TEKTRONIX®

4952

JOYSTICK

OPTION 2

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
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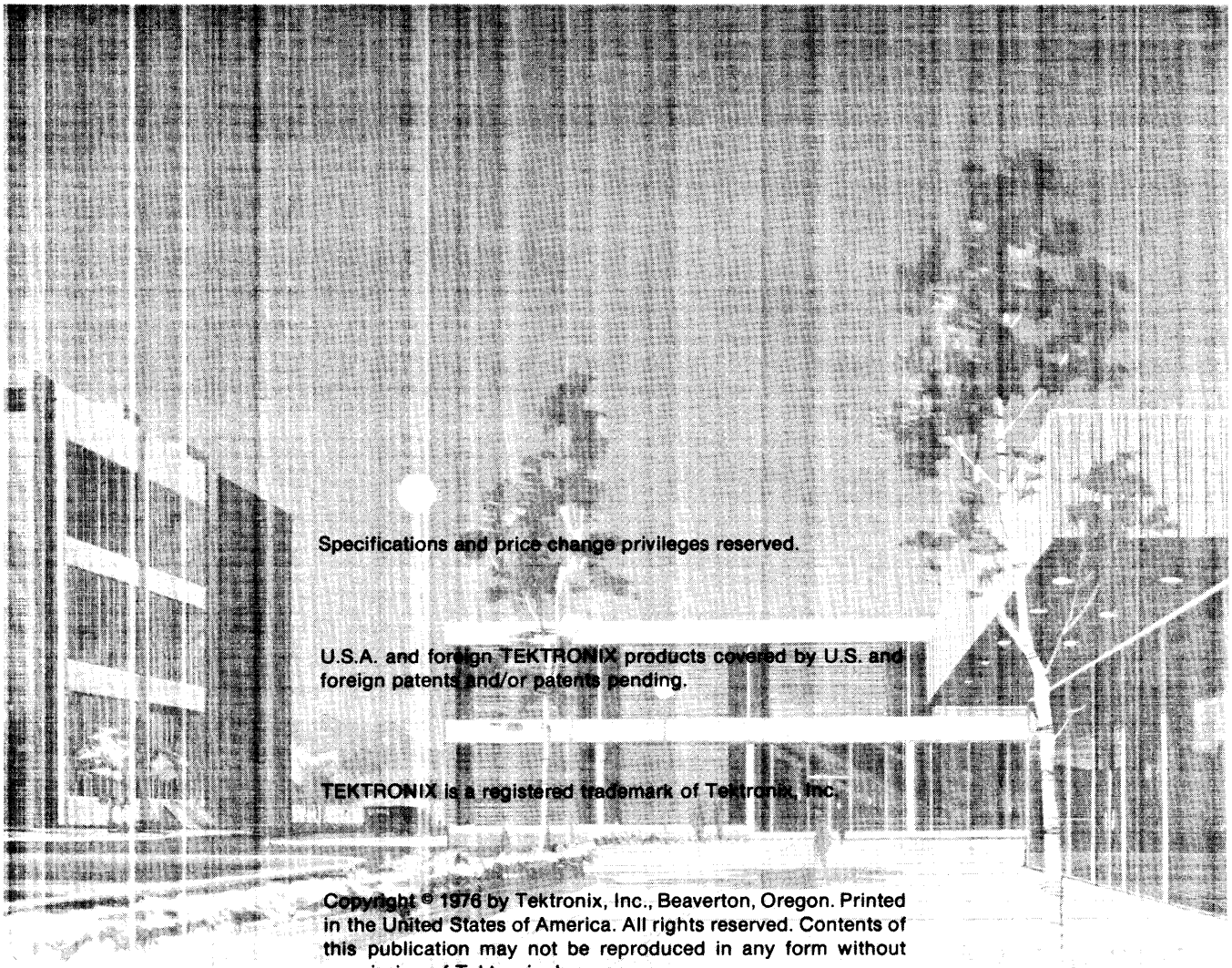

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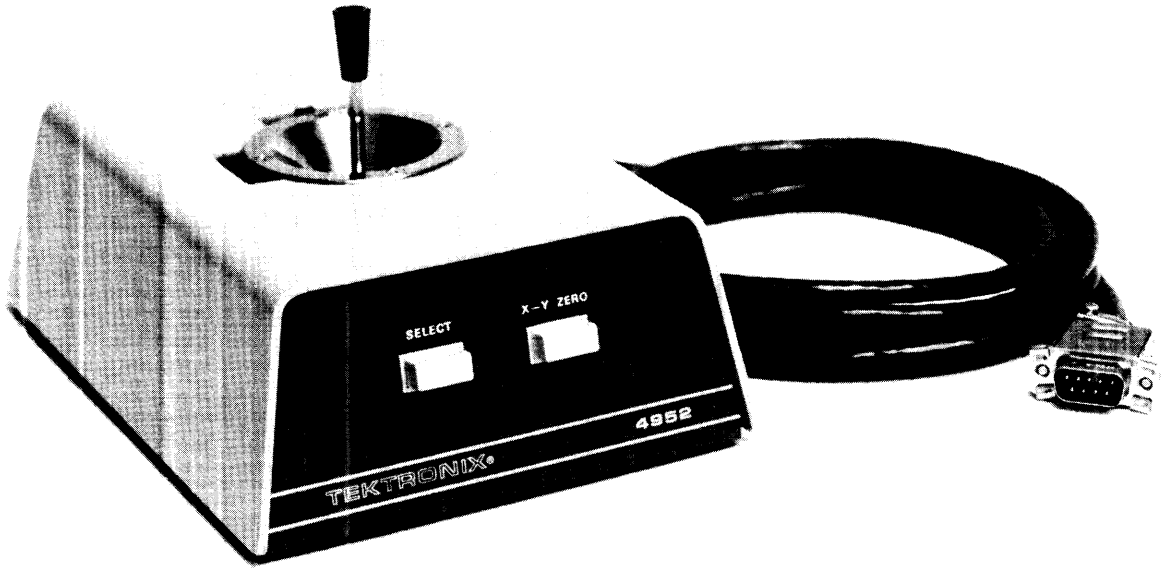

2098-1

Fig. 1-1. 4952 Joystick Option 2.

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Section 1

INSTALLATION AND OPERATION

INTRODUCTION

This manual documents the 4952 Joystick, Option 2. Option 2 enables the Joystick to be operated in conjunction with the 4051 Graphic System. The option consists of an interconnecting cable compatible with the Graphic System. The cable connects to connector J40 on the rear panel of the Graphic System. The SELECT control on the 4952 is not necessary for use with the Graphic System; it is reserved for use with display terminals.

INSTALLATION

The installation procedure consists of connecting the cable plug to connector J40 on the rear panel of the Graphic System and tightening the screws which hold the plug in place.

CONTROLS

Control Lever — Determines the speed and direction of crosshair cursor movement. The greater the control lever tilt, the faster the crosshair 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 (centered) position.

X-Y ZERO — Pushbutton switch that, when pressed, causes the X and Y outputs from the Joystick to immediately become zero volts.

THE POINTER STATEMENT

To display the graphic cursor, a POINTER statement must be executed directly from the Graphic System keyboard or under program control. Use the information which follows to become familiar with the Joystick operation.

Syntax Form:

[Line number] POI numeric variable , numeric variable , string variable

Descriptive Form:

[Line number] POINTER target variable for X coordinate of graphic point in user data units , target variable for Y coordinate of graphic point in user data units , target variable to record the key which is pressed to end the entry

The POINTER statement places the graphic cursor (blinking arrow) on the Graphic System screen. The graphic cursor points to the present position of the graphic point and is moved around the screen by rotating a Joystick (an optional peripheral device). When a keyboard key is pressed, a GIN (Graphic Input) operation is executed to mark the location of the graphic point, and program execution continues to the next statement.

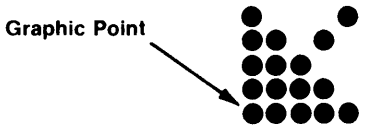
Displaying the Graphic Cursor

The POINTER statement places the graphic cursor on the screen. For example, to input points at target variables A, B, and A$, type

```
100 POINTER A,B,C$
```

When this statement is executed, the graphic cursor appears on the Graphic System screen. The exact position of the cursor depends on the position of the Joystick. The tip of the arrow on the graphic cursor marks the current

location of the graphic point. (This point is normally used as a reference to draw graphic vectors.) The graphic cursor and the location of the graphic point are shown following:



2098-6

Rotating the Joystick moves the graphic cursor to a specific location on the screen. Rotation to the right, for example, moves the cursor to the right side of the screen.

Completing the POINTER Operation

After the graphic cursor is positioned on the screen with the Joystick, a key is pressed on the keyboard. When a key is pressed, the X and Y coordinates of the current location of the graphic point are recorded. The X coordinate is assigned to the first target variable specified in the POINTER statement; in this example the numeric variable A. The Y coordinate is assigned to the second target variable specified in the POINTER statement; in this case, the numeric variable B. Both the X and Y coordinates are measured in user data units as specified by the WINDOW statement. The third target variable records which key is pressed to terminate the operation. The key symbol is recorded, but not echoed on the display. In this case, if the F key is press after the graphic cursor is placed on the screen, the letter "F" is assigned to C$. After the key is pressed, program execution continues to the next statement.

Applications for the POINTER Statement

The POINTER statement and the Joystick provide the keyboard operator with a method to graphically communicate with the system. For example, assume that 1000 data values are input into memory from an external peripheral device over the General Purpose Interface Bus. Assume also that this data is processed by the BASIC program and displayed on the screen as a point plot graph.

The POINTER statement and the Joystick allow the keyboard operator to "talk" to the system about the graph. In this case, program subroutines can be placed in memory so that the keyboard operator can place the graphic cursor over a particular data point on the graph and press a key to execute a predefined function. Pressing the "Y" key might mean "display the numeric value of this data point"; pressing the "D" key might mean "delete this data point from memory."

The POINTER statement only records the X and Y coordinates of the present position of the graphic point. It is up to the programmer to generate the appropriate response by placing program subroutines in memory.

OPERATION AND CHECKOUT

1. When the power is turned on, cause a POINTER statement to be executed from the keyboard of the Graphic System.

2. After the graphic cursor is positioned on the screen, check the operation of the cursor control lever on the Joystick. Any tilt of the control lever causes cursor movement. The rate of cursor movement depends on the degree of control lever 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 cursor movement depends upon the direction of control lever tilt. Tilt away from or tilt toward the operator, causes the cursor to move up or down respectively. Tilt to the left or right results in corresponding left or right movement of the cursor. Permitting the control lever to return to its centered position causes the 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 3.

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

Section 2

SERVICE

INTRODUCTION

This section provides general maintenance information, instrument characteristics, and circuit descriptions to aid in servicing the 4952 Joystick, Option 2. The Joystick is designed to be relatively maintenance free and to have 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 or 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.

Option 2 Cable Connections (Cable No. 175-1842-00)

J40 (4051)			J170 (Joystick)	J171 (Joystick)
Line Name	Pin No.	Color Code	Pin No.	Pin No.
+12 V	1	9-N	2	
Not used	2	7-N	1	
X JOY	3	6-N		5
X JOY GND	4	4-N		4
CHASSIS GND	5	O-N Shield		CHASSIS GND
−12 V	6	O-N	3	
Empty	7			
Y JOY	8	1-N		1
Y JOY GND	9	2-N		2

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 +12 V dc and −12 V dc with an accuracy of 1%.

Resistance meter with 1% accuracy at 1.25 kΩ.

1. Turn off the 4051 power.

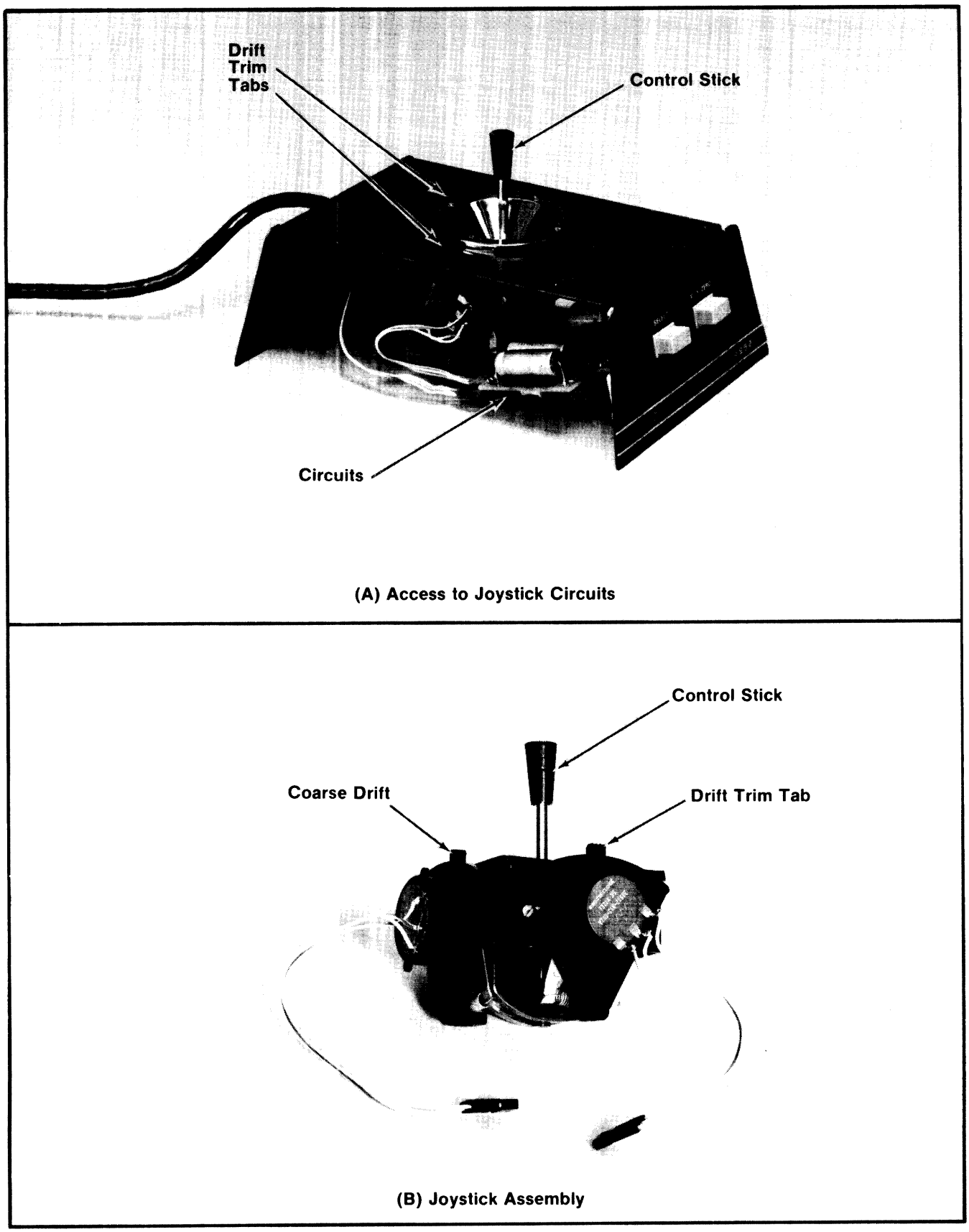


Fig. 2-1. Joystick adjustments and assemblies.

CAUTION

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

2. Disconnect the Joystick cable from J40.

3. Turn the 4051 power on.

4. Measure for approximately + V dc at pin 1 of J40 with respect to ground at pin 5 of J40.

5. Measure for approximately −12 V dc at pin 6 of J40 with respect to ground at pin 5 of J40.

6. The +12 V dc and −12 dc power supplies should be centered about ground potential. Refer to the 4051 Service manual if power supply corrections are necessary.

7. Turn the 4051 power to OFF.

8. 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.

9. 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. 2-1(A).

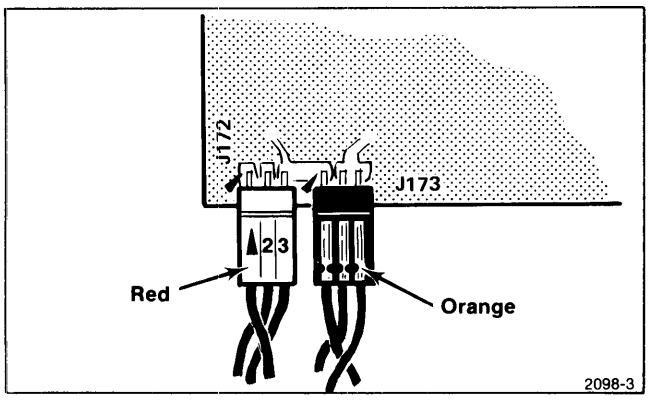


Fig. 2-2. Proper orientation of plugs for Option 2.

10. 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. (Note that J173 is correctly plugged into the connector as shown in Fig. 2-2).

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

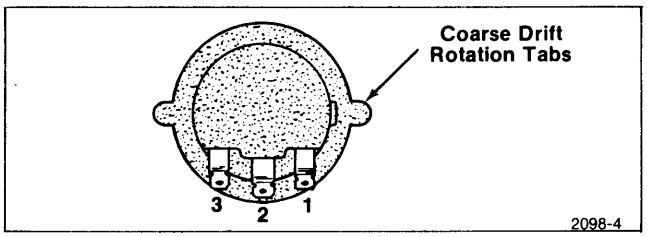


Fig. 2-3. Resistors on the Joystick assembly.

12. 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.

13. If coarse adjustments are needed, it will be necessary to remove the Joystick assembly, see Fig. 2-1(B), 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.

14. 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 (see Fig. 2-2). Replace the top cover using the stand-off mounts. Replace the bottom cover on the stand-off mounts. Reconnect the Joystick cable to J40 on the rear panel.

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 −15 V 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.

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.

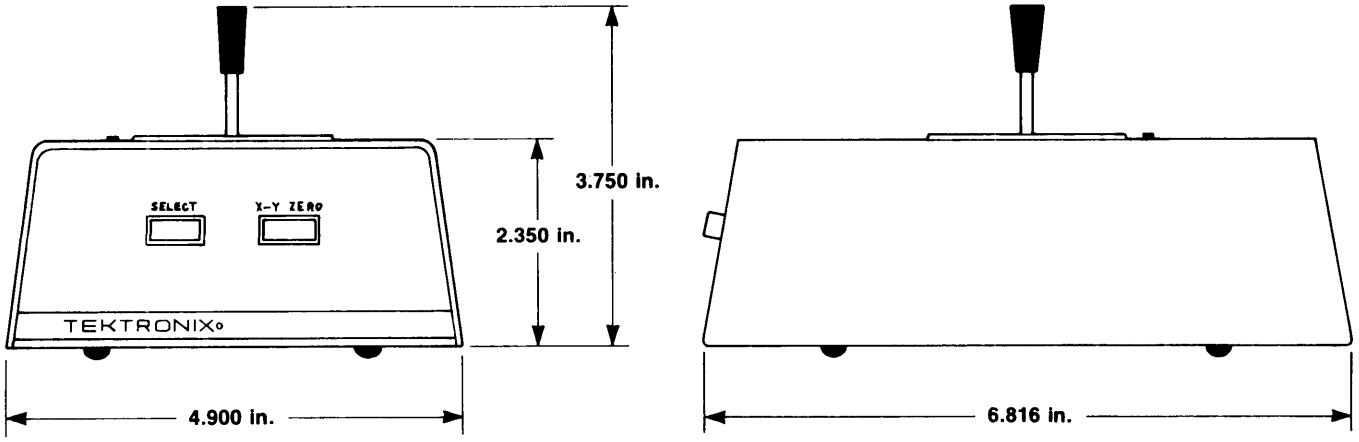


Fig. 2-4. Joystick Dimensions.

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 (centered) the output voltage of U112 is less than ±0.6 volt, 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 volt 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).

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 X-Y ZERO switch, when pressed, causes the integrating capacitors to immediately discharge and move the crosshair 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
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
03508	GENERAL ELECTRIC CO., SEMI-CONDUCTOR PRODUCTS DEPT.	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS., DIVISION OF AVX CORP.	P.O. BOX 867, 19TH AVE. SOUTH	MURTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SAN YSIDRO WAY	SANTA CLARA, CA 95051
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97005

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	30D107G025DD9
C5	283-0010-00	XB020000		CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C8	290-0215-00			CAP.,FXD,ELCTLT:100UF,+75-10%,25V	56289	30D107G025DD9
C9	283-0010-00	XB020000		CAP.,FXD,CER DI:0.05UF,+100-20%,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	56289	LP66A1A505J002
C50	285-0894-00			CAP.,FXD,PLSTC:5UF,5%,50V	56289	LP66A1A505J002
C107	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C139	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
CR5	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR7	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR30	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	80009	152-0323-00
CR31	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	80009	152-0323-00
CR33	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	80009	152-0323-00
CR34	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	80009	152-0323-00
CR52	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	80009	152-0323-00
CR53	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	80009	152-0323-00
CR62	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	80009	152-0323-00
CR64	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	80009	152-0323-00
R14	315-0101-00	XB020000		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R37	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R47	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R60	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R105	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R106	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R124	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R128	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R129	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R137	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R138	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R145	315-0101-00	XB020000		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R159	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R165	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R1001	119-0670-00			RESISTOR ASSY:2 X 5K OHM,1W	0000F	900-032
S25	260-1211-00			SWITCH,PUSH:DPDT,PUSH-PUSH	80009	260-1211-00
S44	260-1421-00			SWITCH,PUSH:1 STA,MOMENTARY,NON-SHORT	80009	260-1421-00
U112	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U133	156-0335-00	B010100	B019999	MICROCIRCUIT,DI:OP AMPL,FET INPUT	27014	LH0042CH
U133	156-0770-00	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0770-00
U147	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U150	156-0335-00	B010100	B019999	MICROCIRCUIT,DI:OP AMPL,FET INPUT	27014	LH0042CH
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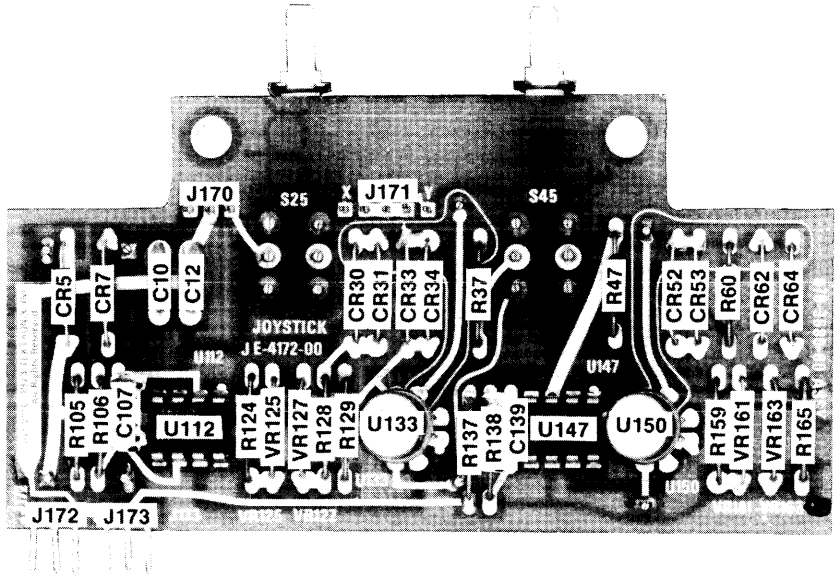
VR125	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR127	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR161	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR163	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00


J170
S25
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CR7
C10
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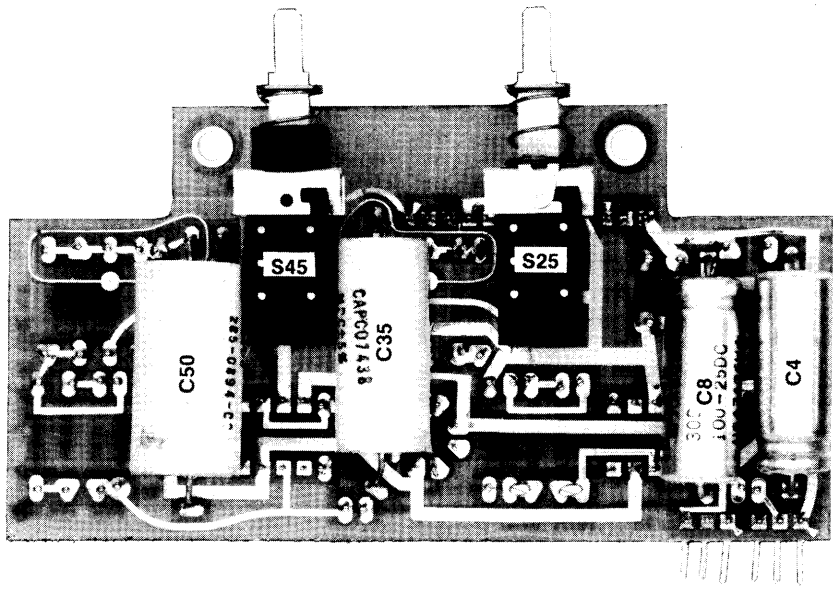
J172
J173

(Front)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S25
C50
C35
C4
C8

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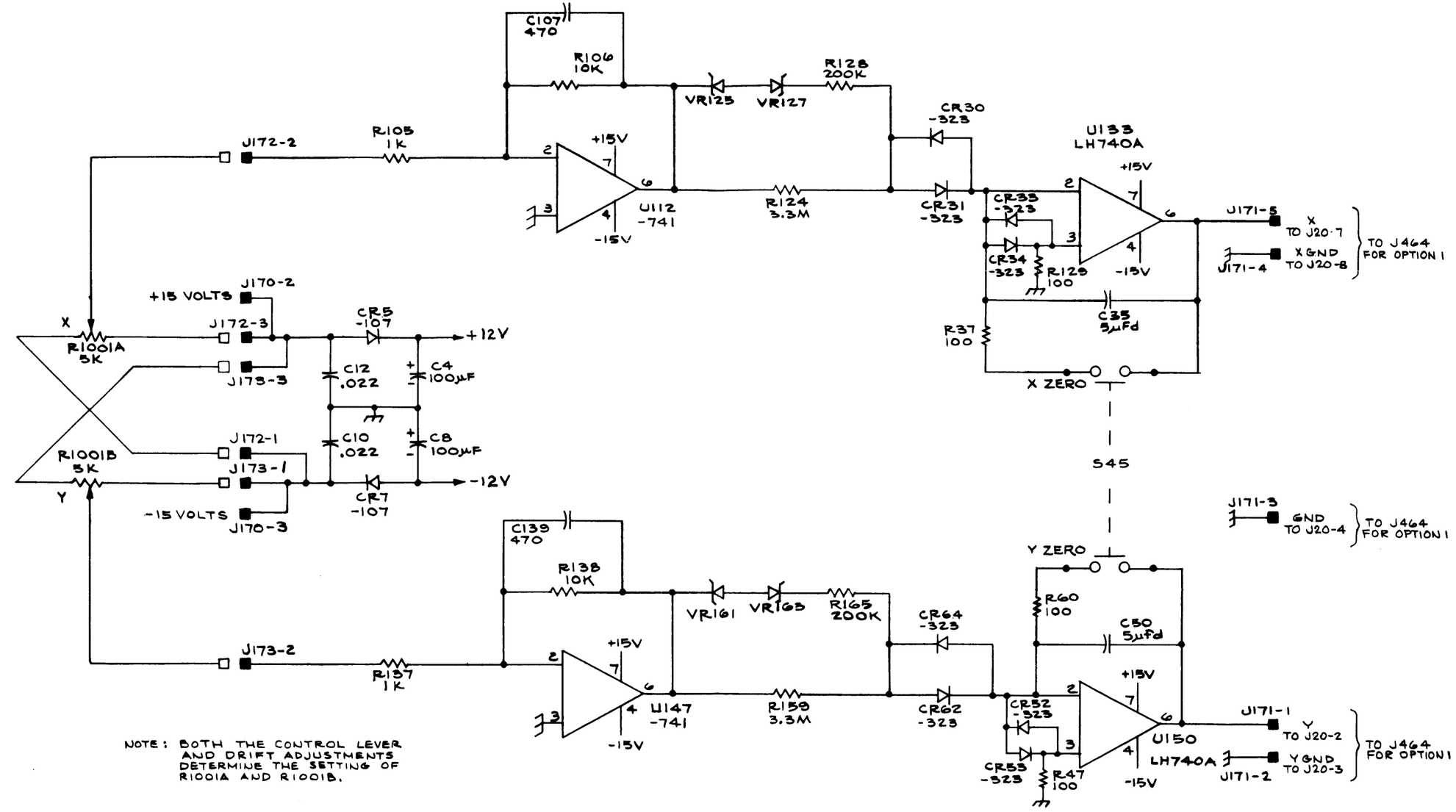


NOTE: BOTH THE CONTROL LEVER AND DRIFT ADJUSTMENTS DETERMINE THE SETTING OF R1001A AND R1001B.

4952 OPTION 2 @ JOYSTICK
670-3680-00

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

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

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

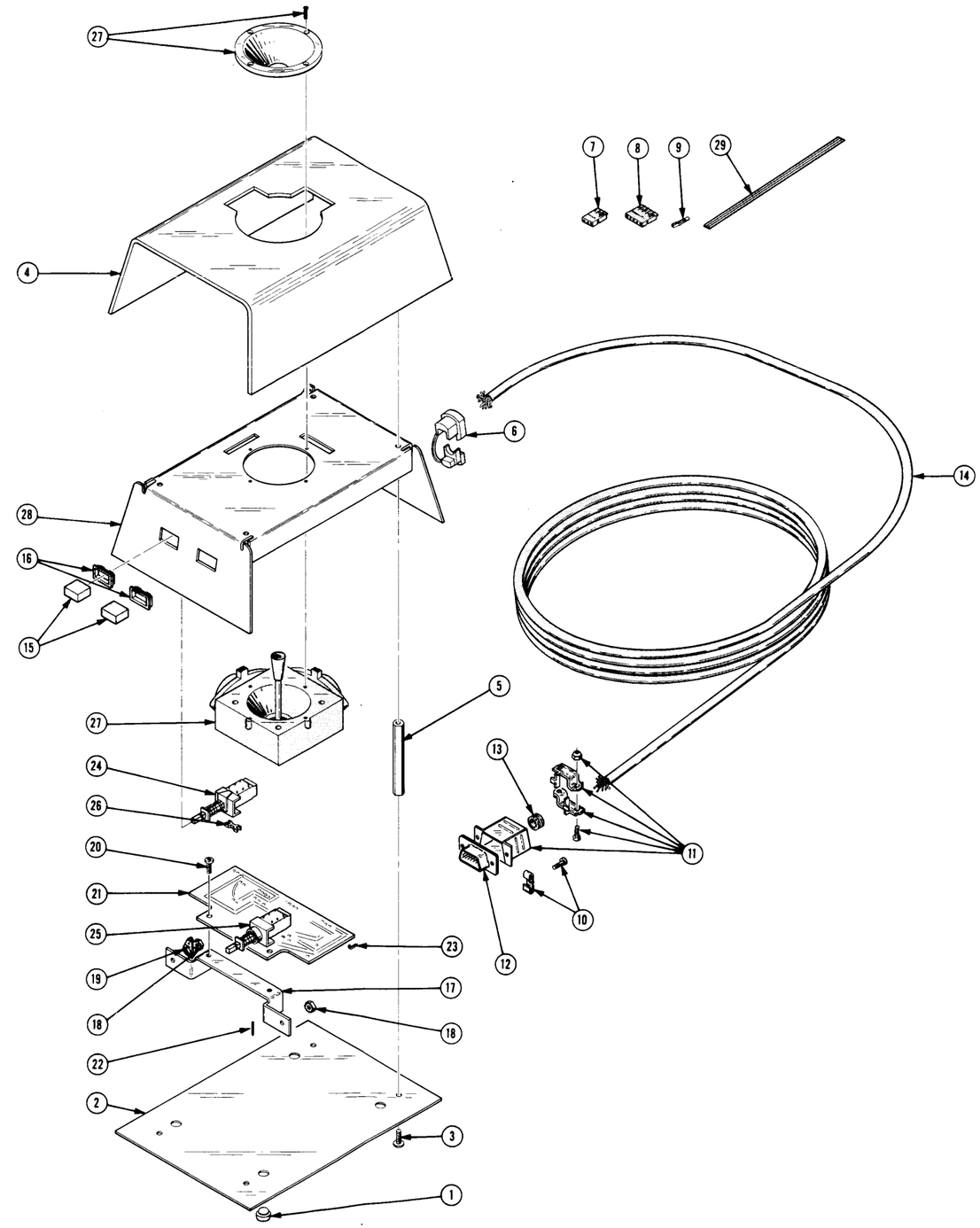
ABBREVIATIONS

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
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 GLOBE-UNION, INC.	5757 N. GREEN BAY AVE.	MILWAUKEE, WI 53201
71785	TRW ELECTRONIC COMPONENTS, CINCH CONNECTOR OPERATIONS	1501 MORSE AVE.	ELK GROVE VILLAGE, IL 60007
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97005
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						OPTION 2		
-1	348-0013-00			4		BUMPER,RUBBER:	70485	1561
-2	390-0454-00			1		CAB.SECT,CONT:BOTTOM	80009	390-0454-00
						(ATTACHING PARTS)		
-3	211-0581-00			4		SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
						- - - * - - -		
-4	390-0453-00			1		CAB.SECT,CONT:TOP AND SIDES	80009	390-0453-00
						(ATTACHING PARTS)		
-5	129-0531-00			4		SPACER,POST:0.25 HEX X 2.0 INCH LONG	80009	129-0531-00
						- - - * - - -		
	175-1842-00			1		CA ASSY,SP ELEC:INTERCONNECT	80009	175-1842-00
						(ATTACHING PARTS)		
-6	358-0161-00			1		BSHG,STRAIN RLF:FOR 0.50 INCH HOLE,PLASTIC	28520	SR5P4
						- - - * - - -		
	----- -----			-		. CABLE ASSY INCLUDES:		
-7	352-0161-00			1		. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0161-00
-8	352-0163-01			1		. CONN BODY,PL,EL:5 WIRE BROWN	80009	352-0163-01
-9	131-0707-00			8		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-10	213-0260-00			2		. SCREW-LOCK ASSY:	71785	D20419-16
-11	200-1170-00			1		. SHLD,ELEC CONN:	71785	DE24657
-12	131-1007-00			1		. CONNECTOR,RCPT,:9 CONTACT,MALE	71785	DE9P
-13	200-0192-00			1		. BUSH.,STRAIN RE:	80009	200-0192-00
-14	175-1157-00			FT		. CABLE,SP ELEC:10 FEET LONG	80009	175-1157-00
-15	366-1161-00			2		PUSH BUTTON:BLANK	80009	366-1161-00
-16	426-0568-00			2		FR,PUSHBUTTON:PANEL MOUNT	80009	426-0568-00
-17	407-1594-00			1		BRACKET,CKT BD:MAIN	80009	407-1594-00
						(ATTACHING PARTS)		
-18	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-19	210-0201-00			1		TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
-20	211-0590-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-21	----- -----			1		CKT BOARD ASSY:JOYSTICK(SEE EPL FOR PN)		
-22	131-0589-00			6		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-23	131-0608-00			8		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-24	----- -----			1		. SWITCH,PUSH:SELECT(SEE S25 EPL)		
-25	----- -----			1		. SWITCH,PUSH:X-Y ZERO(SEE S44 EPL)		
-26	361-0542-00			4		. SPACER,SWITCH:PLASTIC	71590	J-64281
-27	----- -----			1		RESISTOR ASSY:GIMBAL MT,(SEE R1001 EPL)		
-28	390-0452-00			1		CAB,SECT,CONT:FRONT AND REAR	80009	390-0452-00
-29	175-0826-00			FT		WIRE,ELECTRICAL:3 WIRE RIBBON,0.792 FT LONG	08261	TEK-175-0826-00
	131-0707-00			6		CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	352-0161-02			1		CONN BODY,PL,EL:3 WIRE RED	80009	352-0161-02
	352-0161-03			1		CONN BODY,PL,EL:3 WIRE ORANGE	80009	352-0161-03
						ACCESSORIES		
	070-2098-00			1		MANUAL,TECH:INSTRUCTION	80009	070-2098-00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MANUAL CHANGE INFORMATION

PRODUCT 4952 JOYSTICK & 4952 JOYSTICK OPTION 2

CHANGE REFERENCE M30,440

DATE 10-5-76 REV. 11-30-76

CHANGE:	DESCRIPTION

EFF SN B020422 (070-1826-01)
EFF SN B020370-up (Option 2) 070-2098-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

	670-3680-01	CKT BOARD ASSY:JOYSTICK
U133	156-0770-01	MICROCIRCUIT,DI:OPERATIONAL AMPLIFIER,LF356
U150	156-0770-01	MICROCIRCUIT,DI:OPERATIONAL AMPLIFIER,LF356

ADD:

C5	283-0010-00	CAP.,FXD,CER DI:0.05UF,50V
C9	283-0010-00	CAP.,FXD,CER DI:0.05UF,50V
R14	315-0101-00	RES.,FXD,COMP:100 OHM,5%,0.25W
R145	315-0101-00	RES.,FXD,COMP:100 OHM,5%,0.25W

DIAGRAM - JOYSTICK