

**TEKTRONIX®**

**4952**

**JOYSTICK**

Tektronix, Inc.  
P.O. Box 500  
Beaverton, Oregon 97005

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



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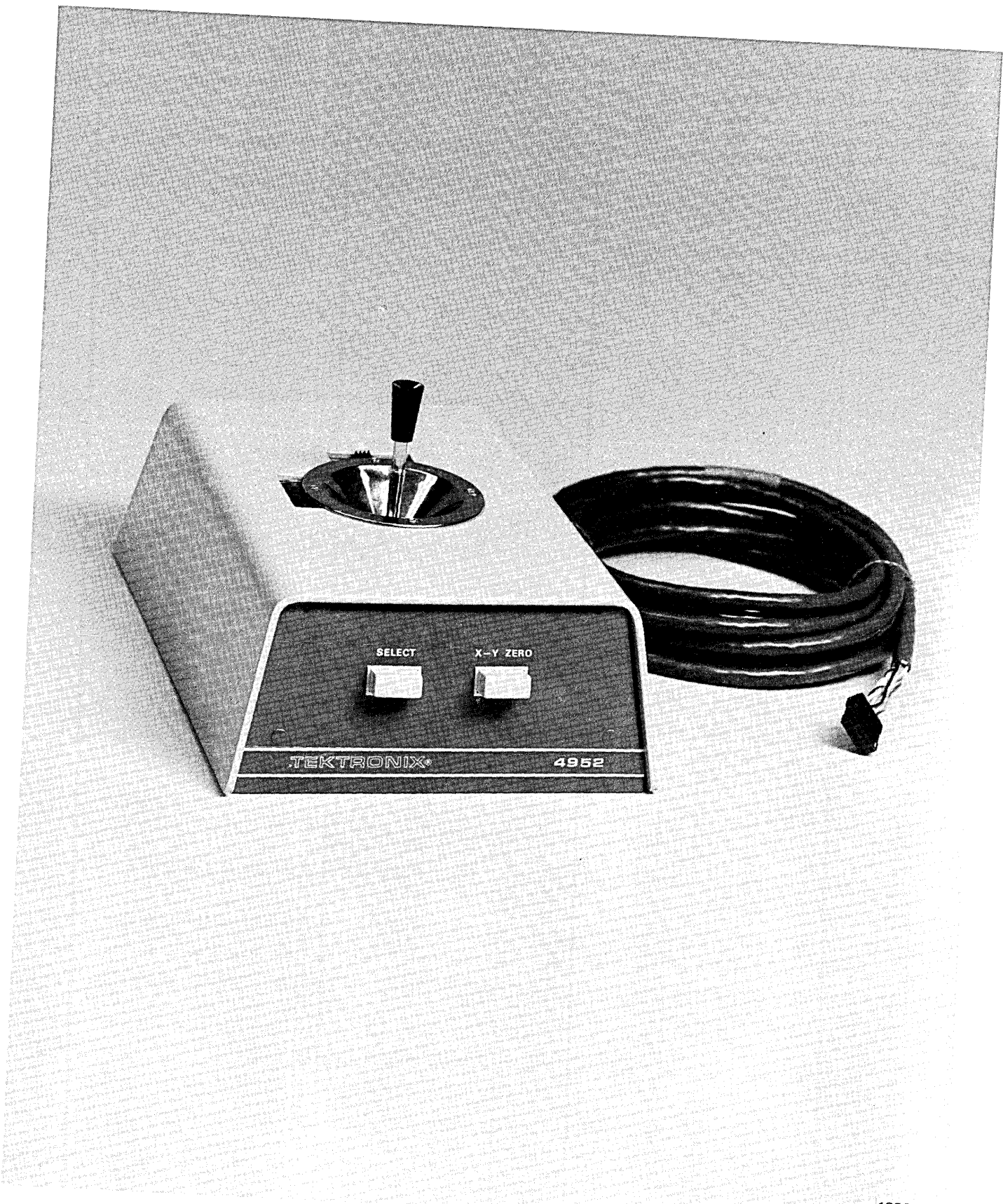
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# TABLE OF CONTENTS

|                    |  |      |
|--------------------|--|------|
| SECTION 1          | INSTALLATION AND OPERATION               | Page |
|                    | Introduction                             | 1-1  |
|                    | Installation                             | 1-1  |
|                    | General                                  | 1-1  |
|                    | Connecting the Joystick to the Terminal  | 1-1  |
|                    | Controls                                 | 1-1  |
|                    | Operation                                | 1-2  |
|                    | Operation and Checkout                   | 1-2  |
| SECTION 2          | SERVICE                                  |      |
|                    | Introduction                             | 2-1  |
|                    | Maintenance                              | 2-1  |
|                    | Adjustment Procedure                     | 2-1  |
|                    | Characteristics                          | 2-4  |
|                    | Circuit Description                      | 2-5  |
| SECTION 3          | ELECTRICAL PARTS LIST                    |      |
| SECTION 4          | DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS |      |
| SECTION 5          | MECHANICAL PARTS LIST                    |      |
| OPTIONS            |  |      |
| CHANGE INFORMATION |  |      |



1826-I

Fig. 1-1. 4952 Joystick.

4952 Joystick

REV. B, JAN. 1975

# INSTALLATION AND OPERATION

## INTRODUCTION

This manual documents the 4952 Joystick. The Joystick is designed as an input device to provide control of the crosshair cursor on terminals (such as the Tektronix 4014, 4014-1, 4015, and 4015-1 Graphic Display Computer Terminals) during operator-controlled portions of the Graphic Input (GIN) Mode. Option 1 permits the Joystick to be used with the 4010, 4010-1, 4012, or the 4013 Computer Display Terminal. The Joystick attaches to the Terminal by a 10 foot cable and, depending on the SELECT switch position, allows either the Joystick or the thumb-wheels (on the Terminal) to control the crosshair cursor position.

## INSTALLATION

### General

The only equipment necessary to install the Joystick is a Phillips screwdriver. The Joystick connector cable contains a ten-pin dual harmonica connector for connecting the Joystick cable to J20 on the TC-2 (Terminal Control) card internal to the pedestal of the Terminal. Access to TC-2 is obtained by opening the pedestal front cover. TC-2 is the card whose plug-pin configuration is as shown in Fig. 1-3. Pin-1 on the plug is labeled with a 1. Pin-1 on the jack pins (J20 on TC-2) is marked by a small arrow. The power should be off before connecting or disconnecting the Joystick cable to TC-2.

### **WARNING**

*Dangerous voltages exist at several locations within the pedestal. Disconnect the Terminal from the power source before feeding the cable through the rectangular cable port (back of pedestal) and connecting the cable to TC-2.*

### Connecting the Joystick to the Terminal

1. Turn off the power switch at the Terminal.
  2. Open the pedestal front cover and locate TC-2, referring to Fig. 1-3.
  3. Insert the cable from the Joystick through the rectangular cable port on back of the Terminal.
  4. Connect the plug to J20 on TC-2; be sure to check the plug and jack index marks on the plug (end of connecting cable) and the jack pins (J20 on TC-2) to ensure proper alignment before connecting the cable to TC-2. The plug is marked by a 1 at pin-1. The jack pins have a small arrow at the base of pin-1. Pins 5 and 6 at the plug are empty.
  5. If your 4014 or 4015 Computer Display Terminal use TC2 circuit card 670-3092-00, 01, 02, or 670-3559-00, 01, 02, it is necessary to change the orientation of the Joystick control. Procedure is to remove the four screws from the bottom of the Joystick housing and remove the bottom plate. Reverse each input connector as shown on the Figure 1-2. Reinstall the bottom plate.
- In addition, circuit cards 670-3092-00, 01, or 670-3559-00, 01 will require a minor strap modification (refer to "Operation" step 7 Page 1-3.
6. Take the cable clamp, screw, washer, and nut from the installation hardware and secure the cable to the rectangular port flange. Use any convenient mounting hole.
  7. Replace the pedestal front cover. The Joystick now is ready for use.

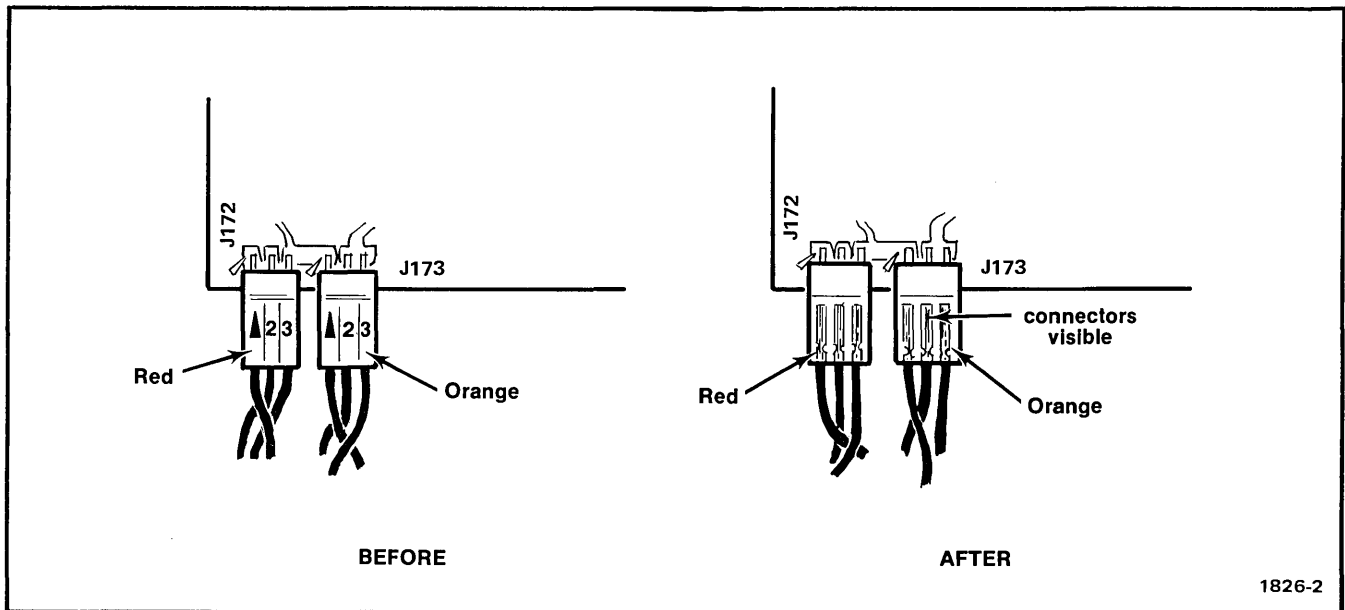


Fig. 1-2. Orientation change for use with some TC-2 circuit cards (see step 5 under the heading — Connecting the Joystick to the Terminal).

**CONTROLS**

- Control Lever      Determines the speed and direction of crosshair cursor movement. The greater the control lever tilt, the faster the crosshair cursor moves. Direction of crosshair cursor movement depends on the direction of control lever tilt.
- Drift Trim          Each axis has a drift trim tab, located near the cursor control lever, which provides adjustments for drift in its respective X or Y axis. They are adjusted for zero drift when the control lever is in its vertical, or centered, position.
- SELECT              Locking push-button switch that, when pressed in, selects the Joystick inputs for crosshair cursor control. The out position disables the Joystick inputs and enables the keyboard thumbwheels to control the crosshair cursor.
- X-Y ZERO          Push-button switch that, when pressed, causes the X and Y outputs from the Joystick to immediately become zero volts. If the SELECT button is in and the crosshair cursor is present on the display, the crosshair cursor moves immediately to the center of the screen.

**OPERATION**

**Operation and Checkout**

The following can be used as an instrument checkout procedure and can also be used to familiarize the operator with use of the Joystick.

1. With the Joystick properly installed in an operating Terminal, turn on the power; switch the Terminal to LOCAL operation; set the SELECT switch on the Joystick to the out position; enter an ESC Control-Shift Z sequence via the keyboard to obtain the GIN (Graphic Input) Mode. The crosshair should be displayed. The thumbwheels on the Terminal keyboard should control the crosshair cursor position.
2. Set the SELECT switch (the locking push-button switch on the Joystick) to the in position. This enables the Joystick to control the position of the crosshair cursor.
3. Press the X-Y ZERO push-button switch on the Joystick. Note that the crosshair cursor is immediately positioned near the center of the screen.
4. Check the operation of the cursor control lever. Any tilt of the control lever causes crosshair cursor movement. The rate of crosshair cursor movement depends on the degree of tilt. The greater the degree of tilt, the faster the cursor moves; the lesser the degree of tilt, the slower the cursor moves. Direction of crosshair cursor movement depends upon the direction of control lever tilt. Tilt away from or tilt toward the operator, causes the

crosshair cursor to move up or down respectively. Tilt to the left or right results in corresponding left or right movement of the crosshair cursor. Permitting the control lever to return to its centered position causes the crosshair cursor to stop at its present location. There may be some drift, which can be eliminated with adjustment of the drift trim tabs as explained in step 5.

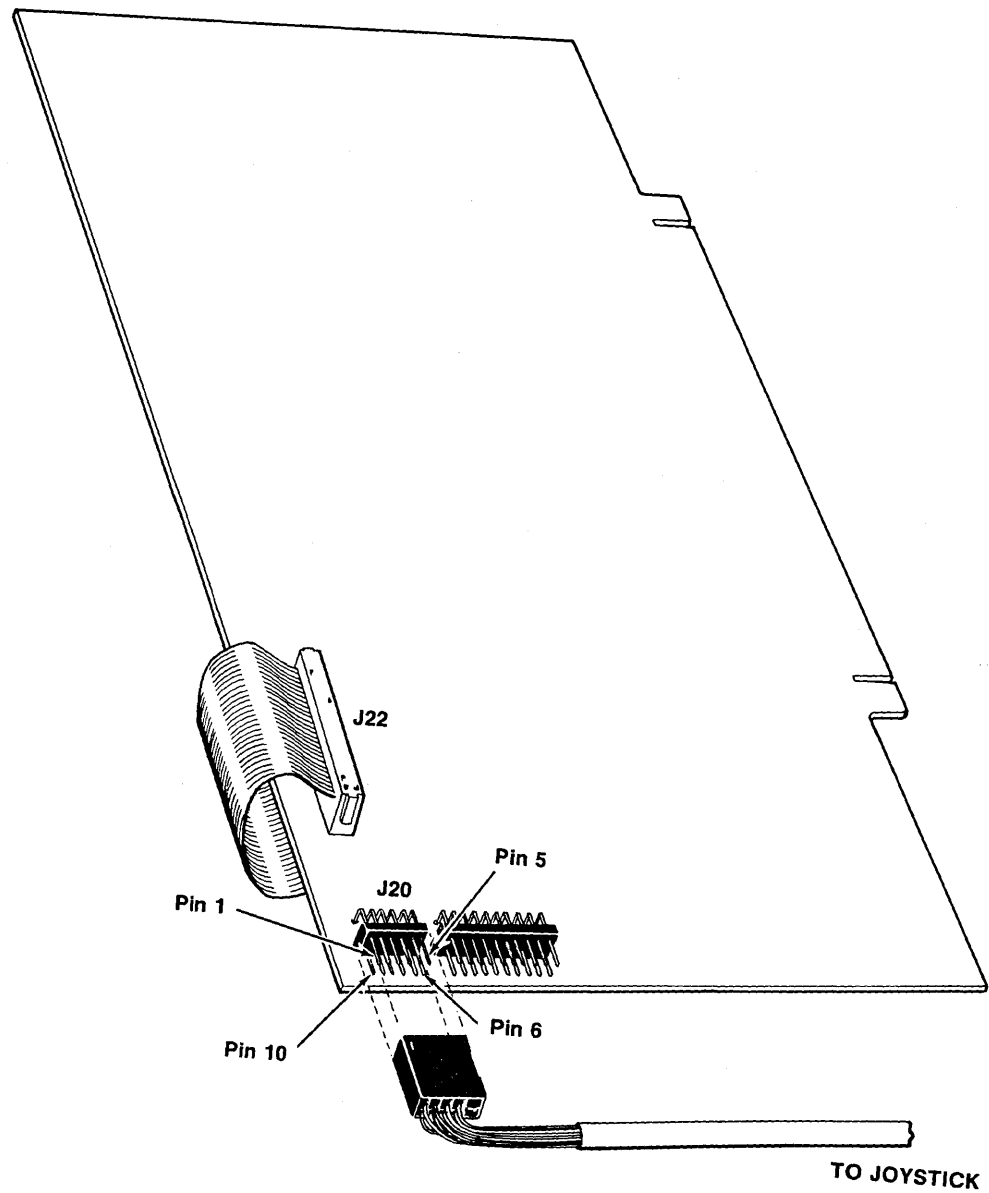
5. Adjust the drift trim tabs, located near the cursor control lever, for zero drift in their respective X or Y axis when the control lever is in its centered position. If the drift cannot be stopped, refer to the Adjustment Procedure in the Service section of this manual.

The following two steps are to be checked if the Joystick refuses to control the crosshair cursor.

6. If the Joystick refuses to operate, check the pin alignment at the Joystick cable connection on the TC-2 card within the Terminal. Refer to Fig. 1-3. Be sure to have the power off when connecting or disconnecting the cable.

7. On some early Terminals (Tektronix 4014, 4014-1, 4015, and 4015-1 Graphic Display Terminals) the TC-2 card (670-3092-00, 01, or 670-3559-00, 01) may require a minor modification to make it compatible with Joystick operation. Steps for modification follow. Refer to Fig. 1-3 as necessary. *If the Joystick controls the crosshair cursor of the Terminal, additional modification of the TC-2 card is not required.*

- (a) Turn off the power at the Terminal.
- (b) Short pin 6 of J20 to pin 8 of J20.
- (c) Short pin 5 of J20 to pin 9 of J20.



1826-3

Fig. 1-3. Terminal Control Card (TC-2) sketch, showing J20 and pin locations.



# SERVICE

## INTRODUCTION

This section provides general maintenance information, instrument characteristics, and circuit descriptions to aid in servicing the 4952 Joystick. The Joystick is designed to be relatively maintenance free and having minimum service requirements. For information on replacement parts and assemblies, refer to the Electrical and Mechanical Parts Lists.

## MAINTENANCE

Design of the Joystick allows it to receive a minimum of preventive maintenance, however, occasional cleaning of the instrument may be desired to keep the Joystick operating at its peak performance.

Cleaning of the instrument may be accomplished by using a cloth of soft-bristled brush to remove loose dirt. Stubborn dirt may be removed by using a cloth or cotton-tipped swab dampened with a mild soap or detergent solution.

Periodic checks of the integrated circuits are not recommended. The best check is actual operation.

To gain access to most of the components and assemblies within the housing, remove the four screws on the bottom of the Joystick, then remove the four stand-off mounts. This allows the bottom plate and the outer housing to be removed.

## ADJUSTMENT PROCEDURE

The basic adjustments necessary for proper Joystick operation are already covered in the Operation and Checkout instructions. Performing the Operation and Checkout instructions should be all that is required in a Joystick adjustment procedure.

In the event that the drift trim tabs do not compensate for crosshair cursor drift, the following procedure may be used to reset the coarse drift adjustments. This procedure involves rotating resistors within the Joystick assembly and should be performed only by a qualified service technician. Refer to Fig. 2-1.

Equipment required to check the Power Supply and the Drift Adjustments include the following:

Voltmeter +15 V dc and -15 V dc with an accuracy of 1%.

Resistance meter with 1% accuracy at 1.25 k $\Omega$ .

For power supply checkout at the TC-2 (Terminal Control) Card within the Terminal, refer to Fig. 2-2 for jack and pin locations.

1. Turn off the power at the Terminal.



*Connecting or disconnecting the Joystick cable while the power is on may cause damage to the Joystick.*

2. To gain access to TC-2, loosen the top two thumbscrews on the Terminal's pedestal front cover.

3. Disconnect the Joystick cable from J20.

4. Turn on the power at the Terminal.



*Dangerous voltages exist at several locations within the pedestal.*

5. Measure for approximately +15 V dc at pin 10 of J20 with respect to ground at pin 3 of J20.

6. Measure for approximately -15 V dc at pin 1 of J20 with respect to ground at pin 3 of J20.

7. The +15 V dc and -15 V dc power supplies should be centered about ground potential. Refer to the Terminal Service Manual if power supply corrections are necessary.

8. Turn off the power at the Terminal.

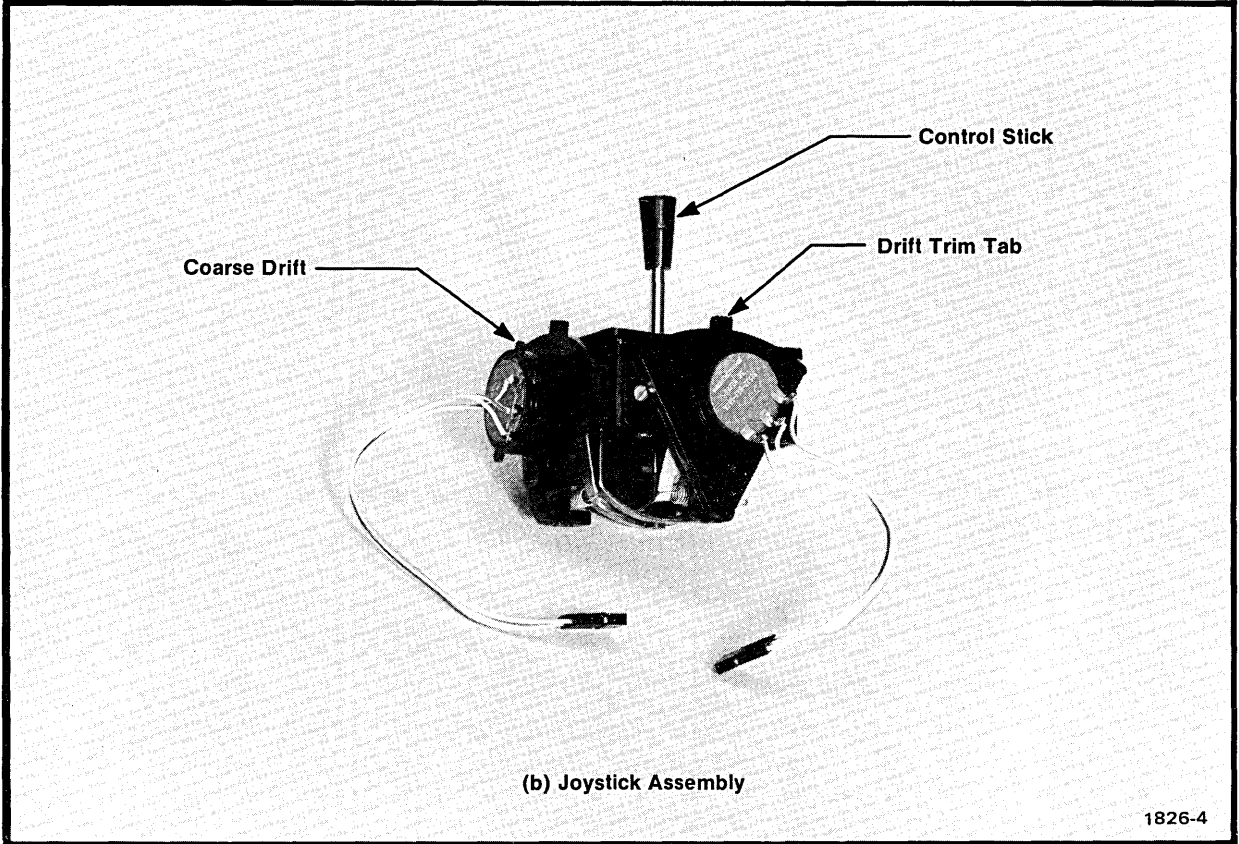
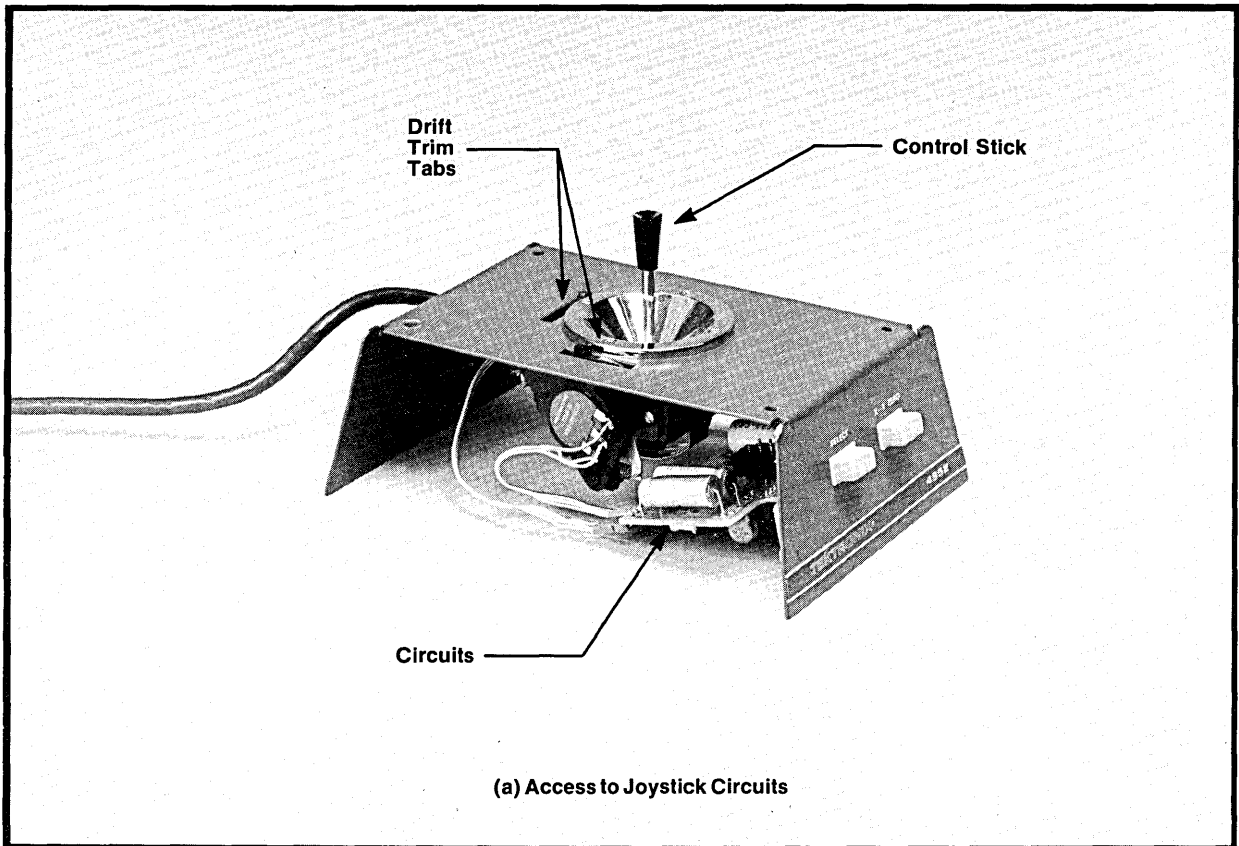
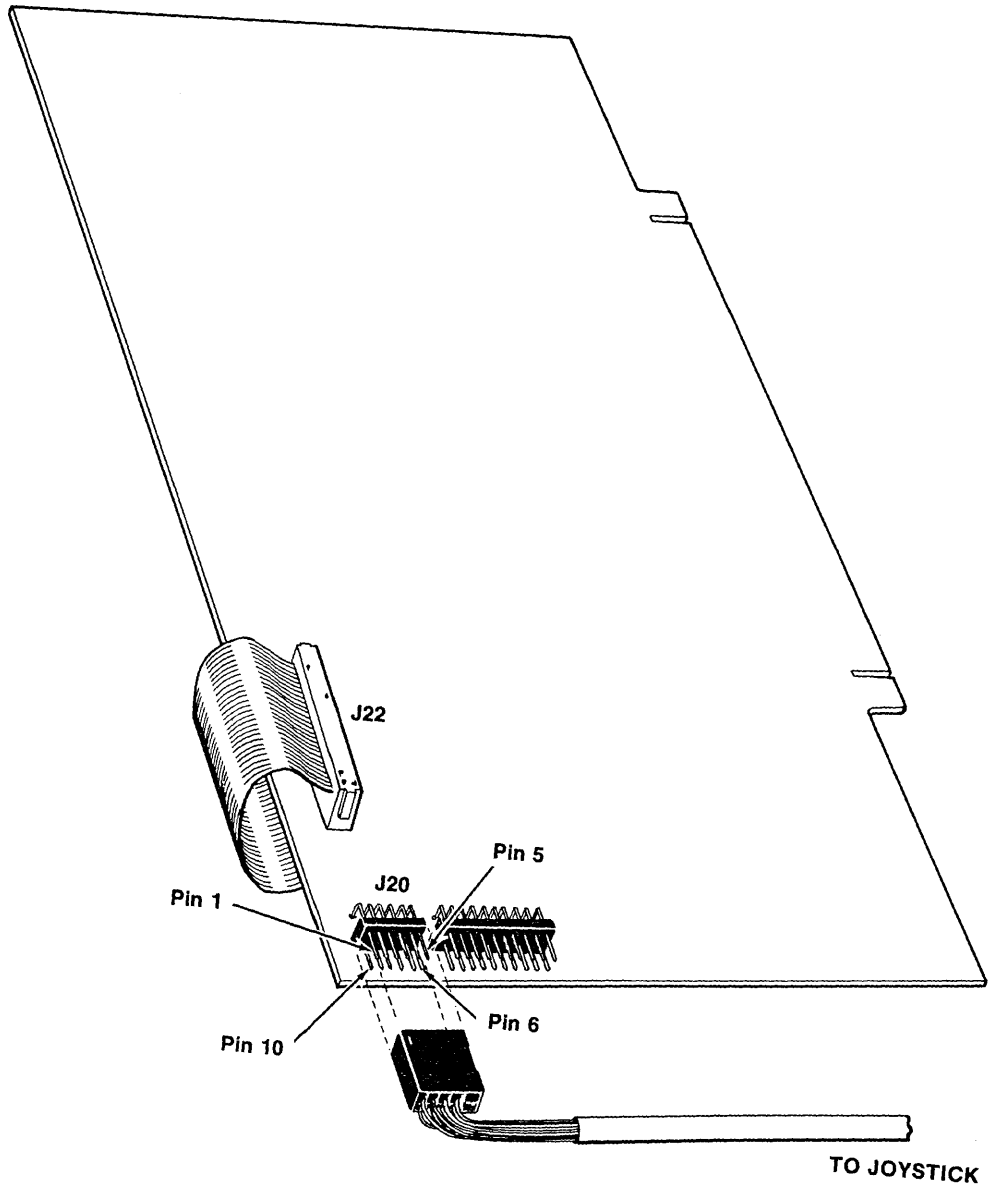


Fig. 2-1. Joystick adjustments and assemblies.



1826-3

Fig. 2-2. Terminal Control Card (TC-2) sketch, showing J20 pin locations.

For checking the coarse drift adjustment, access to the internal circuitry of the Joystick is necessary. Do not perform these procedures if the Joystick functions properly and meets the operational requirements of the Operation and Checkout instructions.

1. Remove the four screws from the bottom of the Joystick housing; then remove the four stand-off mounts within the Joystick housing. Results are illustrated in Fig. 2-1a.

2. Remove the plugs from Y-POT (J173) and X-POT (J172). Note that pin 1 is accompanied with a small arrow on both the circuit card and the plug.

3. Measure the resistance between pins 1 and 3 on the control potentiometers. (Refer to Fig. 2-3.) The resistance should be approximately 5 kΩ.

4. To check the coarse drift adjustment, set the resistance meter to measure 1.25 kΩ. With a small piece of wire, short across pins 1 and 3. (Refer to Fig. 2-3.) Measure the resistance between pin 2 and the shorted pins. As the drift trim tab is moved back and forth from one extreme to the other, the measured resistance should reach a maximum near the center of the range of drift trim tab movement and should decrease as the drift trim tab is moved in either direction from center. If the maximum is reached near the center as just described, the coarse drift adjustments are properly set; assuming that crosshair cursor drift could not be stopped, trouble must exist elsewhere.

5. If coarse adjustments are needed, it will be necessary to remove the Joystick assembly (Fig. 2-1b) in order to properly position the resistors in the assembly. Then set the drift trim tabs at center and rotate the resistors to the position where maximum resistance is encountered. This completes the coarse drift adjustment.

6. Restore original conditions. Replace the Joystick assembly in the housing. Remove all shorting wires and test equipment. Replace the X-POT and Y-POT plugs from the Joystick assembly on J172 and J173. Replace the top cover using the stand-off mounts. Replace the bottom cover on the stand-off mounts. Reconnect the Joystick cable to J20 on the TC-2 (Terminal Control) Card within the Terminal. Replace the Terminal pedestal cover.

## CHARACTERISTICS

The instrument characteristics and specifications, other than operational characteristics described earlier, are tabulated below.

TABLE 2-1

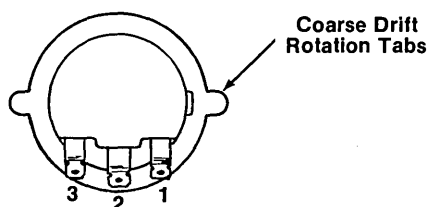
### ELECTRICAL CHARACTERISTICS

| Parameter   | Specification   |
|---|---|
| Output Voltage Range X and Y, referenced to ground. | At least -12.0 V dc to +12.0 V dc (with load of 40 kΩ).   |
| Resolution (X and Y)                                | Within one linear unit of addressable display information in the X or Y axis. There are 1024 units of addressable information per axis. |
| Time Drift  | Adjustable to less than 1 addressable unit of drift in 30 seconds. There are 1024 addressable units per axis.                           |
| Power Source  | +15 V dc and -15V dc from the Terminal.   |
| Current Requirement                                 | 20 mA   |

TABLE 2-2

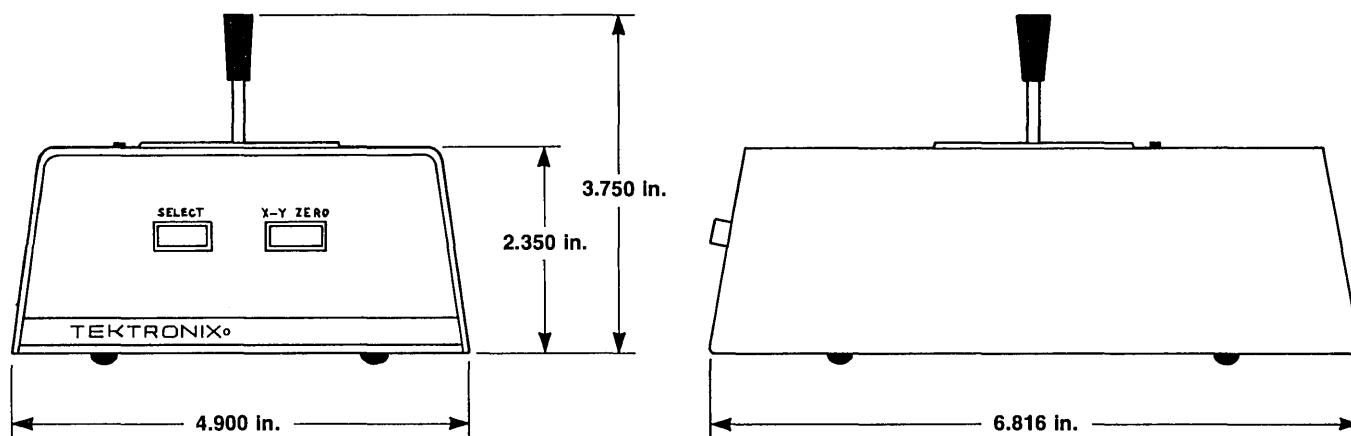
### PHYSICAL CHARACTERISTICS

| Parameter  | Specification  |
|------------|--|
| Joystick   | Spring return to center.   |
| Trim Tabs  | Mechanically rotate the X and Y potentiometers to control drift. |
| Net Weight | Approximately 2 pounds.  |
| Dimensions | See Fig. 2-4 for maximum dimensions                              |



1826-6

Fig. 2-3. Resistors on the Joystick assembly.



1826-5

Fig. 2-4. Joystick Dimensions.

**TABLE 2-3**  
**ENVIRONMENTAL CHARACTERISTICS**

| Parameter          | Specification   |
|--------------------|---|
| Temperature        |   |
| Operating Range    | −10°C to +40°C  |
| Storage Range      | −40°C to +65°C  |
| Humidity (maximum) | 95% humidity at +30°C   |
| Altitude           |   |
| Operating Range    | To 15,000 feet  |
| Storage Range      | To 50,000 feet  |
| Transportation     | Tested to NSTC Procedure 1A with a 24 inch drop within its shipping carton. |

### CIRCUIT DESCRIPTION

Refer to the schematic diagram of the Joystick. The Joystick circuit consists of two integrating amplifiers and their driving amplifiers, controlled by the position of a control lever. Crosshair cursor position is relative to the output voltages from the integrating amplifiers at J171-1 and J171-5. Due to the similarities of X and Y channel operation, only the X channel is discussed.

An integrating amplifier has the ability to change its output at a rate determined by the amplitude of its input signal. If the input signal is removed, the output remains at its last value. If an input signal is continued to be applied, the amplifier output will eventually run into its electrical limit, regardless of the size of the input signal.

The voltage from R1001A at J172-2 is multiplied by ten through U112. Voltage output from U112 provides input to an integrating amplifier. The integrating amplifier consists of U133 with a large capacitor (C35) in the feedback circuit and resistors (R124 and R128) on the input. The sum of the currents through R124 and R128 determines the rate at which C35 charges or discharges.

When the control lever is vertical, or centered, the output voltage of U112 is less than  $\pm 0.6$  volts, neither CR30 nor CR31 conduct current, thus providing a dead band and removing any noise from the input of U133. The voltage output from U133 remains fixed at its present value. The crosshair cursor is held at the intersect point to which it was last driven.

If the control lever is tilted slightly, causing the output voltage of U112 to be greater than 0.6 volts and less than 7 volts, all the charging current for C35 comes through R124. This slow charging rate allows the operator to smoothly and accurately position the crosshair cursor.

The capacitor and diodes, not already discussed, provide power supply filtering and surge current protection for the amplifiers. Surge currents may occur by connecting or disconnecting the Joystick to the Terminal while the power is on, by turning the power on and off, and by pressing the X-Y ZERO switch (S45).

## Service—4952

For large offsets of the control arm, the voltage from U112 exceeds 7 volts, causing zener diodes VR125 and VR127 to become active, thus passing current through R128. The charging time of C35 is thus decreased to permit rapid cursor movement.

The control switches SELECT (S25) and X-Y ZERO (S45) provide the following functions. The SELECT switch causes J170-1 to become grounded, thus activating circuitry within the Terminal to select the output of the Joystick to control the position of the crosshair cursor. The X-Y ZERO switch, when pressed, causes the integrating capacitors to immediately discharge and move the crosshair cursor to the center of the screen.

# REPLACEABLE ELECTRICAL PARTS

## PARTS ORDERING INFORMATION

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

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

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

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

## SPECIAL NOTES AND SYMBOLS

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

## ITEM NAME

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

## ABBREVIATIONS

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

## CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

| MFR.CODE | MANUFACTURER  | ADDRESS                  | CITY,STATE,ZIP           |
|----------|---|--------------------------|--------------------------|
| 0000F    | KRAFT SYSTEM, INC.                                  | 450 WEST CALIFORNIA AVE. | VISTA, CA 92802          |
| 08261    | SPECTRA-STRIP CORP.                                 | 7100 LAMPSON AVE.        | GARDEN GROVE, CA 92642   |
| 22526    | BERG ELECTRONICS, INC.                              | YOUK EXPRESSWAY          | NEW CUMBERLAND, PA 17070 |
| 28520    | HEYMAN MFG. CO.                                     | 147 N. MICHIGAN AVE.     | KENILWORTH, NJ 07033     |
| 70485    | ATLANTIC INDIA RUBBER WORKS, INC.                   | 571 W. POLK ST.          | CHICAGO, IL 60607        |
| 71590    | CENTRALAB ELECTRONICS, DIV. OF<br>GLOBE-UNION, INC. | 5757 N. GREEN BAY AVE.   | MILWAUKEE, WI 53201      |
| 78189    | ILLINOIS TOOL WORKS, INC.<br>SHAKEPROOF DIVISION    | ST. CHARLES ROAD         | ELGIN, IL 60120          |
| 80009    | TEKTRONIX, INC.                                     | P. O. BOX 500            | BEAVERTON, OR 97077      |
| 83385    | CENTRAL SCREW CO.                                   | 2530 CRESCENT DR.        | BROADVIEW, IL 60153      |

## OPTION 1

| MFR.CODE | MANUFACTURER  | ADDRESS              | CITY,STATE,ZIP          |
|----------|---|----------------------|-------------------------|
| 01121    | ALLEN-BRADLEY CO.   | 1201 2ND ST. SOUTH   | MILWAUKEE, WI 53204     |
| 04713    | MOTOROLA, INC., SEMICONDUCTOR<br>PRODUCTS DIV.                              | 5005 E. MCDOWELL RD. | PHOENIX, AZ 85036       |
| 07263    | FAIRCHILD SEMICONDUCTOR, A DIV. OF<br>FAIRCHILD CAMERA AND INSTRUMENT CORP. | 464 ELLIS ST.        | MOUNTAIN VIEW, CA 94042 |
| 18324    | SIGNETICS CORP.   | 811 E. ARQUES        | SUNNYVALE, CA 94086     |
| 56289    | SPRAGUE ELECTRIC CO.  | 644 W. 12TH ST.      | NORTH ADAMS, MA 01247   |
| 72982    | ERIE TECHNOLOGICAL PRODUCTS, INC.   | P. O. BOX 500        | ERIE, PA 16512          |
| 80009    | TEKTRONIX, INC.   | 415 S. 5TH ST.       | BEAVERTON, OR 97077     |
| 86684    | RCA CORP., ELECTRONIC COMPONENTS  |                      | HARRISON, NJ 07029      |



| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont  | Name & Description                    | Mfr Code | Mfr Part Number |
|---------|--------------------|----------------------|---------|---------------------------------------|----------|-----------------|
|         | 670-3680-00        | B010100              | B019999 | CKT BOARD ASSY:JOYSTICK               | 80009    | 670-3680-00     |
|         | 670-3680-01        | B020000              |         | CKT BOARD ASSY:JOYSTICK               | 80009    | 670-3680-01     |
| C4      | 290-0215-00        |                      |         | CAP.,FXD,ELCTLT:100UF,+75-10%,25V     | 56289    | 30D107G025DC4   |
| C5      | 283-0010-00        | XB020000             |         | CAP.,FXD,CER DI:0.05UF,+80-20%,50V    | 56289    | 273C20          |
| C8      | 290-0215-00        |                      |         | CAP.,FXD,ELCTLT:100UF,+75-10%,25V     | 56289    | 30D107G025DC4   |
| C9      | 283-0010-00        | XB020000             |         | CAP.,FXD,CER DI:0.05UF,+80-20%,50V    | 56289    | 273C20          |
| C10     | 283-0080-00        |                      |         | CAP.,FXD,CER DI:0.022UF,+80-20%,25V   | 56289    | 19C611          |
| C12     | 283-0080-00        |                      |         | CAP.,FXD,CER DI:0.022UF,+80-20%,25V   | 56289    | 19C611          |
| C35     | 285-0894-00        |                      |         | CAP.,FXD,PLSTC:5UF,5%,50V             | 84411    | TEK34-505-5-R5  |
| C50     | 285-0894-00        |                      |         | CAP.,FXD,PLSTC:5UF,5%,50V             | 84411    | TEK34-505-5-R5  |
| C107    | 281-0525-00        |                      |         | CAP.,FXD,CER DI:470PF,+/-94PF,500V    | 72982    | 301-000X5U0471M |
| C139    | 281-0525-00        |                      |         | CAP.,FXD,CER DI:470PF,+/-94PF,500V    | 72982    | 301-000X5U0471M |
| CR5     | 152-0107-00        |                      |         | SEMICONV DEVICE:SILICON,375V,400MA    | 80009    | 152-0107-00     |
| CR7     | 152-0107-00        |                      |         | SEMICONV DEVICE:SILICON,375V,400MA    | 80009    | 152-0107-00     |
| CR30    | 152-0323-00        |                      |         | SEMICONV DEVICE:SILICON,35V,100MA     | 03508    | SE365           |
| CR31    | 152-0323-00        |                      |         | SEMICONV DEVICE:SILICON,35V,100MA     | 03508    | SE365           |
| CR33    | 152-0323-00        |                      |         | SEMICONV DEVICE:SILICON,35V,100MA     | 03508    | SE365           |
| CR34    | 152-0323-00        |                      |         | SEMICONV DEVICE:SILICON,35V,100MA     | 03508    | SE365           |
| CR52    | 152-0323-00        |                      |         | SEMICONV DEVICE:SILICON,35V,100MA     | 03508    | SE365           |
| CR53    | 152-0323-00        |                      |         | SEMICONV DEVICE:SILICON,35V,100MA     | 03508    | SE365           |
| CR62    | 152-0323-00        |                      |         | SEMICONV DEVICE:SILICON,35V,100MA     | 03508    | SE365           |
| CR64    | 152-0323-00        |                      |         | SEMICONV DEVICE:SILICON,35V,100MA     | 03508    | SE365           |
| R14     | 315-0101-00        | XB020000             |         | RES.,FXD,COMP:100 OHM,5%,0.25W        | 01121    | CB1015          |
| R37     | 315-0101-00        |                      |         | RES.,FXD,COMP:100 OHM,5%,0.25W        | 01121    | CB1015          |
| R47     | 315-0101-00        |                      |         | RES.,FXD,COMP:100 OHM,5%,0.25W        | 01121    | CB1015          |
| R60     | 315-0101-00        |                      |         | RES.,FXD,COMP:100 OHM,5%,0.25W        | 01121    | CB1015          |
| R105    | 315-0102-00        |                      |         | RES.,FXD,COMP:1K OHM,5%,0.25W         | 01121    | CB1025          |
| R106    | 315-0103-00        |                      |         | RES.,FXD,COMP:10K OHM,5%,0.25W        | 01121    | CB1035          |
| R124    | 315-0335-00        |                      |         | RES.,FXD,COMP:3.3M OHM,5%,0.25W       | 01121    | CB3355          |
| R128    | 315-0204-00        |                      |         | RES.,FXD,COMP:200K OHM,5%,0.25W       | 01121    | CB2045          |
| R129    | 315-0101-00        |                      |         | RES.,FXD,COMP:100 OHM,5%,0.25W        | 01121    | CB1015          |
| R137    | 315-0102-00        |                      |         | RES.,FXD,COMP:1K OHM,5%,0.25W         | 01121    | CB1025          |
| R138    | 315-0103-00        |                      |         | RES.,FXD,COMP:10K OHM,5%,0.25W        | 01121    | CB1035          |
| R145    | 315-0101-00        | XB020000             |         | RES.,FXD,COMP:100K OHM,5%,0.25W       | 01121    | CB1015          |
| R159    | 315-0335-00        |                      |         | RES.,FXD,COMP:3.3M OHM,5%,0.25W       | 01121    | CB3355          |
| R165    | 315-0204-00        |                      |         | RES.,FXD,COMP:200K OHM,5%,0.25W       | 01121    | CB2045          |
| R1001   | 119-0670-00        |                      |         | RESISTOR ASSY:GIMBAL MT,2 X 5K OHM,1W | 0000F    | 900-032         |
| S25     | 260-1211-00        |                      |         | SWITCH,PUSH:DPDT,PUSH-PUSH            | 71590    | 2KAB010000-357  |
| S44     | 260-1421-00        |                      |         | SWITCH,PUSH:                          | 80009    | 260-1421-00     |
| U112    | 156-0067-00        |                      |         | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER | 07263    | U6T7741393      |
| U133    | 156-0335-00        | B010100              | B019999 | MICROCIRCUIT,DI:OP AMPL,FET INPUT     | 12040    | LH740AC         |
| U133    | 158-0770-00        | B020000              |         | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER | 80009    | 156-0770-00     |
| U147    | 156-0067-00        |                      |         | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER | 07263    | U6T7741393      |
| U150    | 156-0335-00        | B010100              | B019999 | MICROCIRCUIT,DI:OP AMPL,FET INPUT     | 12040    | LH740AC         |
| U150    | 156-0770-00        | B020000              |         | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER | 80009    | 156-0770-00     |
| VR125   | 152-0280-00        |                      |         | SEMICONV DEVICE:ZENER,0.4W,6.2V,5%    | 04713    | 1N753A          |
| VR127   | 152-0280-00        |                      |         | SEMICONV DEVICE:ZENER,0.4W,6.2V,5%    | 04713    | 1N753A          |
| VR161   | 152-0280-00        |                      |         | SEMICONV DEVICE:ZENER,0.4W,6.2V,5%    | 04713    | 1N753A          |
| VR163   | 152-0280-00        |                      |         | SEMICONV DEVICE:ZENER,0.4W,6.2V,5%    | 04713    | 1N753A          |



# SECTION 4

## DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

### Symbols and Reference Designators

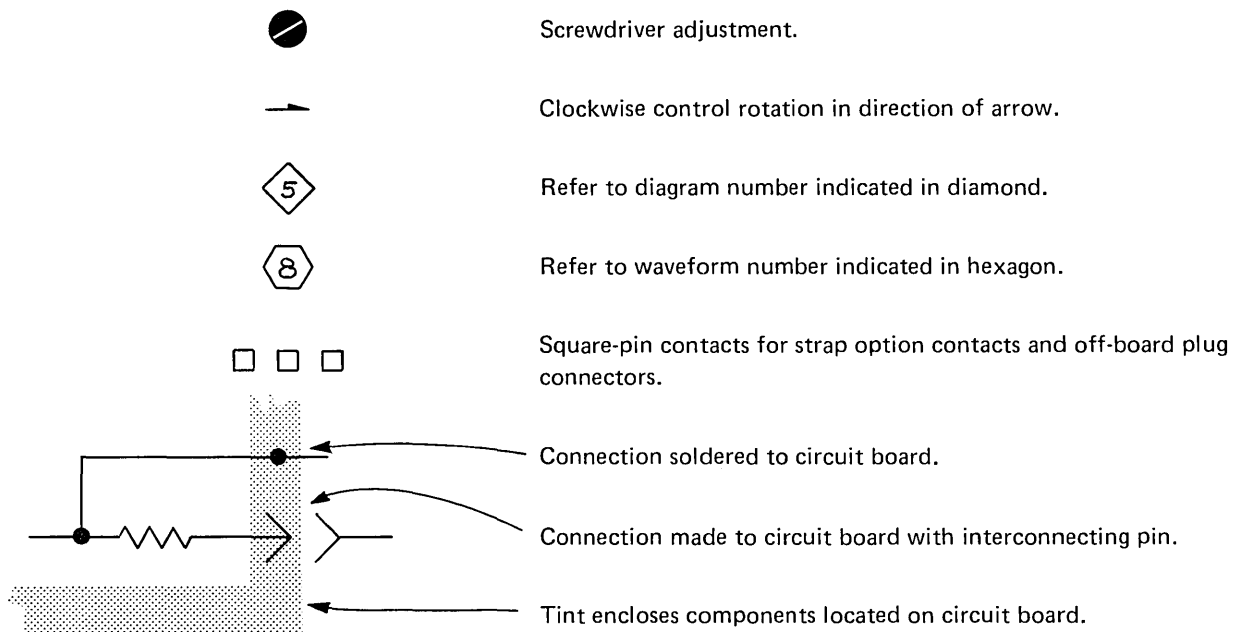
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Symbols used on the diagrams comply with USA Standard Y32.2-1970.

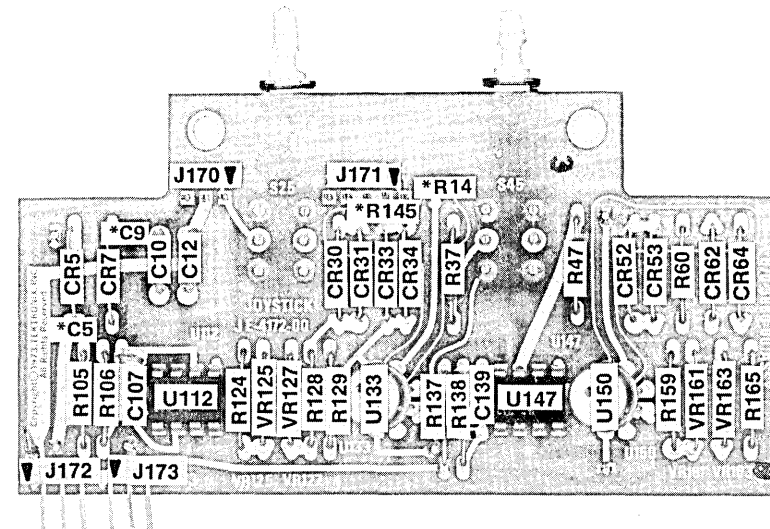
Logic symbology complies with ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:

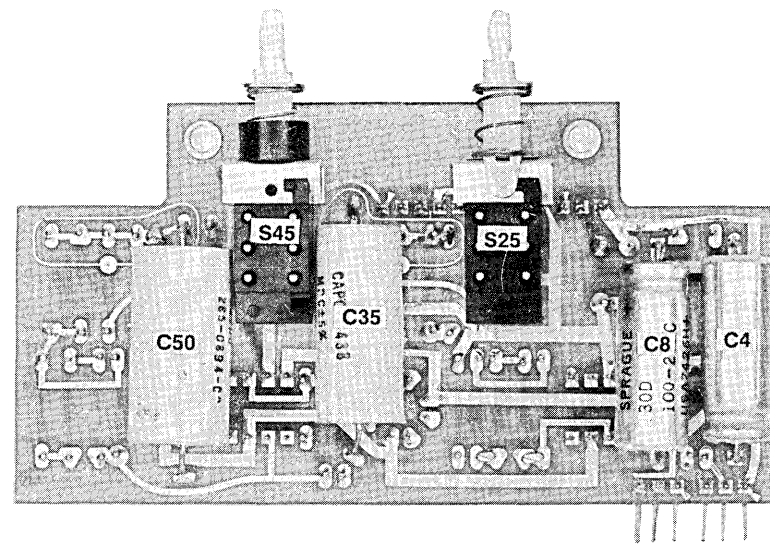


The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

|    |  |    |  |
|----|--|----|--|
| A  | Assembly, separable or repairable (circuit board, etc.)  | LR | Inductor/resistor combination                                      |
| AT | Attenuator, fixed or variable                            | M  | Meter  |
| B  | Motor  | Q  | Transistor or silicon-controlled rectifier                         |
| BT | Battery  | P  | Connector, movable portion   |
| C  | Capacitor, fixed or variable                             | R  | Resistor, fixed or variable  |
| CR | Diode, signal or rectifier                               | RT | Thermistor   |
| DL | Delay line   | S  | Switch   |
| DS | Indicating device (lamp)                                 | T  | Transformer  |
| F  | Fuse   | TP | Test point   |
| FL | Filter   | U  | Assembly, inseparable or non-repairable (integrated circuit, etc.) |
| H  | Heat dissipating device (heat sink, heat radiator, etc.) | V  | Electron tube  |
| HR | Heater   | VR | Voltage regulator (zener diode, etc.)                              |
| J  | Connector, stationary portion                            | Y  | Crystal  |
| K  | Relay  |    |  |
| L  | Inductor, fixed or variable                              |    |  |



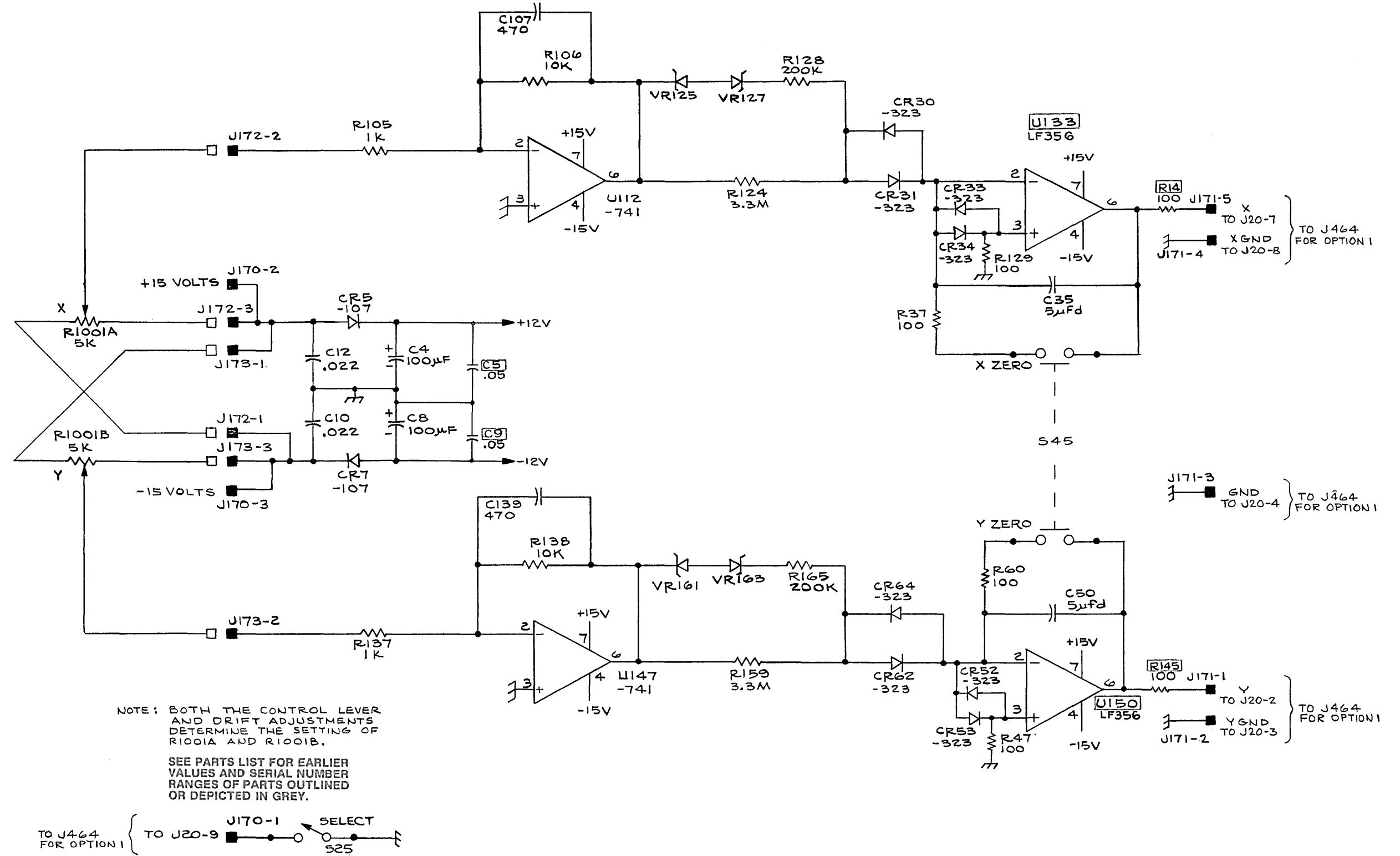
(Front)



(Back)

\*See Parts List for serial number ranges.

1826-7

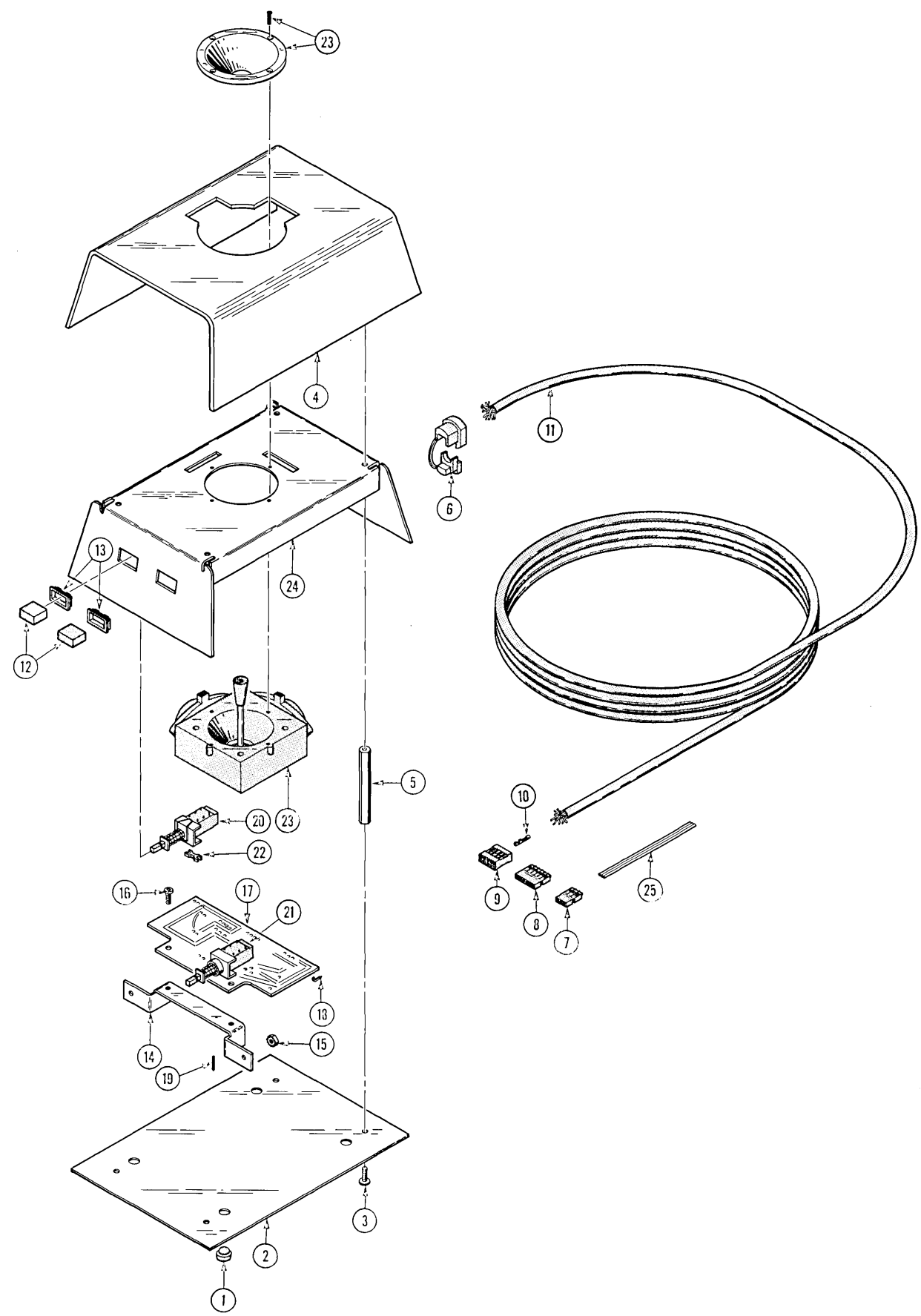


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670-3680-00,01

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# 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           | SHLDR    | 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                | OB       | ORDER BY DESCRIPTION | SQ       | SQUARE          |
| BRKT  | BRACKET            | FR      | FRAME or FRONT        | OD       | OUTSIDE DIAMETER     | SST      | STAINLESS STEEL |
| BRS   | BRASS              | FSTNR   | FASTENER              | OVH      | OVAL HEAD            | STL      | STEEL           |
| BRZ   | BRONZE             | FT      | FOOT                  | PH BRZ   | PHOSPHOR BRONZE      | SW       | SWITCH          |
| BSHG  | BUSHING            | FXD     | FIXED                 | PL       | PLAIN or PLATE       | T        | TUBE            |
| CAB   | CABINET            | GSKT    | GASKET                | PLSTC    | PLASTIC              | TERM     | TERMINAL        |
| CAP   | CAPACITOR          | HDL     | HANDLE                | PN       | PART NUMBER          | THD      | THREAD          |
| CER   | CERAMIC            | HEX     | HEXAGON               | PNH      | PAN HEAD             | THK      | THICK           |
| CHAS  | CHASSIS            | HEX HD  | HEXAGONAL HEAD        | PWR      | POWER                | TNSN     | TENSION         |
| CKT   | CIRCUIT            | HEX SOC | HEXAGONAL SOCKET      | RCPT     | RECEPTACLE           | TPG      | TAPPING         |
| COMP  | COMPOSITION        | HLCPS   | HELICAL COMPRESSION   | RES      | RESISTOR             | TRH      | TRUSS HEAD      |
| CONN  | CONNECTOR          | HLEXT   | HELICAL EXTENSION     | RGD      | RIGID                | V        | VOLTAGE         |
| COV   | COVER              | HV      | HIGH VOLTAGE          | RLF      | RELIEF               | VAR      | VARIABLE        |
| CPLG  | COUPLING           | IC      | INTEGRATED CIRCUIT    | RTNR     | RETAINER             | W/       | WITH            |
| CRT   | CATHODE RAY TUBE   | ID      | INSIDE DIAMETER       | SCH      | SOCKET HEAD          | WSHR     | WASHER          |
| DEG   | DEGREE             | IDENT   | IDENTIFICATION        | SCOPE    | OSCILLOSCOPE         | XFMR     | TRANSFORMER     |
| DWR   | DRAWER             | IMPLR   | IMPELLER              | SCR      | SCREW                | XSTR     | TRANSISTOR      |

**CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER**

| <b>MFR.CODE</b> | <b>MANUFACTURER</b>  | <b>ADDRESS</b>           | <b>CITY,STATE,ZIP</b>   |
|-----------------|--|--------------------------|-------------------------|
| 0000F           | KRAFT SYSTEM, INC.   | 450 WEST CALIFORNIA AVE. | VISTA, CA 92802         |
| 01121           | ALLEN-BRADLEY CO.  | 1201 2ND ST. SOUTH       | MILWAUKEE, WI 53204     |
| 03508           | GENERAL ELECTRIC CO., SEMI-CONDUCTOR PRODUCTS DEPT.                      | ELECTRONICS PARK         | SYRACUSE, NY 13201      |
| 04713           | MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.                              | 5005 E. MCDOWELL RD.     | PHOENIX, AZ 85036       |
| 07263           | FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP. | 464 ELLIS ST.            | MOUNTAIN VIEW, CA 94042 |
| 12040           | NATIONAL SEMICONDUCTOR CORP.   | COMMERCE DRIVE           | DANBURY, CT 06810       |
| 56289           | SPRAGUE ELECTRIC CO.   |                          | NORTH ADAMS, MA 01247   |
| 71590           | CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.                         | 5757 N. GREEN BAY AVE.   | MILWAUKEE, WI 53201     |
| 72982           | ERIE TECHNOLOGICAL PRODUCTS, INC.  | 644 W. 12TH ST.          | ERIE, PA 16512          |
| 80009           | TEKTRONIX, INC.  | P. O. BOX 500            | BEAVERTON, OR 97077     |
| 84411           | TRW ELECTRONIC COMPONENTS, TRW CAPACITORS                                | 112 W. FIRST ST.         | OGALLALA, NB 69153      |

**OPTION 1**

| <b>MFR.CODE</b> | <b>MANUFACTURER</b>                                     | <b>ADDRESS</b>    | <b>CITY,STATE,ZIP</b>    |
|-----------------|---|-------------------|--------------------------|
| 08261           | SPECTRA-STRIP CORP.                                     | 7100 LAMPSON AVE. | GARDEN GROVE, CA 92642   |
| 22526           | BERG ELECTRONICS, INC.                                  | YOUK EXPRESSWAY   | NEW CUMBERLAND, PA 17070 |
| 80009           | TEKTRONIX, INC.   | P. O. BOX 500     | BEAVERTON, OR 97077      |
| 83501           | GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC. | CENTRAL ST.       | BROOKFIELD, MA 01506     |

Mechanical Parts List—4952

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Model No. Dscont | Qty | 1 | 2 | 3 | 4 | 5 | Name & Description                                       | Mfr Code | Mfr Part Number |
|------------------|--------------------|----------------------|------------------|-----|---|---|---|---|---|--|----------|-----------------|
| 1-1              | 348-0013-00        |                      |                  | 4   |   |   |   |   |   | BUMPER,RUBBER:   | 70485    | 1561            |
| -2               | 390-0454-00        |                      |                  | 1   |   |   |   |   |   | CAB SECT,CONT:BOTTOM<br>(ATTACHING PARTS)                | 80009    | 390-0454-00     |
| -3               | 211-0581-00        |                      |                  | 4   |   |   |   |   |   | SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL<br>- - - * - - - | 83385    | OBD             |
| -4               | 390-0453-00        |                      |                  | 1   |   |   |   |   |   | CAB SECT,CONT:TOP AND SIDES<br>(ATTACHING PARTS)         | 80009    | 390-0453-00     |
| -5               | 129-0531-00        |                      |                  | 4   |   |   |   |   |   | SPACER,POST:0.25 HEX,2 INCHES LONG<br>- - - * - - -      | 80009    | 129-0531-00     |
|                  | 175-1566-00        | B010100              | B010339          | 1   |   |   |   |   |   | CABLE ASSEMBLY:MODEM                                     | 80009    | 175-1566-00     |
|                  | 175-1566-01        | B010340              |                  | 1   |   |   |   |   |   | CABLE ASSEMBLY:MODEM<br>(ATTACHING PARTS)                | 80009    | 175-1566-01     |
| -6               | 358-0161-00        |                      |                  | 1   |   |   |   |   |   | BSHG,STRAIN RLF:FOR 0.25 INCH CABLE<br>- - - * - - -     | 28520    | SR5P4           |
|                  | -----              |                      |                  | -   |   |   |   |   |   | . MODEM CABLE INCLUDES:                                  |          |                 |
| -7               | 352-0161-00        |                      |                  | 1   |   |   |   |   |   | . HOLDER,TERM.CON:3 WIRE BLACK                           | 80009    | 352-0161-00     |
| -8               | 352-0163-00        |                      |                  | 1   |   |   |   |   |   | . HOLDER,TERM.CON:5 WIRE BLACK                           | 80009    | 352-0163-00     |
| -9               | 352-0330-03        |                      |                  | 1   |   |   |   |   |   | . HOLDER,TERM.CON:DOUBLE ROW,5                           | 80009    | 352-0330-03     |
| -10              | 131-0707-00        | B010100              | B010339          | 16  |   |   |   |   |   | . CONTACT,ELEC:0.48" L,22-26 SWG WIRE                    | 22526    | 47439           |
|                  | 131-0707-00        | B010340              |                  | 14  |   |   |   |   |   | . CONTACT,ELEC:0.48" L,22-26 AWG WIRE                    | 22526    | 47439           |
|                  | 131-1159-00        | XB010340             |                  | 2   |   |   |   |   |   | . CONTACT,ELEC:250 FASTEN                                | 00779    | 60041-2         |
| -11              | 175-1553-00        | B010100              | B010339          | FT  |   |   |   |   |   | . CABLE,SP,ELEC:11.5 FT LONG                             | 80009    | 175-1553-00     |
|                  | 175-1157-00        | B010340              |                  | FT  |   |   |   |   |   | . CABLE,SP,ELEC:11.5 FT LONG                             | 80009    | 175-1157-00     |
|                  | 343-0549-00        | XB010340             |                  | 1   |   |   |   |   |   | STRAP,TIE DOWN:0.091 W X 3.62 INCH LONG                  | 59730    | TY23M           |
| -12              | 366-1161-00        |                      |                  | 2   |   |   |   |   |   | PUSHBUTTON:GRAY  | 80009    | 366-1161-00     |
| -13              | 426-0568-00        |                      |                  | 2   |   |   |   |   |   | FRAME,PUSH-BTN:GRAY                                      | 80009    | 426-0568-00     |
| -14              | 407-1594-00        |                      |                  | 1   |   |   |   |   |   | BRACKET,CKT BD:MAIN<br>(ATTACHING PARTS)                 | 80009    | 407-1594-00     |
| -15              | 210-0586-00        |                      |                  | 2   |   |   |   |   |   | NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL                     | 78189    | OBD             |
| -16              | 211-0590-00        |                      |                  | 2   |   |   |   |   |   | SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL<br>- - - * - - -  | 83385    | OBD             |
| -17              | -----              |                      |                  | 1   |   |   |   |   |   | CKT BOARD ASSY:JOYSTICK(SEE EPL FOR PN)                  |          |                 |
| -18              | 131-0589-00        |                      |                  | 6   |   |   |   |   |   | . CONTACT,ELEC:0.46 INCH LONG                            | 22526    | 47350           |
| -19              | 131-0608-00        |                      |                  | 8   |   |   |   |   |   | . CONTACT,ELEC:0.365 INCH LONG                           | 22526    | 47357           |
| -20              | 260-1211-00        |                      |                  | 1   |   |   |   |   |   | . SWITCH,PUSH:DPDT,PUSH-PUSH                             | 71590    | 2KAB010000-357  |
| -21              | 260-1421-00        |                      |                  | 1   |   |   |   |   |   | . SWITCH,PUSH:   | 80009    | 260-1421-00     |
| -22              | 361-0542-00        |                      |                  | 4   |   |   |   |   |   | . SPACER,SWITCH:PLASTIC                                  | 71590    | J-64281         |
| -23              | 119-0670-00        |                      |                  | 1   |   |   |   |   |   | RESISTOR,ASSY:GIMBAL MT,2 X 5K OHM,1W                    | 0000F    | 900-032         |
| -24              | 390-0452-00        |                      |                  | 1   |   |   |   |   |   | CAB,SEC,CONT:FRONT AND REAR                              | 80009    | 390-0452-00     |
| -25              | 175-0826-00        |                      |                  | FT  |   |   |   |   |   | WIRE,ELECTRICAL:3 WIRE RIBBON                            | 08261    | TEK-175-0826-00 |
|                  | 131-0707-00        |                      |                  | 6   |   |   |   |   |   | CONTACT,ELEC:0.48" L,22-26 AWG WIRE                      | 22526    | 47439           |
|                  | 352-0161-00        |                      |                  | 2   |   |   |   |   |   | HOLDER,TERM.CON:3 WIRE BLACK                             | 80009    | 352-0161-00     |
|                  | 343-0002-00        |                      |                  | 1   |   |   |   |   |   | CLAMP,LOOP:0.188 INCH DIA<br>(ATTACHING PARTS)           | 95987    | 3-16-6B         |
|                  | 211-0511-00        |                      |                  | 1   |   |   |   |   |   | SCREW,MACHINE:6-32 X 0.500,PNH,STL                       | 83385    | OBD             |
|                  | 210-0863-00        |                      |                  | 1   |   |   |   |   |   | WSHR,LOOP CLAMP:   | 95987    | C191            |
|                  | 210-0457-00        |                      |                  | 1   |   |   |   |   |   | NUT,PL,ASSEM WA:6-32 X 0.312,INCH,STL<br>- - - * - - -   | 83385    | OBD             |
| ACCESSORIES      |                    |                      |                  |     |   |   |   |   |   |  |          |                 |
|                  | 070-1826-01        |                      |                  | 1   |   |   |   |   |   | MANUAL,TECH:INSTRUCTION(NOT SHOWN)                       | 80009    | 070-1826-01     |





# OPTIONS

The 4952 Joystick has the following options available at the time of this printing. Please refer to the Tektronix Catalog for an up-to-date listing of options.

Option 1

This option permits the Joystick to operate with the 4010, 4010-1, 4012, or the 4013 Computer Display Terminal. The Option 1 for the 4952 Joystick can be purchased separately. The part number is given in the Option 1 Replaceable Parts List.

# 4952 JOYSTICK OPTION 1

## CONTENTS

|  | Option 1 |
|--|----------|
|  | Page     |
| INTRODUCTION                             | 1        |
| INSTALLATION                             | 1        |
| CHARACTERISTICS                          | 3        |
| CIRCUIT DESCRIPTION                      | 3        |
| ELECTRICAL PARTS LIST                    | 5        |
| DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS |          |

# 4952 JOYSTICK OPTION 1

## INTRODUCTION

Option 1 permits the Joystick to operate with the 4010, 4010-1, 4012, or the 4013 Computer Display Terminal.

Option 1 consists of a Joystick Adapter circuit card that inserts the minibus within the terminal. Two supplied ribbon cables are used to interconnect to the signals from the TC-2 terminal circuit card. The Joystick interconnects with the Joystick Adapter circuit card.

This insert contains a circuit diagram, circuit board component locations, and other information that are unique to Option 1 and not included elsewhere in the manual. Whenever information contained in the manual might be useful in using the insert, the reader is referred to the proper section of the manual.

## INSTALLATION

### General

Installation of the Joystick Adapter circuit card requires access into the terminal by opening the pedestal front cover. The power should be off before connecting or disconnecting the Joystick cable.

### **WARNING**

*Dangerous voltages exist at several locations within the pedestal. Disconnect the terminal from the power source during installation.*

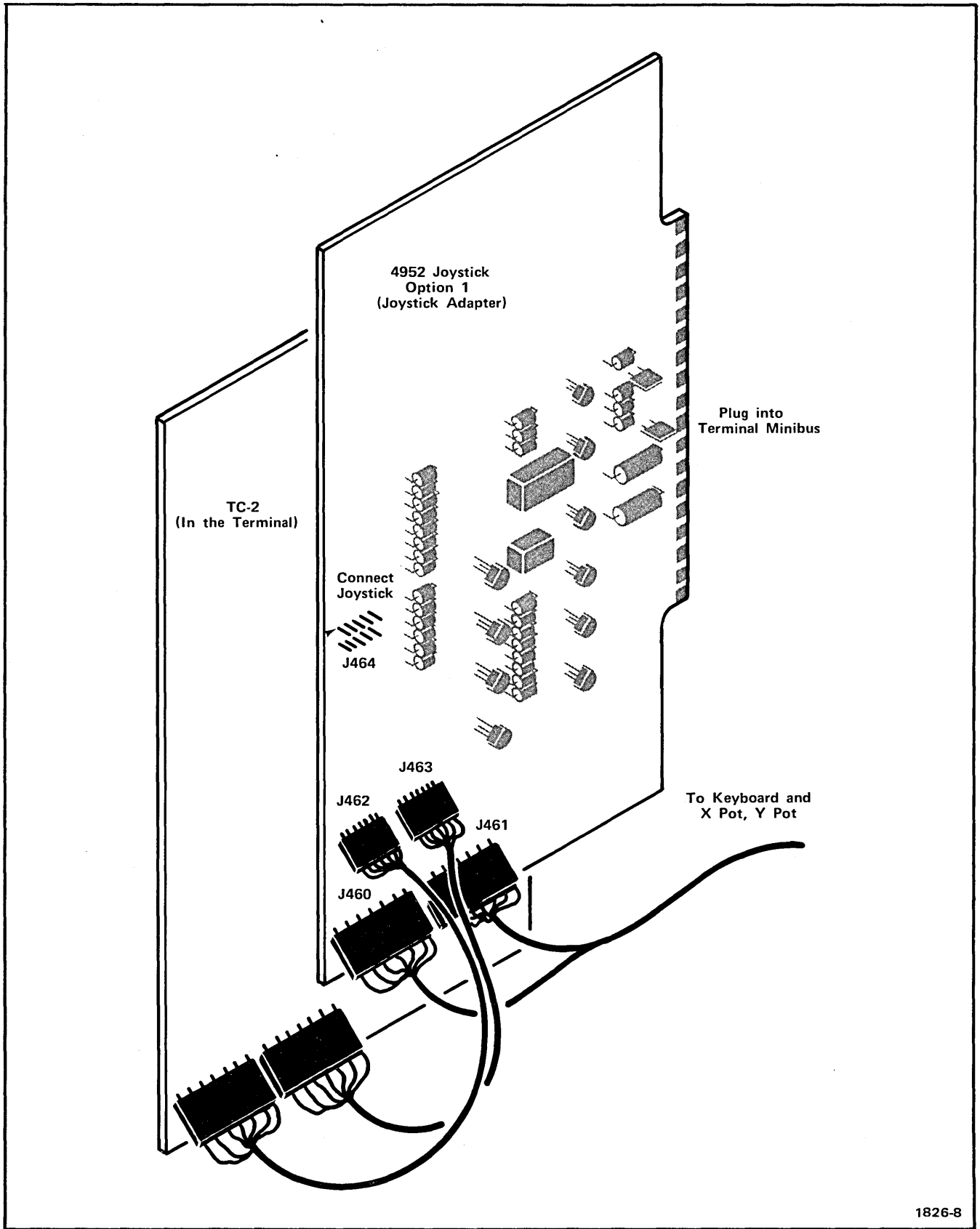
### NOTE

*Early serial numbered 4010's with TC-2 marked 670-1729-04 and below, change R53 and R75 to 18.7 k $\Omega$  1/8 W 1% (Tektronix Part No. 321-0315-00). This will enable the crosshair display to be positioned to the edge of the screen.*

### Procedure

Use the following procedure to install the Joystick Adapter into a 4010, 4010-1, 4012, or 4013 Computer Display Terminal.

1. Turn the terminal Power OFF.
2. Open the terminal pedestal front cover and locate TC-2, refer to Option 1, Fig. 1.
3. Insert the Joystick Adapter circuit board into an available position of the terminal's bus. (If no positions are available, a Minibus Extender, Tektronix Part No. 018-0069-01 must be installed in the terminal to allow the adapter circuit board to be inserted.)
4. Disconnect the cables leading to the TC-2 and connect them with the same arrangement to J460 and J461 on the Joystick Adapter circuit board (see Option 1, Fig. 1).
5. Use the two supplied flat ribbon cables to connect from J462 and J463 on the Joystick Adapter circuit board to the similarly arranged pins on the TC-2.



1826-8

Option 1 Fig. 1. Installation Information.

6. Insert the cable from the Joystick through the rectangular port on the back of the terminal. Connect the cable plug to J464 on the Joystick Adapter circuit board; be sure to check the plug and jack index marks on the plug (end of the connecting cable) and the jack pins on J464 to ensure proper alignment before connecting the cable. The plug is marked with a 1 at pin 1. The jack pins have a small arrow at the base of pin 1.

7. Take the cable clamp, screw, washer, and nut from the installation hardware and secure the cable to the rectangular port flange. Use any convenient mounting hole.

8. Replace the pedestal front cover. The Joystick now is ready for use.

**OPTION 1 TABLE 1**  
**Electrical Characteristics**

| Parameter                       | Maintenance & Operation                                       |
|---------------------------------|---|
| X Axis Output Voltage Range     | -14.5 V to +14.5 V into 30 kΩ with ±15.0 V on edge connector. |
| Y Axis Output Voltage Range     | -14.5 V to +14.5 V into 30 kΩ.                                |
| Worst-case Current Requirements |   |
| +15 V                           | 35 mA max.  |
| -15 V                           | 45 mA max.  |
| + 5 V                           | 5 mA max.   |

## CHARACTERISTICS

### General

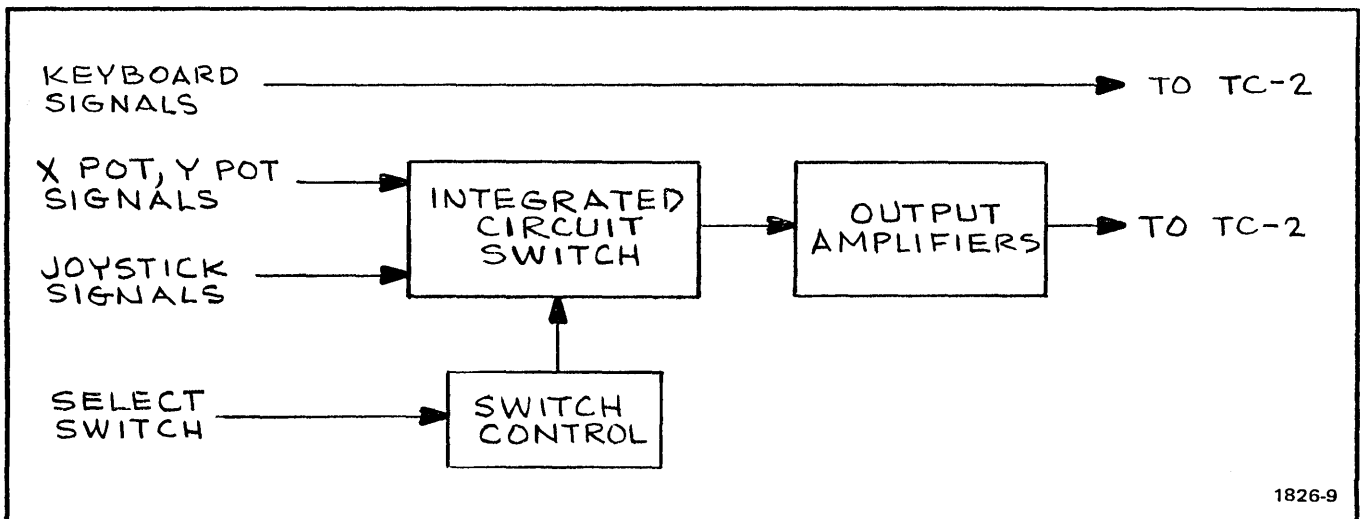
When the Joystick Adapter circuit board is installed in a 4010, 4010-1, 4012, or a 4013 Computer Display Terminal, the general characteristics and operation of the Joystick is the same as described in the manual.

### Electrical Characteristics

The following Electrical Characteristics Table lists the changes as a result of Option 1.

## CIRCUIT DESCRIPTION

Refer to Option 1, Fig. 2 and the Joystick Adapter circuit diagram. The circuit consists of an integrated circuit switch to select the X POT and Y POT signals from the Terminal or the Joystick signals for use of the Terminal. As shown in the block diagram, the Joystick Select switch, through the Switch Control circuit, controls the integrated circuit switch.



Option 1 Fig. 2. Joystick Adapter block diagram.

## 4952 Service

### Input Dividers

The input signals, X POT, Y POT from the Terminal thumbwheels that feed through J460, and the X, Y signals from the Joystick that feed through J464 are divided by the resistor networks in the Input Divider circuit. The reduced signals feed the input of U149.

### Switch

Only one pair of switches are closed at a time in the quad switch U149. The switch connects either the terminal's thumbwheels or the Joystick signals to the output amplifiers. The Switch Control circuit sets a high at pin 12 and 13 to connect the terminal's thumbwheel signals, or a high at pin 5 and 6 to connect the Joystick signals. Note that a -10 volt supply is required for U149, and is set by VR251.

### Output Amplifiers

Each output amplifier (the X and the Y amplifiers are identical) drives the X OUT and Y OUT signals to the TC-2 circuit in the terminal via J462. The X amplifier consists of

operational amplifier U142B driving the bases of Q135 and Q137. Q135 and Q137 drive Q129 and Q142 output circuit to output the X OUT signal. The output circuit allows a large voltage swing and the amplifier has an overall gain of about 9.

### Switch Control

When locking pushbutton switch Select is pressed in, the SELECT line from the Joystick is low. This low turns Q255 on to apply a high to U149 pins 5 and 6 that connects the Joystick signals to the output amplifiers. Conduction of Q255 forward biases Q249 to apply a low on U149 pins 12 and 13 to effectively cutoff the terminal thumbwheel signals to the output amplifiers.

When the Select switch is in the out position (or the Joystick disconnected from J464) both Q255 and Q249 are off. This allows U149 pin 12 and 13 to be pulled high, which connects the terminal thumbwheel signals to the output amplifier.

## REPLACEABLE ELECTRICAL PARTS

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff Dscont | Name & Description                         | Mfr Code | Mfr Part Number |
|---------|--------------------|-----------------------------|--|----------|-----------------|
| .       | 670-4041-00.       |                             | CKT BOARD ASSY:JOYSTICK ADAPTER            | 80009    | 670-4041-00     |
| C242    | 290-0301-00        |                             | CAP.,FXD,ELCTLT:10UF,10%,20V               | 56289    | 150D106X9020B2  |
| C245    | 290-0301-00        |                             | CAP.,FXD,ELCTLT:10UF,10%,20V               | 56289    | 150D106X9020B2  |
| C249    | 283-0177-00        |                             | CAP.,FXD,CER DI:1UF,+80-20%,25V            | 72982    | 8131N039651105Z |
| C254    | 283-0177-00        |                             | CAP.,FXD,CER DI:1UF,+80-20%,25V            | 72982    | 8131N039651105Z |
| Q129    | 151-0190-02        |                             | TRANSISTOR:SILICON,NPN                     | 04713    | 2N3904          |
| Q135    | 151-0188-00        |                             | TRANSISTOR:SILICON,PNP                     | 04713    | 2N3906          |
| Q137    | 151-0190-02        |                             | TRANSISTOR:SILICON,NPN                     | 04713    | 2N3904          |
| Q142    | 151-0188-00        |                             | TRANSISTOR:SILICON,PNP                     | 04713    | 2N3906          |
| Q229    | 151-0190-02        |                             | TRANSISTOR:SILICON,NPN                     | 04713    | 2N3904          |
| Q235    | 151-0188-00        |                             | TRANSISTOR:SILICON,PNP                     | 04713    | 2N3906          |
| Q237    | 151-0190-02        |                             | TRANSISTOR:SILICON,NPN                     | 04713    | 2N3904          |
| Q242    | 151-0188-00        |                             | TRANSISTOR:SILICON,PNP                     | 04713    | 2N3906          |
| Q249    | 151-0341-00        |                             | TRANSISTOR:SILICON,NPN                     | 07263    | 2N3565          |
| Q255    | 151-0342-00        |                             | TRANSISTOR:SILICON,PNP                     | 07263    | 2N4249          |
| R39     | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W            | 01121    | CB1035          |
| R41     | 315-0512-00        |                             | RES.,FXD,CMPSN:5.1K OHM,5%,0.25W           | 01121    | CB5125          |
| R42     | 315-0623-00        |                             | RES.,FXD,CMPSN:62K OHM,5%,0.25W            | 01121    | CB6235          |
| R43     | 315-0682-00        |                             | RES.,FXD,CMPSN:6.8K OHM,5%,0.25W           | 01121    | CB6825          |
| R44     | 315-0202-00        |                             | RES.,FXD,CMPSN:2K OHM,5%,0.25W             | 01121    | CB2025          |
| R45     | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W            | 01121    | CB1035          |
| R47     | 315-0392-00        |                             | RES.,FXD,CMPSN:3.9K OHM,5%,0.25W           | 01121    | CB3925          |
| R49     | 315-0273-00        |                             | RES.,FXD,CMPSN:27K OHM,5%,0.25W            | 01121    | CB2735          |
| R51     | 315-0153-00        |                             | RES.,FXD,CMPSN:15K OHM,5%,0.25W            | 01121    | CB1535          |
| R52     | 315-0273-00        |                             | RES.,FXD,CMPSN:27K OHM,5%,0.25W            | 01121    | CB2735          |
| R54     | 315-0273-00        |                             | RES.,FXD,CMPSN:27K OHM,5%,0.25W            | 01121    | CB2735          |
| R55     | 315-0153-00        |                             | RES.,FXD,CMPSN:15K OHM,5%,0.25W            | 01121    | CB1535          |
| R57     | 315-0273-00        |                             | RES.,FXD,CMPSN:27K OHM,5%,0.25W            | 01121    | CB2735          |
| R59     | 315-0392-00        |                             | RES.,FXD,CMPSN:3.9K OHM,5%,0.25W           | 01121    | CB3925          |
| R129    | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W            | 01121    | CB1035          |
| R131    | 315-0512-00        |                             | RES.,FXD,CMPSN:5.1K OHM,5%,0.25W           | 01121    | CB5125          |
| R135    | 315-0682-00        |                             | RES.,FXD,CMPSN:6.8K OHM,5%,0.25W           | 01121    | CB6825          |
| R137    | 315-0623-00        |                             | RES.,FXD,CMPSN:62K OHM,5%,0.25W            | 01121    | CB6235          |
| R138    | 315-0104-00        |                             | RES.,FXD,CMPSN:100K OHM,5%,0.25W           | 01121    | CB1045          |
| R139    | 315-0104-00        |                             | RES.,FXD,CMPSN:100K OHM,5%,0.25W           | 01121    | CB1045          |
| R140    | 315-0202-00        |                             | RES.,FXD,CMPSN:2K OHM,5%,0.25W             | 01121    | CB2025          |
| R141    | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W            | 01121    | CB1035          |
| R153    | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W            | 01121    | CB1035          |
| R155    | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W            | 01121    | CB1035          |
| R157    | 315-0103-00        |                             | RES.,FXD,CMPSN:10K OHM,5%,0.25W            | 01121    | CB1035          |
| R249    | 315-0751-00        |                             | RES.,FXD,CMPSN:750 OHM,5%,0.25W            | 01121    | CB7515          |
| R252    | 315-0102-00        |                             | RES.,FXD,CMPSN:1K OHM,5%,0.25W             | 01121    | CB1025          |
| R255    | 315-0153-00        |                             | RES.,FXD,CMPSN:15K OHM,5%,0.25W            | 01121    | CB1535          |
| U142    | 156-0158-00        |                             | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 18324    | S5558U          |
| U149    | 156-0289-00        |                             | MICROCIRCUIT,DI:QUAD BILATERAL SWITCH      | 86684    | CD4016AE        |
| VR251   | 152-0149-00        |                             | SEMICOND DEVICE:ZENER,0.4W,10V,5%          | 04713    | 1N961B          |



# REPLACEABLE MECHANICAL PARTS

## (OPTION 1) EXPLODED

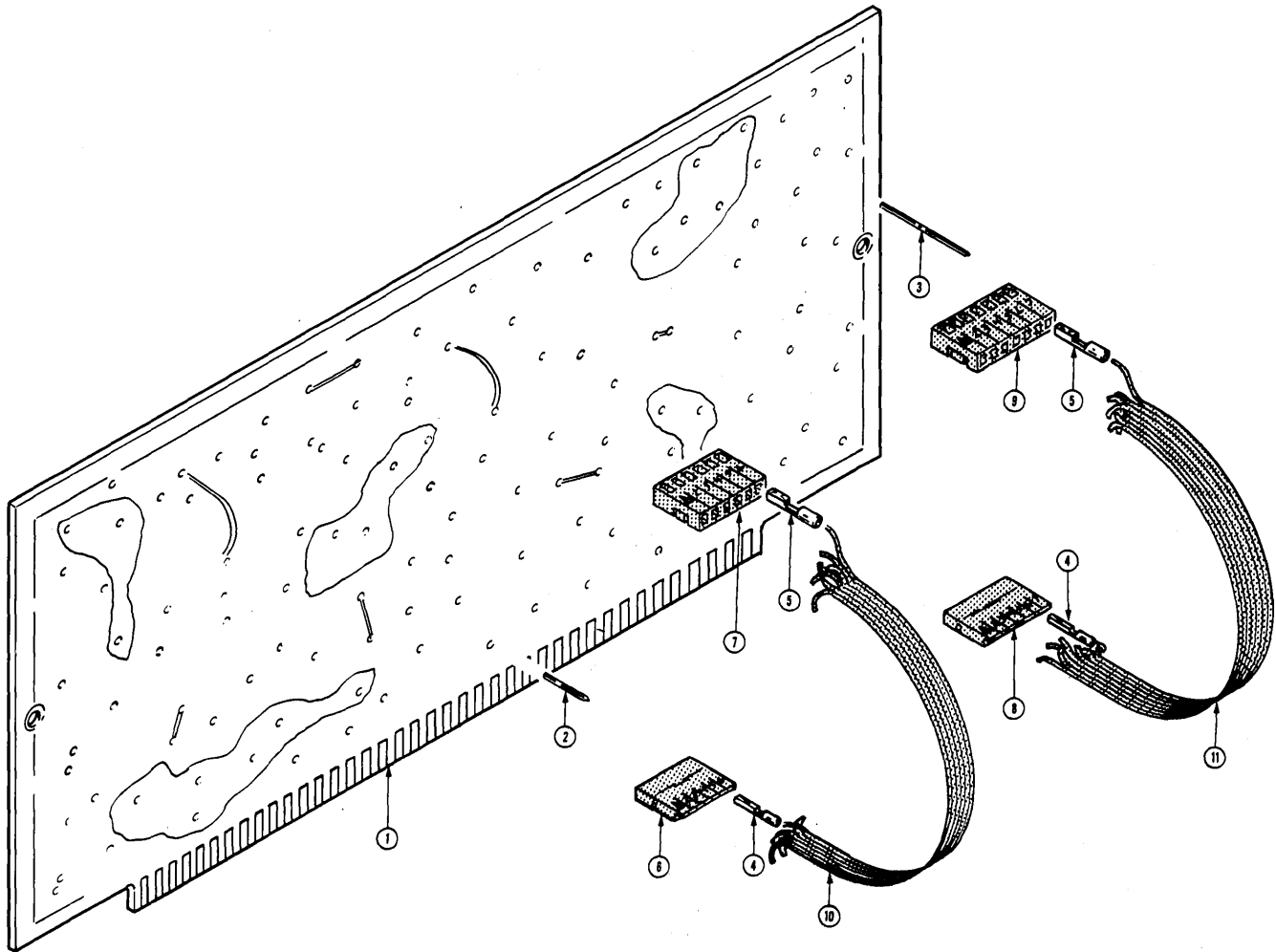
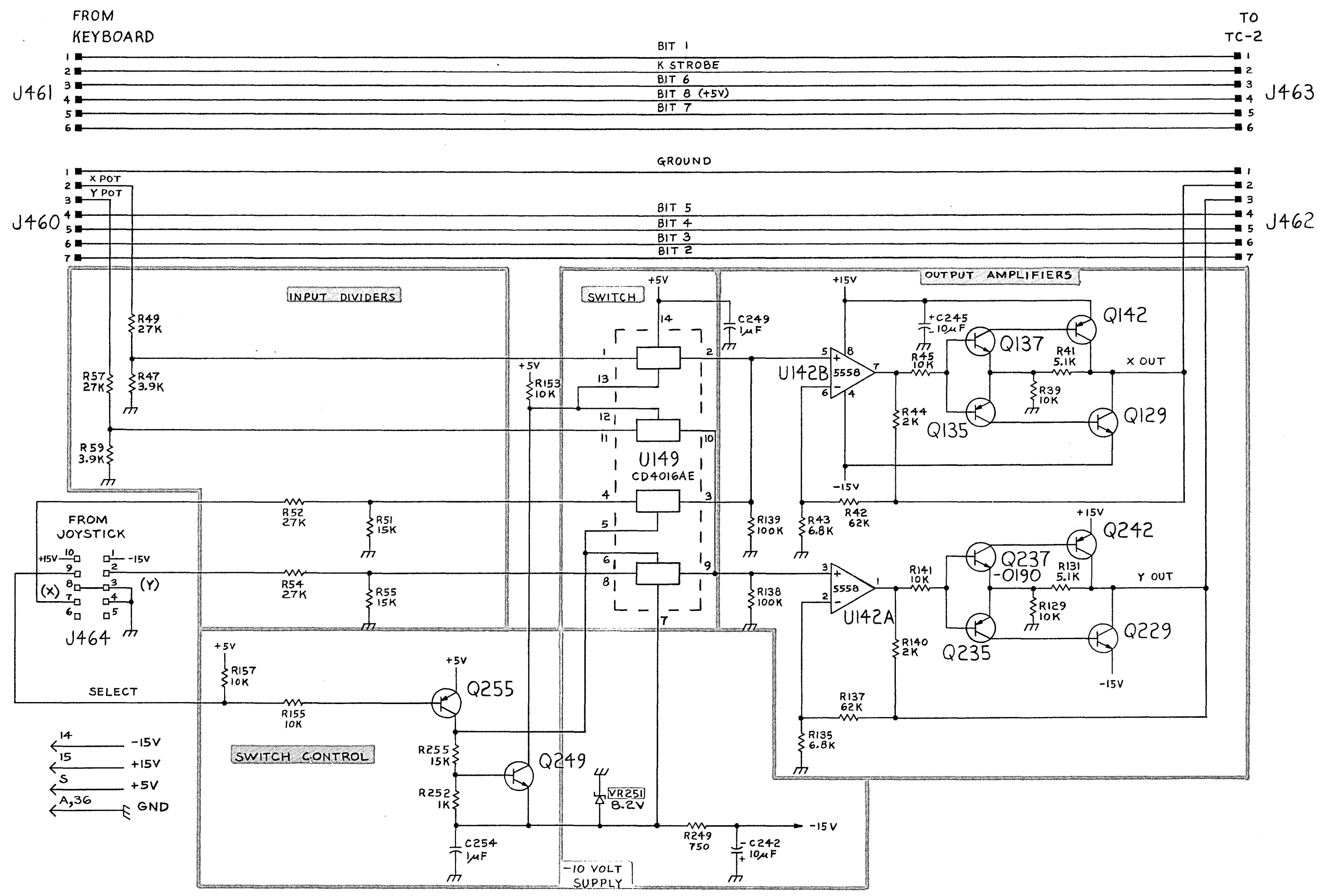
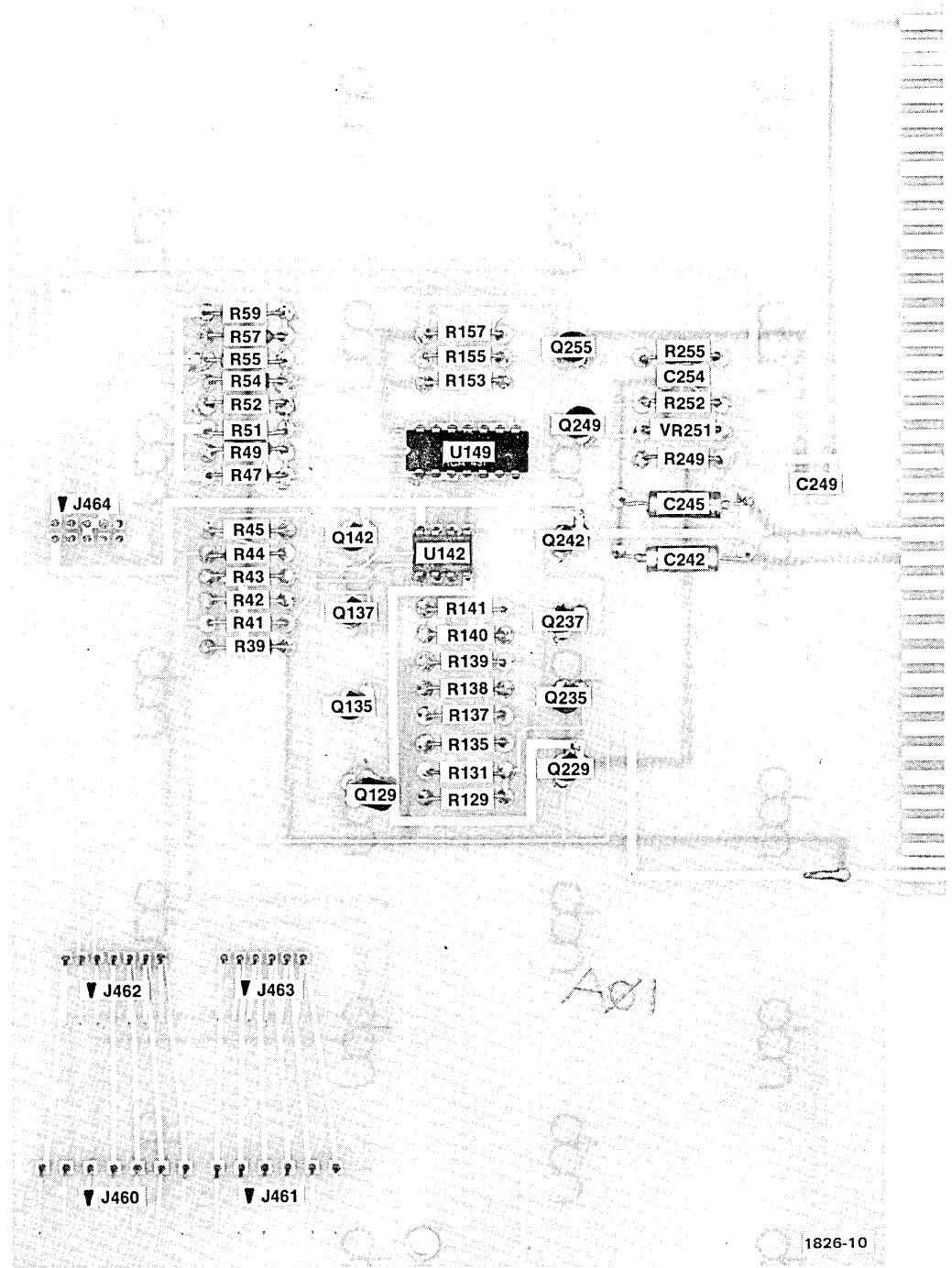


Fig. & Index

| No. | Part No.    | Tektronix Serial/Model No. Eff | Dscnt | Qty | 1 | 2 | 3 | 4 | 5 | Name & Description                       | Mfr   |                 |
|-----|-------------|--------------------------------|-------|-----|---|---|---|---|---|--|-------|-----------------|
|     |             |                                |       |     |   |   |   |   |   |  | Code  | Mfr Part Number |
| 1-  | 018-0103-00 |                                |       | 1   |   |   |   |   |   | CKT BD ASSY:JOYSTICK ADAPTER             | 80009 | 018-0103-00     |
| -1  | -----       |                                |       | 1   |   |   |   |   |   | CKT BOARD ASSY:JOYSTICK ADAPTER(SEE EPL) |       |                 |
| -2  | 131-0608-00 |                                |       | 10  |   |   |   |   |   | CONTACT,ELEC:0.365 INCH LONG             | 22526 | 47357           |
| -3  | 131-0787-00 |                                |       | 26  |   |   |   |   |   | CONTACT,ELEC:0.64 INCH LONG              | 80009 | 131-0787-00     |
|     | 175-1660-00 |                                |       | 1   |   |   |   |   |   | CA ASSY,SP,ELEC:                         | 80009 | 175-1660-00     |
| -4  | 131-0707-00 |                                |       | 13  |   |   |   |   |   | CONTACT,ELEC:0.48"L,22-26 AWG WIRE       | 22526 | 47439           |
| -5  | 131-0621-00 |                                |       | 13  |   |   |   |   |   | CONTACT,ELEC:0.577"L,22-26 AWG WIRE      | 22526 | 46231           |
| -6  | 352-0164-03 |                                |       | 1   |   |   |   |   |   | CONN BODY,PL,EL:6 WIRE ORANGE            | 80009 | 352-0164-03     |
| -7  | 352-0202-01 |                                |       | 1   |   |   |   |   |   | CONN BODY,PL,EL:6 WIRE BROWN             | 80009 | 352-0202-01     |
| -8  | 352-0165-02 |                                |       | 1   |   |   |   |   |   | CONN BODY,PL,EL:7 WIRE RED               | 80009 | 352-0165-02     |
| -9  | 352-0203-00 |                                |       | 1   |   |   |   |   |   | CONN BODY,PL,EL:7 WIRE BLACK             | 80009 | 352-0203-00     |
| -10 | 175-0829-00 |                                |       | FT  |   |   |   |   |   | WIRE,ELECTRICAL:6 WIRE RIBBON            | 83501 | TEK-175-0829-00 |
| -11 | 175-0830-00 |                                |       | FT  |   |   |   |   |   | WIRE,ELECTRICAL:7 WIRE RIBBON            | 08261 | TEK-175-0830-00 |



4952 OPTION 1

1826-12  
REV. A, JAN 1977

JOYSTICK ADAPTER  
670-4041-00,01



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technical excellence

# MANUAL CHANGE INFORMATION

PRODUCT 4952 JOYSTICK  
070-1826-01

CHANGE REFERENCE M23,827

DATE 1-20-76

CHANGE:

DESCRIPTION

## ELECTRICAL PARTS AND SCHEMATIC CHANGE

4952 (Option 1)

Page 5

CHANGE TO:

670-4041-01

CKT BOARD ASSY:JOYSTICK ADAPTER

VR251

152-0217-00

SEMICONV DEVICE:ZENER:0.4W,8.2V,4.5%