

**TEKTRONIX®**

**5A23N  
AMPLIFIER**

INSTRUCTION MANUAL



Scan by Zenith  
*Tillhör Tek AB Demo*

# INSTRUCTION MANUAL

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



**5A23N  
AMPLIFIER**



## WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year.

Any questions with respect to the warranty, mentioned above, should be taken up with your Tektronix Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type (or Part Number) and Serial or Model Number with all requests for parts or service.

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Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.

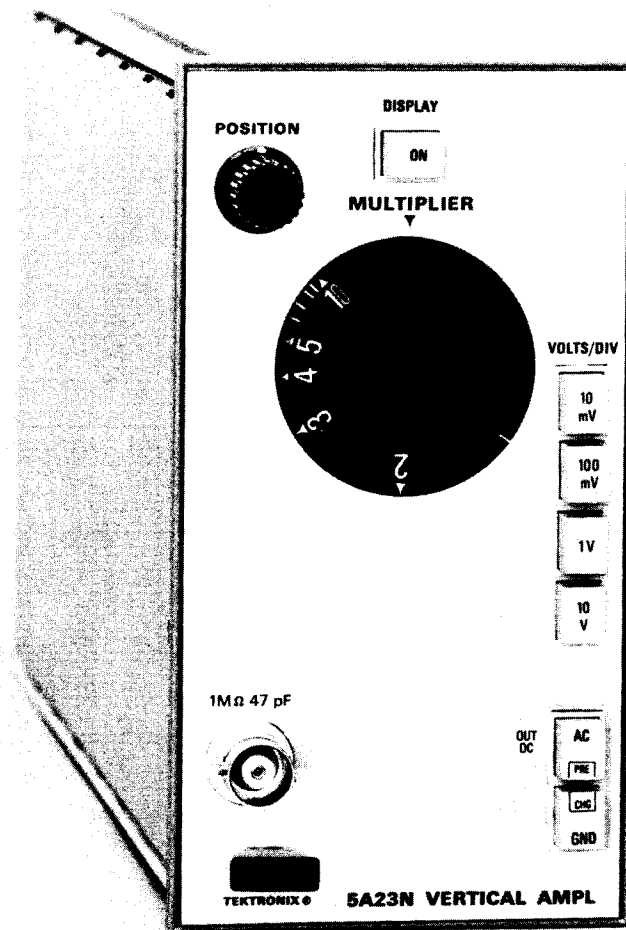


Fig. 1-1. 5A23N Amplifier.

# SECTION 1

## SPECIFICATION

*Change information, if any, affecting this section will be found at the rear of the manual.*

### Introduction

The 5A23N Vertical Amplifier is a general-purpose single-trace amplifier plug-in unit for use with Tektronix 5100-series oscilloscopes. The unit features solid-state circuitry and simplicity of front-panel controls. The 5A23N has calibrated deflection factors from 10 millivolts per division to 10 volts per division in decade steps; a multiplier control permits a variable adjustment between steps from 10 millivolts per division to 100 volts per division. Bandwidth of the instrument is from DC to at least 1.5 megahertz. While designed primarily for use as a vertical ampli-

fier, the unit can be operated in association with the horizontal deflection system of the oscilloscope for X-Y displays.

The following electrical characteristics apply over an ambient temperature range of 0°C to +50°C. Refer to the 5100-series Oscilloscope System manual for environmental characteristics.

In this manual the word Volts/Div or division refers to major graticule division.

TABLE 1-1  
ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Deflection Factor		
Calibrated Range	10 millivolts/division to 10 volts/division.	4 decade steps. Multiplier extends range to 100 volts/division.
Accuracy	Within 3% at each calibrated (Multiplier in X1) step.  Within 5% at the X2 and X5 settings of the Multiplier.	
MULTIPLIER Range		At least 10:1.
Frequency Response		
Bandwidth (8 Div Reference)		
DC (Direct) Coupled	DC to at least 1.5 megahertz.	
AC (Capacitive) Coupled	2 hertz or less to at least 1.5 megahertz.	
Input		
Input R and C	1 megohm, paralleled by about 47 picofarads.	Time constant normalized for 47 microseconds, within 3%.
Maximum Safe Input Voltages		350 volts (DC + peak AC).
POSITION Range		At least + and -10 divisions from graticule center.

# SECTION 2

## OPERATING INSTRUCTIONS

*Change information, if any, affecting this section will be found at the rear of the manual.*

### General

The 5A23N operates with a Tektronix 5100-series oscilloscope and is ready for use as it is received. It can be installed in any compartment of the oscilloscope. To install, align the upper and lower rails of the 5A23N with the plug-in compartment tracks and fully insert it (the plug-in panel must be flush with the oscilloscope panel). To remove, pull the release latch to disengage the 5A23N from the oscilloscope.

### Controls and Connectors

DISPLAY ON	Applies and removes logic levels to the oscilloscope system to enable or disable plug-in operation. The switch functions only when the plug-in is operated in one of the vertical plug-in compartments.
POSITION	Positions display.
VOLTS/DIV	Volts per major graticule division. Four pushbuttons select calibrated deflection factors of 10 millivolts/Div, 100 millivolts/Div, 1 volt/Div, or 10 volts/Div.
VOLTS/DIV	Provides continuously variable deflection factor between calibrated (X1) steps, uncalibrated except at indicated X1, X2, and X5 positions. Extends Volts/Div range to at least 100 volts per division.
Input Coupling	AC-DC: Button pushed in selects capacitive coupling of input signal; button out selects direct coupling of input signal.  GND: Disconnects the input signal and provides ground reference to the amplifier input stage.  PRE CHG: Both the AC-DC and GND buttons pushed in allows pre-charging of the coupling capacitor. Release GND for measurement.
Input Connector	BNC connector for application of external voltage signals.

### Basic Operation

The first few steps of this procedure are intended to help quickly obtain a trace on the screen and prepare the instrument for immediate use. The remainder of the steps demonstrate some of the basic functions of the 5A23N. Operation of other instruments in the system is described in the instruction manuals for those units.

1. Insert the unit all the way into the oscilloscope plug-in compartment.

2. Turn the oscilloscope Intensity control fully counterclockwise and turn the Power on. Preset the time-base and triggering controls for a 2-millisecond/division sweep rate and automatic triggering.

3. Set the 5A23N front-panel controls as follows:

DISPLAY	ON (Multiplier illuminated)
POSITION	Midrange
VOLTS/DIV	100 mV
MULTIPLIER	X1
Input Coupling	DC, GND

4. Adjust the Intensity control for normal viewing of the trace. The trace should appear near the graticule center.

5. Move the trace two divisions below the graticule centerline with the POSITION control.

6. Apply a 400-millivolt peak-to-peak signal (available at the oscilloscope Calibrator loop) to the input connector.

7. Release the GND button. The display should be square waves four divisions in amplitude, with the bottom of the display at the reference established in step 5. Rotate the MULTIPLIER control to X2 and observe that the display reduces to two divisions in amplitude. Continue to turn the MULTIPLIER control throughout its range, observing that at X5 the display amplitude is 0.8 division and at X10, 0.4 division. Return the MULTIPLIER control to the X1 position.

8. To demonstrate AC-coupled operation, re-position the display with the POSITION control to place the bottom of the display at the graticule centerline.

9. Push in the AC button and note that the display shifts downward about two divisions to its average level.

## Applying Signals

When measuring DC voltage, use the largest deflection factor (10 V/Div) when first connecting the 5A23N to an unknown voltage source. If the deflection is too small to make the measurement, switch to a lower deflection factor.

In general, probes offer the most convenient method of connecting a signal to the input of the 5A23N. Tektronix probes are shielded to prevent pickup of electrostatic interference. A 10X attenuator probe offers a high input impedance and allows the circuit under test to perform very close to normal operating conditions. See your Tektronix, Inc., catalog for characteristics and compatibility of probes for use with this system.

Sometimes unshielded test leads can be used to connect the 5A23N to a signal source, particularly when a high-level, low-frequency signal is monitored at a low-impedance point. However, when any of these factors are missing, it becomes increasingly important to use shielded signal cables. In all cases, the signal-transporting leads should be kept as short as practical. Be sure to establish a common ground connection between the device under test and the 5A23N. The shield of a coaxial cable or ground strap of a signal probe provides adequate common ground connection.

## Input Coupling

The AC-DC pushbutton switch allows a choice of input coupling. The type of display desired will determine the coupling used. DC coupling (button out) can be used for most applications. However, if the DC component of the signal is much larger than the AC component, AC coupling (button in) will probably provide a better display. DC coupling should be used to display AC signals below about 2 hertz, as they will be attenuated in the AC position.

In the AC position, the DC component is blocked by a capacitor in the input circuit. The low-frequency response in the AC position is about 2 hertz (−3 dB point). Therefore, some low-frequency attenuation can be expected near this frequency limit. Distortion will also appear in square waves which have low-frequency components.

The GND button provides a ground reference at the amplifier input. The signal applied to the input connector is presented with a one-megohm load, while the amplifier input is grounded. This eliminates the need to externally ground the input to establish a DC ground reference.

**Pre-charging.** To minimize surge currents in the circuit under test when using the 10 mV/Div deflection factor and a 1X probe, use the AC-DC and GND pushbuttons to take advantage of the pre-charging circuit incorporated in the unit. The pre-charging circuit permits charging the coupling capacitor to the DC source voltage when the AC and GND buttons are pressed in. The procedure for using this circuit is as follows:

a. Before connecting the 5A23N to a signal containing a DC component, push in the AC and GND buttons. Then connect the input to the circuit under test.

b. Wait about one second for the coupling capacitor to charge.

c. Release the GND button. The display will remain on screen, and the AC component can be measured in the usual manner.

## Deflection Factor

The amount of trace deflection produced by a signal is determined by the signal amplitude, the attenuation factor (if any) of the probe, the selection of the VOLTS/DIV switch, and the setting of the MULTIPLIER control. The range of the MULTIPLIER control is at least 10:1. The control can be set to extend the deflection factor to at least 100 volts/division.

## Oscilloscope Applications

The 5100-series oscilloscope, including its associated display modules and plug-in units, provides a very flexible measurement system. Specific applications for the individual plug-ins are described in the manuals for those units. Refer to the Operating Instructions section of the 5100-Series Oscilloscope System manual for basic oscilloscope applications, including peak-to-peak AC voltage measurements, instantaneous DC voltage measurements, comparison measurements, time duration measurements, determining frequency, risetime measurements, and X-Y phase measurements.



# SECTION 3

## CIRCUIT DESCRIPTION

*Change information, if any, affecting this section will be found at the rear of the manual.*

### Plug-In Logic

When the DISPLAY ON button, S90, is pressed, a logic level is applied to the electronic switching circuit in the oscilloscope to enable plug-in operation (switch function is limited to operation in a vertical plug-in compartment). Power is applied to illuminate the front-panel knob-skirt readout lamp, DS58, indicating the ON mode.

### Signal Input

Signals applied to the front-panel input connector may be capacitive coupled (AC), direct coupled (DC), or internally disconnected (GND). Input coupling is selected by means of two pushbutton switches, S1A and S1B. When both buttons are out, the applied signal is passed directly to the attenuators. When the AC button is pressed, C1 is placed in the circuit to couple signals of about 2 hertz (−3 dB point) and higher to the attenuators. This capacitor blocks any DC component of the signal. When the GND button is pressed, a ground reference is provided to the input FET gate without the need to remove the applied signal from the input connector.

#### NOTE

*When DC levels (above 10 volts) are to be blocked by AC coupling, both the AC and GND buttons should be pressed in (PRE CHG) while input connections are made or broken, or when voltage levels are changed. This will allow the coupling capacitor to charge without producing a current surge in the input circuit.*

The input attenuators are frequency-compensated voltage dividers which are selected by the VOLTS/DIV switch,

S10. At DC and for low-frequency signals, the dividers are essentially resistive. At higher frequencies, the capacitive reactance becomes effective and the attenuation ratio is determined by the impedance ratio. In addition to providing constant attenuation at all frequencies within the bandwidth capabilities of the instrument, the input attenuators maintain a constant input RC characteristic.

### Operational Amplifier Stage

Q42, Q54, and Q60 form an operational amplifier (non-inverting type) which performs as a voltage follower to isolate the output from the high-impedance input circuitry. As a signal is applied to the gate of Q42A, an in-phase signal is produced at the collector of Q54 (and hence, at the emitter of Q60) and fed back to the gate of Q42B. Gain to the emitter of Q60 is 10 when R58, MULTIPLIER, is at X1, decreasing to unity as R58 is turned to X10. The output signal is divided in half by R60, R61, and R63, and made available to contacts A7 and A13 of the plug-in connector. R45, Var Bal, is adjusted to prevent trace shift when the MULTIPLIER control is rotated. R49 and R61 are adjusted to provide calibrated deflection factor at the X1 and X10 positions of the MULTIPLIER control. R66, POSITION, permits changing the DC level of the other output line (contacts B7 and B13), thus changing the quiescent display position.

### Trigger Signal Amplifier

Q73 and Q83 are connected as a feedback pair, which provides a sample of the displayed signal to the associated time-base plug-in unit. The amplitude is sufficient to meet the sensitivity requirements of the triggering circuits.

# SECTION 4

## CALIBRATION

*Change information, if any, affecting this section will be found at the rear of the manual.*

### Introduction

This section of the manual contains a procedure to return the circuits of the 5A23N to within their designated operating capabilities. Calibration is generally required after a repair has been made, or after long time intervals in which normal aging of components may affect instrument accuracy.

For initial inspection to verify instrument operation, the Basic Operation procedure in Section 2 should be used (the instrument is checked with its covers on, using a minimum of peripheral equipment).

Locations of internal adjustments are shown in Fig. 4-1.

### Instrument Maintenance

Before complete calibration, thoroughly clean and inspect this instrument as outlined in the maintenance section of the Oscilloscope System manual. Also, the system manual contains information for general maintenance of this instrument, including preventive maintenance, component identification and replacement, etc.

### Services Available

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

## TEST EQUIPMENT REQUIRED

### General

The following test equipment and accessories, or their equivalents, are required for complete calibration of the 5A23N. Specifications given for the test equipment are the minimum necessary for accurate calibration. Therefore, some of the specifications listed here may be less rigorous than the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within the listed specifications.

### Calibration Equipment Alternatives

All of the test equipment is required to completely check and adjust this instrument. If other equipment is substituted, control settings or calibration setup may need

altering to meet the requirements of the equipment used. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual if more information is needed.

### Special Calibration Fixtures

Special Tektronix Calibration fixtures are used in this procedure only where they facilitate instrument calibration. These special calibration fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

### Test Instruments

1. 5100N-Series Oscilloscope. For this procedure, a 5103N/D10 with a 5B10N time-base is used.

2. Standard amplitude calibrator. Output signal 1 kHz square wave; output amplitude, 50 mV to 100 V; amplitude accuracy, within 0.25%. Tektronix calibration fixture 067-0502-01 recommended.

3. Constant-amplitude sinewave generator. Frequency, 2 Hz to 2 MHz; output amplitude, from about 0.5 V to 40 V peak-to-peak. For example, General Radio 1310-B Oscillator (use a General Radio Type 274 QBJ Adapter to provide BNC output).

### Accessories

4. Coaxial cable, Impedance, 50  $\Omega$ ; length, 42 inches; BNC connectors. Tektronix Part No. 012-0057-01.

5. Input RC Normalizer, RC time constant 47  $\mu$ s (1 M $\Omega$  X 47 pF); BNC connectors. Tektronix Calibration Fixture 067-0541-00.

6. In-line termination. Impedance, 50  $\Omega$ ; accuracy,  $\pm 2\%$ ; BNC connectors. Tektronix Part No. 011-0049-01.

## CALIBRATION PROCEDURE

## Preparation

## NOTE

*This instrument should be adjusted at an ambient temperature between 25°C and 30°C (between 68°F and 86°F) for best overall accuracy.*

1. Remove the left side plug-in cover and plug the 5A23N in the left plug-in compartment of the 5100-Series Oscilloscope.

2. Turn on the power and preset the controls as indicated below:

## 5A23N

DISPLAY	ON
MULTIPLIER	1
VOLTS/DIV	10 mV
Input Coupling	GND
POSITION	Midrange

## 5B10N

Position	Midrange
Seconds/Div	0.5 ms
Swp Mag	Out (normal)
Triggering Level	CW
Triggering Source	Left
Auto Trig	In
AC Coupl	In
+ Slope	IN
Single Swp	Out

## MAINFRAME

Set Focus and Intensity for a normal trace.

## 1. Adjust Variable Balance

a. ADJUST—Var Bal control for no trace shift while rotating the MULTIPLIER throughout its range. It may be necessary to keep the trace on screen with the POSITION control.

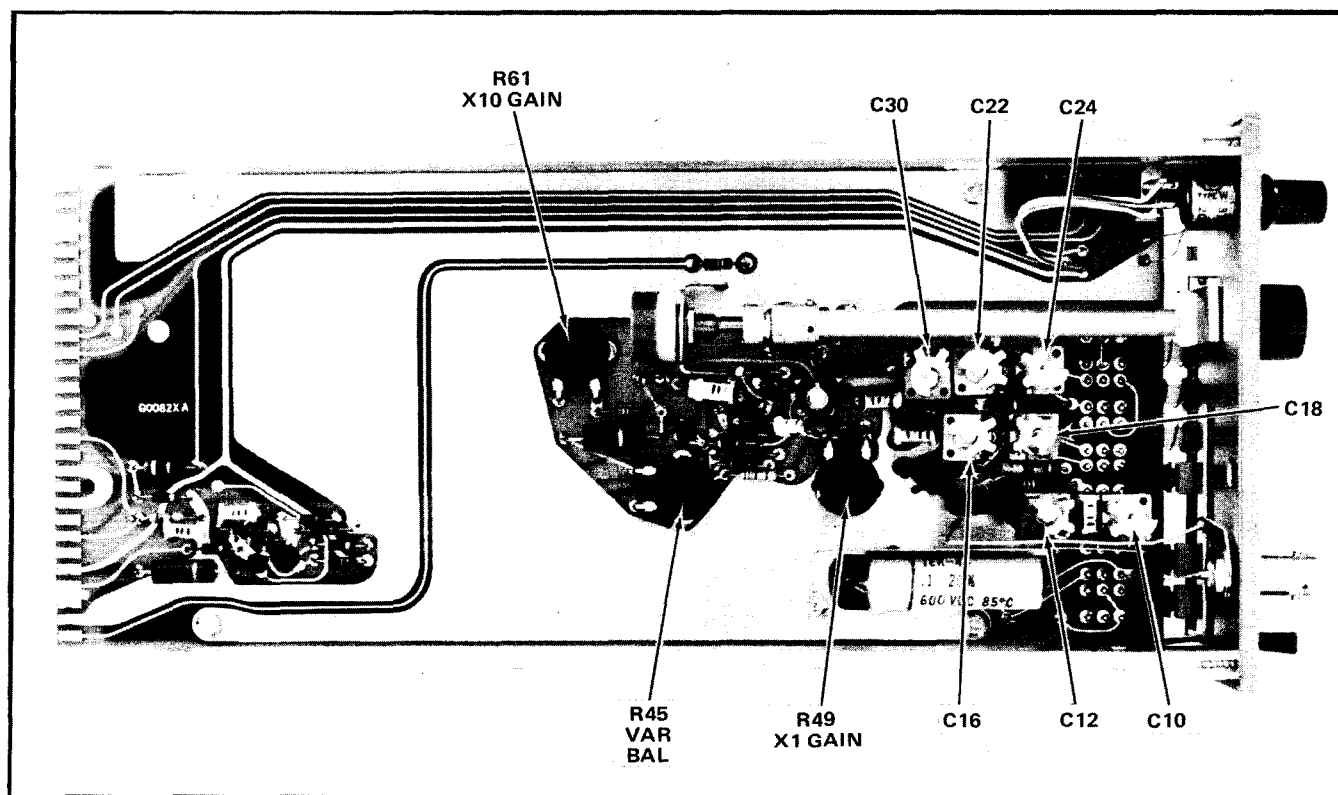


Fig. 4-1. Location of Internal Controls In the 5A23N.

## 2. Adjust X1 and X10 Gains and Check VOLTS/DIV Switch Accuracy

- Apply a 50-mV square wave from the standard amplitude calibrator to the input.
- Set the input selector switches to DC (both buttons out) and the MULTIPLIER to X1. Adjust the time-base Level control for stable triggering.
- ADJUST—The X1 Gain control for a five-division display.
- Set the MULTIPLIER to X5 (exactly), and change the standard amplitude calibrator signal to 0.2 V.
- ADJUST—X10 Gain control for a four-division display.
- Repeat parts a through e until no further interaction results.
- CHECK—VOLTS/DIV switch accuracy, using the VOLTS/DIV and standard amplitude calibrator switch settings given in Table 4-1 (MULTIPLIER at X1):

TABLE 4-1

VOLTS/DIV Switch Setting	Standard Amplitude Calibrator Output	CRT Display (Vertical Deflection)
10 mV	50 mV	5 div, $\pm 0.15$ div
100 mV	0.5 V	5 div, $\pm 0.15$ div
1 V	5 V	5 div, $\pm 0.15$ div
10 V	50 V	5 div, $\pm 0.15$ div

## 3. Adjust Input Compensation and Attenuator Compensation

- Set the VOLTS/DIV to 10 mV and the MULTIPLIER to X1.
- Apply a 0.1 V square wave from the standard amplitude calibrator through a 47 pF normalizer to the input.
- ADJUST—C30 for a square leading corner on the square wave display.

d. Press the 100 mV VOLTS/DIV button and increase the standard amplitude calibrator signal to 1 V.

e. ADJUST—C22 and C24 for a square leading corner on the square wave display.

f. Press the 1 V VOLTS/DIV button and increase the standard amplitude calibrator signal to 10 V.

g. ADJUST—C16 and C18 for a square leading corner on the square wave display.

h. Press the 10 V VOLTS/DIV button and increase the standard amplitude calibrator signal to 100 V.

i. ADJUST—C10 and C12 for a square leading corner on the square wave display.

## 4. Check Amplifier Bandwidth

### LOW-FREQUENCY —3 dB POINT

a. Press the 10 mV VOLTS/DIV button and apply a six-division 1 kHz signal from a constant-amplitude sine wave generator through a 50 ohm termination to the input.

b. Change the input frequency to 2 Hz and check for a six-division signal.

c. CHECK—For a signal of at least 4.2 divisions when the input button is pressed to AC-couple the input.

### HIGH-FREQUENCY —3 dB POINT

d. Press the 10 mV VOLTS/DIV button and apply a six-division 50 kHz signal from the constant-amplitude sine wave generator through a 50 ohm termination to the input.

e. CHECK—For a display of at least 4.2 divisions when the generator frequency is changed to 1.5 MHz.

This completes the calibration procedure.



# SECTION 5

## DIAGRAMS AND PARTS LISTS

### Symbols and Reference Designators

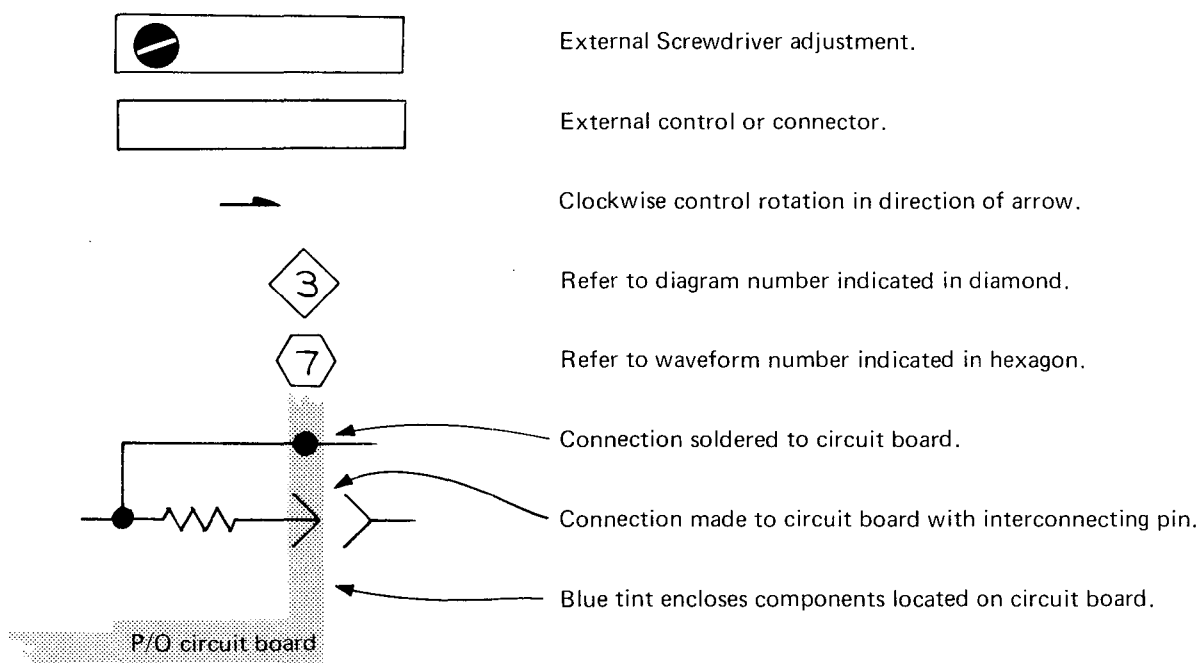
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

Logic symbology is based on MIL-STD-806B 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:

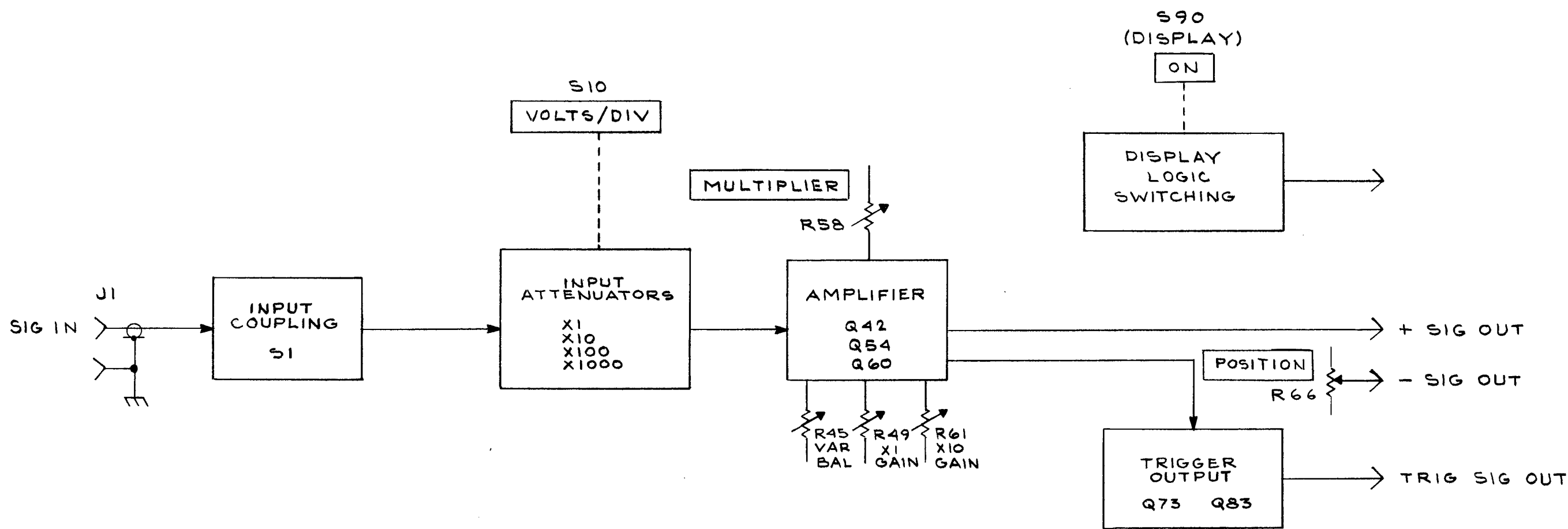


The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

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		

## PARTS LIST ABBREVIATIONS

BHB	binding head brass	int	internal
BHS	binding head steel	lg	length or long
cap.	capacitor	met.	metal
cer	ceramic	mtg hdw	mounting hardware
comp	composition	OD	outside diameter
conn	connector	OHB	oval head brass
CRT	cathode-ray tube	OHS	oval head steel
csk	countersunk	P/O	part of
DE	double end	PHB	pan head brass
dia	diameter	PHS	pan head steel
div	division	plstc	plastic
elect.	electrolytic	PMC	paper, metal cased
EMC	electrolytic, metal cased	poly	polystyrene
EMT	electrolytic, metal tubular	prec	precision
ext	external	PT	paper, tubular
F & I	focus and intensity	PTM	paper or plastic, tubular, molded
FHB	flat head brass	RHB	round head brass
FHS	flat head steel	RHS	round head steel
Fil HB	fillister head brass	SE	single end
Fil HS	fillister head steel	SN or S/N	serial number
h	height or high	S or SW	switch
hex.	hexagonal	TC	temperature compensated
HHB	hex head brass	THB	truss head brass
HHS	hex head steel	thk	thick
HSB	hex socket brass	THS	truss head steel
HSS	hex socket steel	tub.	tubular
ID	inside diameter	var	variable
inc	incandescent	w	wide or width
		WW	wire-wound



BLOCK DIAGRAM

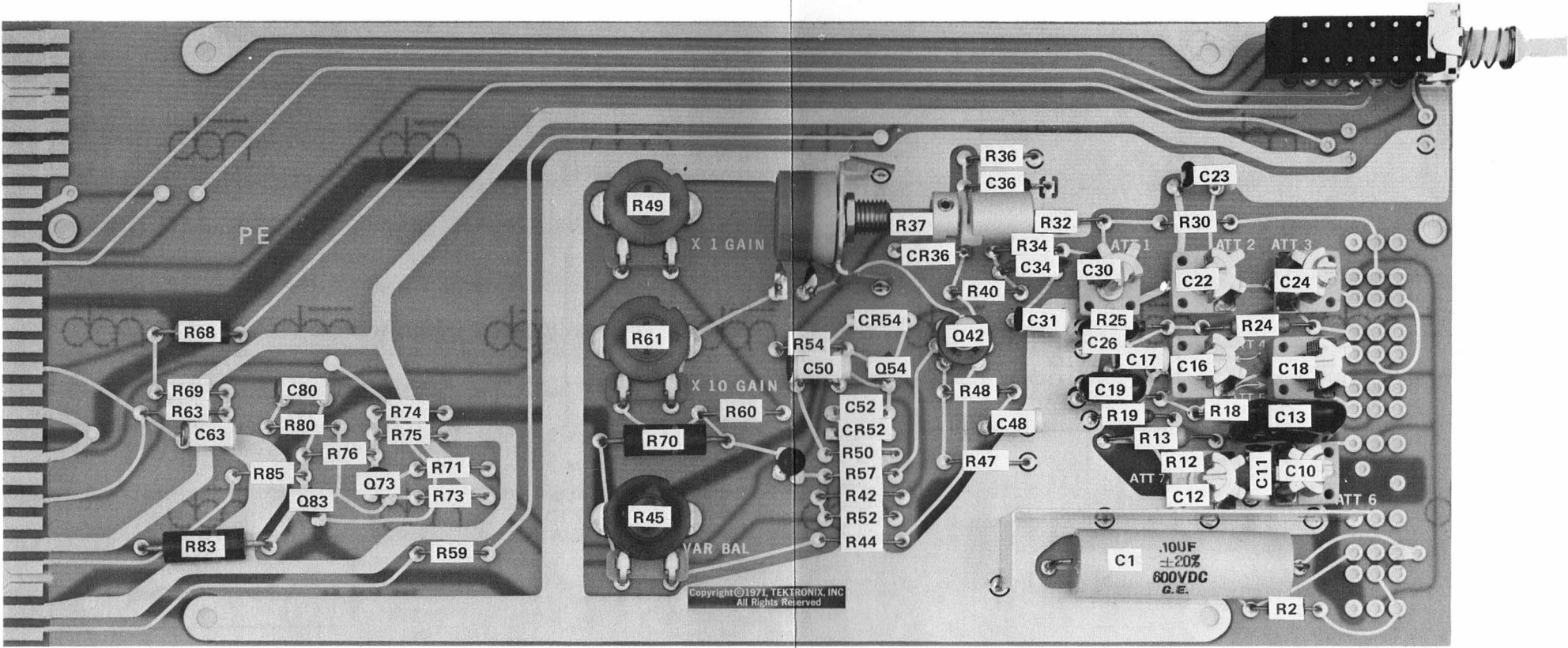
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BLOCK DIAGRAM

COMPONENT LOCATIONS

5A23N COMPONENT LOCATIONS





## PARTS ORDERING INFORMATION

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

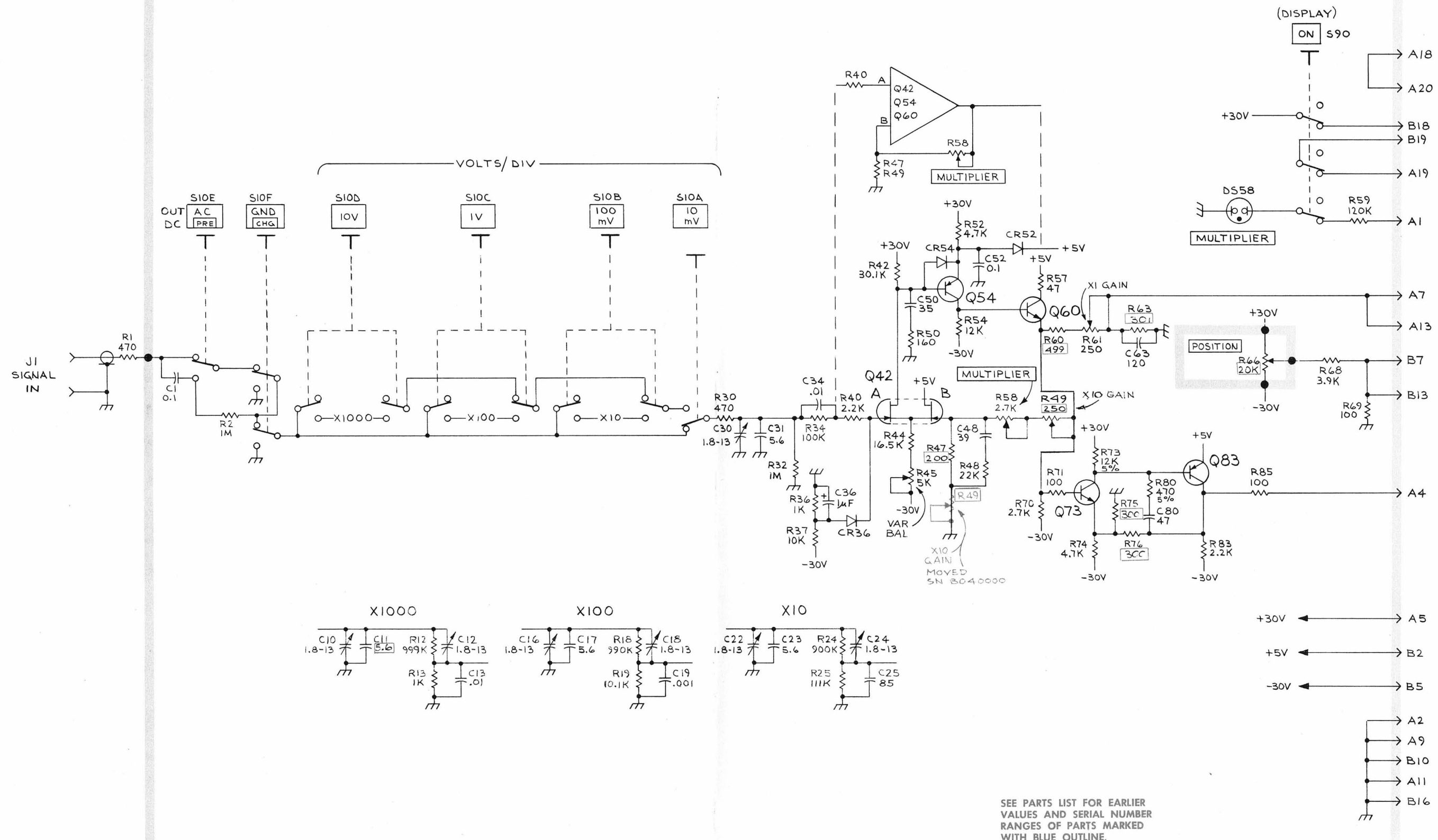
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information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

## SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
00X	Part removed after this serial number.
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated as direct replacement.

Ckt. No.	Tektronix Part No.	Serial No.	Description
CAPACITORS			
Tolerance $\pm 20\%$ unless otherwise indicated.			
C1	285-0587-00		0.1 $\mu$ F PFM 600 V
C10	281-0081-00		1.8-13 pF, Var Air
C11	281-0601-00	B010100 B039999	7.5 pF Cer
C11	281-0544-00	B040000	5.6 pF Cer 500 V 10%
C12	281-0081-00		1.8-13 pF, Var Air
C13	283-0593-01		0.01 $\mu$ F Mica 100 V 1%
C16	281-0081-00		1.8-13 pF, Var Air
C17	281-0544-00		5.6 pF Cer 500 V 10%
C18	281-0081-00		1.8-13 pF, Var Air
C19	283-0594-00		0.001 $\mu$ F Mica 100 V 1%
C22	281-0081-00		1.8-13 pF, Var Air
C23	281-0544-00		5.6 pF Cer 500 V 10%
C24	281-0081-00		1.8-13 pF, Var Air
C25	283-0674-00		85 pF Mica 500 V 1%
C30	281-0081-00		1.8-13 pF, Var Air
C31	281-0544-00		5.6 pF Cer 500 V 10%
C34	283-0002-00		0.01 $\mu$ F Cer 500 V
C36	290-0267-00		1 $\mu$ F Elect. 35 V
C48	281-0562-00		39 pF Cer 500 V
C50	281-0600-00		35 pF Cer 10%
C52	283-0111-00		0.1 $\mu$ F Cer 50 V
C63	281-0550-00		120 pF Cer 500 V 10%
C80	281-0518-00		47 pF Cer 500 V
SEMICONDUCTOR DEVICE, DIODES			
CR36	152-0246-00		Silicon Replaceable by CD12676 or FD3375
CR52	152-0185-00		Silicon Selected from 1N4152 or 1N3605
CR54	152-0185-00		Silicon Selected from 1N4152 or 1N3605
BULB			
DS58	150-0111-00		Neon, AIC, 1.2 mA
CONNECTOR			
J1	131-0955-00		Receptacle, electrical, BNC, female
TRANSISTORS			
Q42	151-1054-00		Silicon JFET N channel
Q54	151-0216-00		Silicon PNP Replaceable by MPS 6523
Q60	151-0341-00		Silicon NPN Replaceable by 2N3565
Q73	151-0341-00		Silicon NPN Replaceable by 2N3565
Q83	151-0220-00		Silicon PNP Replaceable by 2N4122
RESISTORS			
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.			
R1	315-0471-00		470 $\Omega$ 1/4 W 5%
R2	316-0105-00		1 M $\Omega$ 1/4 W 5%
R12	322-0629-01		999 k $\Omega$ 1/4 W Prec 1/2%
R13	321-0193-00		1 k $\Omega$ 1/8 W Prec 1%
R18	322-0624-00		990 k $\Omega$ 1/4 W Prec 1%
R19	321-0614-00		10.1 k $\Omega$ 1/8 W Prec 1%
R24	322-0621-00		900 k $\Omega$ 1/4 W Prec 1%
R25	321-0617-00		111 k $\Omega$ 1/8 W Prec 1%
R30	315-0471-00		470 $\Omega$ 1/4 W 5%
R32	322-0481-00		1 M $\Omega$ 1/4 W Prec 1%
R34	316-0104-00		100 k $\Omega$ 1/4 W
R36	316-0102-00		1 k $\Omega$ 1/4 W
R37	316-0103-00		10 k $\Omega$ 1/4 W
R40	316-0222-00		2.2 k $\Omega$ 1/4 W
R42	321-0335-00		30.1 k $\Omega$ 1/8 W Prec 1%
R44	321-0310-00		16.5 k $\Omega$ 1/8 W Prec 1%
R45	311-1204-00		5 k $\Omega$ , Var
R47	321-0132-00	B010100 B029999	232 $\Omega$ 1/8 W Prec 1%
R47	321-0126-00	B030000	200 $\Omega$ 1/8 W Prec 1%
R48	316-0223-00		22 k $\Omega$ 1/4 W
R49	311-1120-00	B010100 B039999	100 $\Omega$ , Var
R49	311-1124-00	B040000	250 $\Omega$ , Var
R50	315-0161-00		160 $\Omega$ 1/4 W
R52	315-0472-00		4.7 k $\Omega$ 1/4 W 5%
R54	315-0123-00		12 k $\Omega$ 1/4 W 5%
R57	316-0470-00		47 $\Omega$ 1/4 W
R58	*311-1202-00		2.7 k $\Omega$ , Var
R59	316-0124-00		120 k $\Omega$ 1/4 W
R60	321-0160-00	B010100 B029999	453 $\Omega$ 1/8 W Prec 1%
R60	321-0164-00	B030000	499 $\Omega$ 1/8 W Prec 1%
R61	311-1124-00		250 $\Omega$ , Var
R63	321-0160-00	B010100 B029999	453 $\Omega$ 1/8 W Prec 1%
R63	321-0155-00	B030000 B039999	402 $\Omega$ 1/8 W Prec 1%
R63	321-0143-00	B040000	301 $\Omega$ 1/8 W Prec 1%
R66	311-0642-00		20 k $\Omega$ , Var
R68	302-0392-00		3.9 k $\Omega$ 1/2 W
R69	316-0101-00		100 $\Omega$ 1/4 W
R70	304-0272-00		2.7 k $\Omega$ 1 W
R71	316-0101-00		100 $\Omega$ 1/4 W
R73	315-0123-00		12 k $\Omega$ 1/4 W
R74	315-0472-00		4.7 k $\Omega$ 1/4 W 5%
R75	315-0271-00	B010100 B039999	270 $\Omega$ 1/4 W 5%
R75	315-0301-00	B040000	300 $\Omega$ 1/4 W 5%
R76	315-0471-00	B010100 B029999	470 $\Omega$ 1/4 W 5%
R76	315-0391-00	B030000 B039999	390 $\Omega$ 1/4 W 5%
R76	315-0301-00	B040000	300 $\Omega$ 1/4 W 5%
R80	315-0471-00		470 $\Omega$ 1/4 W 5%
R83	304-0222-00		2.2 k $\Omega$ 1 W
R85	316-0101-00		100 $\Omega$ 1/4 W
SWITCHES			
Wired or Unwired			
S90	260-1209-00		Pushbutton DISPLAY
S10A	260-1284-00		Pushbutton VOLTS/DIV and Input Coupling
S10B			
S10C			
S10D			
S10E			
S10F			



# MECHANICAL PARTS LIST

## FIGURE 1 EXPLODED & STANDARD ACCESSORIES

### FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear on the pullout pages immediately following the Diagrams section of this instruction manual.

### 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.

- Assembly and/or Component*
  - Detail Part of Assembly and/or Component*
    - mounting hardware for Detail Part*
      - Parts of Detail Part*
        - mounting hardware for Parts of Detail Part*
          - mounting hardware for Assembly and/or Component*

Mounting hardware always appears 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.

**Mounting hardware must be purchased separately, unless otherwise specified.**

MECHANICAL PARTS LIST

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q t y	Description
		Eff	Disc		
1-1	366-0494-00			1	KNOB, gray--POSITION
	- - - - -			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch
-2	366-1348-00			1	KNOB, w/skirt--MULTIPLIER
	- - - - -			-	knob includes:
	213-0153-00			2	SETSCREW, 5-40 x 0.125 inch
-3	366-1257-14			1	PUSHBUTTON--ON
-4	366-1257-52			1	PUSHBUTTON--10 mV
-5	366-1257-54			1	PUSHBUTTON--100 mV
-6	366-1257-55			1	PUSHBUTTON--1 V
-7	366-1257-53			1	PUSHBUTTON--10 V
-8	366-1257-11			1	PUSHBUTTON--AC
-9	366-1257-12			1	PUSHBUTTON--GND
-10	366-1286-00			1	KNOB, latch
-11	358-0029-00			1	BUSHING, 0.375-32 x 0.50 inch
	- - - - -			-	mounting hardware: (not included w/bushing)
-12	210-0590-00			1	NUT, hex., 0.375-32 x 0.438 inch
-13	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-14	344-0195-01	B010100	B039999	1	CLIP, grounding
	210-0012-00	B040000		1	WASHER, lock, internal
-15	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
-16	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-17	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch
-18	131-0955-00			1	CONNECTOR, receptacle, BNC, w/hardware
	- - - - -			-	mounting hardware: (not included w/connector)
-19	210-0590-00			1	NUT, hex., 0.375-32 x 0.438 inch
-20	210-0225-00			1	LUG, solder, 0.375 inch diameter, SE
-21	342-0107-00			2	INSULATOR, bushing
-22	426-0681-00			7	FRAME, pushbutton
-23	333-1455-00			1	PANEL, front
-24	214-1513-00			1	LATCH, plug-in retaining
	- - - - -			-	mounting hardware: (not included w/latch)
-25	213-0254-00			1	SCREW, thread forming, 2-56 x 0.25 inch, 100° csk, FHS

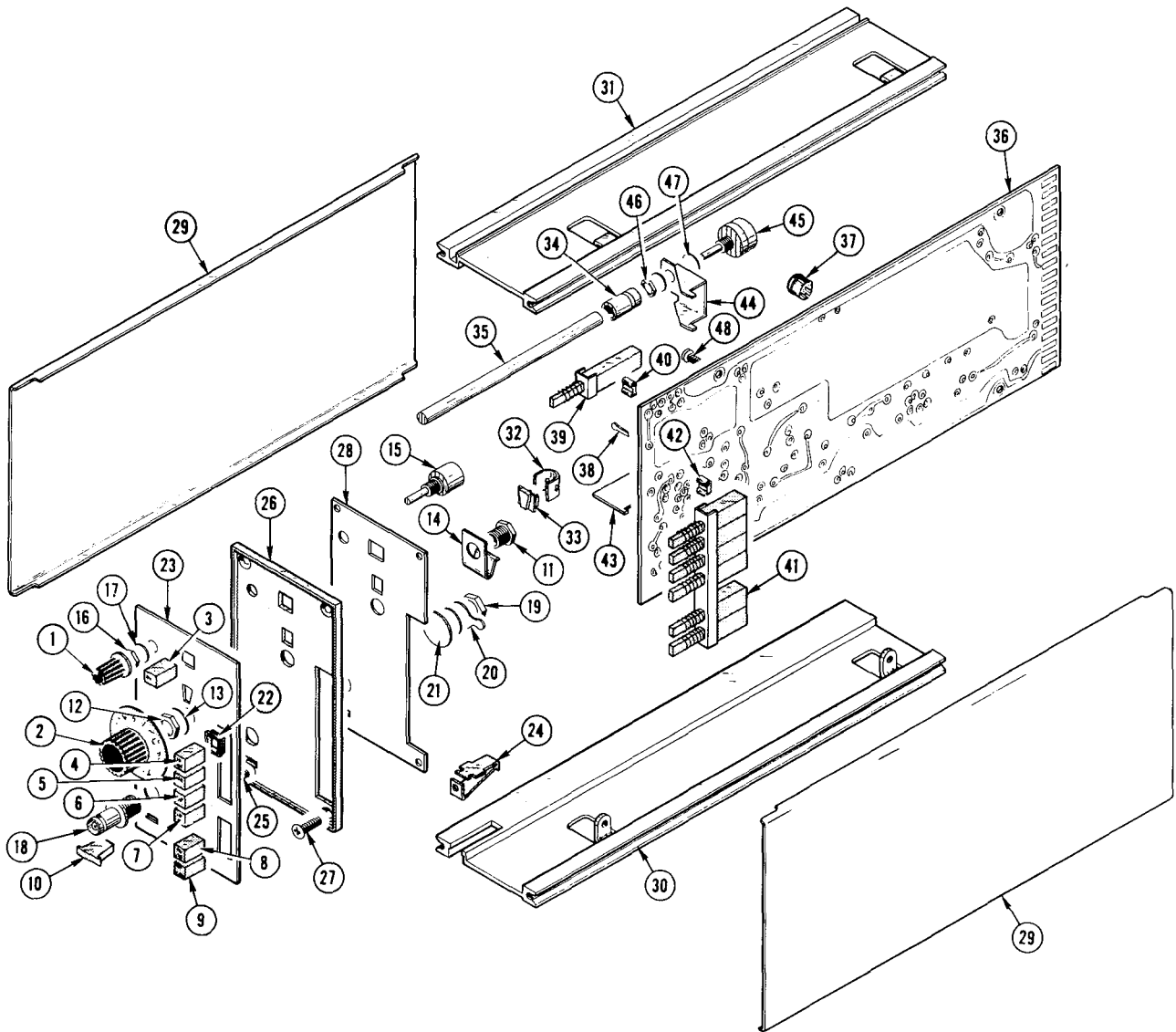
Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q t y	Description
		Eff	Disc		
1-26	386-2019-00			1	SUBPANEL, front
	- - - - -			-	mounting hardware: (not included w/subpanel)
-27	213-0229-00			4	SCREW, thread forming, 6-20 x 0.372 inch, 100° csk, FHS
-28	337-1469-00			1	SHIELD, electrical
-29	337-1399-00			2	SHIELD, elctrical, side
-30	426-0724-00			1	FRAME SECTION, bottom
-31	426-0725-00			1	FRAME SECTION, top
-32	337-1430-00			1	SHIELD, light
-33	136-0429-00			1	LIGHT, indicator
-34	376-0052-00			1	COUPLING
	- - - - -			-	coupling includes:
	354-0251-00			1	RING, coupling, 0.187 inch long
	354-0261-00			1	RING, coupling, 0.437 inch long
	376-0049-00			1	COUPLING, plastic
	213-0022-00			2	SETSCREW, 4-40 x 0.188 inch, HSS
	213-0075-00			2	SETSCREW, 4-40 x 0.94 inch, HSS
	213-0115-00			1	SETSCREW, 4-40 x 0.312 inch, HSS
-35	384-0261-00	B010100	B039999	1	ROD, extension, 4.312 inches long
	384-1192-00	B040000		1	SHAFT, extension, plastic
-36	670-1565-00			1	CIRCUIT BOARD ASSEMBLY--MAIN
	- - - - -			-	circuit board assembly includes:
	388-2125-00			1	CIRCUIT BOARD
-37	136-0235-00			1	SOCKET, transistor, 6 pin
-38	214-0579-00			2	PIN, test point
-39	260-1209-00			1	SWITCH, push--DISPLAY
	- - - - -			-	mounting hardware: (not included w/switch)
-40	361-0383-00			2	SPACER, gray plastic
-41	260-1284-00			1	SWITCH, push--VOLTS/DIV & INPUT COUPLING
	- - - - -			-	mounting hardware: (not included w/switch)
-42	361-0382-00			6	SPACER, brown plastic
-43	337-1502-00			1	SHIELD, electrical
-44	407-0803-00			1	BRACKET, component
-45	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
-46	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-47	210-0046-00			2	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
	- - - - -			-	mounting hardware: (not included w/circuit board assembly)
-48	213-0146-00			4	SCREW, thread forming, 6-32 x 0.312 inch, PHS

STANDARD ACCESSORIES

070-1144-00

1 MANUAL, instruction (not shown)





5A23N

CARTON ASSEMBLY  
(Part No. 065-0151-00)

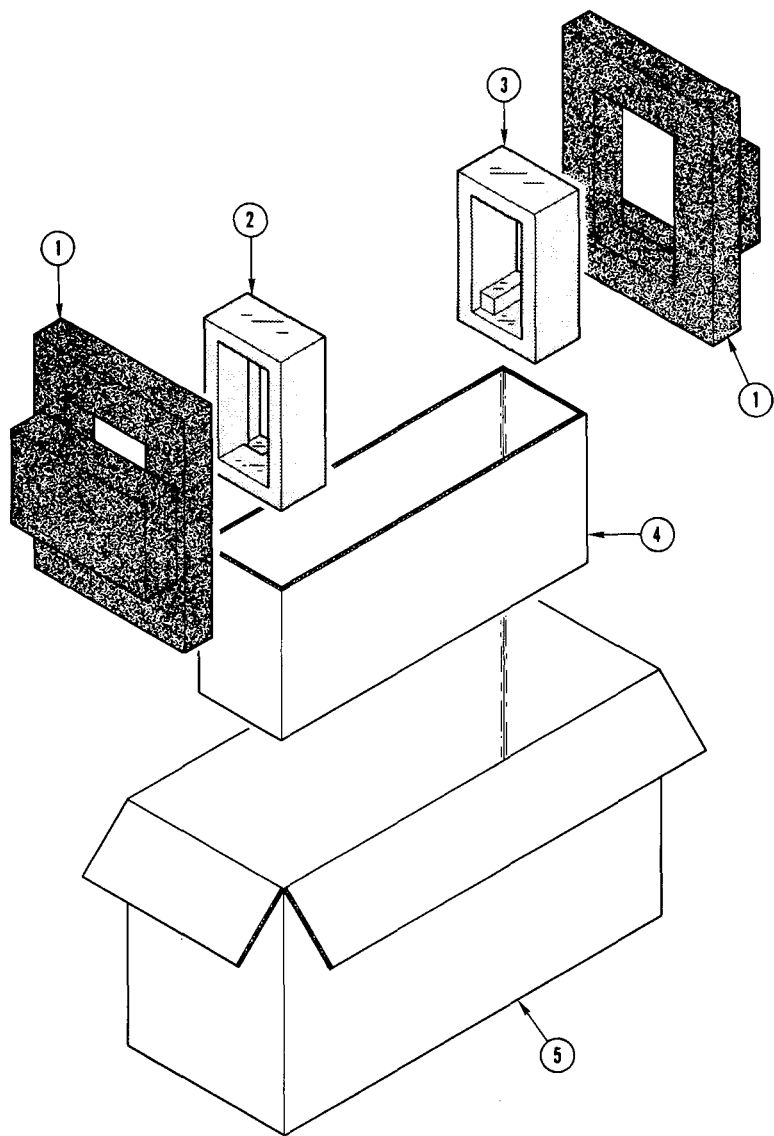


Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q ↑ y						Description
					1	2	3	4	5	
	065-0151-00			1						CARTON ASSEMBLY
	- - - - -			-						carton assembly includes:
2-1	004-0282-00			2						FRAME
-2	004-0243-00			1						END CAP, front
-3	004-0242-00			1						END CAP, rear
-4	004-1093-00			1						PAD SET, 1 piece
-5	004-0612-00			1						CARTON