G243R0F  |
| A10R2025      | 315-0201-00           |                                | RES., FXD, CMPSN:200 OHM, 5%, 0.25W    | 01121       | CB2015          |
| A10R2026      | 307-0055-00           |                                | RES., FXD, CMPSN:3.9 OHM, 5%, 0.50W    | 01121       | EB3965          |
| A10R2031      | 315-0105-00           |                                | RES., FXD, CMPSN:1M OHM, 5%, 0.25W     | 01121       | CB1055          |
| A10R2033      | 305-0101-00           |                                | RES., FXD, CMPSN:100 OHM, 5%, 2W       | 01121       | HB1015          |
| A10R2041      | 315-0125-00           |                                | RES., FXD, CMPSN:1.2M OHM, 5%, 0.25W   | 01121       | CB1255          |
| A10R2043      | 315-0332-00           |                                | RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W   | 01121       | CB3325          |
| A10R2045      | 315-0332-00           |                                | RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W   | 01121       | CB3325          |
| A10R2047      | 315-0125-00           |                                | RES., FXD, CMPSN:1.2M OHM, 5%, 0.25W   | 01121       | CB1255          |
| A10R2101      | 321-0112-00           |                                | RES., FXD, FILM:143 OHM, 1%, 0.125W    | 91637       | MFF1816G143R0F  |
| A10R2111      | 321-0151-00           |                                | RES., FXD, FILM:365 OHM, 1%, 0.125W    | 91637       | MFF1816G365R0F  |
| A10R2113      | 321-0122-00           |                                | RES., FXD, FILM:182 OHM, 1%, 0.125W    | 91637       | MFF1816G182R0F  |
| A10R2121      | 315-0100-00           |                                | RES., FXD, CMPSN:10 OHM, 5%, 0.25W     | 01121       | CB1005          |
| A10R2122      | 315-0100-00           |                                | RES., FXD, CMPSN:10 OHM, 5%, 0.25W     | 01121       | CB1005          |
| A10R2123      | 315-0270-00           |                                | RES., FXD, CMPSN:27 OHM, 5%, 0.25W     | 01121       | CB2705          |
| A10R2124      | 321-0049-00           |                                | RES., FXD, FILM:31.6 OHM, 1%, 0.125W   | 91637       | MFF1816G31R00F  |
| A10R2131      | 305-0101-00           |                                | RES., FXD, CMPSN:100 OHM, 5%, 2W       | 01121       | HB1015          |
| A10R2141      | 321-0002-00           |                                | RES., FXD, FILM:10.2 OHM, 1%, 0.125W   | 91637       | MFF1816G10R20F  |
| A10R2143      | 321-0059-00           |                                | RES., FXD, FILM:40.2 OHM, 1%, 0.125W   | 91637       | MFF1816G40R20F  |
| A10R2201      | 311-1560-00           |                                | RES., VAR, NONWIR:5K OHM, 20%, 0.50W   | 73138       | 91-82-0         |
| A10R2202      | 321-0238-00           |                                | RES., FXD, FILM:2.94K OHM, 1%, 0.125W  | 91637       | MFF1816G29400F  |
| A10R2203      | 321-0271-00           |                                | RES., FXD, FILM:6.49K OHM, 1%, 0.125W  | 91637       | MFF1816G64900F  |

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| A10R2204      | 321-0238-00           |                                | RES.,FXD,FILM:2.94K OHM,1%,0.125W       | 91637       | MFF1816G29400F  |
| A10R2211      | 321-0122-00           |                                | RES.,FXD,FILM:182 OHM,1%,0.125W         | 91637       | MFF1816G182R0F  |
| A10R2213      | 321-0112-00           |                                | RES.,FXD,FILM:143 OHM,1%,0.125W         | 91637       | MFF1816G143R0F  |
| A10R2223      | 315-0270-00           |                                | RES.,FXD,CMPSN:27 OHM,5%,0.25W          | 01121       | CB2705          |
| A10R2225      | 315-0100-00           |                                | RES.,FXD,CMPSN:10 OHM,5%,0.25W          | 01121       | CB1005          |
| A10R2226      | 315-0100-00           |                                | RES.,FXD,CMPSN:10 OHM,5%,0.25W          | 01121       | CB1005          |
| A10R2227      | 321-0049-00           |                                | RES.,FXD,FILM:31.6 OHM,1%,0.125W        | 91637       | MFF1816G31R60F  |
| A10R2228      | 307-0055-00           |                                | RES.,FXD,CMPSN:3.9 OHM,5%,0.50W         | 01121       | EB3905          |
| A10R2231      | 323-0088-00           |                                | RES.,FXD,FILM:80.6 OHM,1%,0.50W         | 75042       | CECTO-80R60F    |
| A10R2233      | 323-0089-00           |                                | RES.,FXD,FILM:82.5 OHM,1%,0.50W         | 19701       | MF7CD82R50F     |
| A10R2251      | 321-0059-00           |                                | RES.,FXD,FILM:40.2 OHM,1%,0.125W        | 91637       | MFF1816G40R20F  |
| A10R2253      | 321-0002-00           |                                | RES.,FXD,FILM:10.2 OHM,1%,0.125W        | 91637       | MFF1816G10R20F  |
| A10R2255      | 321-0089-00           |                                | RES.,FXD,FILM:82.5 OHM,1%,0.125W        | 91637       | MFF1816G82R50F  |
| A10R2257      | 321-0002-00           |                                | RES.,FXD,FILM:10.2 OHM,1%,0.125W        | 91637       | MFF1816G10R20F  |
| A10R2301      | 315-0183-00           |                                | RES.,FXD,CMPSN:18K OHM,5%,0.25W         | 01121       | CB1835          |
| A10R2303      | 315-0302-00           |                                | RES.,FXD,CMPSN:3K OHM,5%,0.25W          | 01121       | CB3025          |
| A10R2301      | 315-0330-00           |                                | RES.,FXD,CMPSN:33 OHM,5%,0.25W          | 01121       | CB3305          |
| A10R2335      | 315-0750-00           | B010100 B020709                | RES.,FXD,CMPSN:75 OHM,5%,0.25W          | 01121       | CB7505          |
| A10R2335      | 321-0046-00           | B020710                        | RES.,FXD,FILM:29.4 OHM,1%,0.125W        | 91637       | MFF1816G29R40F  |
| A10R2351      | 315-0561-00           |                                | RES.,FXD,CMPSN:560 OHM,5%,0.25W         | 01121       | CB5615          |
| A10R2353      | 323-0089-00           |                                | RES.,FXD,FILM:82.5 OHM,1%,0.50W         | 19701       | MF7CD82R50F     |
| A10R2355      | 323-0088-00           |                                | RES.,FXD,FILM:80.6 OHM,1%,0.50W         | 75042       | CECTO-80R60F    |
| A10S1901      | 260-1268-01           |                                | SWITCH,PUSH:3 BUTTON,2 POLE,FUNCTION    | 80009       | 260-1268-01     |
| A10S2331      | 260-2020-00           |                                | SWITCH,PUSH:4 BUTTON,2 POLE,ATTENUATOR  | 80009       | 260-2020-00     |
| A10TP1241     | 214-0579-00           |                                | TERM,TEST POINT:BRS CD PL               | 80009       | 214-0579-00     |
| A10TP1321     | 214-0579-00           |                                | TERM,TEST POINT:BRS CD PL               | 80009       | 214-0579-00     |
| A10TP1323     | 214-0579-00           |                                | TERM,TEST POINT:BRS CD PL               | 80009       | 214-0579-00     |
| A10TP1331     | 214-0579-00           |                                | TERM,TEST POINT:BRS CD PL               | 80009       | 214-0579-00     |
| A10TP1451     | 214-0579-00           |                                | TERM,TEST POINT:BRS CD PL               | 80009       | 214-0579-00     |
| A10U1210      | 156-0071-00           |                                | MICROCIRCUIT,LI:VOLTAGE REGULATOR       | 04713       | MC1723CL        |
| A10U1230      | 156-0495-00           |                                | MICROCIRCUIT,LI:OPNL AMPL               | 27014       | LM324N          |
| A10U1400      | 156-0495-00           |                                | MICROCIRCUIT,LI:OPNL AMPL               | 27014       | LM324N          |
| A10U1440      | 156-0067-00           |                                | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER   | 02735       | 85145           |
| A10U1501      | 156-0991-00           |                                | MICROCIRCUIT,LI:VOLTAGE REGULATOR       | 04713       | MC78L05ACP      |
| A10U1540      | 156-0495-00           |                                | MICROCIRCUIT,LI:OPNL AMPL               | 27014       | LM324N          |
| A10U1600      | 156-0331-00           |                                | MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP   | 80009       | 156-0331-00     |
| A10U1700      | 156-1056-00           |                                | MICROCIRCUIT,LI:DIFFERENTIAL COMPARATOR | 04713       | MC1514L         |
| A10U1930      | 156-1156-00           |                                | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER   | 80009       | 156-1156-00     |
| A10U1940      | 156-1156-00           |                                | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER   | 80009       | 156-1156-00     |
| A10VR1241     | 152-0149-00           |                                | SEMICONV DEVICE:ZENER,0.4W,10V,5%       | 04713       | SZG35009K3      |
| A10VR1413     | 152-0456-00           |                                | SEMICONV DEVICE:ZENER,0.4W,6.2V,5%      | 04713       | 1N827           |
| A10VR1532     | 152-0667-00           |                                | SEMICONV DEVICE:ZENER,0.4W,3.0V,2%      | 04713       | SZG30025RL      |
| A10VR1811     | 152-0278-00           |                                | SEMICONV DEVICE:ZENER,0.4W,3V,5%        | 04713       | SZG35009K20     |
| A10VR1813     | 152-0212-00           |                                | SEMICONV DEVICE:ZENER,0.5W,9V,5%        | 04713       | SZ50646RL       |
| A10VR2213     | 152-0590-00           |                                | SEMICONV DEVICE:ZENER,18V,5% AT 7MA     | 80009       | 152-0590-00     |
| A10W1411      | 131-0566-00           |                                | BUS CONDUCTOR:DUMMY RES,2.375,22 AWG    | 55210       | L-2007-1        |
| A10W1503      | 131-0566-00           |                                | BUS CONDUCTOR:DUMMY RES,2.375,22 AWG    | 55210       | L-2007-1        |
| A10W1531      | 131-0566-00           |                                | BUS CONDUCTOR:DUMMY RES,2.375,22 AWG    | 55210       | L-2007-1        |
| A10W1535      | 131-0566-00           |                                | BUS CONDUCTOR:DUMMY RES,2.375,22 AWG    | 55210       | L-2007-1        |



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| A12           |                       |                                | CKT BOARD ASSY:AUXILIARY                   |             |                 |
| A12C1000      | 290-0301-00           |                                | CAP.,FXD,ELCTLT:10UF,10%,20V               | 56289       | 150D106X9020B2  |
| A12C1002      | 281-0810-00           |                                | CAP.,FXD,CER DI:5.6PF,0.5%,100V            | 04222       | GC10-1A5R6D     |
| A12C1020      | 281-0810-00           |                                | CAP.,FXD,CER DI:5.6PF,0.5%,100V            | 04222       | GC10-1A5R6D     |
| A12C1022      | 281-0810-00           |                                | CAP.,FXD,CER DI:5.6PF,0.5%,100V            | 04222       | GC10-1A5R6D     |
| A12C1100      | 290-0301-00           |                                | CAP.,FXD,ELCTLT:10UF,10%,20V               | 56289       | 150D106X9020B2  |
| A12C1110      | 281-0773-00           |                                | CAP.,FXD,CER DI:0.01UF,10%,100V            | 04222       | GC70-1C103K     |
| A12C1112      | 281-0773-00           |                                | CAP.,FXD,CER DI:0.01UF,10%,100V            | 04222       | GC70-1C103K     |
| A12C1120      | 281-0773-00           |                                | CAP.,FXD,CER DI:0.01UF,10%,100V            | 04222       | GC70-1C103K     |
| A12C1200      | 281-0773-00           |                                | CAP.,FXD,CER DI:0.01UF,10%,100V            | 04222       | GC70-1C103K     |
| A12C1202      | 290-0301-00           |                                | CAP.,FXD,ELCTLT:10UF,10%,20V               | 56289       | 150D106X9020B2  |
| A12C1215      | 281-0630-00           | XB020350                       | CAP.,FXD,CER DI:390PF,5%,500V              | 72982       | 630000Y5D39J1   |
| A12C1220      | 281-0764-00           |                                | CAP.,FXD,CER DI:82PF,5%,100V               | 72982       | 8035D9AADC1G802 |
| A12C1300      | 283-0177-00           |                                | CAP.,FXD,CER DI:1UF,+80-20%,25V            | 56289       | 273C5           |
| A12C1310      | 281-0773-00           |                                | CAP.,FXD,CER DI:0.01UF,10%,100V            | 04222       | GC70-1C103K     |
| A12C1320      | 283-0177-00           |                                | CAP.,FXD,CER DI:1UF,+80-20%,25V            | 56289       | 273C5           |
| A12CR1000     | 152-0141-02           |                                | SEMICON DEVICE:SILICON,30V,150MA           | 01295       | 1N4152R         |
| A12CR1110     | 152-0141-02           |                                | SEMICON DEVICE:SILICON,30V,150MA           | 01295       | 1N4152R         |
| A12CR1200     | 152-0141-02           |                                | SEMICON DEVICE:SILICON,30V,150MA           | 01295       | 1N4152R         |
| A12CR1220     | 152-0141-02           |                                | SEMICON DEVICE:SILICON,30V,150MA           | 01295       | 1N4152R         |
| A12CR1221     | 152-0141-02           |                                | SEMICON DEVICE:SILICON,30V,150MA           | 01295       | 1N4152R         |
| A12CR1225     | 152-0141-02           | XB020350                       | SEMICON DEVICE:SILICON,30V,150MA           | 01295       | 1N4152R         |
| A12CR1226     | 152-0141-02           | XB020350                       | SEMICON DEVICE:SILICON,30V,150MA           | 01295       | 1N4152R         |
| A12CR1320     | 152-0141-02           |                                | SEMICON DEVICE:SILICON,30V,150MA           | 01295       | 1N4152R         |
| A12J1000      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG           | 80009       | 131-1003-00     |
| A12J1020      | 131-1425-00           |                                | CONTACT SET,ELE:R ANGLE,0.150" L,STR OF 36 | 22526       | 65521-136       |
| A12J1220      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG           | 80009       | 131-1003-00     |
| A12J1300      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG           | 80009       | 131-1003-00     |
| A12J1302      | 131-1003-00           |                                | CONN,RCPT,ELEC:CKT BD MT,3 PRONG           | 80009       | 131-1003-00     |
| A12J1400      | 131-1425-00           |                                | CONTACT SET,ELE:R ANGLE,0.150"L,STR OF 36  | 22526       | 65521-136       |
| A12L1010      | 108-0419-00           |                                | COIL,RF:FIXED,1.1UH                        | 80009       | 108-0419-00     |
| A12Q1010      | 151-0190-00           |                                | TRANSISTOR:SILICON,NPN                     | 07263       | S032677         |
| A12Q1012      | 151-0188-00           |                                | TRANSISTOR:SILICON,PNP                     | 04713       | SPS6868K        |
| A12Q1200      | 151-0188-00           |                                | TRANSISTOR:SILICON,PNP                     | 04713       | SPS6868K        |
| A12Q1210      | 151-0220-00           |                                | TRANSISTOR:SILICON,PNP                     | 07263       | S036228         |
| A12Q1212      | 151-0220-00           |                                | TRANSISTOR:SILICON,PNP                     | 07263       | S036228         |
| A12Q1320      | 151-0188-00           |                                | TRANSISTOR:SILICON,PNP                     | 04713       | SPS6868K        |
| A12Q1322      | 151-0188-00           |                                | TRANSISTOR:SILICON,PNP                     | 04713       | SPS6868K        |
| A12Q1324      | 151-0190-00           |                                | TRANSISTOR:SILICON,NPN                     | 07263       | S032677         |
| A12R1000      | 321-0256-00           |                                | RES.,FXD,FILM:4.53K OHM,1%,0.125W          | 91637       | MFF1816G45300F  |
| A12R1010      | 321-0181-00           |                                | RES.,FXD,FILM:750 OHM,1%,0.125W            | 91637       | MFF1816G750R0F  |
| A12R1012      | 321-0181-00           |                                | RES.,FXD,FILM:750 OHM,1%,0.125W            | 91637       | MFF1816G750R0F  |
| A12R1014      | 315-0242-00           |                                | RES.,FXD,CMPSN:2.4K OHM,5%,0.25W           | 01121       | CB2425          |
| A12R1015      | 315-0622-00           |                                | RES.,FXD,CMPSN:6.2K OHM,5%,0.25W           | 01121       | CB6225          |
| A12R1016      | 315-0100-00           |                                | RES.,FXD,CMPSN:10 OHM,5%,0.25W             | 01121       | CB1005          |
| A12R1020      | 321-0256-00           |                                | RES.,FXD,FILM:4.53K OHM,1%,0.125W          | 91637       | MFF1816G45300F  |
| A12R1022      | 315-0100-00           |                                | RES.,FXD,CMPSN:10 OHM,5%,0.25W             | 01121       | CB1005          |
| A12R1100      | 321-0269-00           |                                | RES.,FXD,FILM:6.19K OHM,1%,0.125W          | 91637       | MFF1816G61900F  |
| A12R1102      | 321-0269-00           |                                | RES.,FXD,FILM:6.19K OHM,1%,0.125W          | 91637       | MFF1816G61900F  |
| A12R1104      | 311-0634-00           |                                | RES.,VAR,NONWIR:TRMR,500 OHM,0.5W          | 32997       | 3326H-G48-501   |
| A12R1106      | 311-0643-00           |                                | RES.,VAR,NONWIR:50 OHM,10%,0.50W           | 73138       | 82-33-2         |
| A12R1108      | 321-0216-00           |                                | RES.,FXD,FILM:1.74K OHM,1%,0.125W          | 91637       | MFF1816G17400F  |
| A12R1110      | 315-0133-00           |                                | RES.,FXD,CMPSN:13K OHM,5%,0.25W            | 01121       | CB1335          |
| A12R1111      | 315-0222-00           |                                | RES.,FXD,CMPSN:2.2K OHM,5%,0.25W           | 01121       | CB2225          |
| A12R1113      | 315-0301-00           |                                | RES.,FXD,CMPSN:300 OHM,5%,0.25W            | 01121       | CB3015          |
| A12R1115      | 315-0101-00           |                                | RES.,FXD,CMPSN:100 OHM,5%,0.25W            | 01121       | CB1015          |
| A12R1116      | 315-0101-00           |                                | RES.,FXD,CMPSN:100 OHM,5%,0.25W            | 01121       | CB1015          |

| COMPONENT NO. | TEKTRONIX<br>PART NO. | SERIAL/MODEL NO.<br>EFF DSCONT | NAME & DESCRIPTION                        | MFR<br>CODE | PART NUMBER      |
|---------------|-----------------------|--------------------------------|-------------------------------------------|-------------|------------------|
| A12R1119      | 315-0181-00           |                                | RES.,FXD,CMPSN:180 OHM,5%,0.25W           | 01121       | CB1815           |
| A12R1120      | 315-0221-00           |                                | RES.,FXD,CMPSN:220 OHM,5%,0.25W           | 01121       | CB2215           |
| A12R1121      | 315-0510-00           |                                | RES.,FXD,CMPSN:51 OHM,5%,0.25W            | 01121       | CB5105           |
| A12R1122      | 315-0510-00           |                                | RES.,FXD,CMPSN:51 OHM,5%,0.25W            | 01121       | CB5105           |
| A12R1123      | 315-0510-00           |                                | RES.,FXD,CMPSN:51 OHM,5%,0.25W            | 01121       | CB5105           |
| A12R1125      | 315-0301-00           |                                | RES.,FXD,CMPSN:300 OHM,5%,0.25W           | 01121       | CB3015           |
| A12R1200      | 321-0229-00           |                                | RES.,FXD,FILM:2.37K OHM,1%,0.125W         | 91637       | MFF1816G23700F   |
| A12R1202      | 315-0432-00           |                                | RES.,FXD,CMPSN:4.3K OHM,5%,0.25W          | 01121       | CB4325           |
| A12R1203      | 315-0102-00           |                                | RES.,FXD,CMPSN:1K OHM,5%,0.25W            | 01121       | CB1025           |
| A12R1204      | 315-0102-00           |                                | RES.,FXD,CMPSN:1K OHM,5%,0.25W            | 01121       | CB1025           |
| A12R1210      | 321-0224-00           |                                | RES.,FXD,FILM:2.1K OHM,1%,0.125W          | 91637       | MFF1816G21000F   |
| A12R1212      | 321-0242-00           |                                | RES.,FXD,FILM:3.24K OHM,1%,0.125W         | 91637       | MFF1816G32400F   |
| A12R1215      | 315-0204-00           | XB020350                       | RES.,FXD,CMPSN:200K OHM,5%,0.25W          | 01121       | CB2045           |
| A12R1216      | 321-0183-00           |                                | RES.,FXD,FILM:787 OHM,1%,0.125W           | 91637       | MFF1816G787R0F   |
| A12R1217      | 321-0183-00           |                                | RES.,FXD,FILM:787 OHM,1%,0.125W           | 91637       | MFF1816G787R0F   |
| A12R1220      | 315-0101-00           |                                | RES.,FXD,CMPSN:100 OHM 5%,0.25W           | 01121       | CB1015           |
| A12R1221      | 315-0101-00           |                                | RES.,FXD,CMPSN:100 OHM,5%,0.25W           | 01121       | CB1015           |
| A12R1225      | 315-0472-00           | XB020350                       | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W          | 01121       | CB4725           |
| A12R1300      | 315-0361-00           |                                | RES.,FXD,CMPSN:360 OHM,5%,0.25W           | 01121       | CB3615           |
| A12R1310      | 315-0162-00           |                                | RES.,FXD,CMPSN:1.6K OHM,5%,0.25W          | 01121       | CB1625           |
| A12R1312      | 321-0222-00           |                                | RES.,FXD,FILM:2K OHM,1%,0.125W            | 91637       | MFF1816G20000F   |
| A12R1313      | 315-0101-00           |                                | RES.,FXD,CMPSN:100 OHM,5%,0.25W           | 01121       | CB1015           |
| A12R1314      | 321-0285-00           |                                | RES.,FXD,FILM:9.09K OHM,1%,0.125W         | 91637       | MFF1816G90900F   |
| A12R1320      | 315-0103-00           |                                | RES.,FXD,CMPSN:10K OHM,5%,0.25W           | 01121       | CB1035           |
| A12R1322      | 321-0193-00           |                                | RES.,FXD,FILM:1K OHM,1%,0.125W            | 91637       | MFF1816G10000F   |
| A12R1324      | 315-0221-00           |                                | RES.,FXD,CMPSN:220 OHM,5%,0.25W           | 01121       | CB2215           |
| A12R1325      | 315-0621-00           |                                | RES.,FXD,CMPSN:620 OHM,5%,0.25W           | 01121       | CB6215           |
| A12S1400      | 260-2040-00           |                                | SWITCH,PUSH:4 BTN 2 POLE,MODE             | 80009       | 260-2040-00      |
| A12U1020      | 156-0048-00           |                                | MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY | 02735       | CA3046           |
| A12U1120      | 156-0048-00           |                                | MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY | 02735       | CA3046           |
| A12U1220      | 156-0048-00           |                                | MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY | 02735       | CA3046           |
| A12U1310      | 156-0382-00           |                                | MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE    | 01295       | SN74LS00(N OR J) |

| COMPONENT NO. | TEKTRONIX<br>PART NO. | SERIAL/MODEL NO.<br>EFF DSCONT | NAME & DESCRIPTION                                                        | CODE  | MFR<br>MFR PART NUMBER |
|---------------|-----------------------|--------------------------------|---------------------------------------------------------------------------|-------|------------------------|
| CR500         | 150-1033-00           |                                | LT EMITTING DIO:YELLOW,585NM,40MA MAX                                     | 50434 | HLMP 1401              |
| CR510         | 150-1029-00           |                                | LT EMITTING DIO:GREEN,565NM,35MA                                          | 53184 | XC209G                 |
| J500          | 131-0955-00           |                                | CONN,RCPT,ELECT:BNC,FEMALE                                                | 13511 | 31-279                 |
| J510          | 131-0955-00           |                                | CONN,RCPT,ELEC:BNC,FEMALE                                                 | 13511 | 31-279                 |
| J520          | 131-0955-00           |                                | CONN,RCPT,ELEC:BNC,FEMALE                                                 | 13511 | 31-279                 |
| J530          | 131-0955-00           |                                | CONN,RCPT,ELEC:BNC,FEMALE                                                 | 13511 | 31-279                 |
| R510          | 311-0169-00           |                                | RES.,VAR, NONWIR:100 OHM,20%,0.50W                                        | 01121 | W-7564B                |
| R520          | 321-0085-00           |                                | RES.,FXD,FILM:75 OHM,1%,0.125W                                            | 91637 | MFF1816G75R00F         |
| R530          | 311-2104-00           |                                | RES.,VAR, NONWIR:PNL,15K OHM,10%,0.25W<br>(FURNISHED AS A UNIT WITH S500) | 12697 | CM41780                |
| R540          | 321-0085-00           |                                | RES.,FXD,FILM:75 OHM,1%,0.125W                                            | 91637 | MFF1816G75R00F         |
| R550          | 311-1298-00           |                                | RES.,VAR, NONWIR:10K OHM,20%,0.50W                                        | 01121 | W-7909                 |
| R560          | 311-2107-00           |                                | RES.,VAR, NONWIR:DUAL,PNL,1K X 50K OHM<br>(FURNISHED AS A UNIT WITH S510) | 12697 | CM41781                |
| S500          |                       |                                | (PART OF R530)                                                            |       |                        |
| S510          |                       |                                | (PART OF R560)                                                            |       |                        |
| S1731         | 263-1189-00           |                                | SW CAM ACTR AS:FREQUENCY MULTIPLIER                                       | 80009 | 263-1189-00            |

# DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

## Symbols

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

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

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

Abbreviations are based on ANSI Y1.1-1972.

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

Y14.15, 1966 Drafting Practices.

Y14.2, 1973 Line Conventions and Lettering.

Y10.5, 1968 Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

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

## Component Values

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

Capacitors = Values one or greater are in picofarads (pF).  
Values less than one are in microfarads ( $\mu$ F).

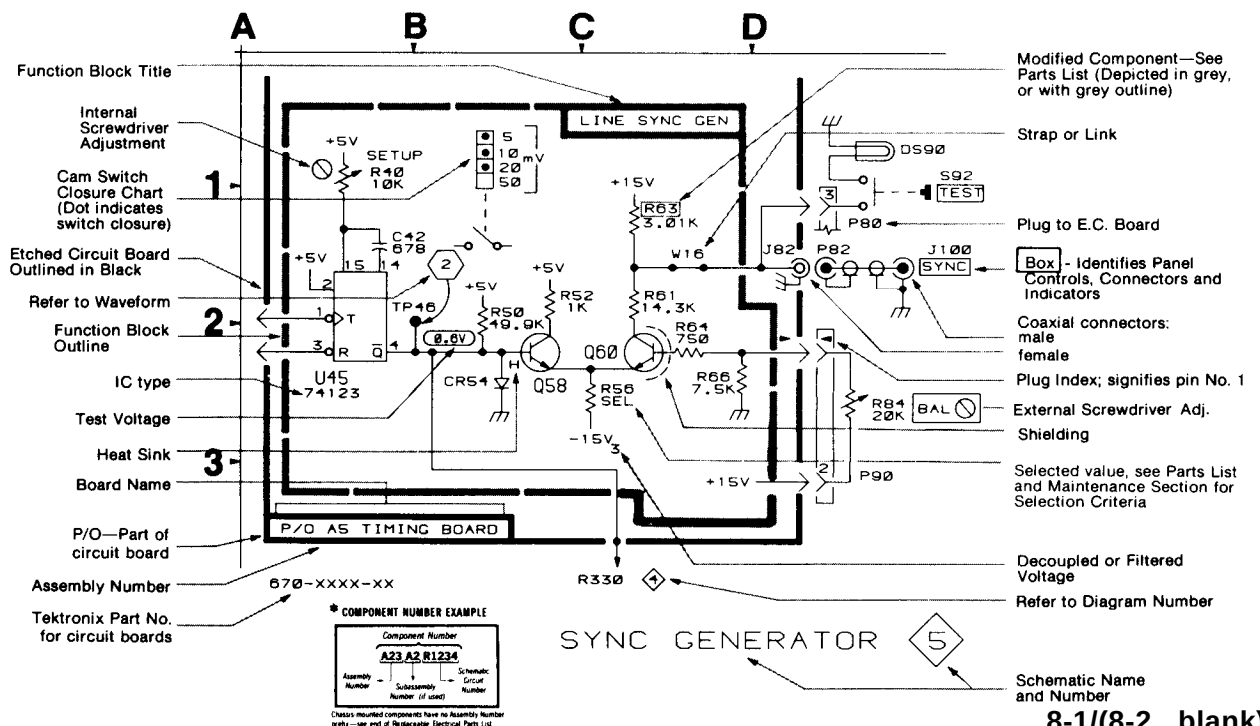
Resistors = Ohms ( $\Omega$ ).

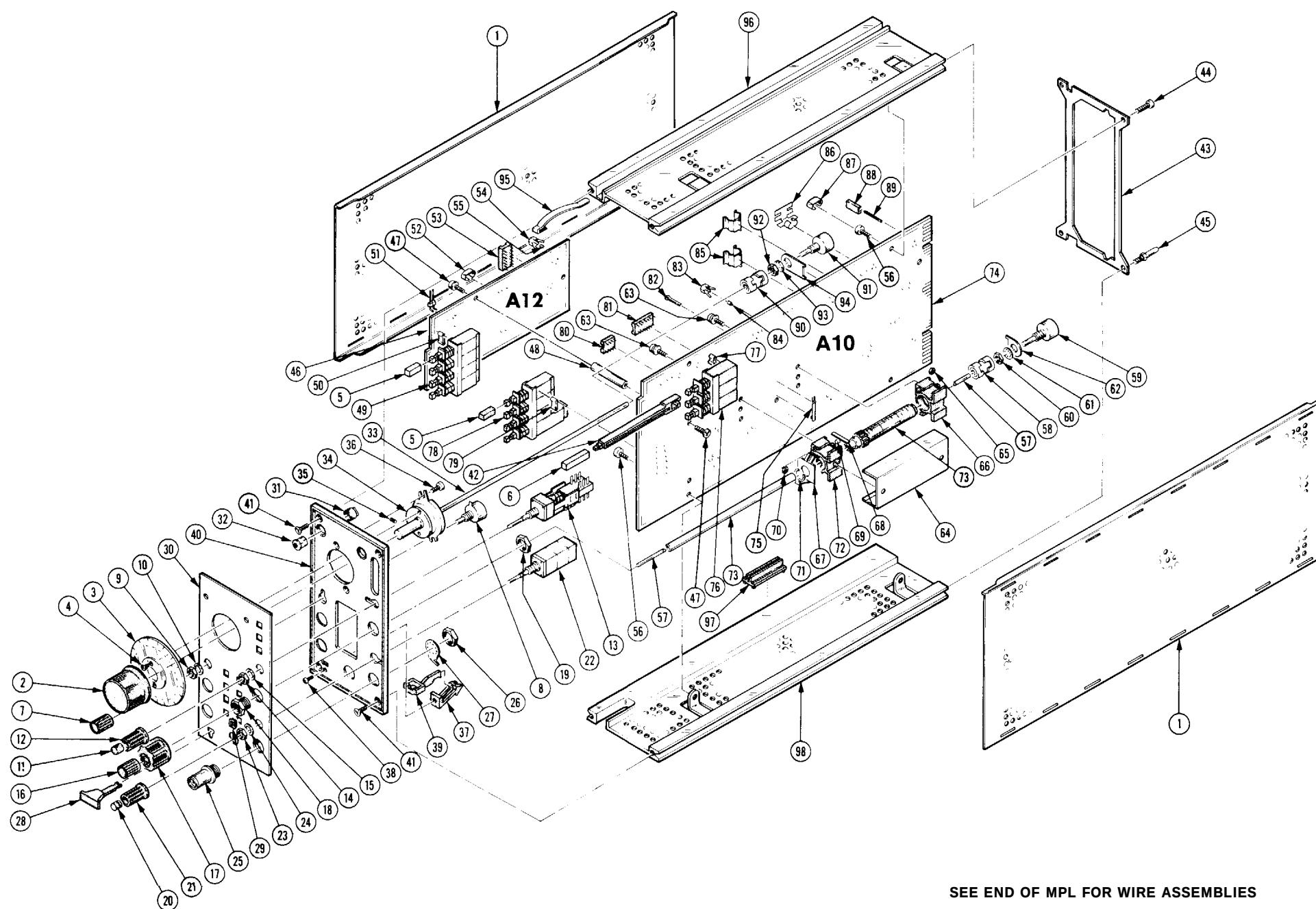
———— The information and special symbols below may appear in this manual. ————

## Assembly Numbers and Grid Coordinates

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

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

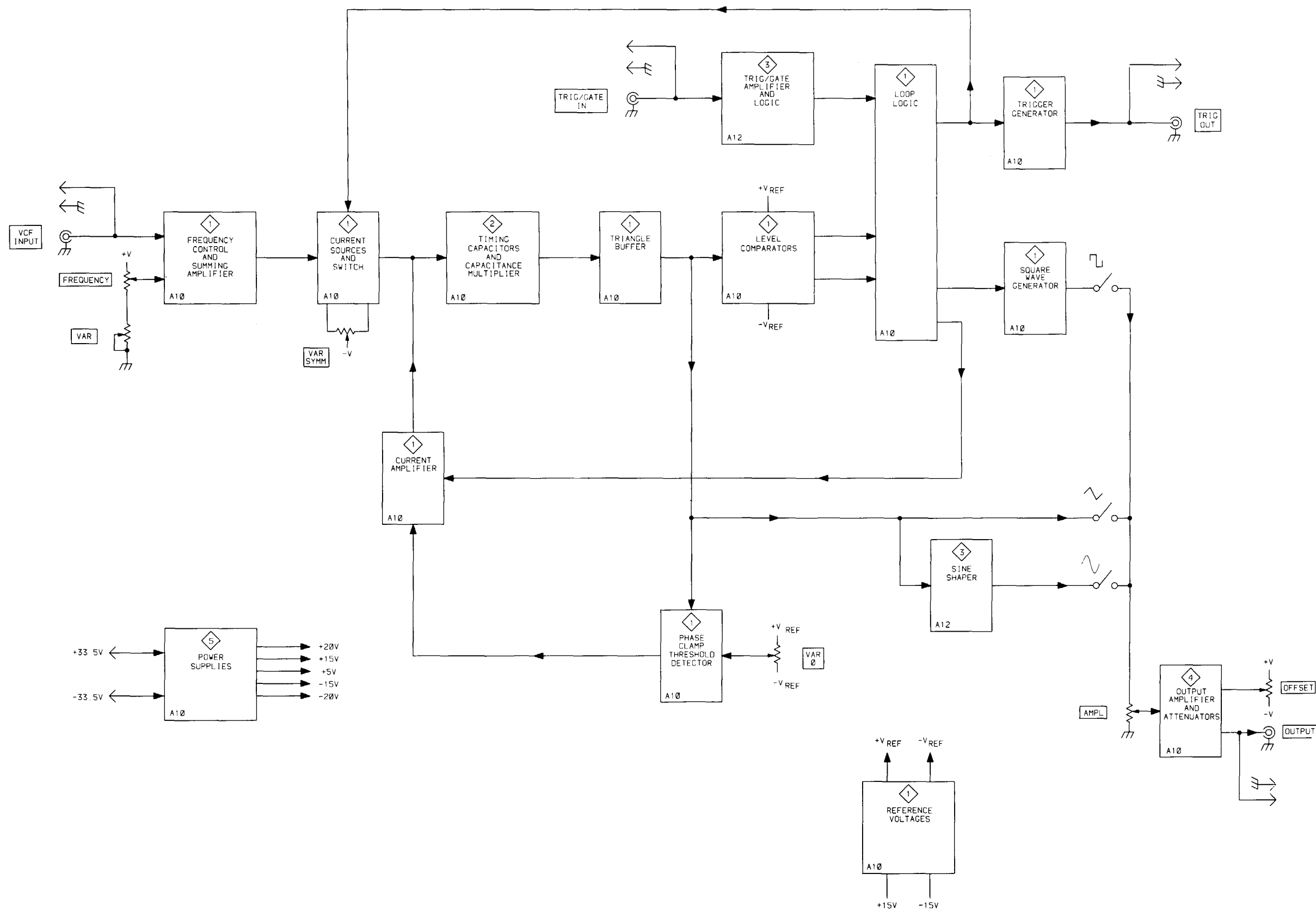




SEE END OF MPL FOR WIRE ASSEMBLIES

**FG 501A FUNCTION GENERATOR  
EXPLODED VIEW**





FG 501A

Fig. 8-3.

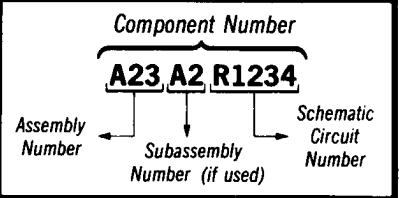
2957-40





 **Static Sensitive Devices**  
See Maintenance Section

### COMPONENT NUMBER EXAMPLE

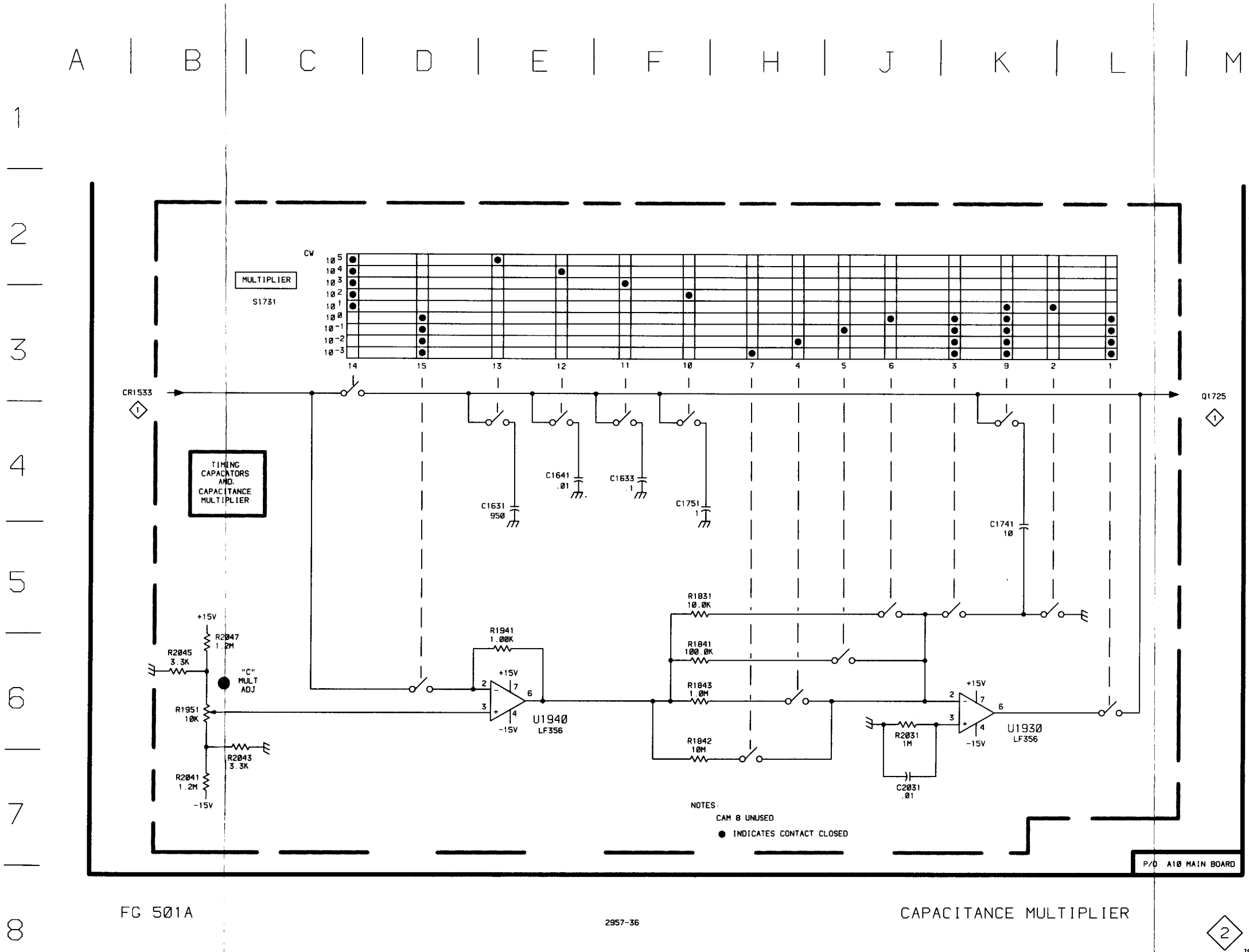


chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

TABLE 8-2  
COMPONENT REFERENCE CHART

| P/O            | A10 ASSY           | MAIN BOARD     | 2 |
|----------------|--------------------|----------------|---|
| CIRCUIT NUMBER | SCHEMATIC LOCATION | BOARD LOCATION |   |
| C1631          | E4                 | G4             |   |
| C1633          | F4                 | G4             |   |
| C1641          | E4                 | G5             |   |
| C1741          | K4                 | H5             |   |
| C1751          | F4                 | H6             |   |
| C2031          | J7                 | J4             |   |
| R1831          | F5                 | H4             |   |
| R1841          | F6                 | H4             |   |
| R1842          | F7                 | H4             |   |
| R1843          | F6                 | H5             |   |
| R1941          | E6                 | I5             |   |
| R1951          | B6                 | J6             |   |
| R2031          | J6                 | J4             |   |
| R2041          | B7                 | J5             |   |
| R2043          | B7                 | J5             |   |
| R2045          | B6                 | J5             |   |
| R2047          | B6                 | J5             |   |
| S1731          | C3                 | H4             |   |
| U1930          | K6                 | J4             |   |
| U1940          | E6                 | J5             |   |

P/O A10 ASSY also shown on 1 3 4 5



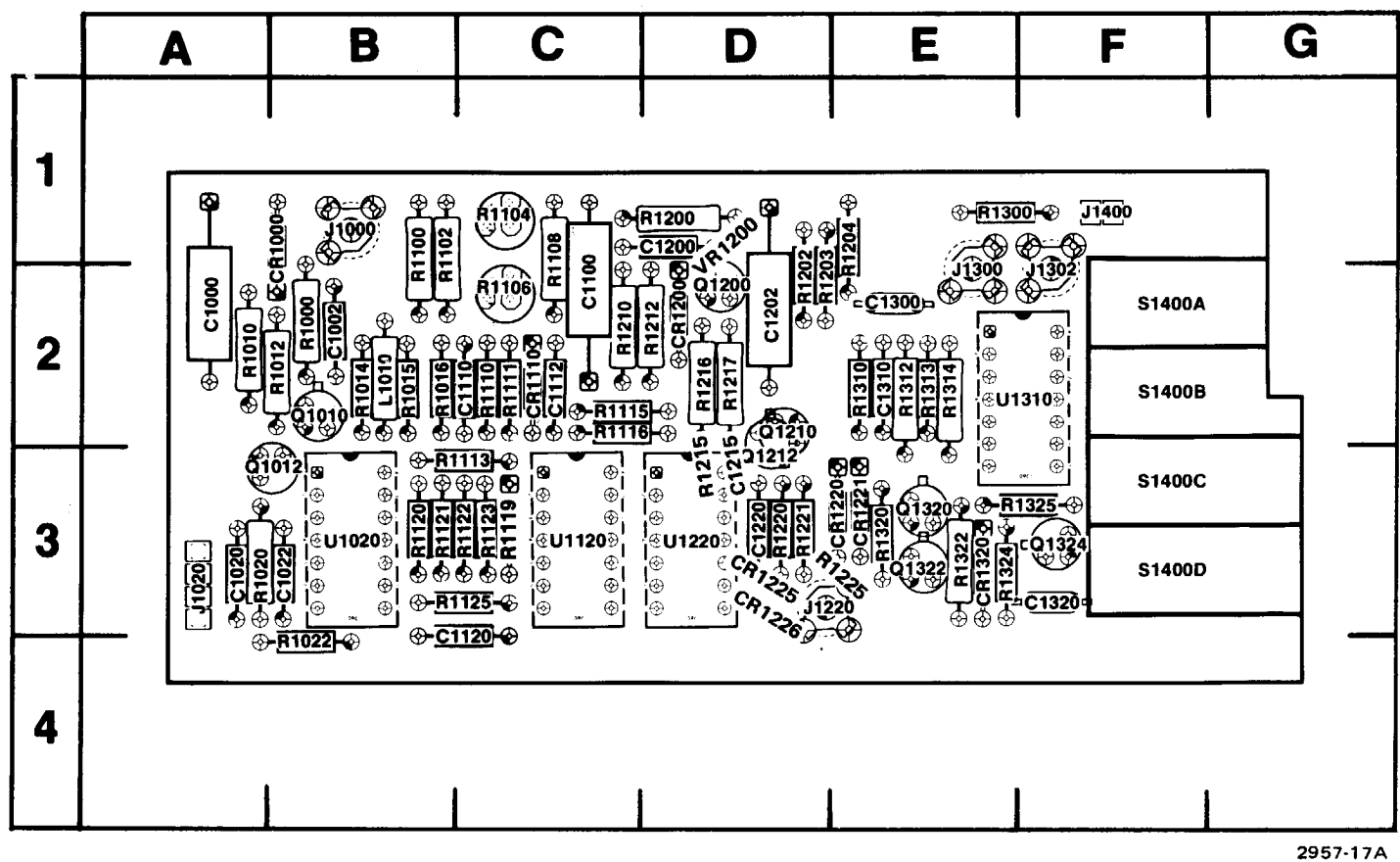
**Static Sensitive Devices**  
See Maintenance Section

**COMPONENT NUMBER EXAMPLE**

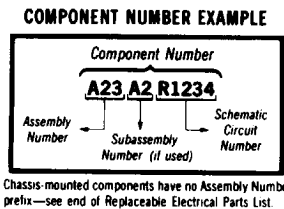
| Component Number |                              |                          |
|------------------|------------------------------|--------------------------|
| A23              | A2                           | R1234                    |
| Assembly Number  | Subassembly Number (if used) | Schematic Circuit Number |

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

### TABLE 8-3 COMPONENT REFERENCE CHART



**Fig. 8-5. Auxiliary Board (A12 Assy).**

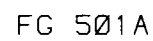


 **Static Sensitive Devices**  
See Maintenance Section

| A12 ASSY       |                    |                | AUXILIARY BOARD  |                    |                |                |                    |                |
|----------------|--------------------|----------------|-----------------------------------------------------------------------------------------------------|--------------------|----------------|----------------|--------------------|----------------|
| CIRCUIT NUMBER | SCHEMATIC LOCATION | BOARD LOCATION | CIRCUIT NUMBER                                                                                      | SCHEMATIC LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEMATIC LOCATION | BOARD LOCATION |
| C1000          | J5                 | A2             | Q1012                                                                                               | J6                 | A3             | R1221          | B5                 | D3             |
| C1002          | F5                 | B2             | Q1200                                                                                               | C4                 | D2             | R1225          | H4                 | D3             |
| C1020          | J6                 | A3             | Q1210                                                                                               | C5                 | D2             | R1300          | C1                 | E1             |
| C1022          | K6                 | B3             | Q1212                                                                                               | F4                 | D3             | R1310          | E1                 | E2             |
| C1100          | E8                 | C2             | Q1320                                                                                               | D1                 | E3             | R1312          | D2                 | E2             |
| C1110          | D5                 | C2             | Q1322                                                                                               | E3                 | E3             | R1313          | D1                 | E2             |
| C1112          | B8                 | C2             | Q1324                                                                                               | F3                 | F3             | R1314          | D1                 | E2             |
| C1120          | B7                 | C3             | R1000                                                                                               | H7                 | B2             | R1320          | D3                 | E3             |
| C1200          | B4                 | D1             | R1010                                                                                               | J6                 | A2             | R1322          | E4                 | E3             |
| C1202          | C4                 | D2             | R1012                                                                                               | J6                 | B2             | R1324          | F3                 | E3             |
| C1215          | C4                 | D3             | R1014                                                                                               | L7                 | B2             | R1325          | F2                 | F3             |
| C1220          | F4                 | D3             | R1015                                                                                               | J8                 | B2             | S1400A         | L2                 | F2             |
| C1300          | E1                 | E2             | R1016                                                                                               | B7                 | B2             | S1400B         | L2                 | F2             |
| C1310          | C2                 | E2             | R1020                                                                                               | K7                 | A3             | S1400C         | L2                 | F3             |
| C1320          | F4                 | F3             | R1022                                                                                               | B6                 | B4             | S1400D         | E3                 | F3             |
| CR1000         | J6                 | B1             | R1100                                                                                               | J5                 | B1             |                |                    |                |
| CR1110         | C8                 | C2             | R1102                                                                                               | J5                 | B1             | U1020A         | J7                 | B3             |
| CR1120         | C7                 | C3             | R1104                                                                                               | J5                 | C1             | U1020B         | J7                 | B3             |
| CR1200         | B4                 | D2             | R1106                                                                                               | M7                 | C2             | U1020C         | L6                 | B3             |
| CR1220         | C3                 | E3             | R1108                                                                                               | C8                 | C1             | U1020D         | D5                 | B3             |
| CR1221         | C2                 | E3             | R1110                                                                                               | H8                 | C2             | U1020E         | J7                 | B3             |
| CR1225         | H5                 | D3             | R1111                                                                                               | D6                 | C2             |                |                    |                |
| CR1226         | H5                 | D3             | R1113                                                                                               | E6                 | B3             | U1020          | J7                 | B3             |
| CR1320         | E4                 | E3             | R1115                                                                                               | D8                 | C2             | U1120A         | E7                 | C3             |
|                |                    |                | R1116                                                                                               | D8                 | C2             | U1120B         | E7                 | C3             |
| J1000          | M7                 | B1             | R1119                                                                                               | C7                 | C3             | U1120C         | C7                 | C3             |
| J1020          | B6                 | A3             | R1120                                                                                               | L6                 | B3             | U1120D         | F7                 | C3             |
| J1100          | B3                 | B2             | R1121                                                                                               | D5                 | B3             | U1120E         | E8                 | C3             |
| J1220          | K4                 | D3             | R1122                                                                                               | D5                 | C3             | U1220A         | D6                 | D3             |
| J1300          | B2                 | E2             | R1123                                                                                               | H7                 | C3             | U1220B         | E7                 | D3             |
| J1302          | M2                 | F2             | R1125                                                                                               | D6                 | C3             | U1220C         | C6                 | D3             |
| J1400          | B1                 | F1             | R1200                                                                                               | C4                 | D1             | U1220D         | F6                 | D3             |
| L1010          | L7                 | B2             | R1202                                                                                               | B4                 | D2             | U1220E         | D8                 | D3             |
| P1000          | M7                 | B1             | R1203                                                                                               | C3                 | C2             | U1310A         | J3                 | F2             |
| P1020          | B6                 | A3             | R1204                                                                                               | C2                 | E1             | U1310B         | K2                 | F2             |
| P1030          | A3                 | A4             | R1210                                                                                               | E8                 | C2             | U1310C         | J2                 | F2             |
| P1220          | K4                 | D3             | R1212                                                                                               | D8                 | D2             | U1310D         | H2                 | F2             |
| P1300          | B2                 | E2             | R1215                                                                                               | C5                 | D3             |                |                    |                |
| P1302          | M2                 | F2             | R1216                                                                                               | C5                 | D2             | VR1200 *       | B4                 | D1             |
| P1400          | B1                 | F1             | R1217                                                                                               | E4                 | D2             | CR510          | B1                 | Chassis        |
| Q1010          | E5                 | B2             | R1220                                                                                               | H4                 | D3             | J520           | B2                 | Chassis        |

| P/O A10 ASSY |    |    | MAIN BOARD  |  |  |
|--------------|----|----|--------------------------------------------------------------------------------------------------|--|--|
| J1100        | B3 | S2 |                                                                                                  |  |  |
| P1100        | B3 | B2 |                                                                                                  |  |  |

| P/O | A10 ASSY also shown on |  |  |  |  |
|-----|------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|     |                        |                                                                                       |                                                                                       |                                                                                       |                                                                                       |



A12 AUXILIARY BOARD .

 **Static Sensitive Devices**  
See *Maintenance Section*

**Component Number**

**A23 A2 R1234**

Assembly Number      Subassembly Number (if used)      Schematic Circuit Number

3

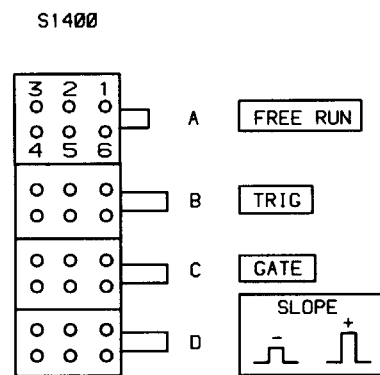
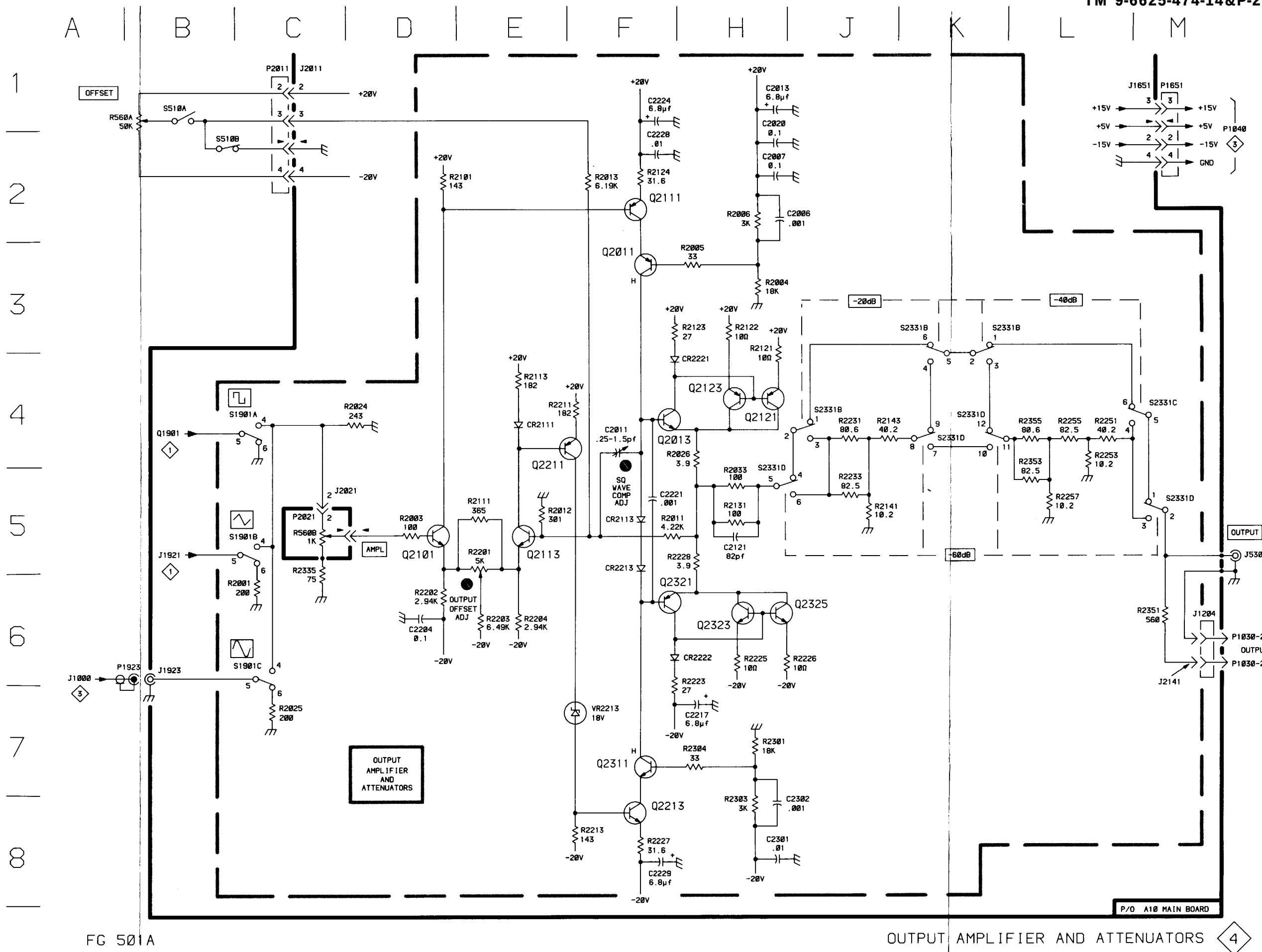
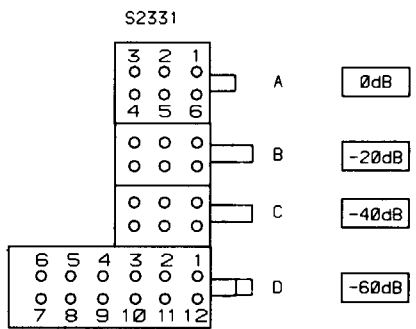
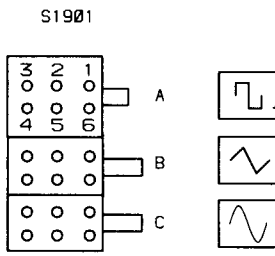




TABLE 8-4  
COMPONENT REFERENCE CHART

| P/O A10 ASSY   |                    |                | MAIN BOARD 4   |                    |                |
|----------------|--------------------|----------------|----------------|--------------------|----------------|
| CIRCUIT NUMBER | SCHEMATIC LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEMATIC LOCATION | BOARD LOCATION |
| C2006          | H2                 | K1             | R2012          | ES                 | J2             |
| C2007          | H2                 | K1             | R2013          | F2                 | J1             |
| C2011          | F4                 | K2             | R2024          | D4                 | J2             |
| C2013          | H1                 | K3             | R2025          | C7                 | J3             |
| C2020          | H2                 | K2             | R2026          | H4                 | K3             |
| C2121          | H5                 | K4             | R2033          | H5                 | J4             |
| C2204          | D6                 | L1             | R2101          | D2                 | K2             |
| C2217          | H7                 | M2             | R2111          | ES                 | L1             |
| C2221          | F5                 | L3             | R2113          | E4                 | L2             |
| C2224          | F1                 | L3             | R2121          | H3                 | K3             |
| C2228          | F2                 | L3             | R2122          | H3                 | K3             |
| C2229          | F8                 | L3             | R2123          | F3                 | K3             |
| C2301          | H8                 | M1             | R2124          | F2                 | K2             |
| C2302          | H8                 | M1             | R2131          | H5                 | K4             |
| CR2111         | E4                 | L2             | R2141          | J5                 | KS             |
| CR2113         | F5                 | L2             | R2143          | J4                 | L5             |
| CR2213         | F5                 | L3             | R2201          | E5                 | L1             |
| CR2221         | F4                 | L3             | R2202          | D6                 | L1             |
| CR2222         | H6                 | L3             | R2203          | E6                 | L1             |
| J1204          | M6                 | D1             | R2204          | E6                 | L1             |
| J1651          | M1                 | F5             | R2211          | F4                 | L2             |
| J1923          | B6                 | J3             | R2213          | F8                 | L2             |
| J2011          | C1                 | J3             | R2223          | H7                 | L3             |
| J2021          | C5                 | J3             | R2225          | H6                 | L3             |
| J2141          | M6                 | KS             | R2226          | J6                 | L3             |
| P1030          | M6                 | A4             | R2227          | F8                 | L2             |
| P1651          | M1                 | F5             | R2228          | H5                 | K4             |
| P1923          | B6                 | J3             | R2231          | J4                 | L4             |
| P2011          | C1                 | J3             | R2233          | J5                 | L4             |
| P2021          | C5                 | J3             | R2251          | K4                 | L5             |
| Q2011          | F3                 | K2             | R2253          | K4                 | L5             |
| Q2013          | F4                 | K3             | R2255          | K4                 | L6             |
| Q2101          | D5                 | K2             | R2257          | K4                 | L6             |
| Q2111          | F2                 | K2             | R2301          | M1                 | M1             |
| Q2113          | E5                 | K2             | R2303          | H8                 | M1             |
| Q2121          | H4                 | K3             | R2304          | H7                 | M2             |
| Q2123          | H4                 | K3             | R2305          | C5                 | N4             |
| Q2211          | E4                 | L2             | R2351          | M6                 | L5             |
| Q2213          | F8                 | L2             | R2353          | KS                 | M5             |
| Q2311          | F7                 | M2             | R2355          | K4                 | M6             |
| Q2321          | F6                 | M2             | S1901A         | C4                 | J1             |
| Q2323          | H6                 | M3             | S1901B         | C5                 | J2             |
| Q2325          | H6                 | M3             | S1901C         | C6                 | J2             |
| R2001          | C6                 | J1             | S2331B         | J4                 | M4             |
| R2003          | D5                 | J1             | S2331C         | K3                 | M4             |
| R2004          | H3                 | J1             | S2331D         | K4                 | M5             |
| R2005          | H3                 | J1             | VR2213         | F7                 | L2             |
| R2006          | H2                 | K1             | J530           | M5                 | Chassis        |
| R2011          | F5                 | J2             | R560A          | B1                 | Chassis        |
|                |                    |                | R560B          | C5                 | Chassis        |
|                |                    |                |                | B1                 | Chassis        |
|                |                    |                |                | B2                 | Chassis        |

P/O A10 ASSY also shown on 1 2 3 5



| P/O A10 ASSY   |                    |                | MAIN BOARD 5   |                    |                |
|----------------|--------------------|----------------|----------------|--------------------|----------------|
| CIRCUIT NUMBER | SCHEMATIC LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEMATIC LOCATION | BOARD LOCATION |
| C1115          | C1                 | C2             | R1135          | F6                 | C4             |
| C1201          | B1                 | C2             | R1141          | K8                 | B5             |
| C1203          | F3                 | D2             | R1143          | L8                 | C5             |
| C1224          | H4                 | C3             | R1201          | F3                 | C2             |
| C1235          | H6                 | C4             | R1203          | E2                 | C2             |
| C1251          | D8                 | D6             | R1225          | J4                 | C3             |
| C1253          | D8                 | C6             | R1226          | J4                 | C3             |
| C1313          | E4                 | D2             | R1227          | L4                 | C3             |
| C1321          | J5                 | D3             | R1228          | K5                 | D3             |
| C1323          | J3                 | D3             | R1229          | H4                 | C3             |
| C1325          | J5                 | D3             | R1231          | H3                 | C3             |
| C1341          | J6                 | D5             | R1232          | H4                 | C4             |
| C1451          | D6                 | E5             | R1233          | H5                 | C4             |
| F1111          | B1                 | B3             | R1235          | F7                 | C4             |
| F1131          | B8                 | B5             | R1241          | J7                 | C4             |
|                |                    |                | R1242          | K7                 | C5             |
|                |                    |                | R1243          | H8                 | C5             |
| L1111          | B1                 | B2             | R1245          | B6                 | C5             |
| L1251          | C8                 | C5             | R1247          | C6                 | C5             |
| P1030          | L8                 | A4             | R1301          | F4                 | D2             |
| P1030          | A1                 | A4             | R1311          | C2                 | D3             |
| P1030          | A8                 | A4             | R1315          | F4                 | D2             |
| P1030          | J2                 | A4             | R1331          | J5                 | D4             |
| P1030          | H2                 | A4             | R1333          | C7                 | D4             |
| P1030          | L7                 | A4             | R1341          | C6                 | D5             |
| P1030          | A4                 | A4             | R1346          | E7                 | D5             |
|                |                    |                | R1451          | E6                 | E6             |
| Q1221          | L4                 | C3             | TP1241         | L6                 | D5             |
| Q1231          | F3                 | C3             | TP1321         | L3                 | D3             |
| Q1241          | L7                 | C5             | TP1323         | L4                 | D3             |
| Q1243          | K8                 | C5             | TP1331         | L5                 | D4             |
| Q1245          | J7                 | C5             | TP1451         | L6                 | E5             |
| Q1331          | K5                 | D4             |                |                    |                |
| Q1335          | D7                 | D4             | U1210          | D3                 | C2             |
| Q1345          | E7                 | D5             | U1230A         | H7                 | C4             |
|                |                    |                | U1230B         | C7                 | C4             |
| R1113          | F2                 | B3             | U1230C         | J5                 | C4             |
| R1121          | J3                 | B3             | U1230D         | J4                 | C4             |
| R1131          | C7                 | B4             |                |                    |                |
| R1133          | J6                 | C4             | VR1241         | H7                 | C5             |

P/O A10 ASSY also shown on

1

2

3

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## SECTION 9

# REPLACEABLE MECHANICAL PARTS

## PARTS ORDERING INFORMATION

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

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

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

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

## SPECIAL NOTES AND SYMBOLS

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

## FIGURE AND INDEX NUMBERS

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

## INDENTATION SYSTEM

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

1 2 3 4 5 *Name & Description*

*Assembly and/or Component*

*Attaching parts for Assembly and/or Component*

---\*---

*Detail Part of Assembly and/or Component*

*Attaching parts for Detail Part*

---\*---

*Parts of Detail Part*

*Attaching parts for Parts of Detail Part*

---\*---

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

**Attaching parts must be purchased separately, unless otherwise specified.**

## ITEM NAME

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

## ABBREVIATIONS

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

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

| Mfr. Code | Manufacturer                           | Address                 | City, State, Zip           |
|-----------|----------------------------------------|-------------------------|----------------------------|
| K0099     | JACKSON BROS (LONDON) LTD.             | 258 BROADWAY            | NEW YORK, NEW YORK 10007   |
| 00779     | AMP, INC.                              | P O BOX 3608            | HARRISBURG. PA 17105       |
| 01536     | CAMCAR DIV OF TEXTRON INC. SEMS        |                         |                            |
|           | PRODUCTS UNIT                          | 1818 CHRISTINA ST.      | ROCKFORD, IL 61108         |
| 13103     | THERMALLOY COMPANY, INC.               | 2021 W VALLEY VIEW LANE |                            |
|           |                                        | P O BOX 34829           | DALLAS, TX 75234           |
| 22526     | BERG ELECTRONICS, INC.                 | YOUK EXPRESSWAY         | NEW CUMBERLAND, PA 17070   |
| 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     | HOLLO-KROME CO.                        | 31 BROOK ST. WEST       | HARTFORD, CT 06110         |
| 75915     | LITTELFUSE, INC.                       | 800 E. NORTHWEST HWY    | DES PLAINES, IL 60016      |
| 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            |
| 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        |
| 83385     | CENTRAL SCREW CO.                      | 2530 CRESCENT DR.       | BROADVIEW, IL 60153        |
| 93907     | TEXTRON INC. CAMCAR DIV                | 600 18TH AVE            | ROCKFORD, IL 61101         |



| FIG. &<br>INDEX<br>NO. | TEKTRONIX<br>PART NO. | SERIAL/MODEL NO.<br>EFF DSCONT | QTY | 1 2 3 4 5 NAME & DESCRIPTION                                            | MFR<br>CODE | MFR PART NUMBER |
|------------------------|-----------------------|--------------------------------|-----|-------------------------------------------------------------------------|-------------|-----------------|
| 1-1                    | 337-1399-04           |                                | 2   | SHIELD,ELEC:SIDE                                                        | 80009       | 337-1399-04     |
| -2                     | 366-1837-00           |                                | 1   | KNOB:GRAY,0.252 ID X 1.041 OD,0.7                                       | 80009       | 366-1837-00     |
| -3                     | 354-0557-05           |                                | 1   | RING, KNOB SKIRT: CLEAR, 1.875 OD<br>(ATTACHING PARTS)                  | 80009       | 354-0557-05     |
| -4                     | 211-0088-00           |                                | 2   | SCREW, MACHINE: 2-56 X 0.281"82 DEG, FLH STL<br>- *-                    | 77250       | OBD             |
| -5                     | 366-1559-00           |                                | 8   | PUSH BUTTON: STL GY, 0.18 SQ X 0.43                                     | 80009       | 366-1559-00     |
| -6                     | 366-1512-00           |                                | 3   | PUSH BUTTON: GRAY, 0.18 SQ X 0.83 INCH LG                               | 80009       | 366-1512-00     |
| -7                     | 366-1023-07           |                                | 1   | KNOB: GRAY, 0.127 ID, 0.392 OD, 0.466                                   | 80009       | 366-1023-07     |
| -8                     |                       |                                | 1   | RES., VAR, NONWIR: (SEE R550 REPL)<br>(ATTACHING PARTS)                 |             |                 |
| -9                     | 210-0583-00           |                                | 1   | NUT, PLAIN, HEX: 0.25-32 X 0.312 INCH, BRS                              | 73743       | 2X20317-402     |
| -10                    | 210-0940-00           |                                | 1   | WASHER, FLAT: 0.25 ID X 0.375 INCH OD, STL<br>- *-                      | 79807       | OBD             |
| -11                    | 366-1059-03           |                                | 1   | PUSH BUTTON: GY W/YEL BND, 0.227                                        | 80009       | 366-1059-03     |
| -12                    | 366-1215-01           |                                | 1   | KNOB: GY, 0.127 ID X 0.5 OD, 0.531                                      | 80009       | 366-1215-01     |
| -13                    |                       |                                | 1   | RES., VAR, NONWIR: (SEE R530, S500 REPL)<br>(ATTACHING PARTS)           |             |                 |
| -14                    | 210-0583-00           |                                | 1   | NUT, PLAIN, HEX: 0.25-32 X 0.312 INCH, BRS                              | 73743       | 2X20317-402     |
| -15                    | 210-0940-00           |                                | 1   | WASHER, FLAT: 0.25 ID X 0.375 INCH OD, STL<br>- *-                      | 79807       | OBD             |
| -16                    | 366-1031-06           |                                | 1   | KNOB: GRAY--VAR                                                         | 80009       | 366-1031-06     |
| -17                    | 366-1170-03           |                                | 1   | KNOB: GRAY, 0.25 ID X 0.706 OD, 0.6H                                    | 80009       | 366-1170-03     |
| -18                    | 358-0029-00           |                                | 1   | BSHG, MACH. THD: HEX, 0.375-32 X 0.438" LONG<br>(ATTACHING PARTS)       | 80009       | 358-0029-00     |
| -19                    | 210-0413-00           |                                | 1   | NUT, PLAIN, HEX.: 0.375-32 X 0.50 INCH, STL<br>- *-                     | 73743       | 3145-402        |
| -20                    | 366-1319-03           |                                | 1   | KNOB: GY, W/IDX, 0.79 ID, 0.28 OD, 0.32 H                               | 80009       | 366-1319-03     |
| -21                    | 366-1077-01           |                                | 1   | KNOB: GRAY, 0.127 ID, 0.5 OD, 0.531H                                    | 80009       | 366-1077-01     |
| -22                    |                       |                                | 1   | RES., VAR, NONWIR: (SEE R560, S510 REPL)<br>(ATTACHING PARTS)           |             |                 |
| -23                    | 210-0583-00           |                                | 1   | NUT, PLAIN, HEX: 0.25-32 X 0.312 INCH BRS                               | 73743       | 2X20317-402     |
| -24                    | 210-0940-00           |                                | 1   | WASHER, FLAT: 0.25 ID X 0.375 INCH OD, STL<br>- *-                      | 79807       | OBD             |
| -25                    |                       |                                | 4   | CONNECTOR, RCPT: (SEE J500, J510, J520, J530 REPL)<br>(ATTACHING PARTS) |             |                 |
| -26                    | 220-0495-00           |                                | 1   | NUT, PLAIN, HEX.: 0.375-32 X 0.438 INCH BRS                             | 73743       | OBD             |
| -27                    | 210-0255-00           |                                | 4   | TERMINAL, LUG: 0.391 ID, LOCKING, BRS CD PL<br>- *-                     | 80009       | 210-0255-00     |
| -28                    | 366-1690-00           |                                | 1   | KNOB: SIL GY, 0.53 X 0.23 X 1.059                                       | 80009       | 366-1690-00     |
| -29                    | 426-1072-00           |                                | 11  | FRAME, PUSH BTN: PLASTIC                                                | 80009       | 426-1072-00     |
| -30                    | 333-2684-00           |                                | 1   | PANEL, FRONT:                                                           | 80009       | 333-2684-00     |
| -31                    | 200-0935-00           |                                | 2   | BASE, LAMPHOLDER: 0.29 OD X 0.19 CASE                                   | 80009       | 200-0935-00     |
| -32                    | 352-0157-00           |                                | 2   | LAMPHOLDER: WHITE PLASTIC                                               | 80009       | 352-0157-00     |
| -33                    | 384-1406-00           |                                | 1   | EXTENSION SHAFT: 6.64 L X 0.125 OD, AL, CRM                             | 80009       | 384-1406-00     |
| -34                    | 401-0206-00           |                                | 1   | GR ASSY, SP RDCN: 6 TO 1<br>(ATTACHING PARTS)                           | 80009       | 4511/DAF        |
| -35                    | 213-0022-00           |                                | 1   | SETSCREW: 4-40 X 0.188 INCH, HEX SOC STL                                | 74445       | OBD             |
| -36                    | 211-0008-00           |                                | 2   | SCREW, MACHINE: 4-40 X 0.250, PNH, STL, CD PL<br>- *-                   | 83385       | OBD             |
| -37                    | 105-0719-00           |                                | 1   | LATCH, RETAINING: PLUG-IN<br>(ATTACHING PARTS)                          | 80009       | 105-0719-00     |
| -38                    | 213-0113-00           |                                | 1   | SCR, TPG, THD FOR: 2-32 X 0.312 INCH, PNH STL<br>- *-                   | 93907       | OBD             |
| -39                    | 105-0718-01           |                                | 1   | BAR, LATCH RLSE:                                                        | 80009       | 105-0718-01     |
| -40                    | 386-4469-00           |                                | 1   | SUBPANEL, FRONT:<br>(ATTACHING PARTS)                                   | 80009       | 386-4469-00     |
| -41                    | 213-0229-00           |                                | 4   | SCR, TPG, THD FOR: 6-20 X 0.375"100 GED, FLH STL<br>- *-                | 93907       | OBD             |
| -42                    | 384-1292-00           |                                | 3   | EXTENSION SHAFT: 2.417 INCH LONG, PLASTIC                               | 80009       | 384-1292-00     |
| -43                    | 386-4278-00           |                                | 1   | SUPPORT, FRAME: REAR, AL<br>(ATTACHING PARTS)                           | 80009       | 386-4278-00     |
| -44                    | 213-0868-00           |                                | 2   | SCREW, TPG, TF: 6-32 X 0.375 L, FILM, STEEL                             | 93907       | OBD             |
| -45                    | 386-3657-01           |                                | 2   | SUPPORT, PLUG IN:<br>- *-                                               | 93907       | OBD             |

| FIG. &<br>INDEX<br>NO.<br>1-46 | TEKTRONIX<br>PART NO. | SERIAL/MODEL NO.<br>EFF DSCONT | QTY | 1 2 3 4 5 NAME & DESCRIPTION                                                                                      | MFR<br>CODE | MFR PART NUMBER  |
|--------------------------------|-----------------------|--------------------------------|-----|-------------------------------------------------------------------------------------------------------------------|-------------|------------------|
|                                |                       |                                | 1   | CKT BOARD ASSY:AUXILIARY(SEE A12 REPL)<br>(ATTACHING PARTS)                                                       |             |                  |
| -47                            | 211-0678-00           |                                | 6   | SCR,ASSEM WSHR:4-40 X 0.281 L,PNH STEEL                                                                           | 01536       | OBD              |
| -48                            | 129-0251-00           |                                | 3   | INSULATOR,STDF:0.250 OD X 1.125" L,PLSTC                                                                          | 80009       | 129-0251-00      |
|                                |                       |                                | -   | CKT BOARD ASSY INCLUDES:                                                                                          |             |                  |
| -49                            |                       |                                | 1   | .SWITCH,PUSH:(SEE A14S1400 REPL)                                                                                  |             |                  |
| -50                            | 361-0385-00           |                                | 4   | .SPACER,PB SW:0.164 INCH LONG                                                                                     | 80009       | 361-0385-00      |
| -51                            |                       |                                | 1   | .TERMINAL,SET PIN:(SEE A12J1020,J1400 REPL)                                                                       |             |                  |
| -52                            | 214-0973-00           |                                | 1   | .HEAT SINK,ELEC:0.28 X 0.18 OVAL X 0.187"H                                                                        | 80009       | 214-0973-00      |
| -53                            | 136-0269-02           |                                | 4   | .SKT,PL-IN ELEC:MICROCIRCUIT,14 DIP,LOW CLE                                                                       | 73803       | CS9002-14        |
| -54                            |                       |                                | 4   | .CONN,RCPT,ELEC:(SEE A14J1000,J1220,J1300,<br>J1302 REPL)                                                         |             |                  |
| -55                            | 136-0252-07           |                                | 4   | .SOCKET,PIN CONN:W/O DIMPLE                                                                                       | 22526       | 75060-012        |
|                                | 672-0924-00           | B010100                        | 1   | CKT BOARD ASSY:FUNCTION GEN 1 WIDE                                                                                | 80009       | 672-0924-00      |
|                                | 672-0924-01           | B020350                        | 1   | CKT BOARD ASSY:FUNCTION GEN 1 WIDE<br>(ATTACHING PARTS)                                                           | 80009       | 672-0924-01      |
| -56                            | 213-0124-00           |                                | 4   | SCR,TPG,THD FOR:6-20 X 0.250 INCH,PNH STL                                                                         | 83385       | OBD              |
|                                |                       |                                | -   | CKT BOARD W/SW ASSY INCLUDES:                                                                                     |             |                  |
| -57                            | 384-1007-00           |                                | 1   | .EXTENSION SHAFT:8.328 L X 0.123 OD                                                                               | 80009       | 384-1007-00      |
| -58                            | 376-0051-01           |                                | 1   | .CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD                                                                              | 80009       | 376-0051-01      |
| -59                            |                       |                                | 1   | .RES.,VAR,NONWIR:(SEE R510 REPL)<br>(ATTACHING PARTS)                                                             |             |                  |
| -60                            | 210-0583-00           |                                | 1   | .NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS                                                                           | 73743       | 2X20317-402      |
| -61                            | 210-0046-00           |                                | 1   | .WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS                                                                          | 78189       | 1214-05-00-0541C |
|                                |                       |                                | -   | CKT BOARD W/SW ASSY INCLUDES:                                                                                     |             |                  |
| -62                            | 407-0579-00           |                                | 1   | .BRACKET,VAR RES:BRASS CD,PL                                                                                      | 80009       | 407-0579-00      |
|                                |                       |                                | 1   | .SW,CAM ACTR AS:(SEE S1731 REPL)<br>(ATTACHING PARTS)                                                             |             |                  |
| -63                            | 211-0678-00           |                                | 4   | SCR,ASSEM WSHR:4-40 X 0.281 L,PNH STEEL                                                                           | 01536       | OBD              |
|                                |                       |                                | -   | ACTR ASSY INCLUDES:                                                                                               |             |                  |
| -64                            | 200-2524-00           |                                | 1   | .COVER,CAM SW:15 ELEMENT,AL                                                                                       | 80009       | 200-2524-00      |
| -65                            | 210-0406-00           |                                | 2   | .NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS                                                                             | 73743       | 12161-50         |
| -66                            | 401-0156-00           |                                | 1   | .BEARING,CAM SW:REAR                                                                                              | 80009       | 401-0156-00      |
| -67                            | 131-1248-00           |                                | 1   | .CONTACT,ELEC:SHAFT GND,NI BE                                                                                     | 80009       | 131-1248-00      |
| -68                            | 214-1704-00           |                                | 2   | .SPRING,FLAT:CAM SW DETENT,0.006 INCH THK                                                                         | 80009       | 214-1704-00      |
| -69                            | 214-1127-00           |                                | 2   | .ROLLER,DETENT:0.125 DIA X 0.125,SST                                                                              | 80009       | 214-1127-00      |
| -70                            | 210-0406-00           |                                | 2   | .NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS                                                                             | 73743       | 12161-50         |
| -71                            | 354-0219-00           |                                | 1   | .RING,RETAINING:FOR 0.25 INCH SHAFT                                                                               | 79136       | 5103-25-MD-R     |
| -72                            | 401-0155-00           |                                | 1   | .BEARING,CAM SW:FRONT                                                                                             | 80009       | 401-0155-00      |
| -73                            | 105-0856-00           |                                | 1   | .ACTR,CAM SW:FREQUENCY MULTIPLIER                                                                                 | 80009       | 105-0856-00      |
| -74                            |                       |                                | 1   | .CKT BOARD ASSY:FUNCTION GEN(SEE A10 REPL)                                                                        |             |                  |
| -75                            | 131-0604-00           |                                | 15  | .CONTACT,ELEC:CKT BD SW,SPR,CU BE                                                                                 | 80009       | 131-0604-00      |
| -76                            |                       |                                | 1   | .SWITCH,PUSH:(SEE A10S1901 REPL)                                                                                  |             |                  |
| -77                            | 361-0385-00           |                                | 4   | .SPACER,PB SW:0.164 INCH LONG                                                                                     | 80009       | 361-0385-00      |
| -78                            |                       |                                | 1   | .SWITCH,PUSH:(SEE A10S2331 REPL)                                                                                  |             |                  |
| -79                            | 361-0385-00           |                                | 4   | .SPACER,PB SW:0.164 INCH LONG                                                                                     | 80009       | 361-0385-00      |
| -80                            | 136-0514-00           |                                | 3   | .SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP                                                                                | 73803       | CS9002-8         |
| -81                            | 136-0269-02           |                                | 6   | .SKT,PL-IN ELEC:MICROCIRCUIT,14 DIP,LOW CLE                                                                       | 73803       | CS9002-14        |
| -82                            | 214-0579-02           |                                | 5   | .TERM,TEST POINT:BRASS                                                                                            | 80009       | 214-0579-02      |
| -83                            |                       |                                | 5   | .CONN,RCP,ELEC:(A10J1801,J1921,J1923,<br>J2041,J2043 REPL)                                                        |             |                  |
| -84                            | 136-0252-07           |                                | 5   | .SOCKET,PIN CONN:W/O DIMPLE                                                                                       | 22526       | 75060-012        |
| -85                            | 344-0326-00           |                                | 4   | .CLIP,ELECTRICAL:FUSE,BRASS                                                                                       | 75915       | 102071           |
| -86                            | 214-3057-00           |                                | 2   | .HEAT SINK,XSTR:T0-5,SIL BRZ PTD,BLACK                                                                            | 13103       | 6024U SPECIAL    |
| -87                            | 214-0973-00           |                                | 1   | .HEAT SINK,ELEC:0.28 X 0.18 OVAL X 0.187"H                                                                        | 80009       | 214-0973-00      |
| -88                            | 131-0993-00           |                                | 1   | .BUS,CONDUCTOR:2 WIRE BLACK                                                                                       | 00779       | 530153-2         |
| -89                            |                       |                                | 33  | .TERMINAL,PIN:(SEE A10J1100,J1121,J1202,<br>J1203,J1204,J1301,J1541,J1611,J1641,J1651,<br>J2011,J2021,J2141 REPL) |             |                  |
| -90                            | 376-0051-01           |                                | 1   | .CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD                                                                              | 80009       | 376-0051-01      |
| -91                            |                       |                                | 1   | .RES.,VAR,NONWIR:(SEE A10R500 REPL)<br>(ATTACHING PARTS)                                                          |             |                  |
| -92                            | 210-0583-00           |                                | 1   | .NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS                                                                           | 73743       | 2X20317-402      |
| -93                            | 210-0046-00           |                                | 1   | .WASHER,LOCK 0.261 ID,INTL,0.018 THK,BRS                                                                          | 78189       | 1214-05-00-0541C |
|                                |                       |                                | -   | CKT BOARD W/SW ASSY INCLUDES:                                                                                     |             |                  |

| FIG. &<br>INDEX<br>NO. | TEKTRONIX<br>PART NO. | SERIAL/MODEL NO.<br>EFF DSCONT | QTY | 1 2 3 4 5 | NAME & DESCRIPTION             | MFR<br>CODE | MFR PART NUMBER |
|------------------------|-----------------------|--------------------------------|-----|-----------|--------------------------------|-------------|-----------------|
| 1-94                   | 386-4470-00           |                                | 1   |           | ..PLATE, RES MTG: BRASS        | 80009       | 386-4470-00     |
| -95                    | 214-1061-00           |                                | 1   |           | SPRING, GROUND: FLAT           | 80009       | 214-1061-00     |
| -96                    | 426-0724-19           |                                | 1   |           | FR SECT, PLUG-IN: BOTTOM       | 80009       | 426-0724-19     |
| -97                    | 351-0612-00           |                                | 2   |           | GUIDE, CKT BOARD: NYLON, 1.0 L | 80009       | 351-0612-00     |
| -98                    | 426-0725-05           |                                | 1   |           | FR SECT, PLUG-IN: TOP          | 80009       | 426-0725-05     |

| FIG. &<br>INDEX<br>NO. | TEKTRONIX<br>PART NO. | SERIAL/MODEL NO.<br>EFF DSCONT | QTY | 1 2 3 4 5<br>WIRE ASSEMBLIES | NAME & DESCRIPTION                         | MFR<br>CODE | MFR PART NUMBER |
|------------------------|-----------------------|--------------------------------|-----|------------------------------|--------------------------------------------|-------------|-----------------|
|                        | 175-2101-00           |                                | 1   |                              | CA ASSY, SP, ELEC:3, 26 AWG, 3.5 L         | 80009       | 175-2101-00     |
|                        |                       |                                | -   |                              | (FROM A10R500 TO A10J1203)                 |             |                 |
|                        | 352-0161-03           |                                | 1   |                              | .CONN BODY, PL, EL:3 WIRE ORANGE           | 80009       | 352-0161-03     |
|                        | 175-5119-00           |                                | 1   |                              | CA ASSY, SP, ELEC:2, 26AWS, 8.5L, RIBBON   | 80009       | 175-5119-00     |
|                        |                       |                                | -   |                              | (FROM A10J1100 TO A12J1210)                |             |                 |
|                        | 352-0169-02           |                                | 1   |                              | .CONN BODY, PL, EL:2 WIRE RED              | 80009       | 352-0169-00     |
|                        | 175-2101-00           |                                | 1   |                              | CA ASSY, SP, ELEC:3, 26 AWG, 3.5 L, RIBBON | 80009       | 175-2101-00     |
|                        |                       |                                | -   |                              | (FROM A10J1121 TO R510)                    |             |                 |
|                        | 352-0161-03           |                                | 1   |                              | .CONN BODY, PL, EL:3 WIRE ORANGE           | 80009       | 352-0161-03     |
|                        | 175-5124-00           |                                | 1   |                              | CA ASSY, SP, ELEC:4, 26 AWG, 7.0 L, RIBBON | 80009       | 175-5124-00     |
|                        |                       |                                | -   |                              | (FROM A10J1541 TO R530, S500)              |             |                 |
|                        | 352-0162-04           |                                | 1   |                              | .CONN BODY, PL, EL:4 WIRE YELLOW           | 80009       | 352-0162-04     |
|                        | 175-5120-00           |                                | 1   |                              | CA ASSY, SP, ELEC:3, 26 AWG, 7.0 L, RIBBON | 80009       | 175-5120-00     |
|                        |                       |                                | -   |                              | (FROM A10J1611 TO R550)                    |             |                 |
|                        | 352-0161-03           |                                | 1   |                              | .CONN BODY, PL, EL:3 WIRE ORANGE           | 80009       | 352-0161-03     |
|                        | 175-3242-00           |                                | 1   |                              | CA ASSY, SP, ELEC:2, 26 AWG, 8.0 L, RIBBON | 80009       | 175-3242-00     |
|                        |                       |                                | -   |                              | (FROM A10J1641 TO CR500)                   |             |                 |
|                        | 352-0169-02           |                                | 1   |                              | .CONN BODY, PL, EL:2 WIRE RED              | 80009       | 352-0169-00     |
|                        | 175-5117-00           |                                | 1   |                              | CA ASSY, SP, ELEC:4, 26 AWG, 3.5 L, RIBBON | 80009       | 175-5117-00     |
|                        |                       |                                | -   |                              | (FROM A10J1651 TO A12J1020)                |             |                 |
|                        | 352-0162-04           |                                | 2   |                              | .CONN BODY, PL, EL:4 WIRE YELLOW           | 80009       | 352-0162-04     |
|                        | 175-5113-00           |                                | 1   |                              | CABLE ASSY, RF:50 OHM COAX, 5.5 L          | 80009       | 175-5113-00     |
|                        |                       |                                | -   |                              | (FROM A10J1801 TO A12J1302)                |             |                 |
|                        | 175-3073-00           |                                | 1   |                              | CABLE ASSY, RF:50 OHM COAX, 4L5 L, 9-2     | 80009       | 175-3073-00     |
|                        |                       |                                | -   |                              | (FROM A10J1921 TO A12J1220)                |             |                 |
|                        | 175-3074-00           |                                | 1   |                              | CA ASSY, RF:50 OHM COAX, 3L5 L, 9-1        | 80009       | 175-3074-00     |
|                        |                       |                                | -   |                              | (FROM A10J1923 TO A12J1000)                |             |                 |
|                        | 175-3432-00           |                                | 1   |                              | CA ASSY, SP, ELEC:4, 26 AWG, 3L5 L, RIBBON | 80009       | 175-3432-00     |
|                        |                       |                                | -   |                              | (FROM A10J2011 TO R560, S510)              |             |                 |
|                        | 352-0162-04           |                                | 1   |                              | .CONN BODY, PL, EL:4 WIRE YELLOW           | 80009       | 352-0162-04     |
|                        | 175-5122-00           |                                | 1   |                              | CA ASSY, SP, ELEC:2, 26 AWG, 4.0 L, RIBBON | 80009       | 175-5122-00     |
|                        |                       |                                | -   |                              | (FROM A10J2021 TO R560, S510)              |             |                 |
|                        | 352-0169-02           |                                | 1   |                              | .CONN BODY, PL, EL:2 WIRE RED              | 80009       | 352-0169-00     |
|                        | 175-3272-00           |                                | 1   |                              | CABLE ASSY, RF:50 OHM COAX, 4.0 L          | 80009       | 175-3272-00     |
|                        |                       |                                | -   |                              | (FROM A10J2041 TO J510)                    |             |                 |
|                        | 175-3255-00           |                                | 1   |                              | CABLE ASSY, RF:50 OHM COAX, 3.5 L          | 80009       | 175-3255-00     |
|                        |                       |                                | -   |                              | (FROM A10J2043 TO J500)                    |             |                 |
|                        | 175-5115-00           |                                | 1   |                              | CABLE ASSY, RF:50 OHM COAX, 3.0 L          | 80009       | 175-5115-00     |
|                        |                       |                                | -   |                              | (FROM A12J1300 TO J520)                    |             |                 |
|                        | 175-3062-00           |                                | 1   |                              | CA ASSY, SP, ELEC:2, 26 AWG, 3.0 L, RIBBON | 80009       | 175-3062-00     |
|                        |                       |                                | -   |                              | (FROM A12J1400 TO CR510)                   |             |                 |
|                        | 352-0169-02           |                                | 1   |                              | .CONN BODY, PL, EL:2 WIRE RED              | 80009       | 352-0169-00     |

## APPENDIX A

### REFERENCES

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|              |                                                                                                                               |
|--------------|-------------------------------------------------------------------------------------------------------------------------------|
| DA PAM 310-4 | Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders |
| DA PAM 310-7 | Index of US Army Equipment Modification Work Orders                                                                           |
| FM 21-11     | First Aid for Soldiers                                                                                                        |
| AR 385-40    | Accident Reporting and Records                                                                                                |
| AR 750-1     | Army Materiel Maintenance Concept and Policies                                                                                |
| TB 750-25-1  | Maintenance Supplies and Equipment: Army Metrology and Calibration System                                                     |
| TM 38-750    | The Army Maintenance Management System (TAMMS)                                                                                |
| TM 750-244-2 | Procedures for Destruction of Electronics Materiel to Prevent Enemy Use                                                       |

## APPENDIX B

### MAINTENANCE ALLOCATION CHART

---

#### Section 1. INTRODUCTION

##### B-1. GENERAL.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end items or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the tools and test equipment (both special and common) required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

##### B-2. MAINTENANCE FUNCTIONS. Maintenance Functions will be limited to and defined as follows:

a. *Inspect.* To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. *Test.* To verify serviceability by measuring the mechanical, pneumatic, hydraulic, electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. *Service.* Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

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

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

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

g. *Removal/Install.* To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. *Replace.* To remove an unserviceable item and install a serviceable counterpart in its place.

i. *Repair.* The application of maintenance services 1, including fault location/troubleshooting 2, removal/installation, and disassembly/assembly 3, procedures, and maintenance actions 4, to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

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

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

- (1) Services - inspect, test, service, adjust, aline, calibrate, and/or replace.
- (2) Fault locate/troubleshoot - the process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or Unit Under Test (UUT).
- (3) Disassembly/assembly - encompasses the step-by-step taking apart (or breakdown) of a repairable assembly (group numbered item) to the level of its least componency identified as maintenance significant (i.e., assigned an SMR code) for the category of maintenance under consideration.
- (4) Actions - welding, griding, riveting, straightening, facing, remachinery, and/or resurfacing.

**B-3. EXPLANATION OF COLUMNS IN THE MAC, SECTION II.**

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

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

c. *Column 3, Maintenance Function.* Column 3 lists the functions to be performed on the item listed in Column 2 (for detailed explanation of these functions, see paragraph B-2).

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

|   |       |                                                |
|---|-------|------------------------------------------------|
| C | ..... | Operator or Crew                               |
| O | ..... | Organizational Maintenance                     |
| F | ..... | Direct Support Maintenance                     |
| H | ..... | General Support Maintenance                    |
| L | ..... | Specialized Repair Activity (SRA) <sup>5</sup> |
| D | ..... | Depot Maintenance                              |

5 This maintenance category is not included in Section II, column (4) of the Maintenance Allocation Chart. To identify functions to this category of maintenance, enter a work time figure in the “H” column of Section II, column (4), and use an associated reference code in the Remarks column (6). Key the code to Section IV, Remarks, and explain the SRA complete repair application there. The explanatory remark(s) shall reference the specific Repair Parts and Special Tools LIST (RPSTL) TM which contains additional SRA criteria and the authorized spare/repair parts.

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

f. *Column 6, Remarks.* This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in Section IV.

**B-4. EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III.**

a. *Column 1, Reference Code.* The tool and test equipment reference code correlates with a code used in the MAC, Section III, Column 5.

b. *Column 2, Maintenance Category.* The lowest category of maintenance authorized to use the tool or test equipment.

c. *Column 3, Nomenclature.* Name or identification of the tool or test equipment.

d. *Column 4, National Stock Number.* The National Stock Number of the tool or test equipment.

e. *Column 5, Tool Number.* The manufacturer's part number

**B-5. EXPLANATION OF COLUMNS IN REMARKS, SECTION IV.**

a. *Column 1, Reference Code.* The code recorded in Column 6, Section II.

b. *Column 2, Remarks.* This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.



**SECTION II. MAINTENANCE ALLOCATION CHART  
FOR  
TEKTRONIC 501A FUNCTION GENERATOR**

| (1)             | (2)                            | (3)                     | (4)                   |   |   |      |   | (5)                   | (6)     |
|-----------------|--------------------------------|-------------------------|-----------------------|---|---|------|---|-----------------------|---------|
| GROUP<br>NUMBER | COMPONENT/ASSEMBLY             | MAINTENANCE<br>FUNCTION | MAINTENANCE CATEGORY* |   |   |      |   | TOOLS<br>AND<br>EQUIP | REMARKS |
|                 |                                |                         | C                     | O | F | H    | D |                       |         |
| Fig 1           | TEK 501A Function<br>Generator | Insp                    | 0.10                  |   |   |      |   | 1-20                  | A       |
|                 |                                | Calibrate               |                       |   |   | 1.00 |   |                       |         |
|                 | Circuit Card Assy<br>A-12      | Repair                  |                       |   |   | 1.50 |   | 20                    | B       |
|                 |                                |                         |                       |   |   |      |   |                       | C D     |
|                 | Circuit Card Assy<br>A-12      | Insp                    |                       |   |   | .10  |   | 20                    | A       |
|                 |                                | Replace                 |                       |   |   | .50  |   |                       |         |
|                 | Circuit Card Assy              | Insp                    |                       |   |   | .10  |   | 20                    | A       |
|                 |                                | Replace                 |                       |   |   | .50  |   |                       |         |
|                 | Lt. Emitting Diode             | Insp                    |                       |   |   | .10  |   | 20                    | A       |
|                 |                                | Replace                 |                       |   |   | .50  |   |                       |         |

\*C.operator/crew    O.organizational    F.direct support    H.general support    D.depot

**SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS  
FOR  
TEKTRONIC 501A FUNCTIONAL GENERATOR**

| TOOL OR TEST<br>EQUIPMENT | MAINTENANCE<br>CATEGORY | NOMENCLATURE               | NATIONAL/NATO<br>STOCK NUMBER | TOOL NUMBER   |
|---------------------------|-------------------------|----------------------------|-------------------------------|---------------|
| 1-14                      | H                       | Test Equipment             |                               | Ref Table 4-1 |
| 20                        | H                       | JTK 17LAL, 35H<br>Tool Kit | 4931-01-073-3845              |               |

SECTION IV. REMARKS

| REFERENCE<br>CODE | REMARKS                                                                                                                                                                        |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A                 | Organizational maintenance will be accomplished by the organization owning and using the equipment.                                                                            |
| B                 | All special tools and test equipment are called out in Table 4-1.                                                                                                              |
| C                 | Supply of parts will be through normal supply channels.                                                                                                                        |
| D                 | A recommended repair parts list will be published as part of this manual.<br>Parts that have NSN'S assigned will be requisitioned separately and will not be part of this kit. |

## APPENDIX C

RECOMMENDED SPARE PARTS LIST  
FOR  
TEKTRONIX 501A FUNCTIONAL GENERATOR

| ITEM<br>NO. | TEKTRONIX<br>PART NO. | ITEM NAME          | REC. QTY |
|-------------|-----------------------|--------------------|----------|
| 1           | 150-1029-00           | LT EMITTING DIO    | 1        |
| 2           | 150-1033-00           | LT EMITTING DIO    | 1        |
| 3           | 670-6694-02           | CIRCUIT BOARD ASSY | 1        |
| 4           | 670-6697-05           | CIRCUIT BOARD ASSY | 1        |

APPENDIX D  
MANUAL CHANGE INFORMATION  
DESCRIPTION

EFF SN B022260 (FG 501A) 070-2957-00

EFF SN B020890 (FG 507) 070-2986-00

REPLACEABLE ELECTRICAL PARTS AND SCHEMATIC CHANGES

CHANGE TO:

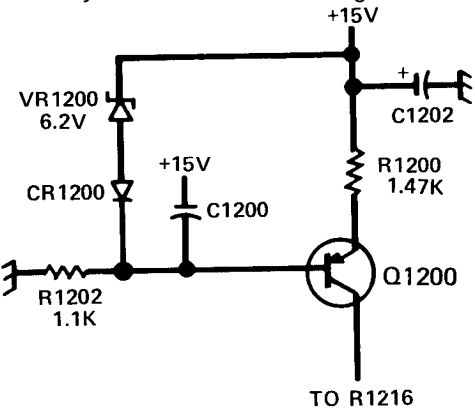
|           |             |                                                                                   |
|-----------|-------------|-----------------------------------------------------------------------------------|
| A10       | ----        | CKT BOARD ASSY: FUNCTION GEN<br><br>(NOT REPLACEABLE ORDER 672-0924-03) (FG 501A) |
| A10       | ----        | CKT BOARD ASSY: FUNCTION GEN<br><br>(NOT REPLACEABLE ORDER 672-0897-03) (FG 507)  |
| A12       | 670-6694-02 | CKT BOARD ASSY: AUXILIARY (FG 501A & FG 507)                                      |
| A10U1400  | 156-0495-01 | MICROCIRCUIT, LI: OPNL AMPL, SEL                                                  |
| A10VR1813 | 152-0217-00 | SEMICOND DEVICE: ZENER, 0.4W, 8.2V, 5%                                            |
| A12R1200  | 321-0209-00 | RES., FXD, FILM: 1.47K OHM, 1%, 0.125W                                            |
| A12R1202  | 315-0112-00 | RES., FXD, CMPSN: 1.1K OH, 5%, 0.25W                                              |

ADD:

|           |             |                                         |
|-----------|-------------|-----------------------------------------|
| A12VR1200 | 152-0486-00 | SEMICOND DEVICE: ZENER, 0.25W, 6.2V, 2% |
|-----------|-------------|-----------------------------------------|

U1400 and VR1813 are located on the MAIN circuit board assembly and are shown on diagram 1 LOOP.

DIAGRAM 3 TRIG/GATE AND  
SINE SHAPER AMPLIFIER - partial



**By Order of the Secretary of the Army:**

**JOHN A. WICKHAM, JR.**  
*General, United States Army*  
*Chief of Staff*

**Official:**

**DONALD J. DELANDRO**  
*Brigadier General, United States Army*  
*The Adjutant General*

Distribution:

To be distributed in accordance with DA Form 12-37, Operator, Organizational,  
DS and GS Maintenance requirements for Bradley Fighting Vehicle TOW Subsystem.

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# THE METRIC SYSTEM AND EQUIVALENTS

## LENGTH MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches  
 1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches  
 1 Kilometer = 1000 Meters = 0.621 Miles

## WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces  
 1 Kilogram = 1000 Grams = 2.2 lb.  
 1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

## LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces  
 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

## SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches  
 1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet  
 1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

## CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches  
 1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

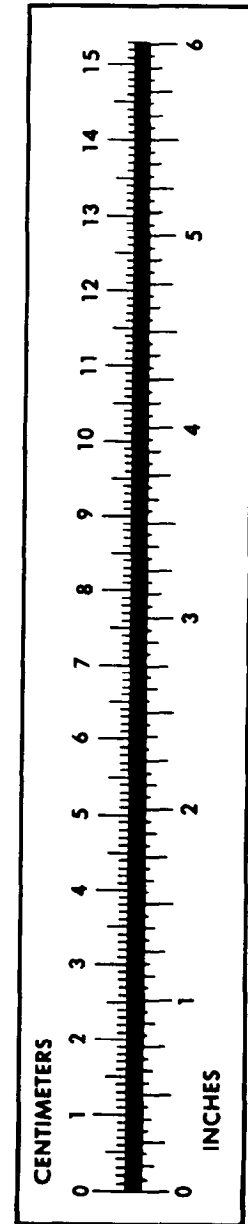
## TEMPERATURE

$5/9(^{\circ}\text{F} - 32) = ^{\circ}\text{C}$   
 212° Fahrenheit is equivalent to 100° Celsius  
 90° Fahrenheit is equivalent to 32.2° Celsius  
 32° Fahrenheit is equivalent to 0° Celsius  
 $9/5^{\circ}\text{C} + 32 = ^{\circ}\text{F}$

## APPROXIMATE CONVERSION FACTORS

| TO CHANGE              | TO                   | MULTIPLY BY |
|------------------------|----------------------|-------------|
| Inches                 | Centimeters          | 2.540       |
| Feet                   | Meters               | 0.305       |
| Yards                  | Meters               | 0.914       |
| Miles                  | Kilometers           | 1.609       |
| Square Inches          | Square Centimeters   | 6.451       |
| Square Feet            | Square Meters        | 0.093       |
| Square Yards           | Square Meters        | 0.836       |
| Square Miles           | Square Kilometers    | 2.590       |
| Acres                  | Square Hectometers   | 0.405       |
| Cubic Feet             | Cubic Meters         | 0.028       |
| Cubic Yards            | Cubic Meters         | 0.765       |
| Fluid Ounces           | Milliliters          | 29.573      |
| its                    | Liters               | 0.473       |
| arts                   | Liters               | 0.946       |
| allons                 | Liters               | 3.785       |
| Ounces                 | Grams                | 28.349      |
| Pounds                 | Kilograms            | 0.454       |
| Short Tons             | Metric Tons          | 0.907       |
| Pound-Feet             | Newton-Meters        | 1.356       |
| Pounds per Square Inch | Kilopascals          | 6.895       |
| Miles per Gallon       | Kilometers per Liter | 0.425       |
| Miles per Hour         | Kilometers per Hour  | 1.609       |

| TO CHANGE          | TO                     | MULTIPLY BY |
|--------------------|------------------------|-------------|
| Centimeters        | Inches                 | 0.394       |
| Meters             | Feet                   | 3.280       |
| Meters             | Yards                  | 1.094       |
| Kilometers         | Miles                  | 0.621       |
| Square Centimeters | Square Inches          | 0.155       |
| Square Meters      | Square Feet            | 10.764      |
| Square Meters      | Square Yards           | 1.196       |
| Square Kilometers  | Square Miles           | 0.386       |
| Square Hectometers | Acres                  | 2.471       |
| Cubic Meters       | Cubic Feet             | 35.315      |
| Cubic Meters       | Cubic Yards            | 1.308       |
| Milliliters        | Fluid Ounces           | 0.034       |
| Liters             | Pints                  | 2.113       |
| Liters             | Quarts                 | 1.057       |
| ers                | Gallons                | 0.264       |
| ms                 | Ounces                 | 0.035       |
| ograms             | Pounds                 | 2.205       |
| Metric Tons        | Short Tons             | 1.102       |
| Newton-Meters      | Pounds-Feet            | 0.738       |
| Kilopascals        | Pounds per Square Inch | 0.145       |
| ometers per Liter  | Miles per Gallon       | 2.354       |
| ometers per Hour   | Miles per Hour         | 0.621       |



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