

# INSTRUCTION MANUAL

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

**TYPE 3A2**

**DUAL-TRACE  
AMPLIFIER**

*Tektronix, Inc.*

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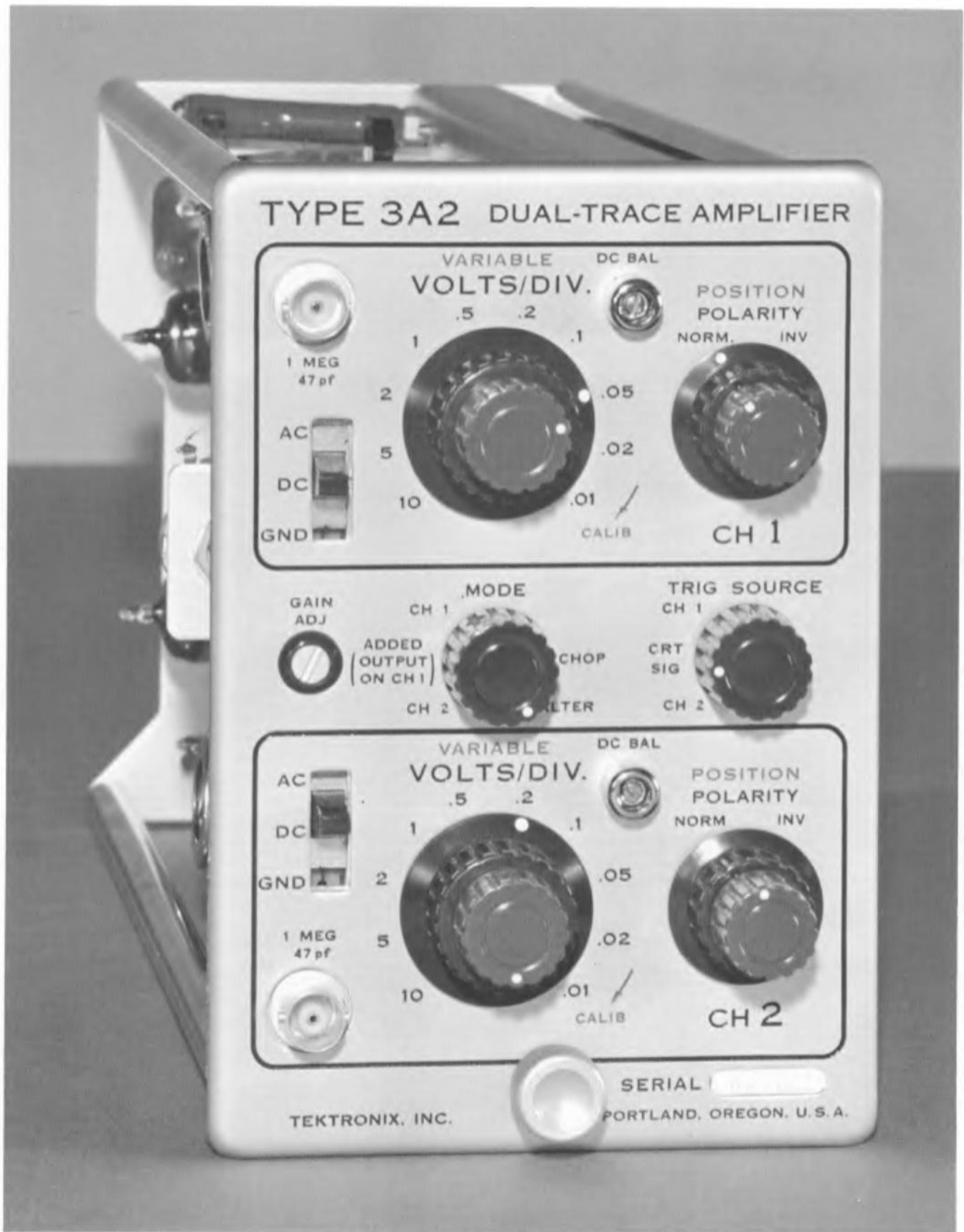


## CONTENTS

Warranty

- Section 1 Characteristics
- Section 2 Operating Instructions
- Section 3 Applications
- Section 4 Circuit Description
- Section 5 Maintenance
- Section 6 Calibration
- Section 7 Parts List and Schematics

A list of abbreviations and symbols used in this manual will be found on page 7-1.



Type 3A2

Type 3A2 Dual-Trace Amplifier.

# SECTION 1

## CHARACTERISTICS

### General Information

The Type 3A2 Dual-Trace Amplifier plug-in unit (non-sampling) contains two similar channels that can be used singly or combined for a variety of measurements. The unit was designed to work with a digital readout system, such as the Tektronix Type 567 Readout Oscilloscope with a Type 3B2 Time Base and Type 6R1 Digital Unit. It can also be used in the Tektronix Type 561A, 564, and 565 Oscilloscopes for conventional dual-trace displays.

### Sensitivity

Each channel has ten calibrated attenuator steps from 0.01 volt to 10 volts/div ( $\pm 3\%$ ) in a 1, 2, 5 sequence. A VARIABLE VOLTS/DIV control with a range of 2.5 to 1 varies input sensitivity continuously from 0.01 volt to about 25 volts/div (uncalibrated).

### Frequency Response

Dc to 500 kc (3 db down).

### Risetime

Approximately 0.7  $\mu$ sec.

### Input Impedance

1 megohm paralleled by approximately 47 pf.

### Input Coupling

Choice of ac or dc coupling. A 0.1- $\mu$ f capacitor limits the amplifier low-frequency response to about 2 cps with ac coupling.

### Operating Modes

Channel 1 only, or channel 2 only.

Alternate: Electronic switching between channels with the switch occurring at the end of each sweep.

Chopped: Electronic switching between channels at approximately a 30- to 50-kc rate. Switching transient is suppressed by momentarily blanking the crt.

Added: The algebraic sum of both channels appears as the vertical display signal. The algebraic difference between channels is displayed when either channel POLARITY switch is set to INV.

### Trigger Source

The internal trigger signal is selected by a front-panel switch. Either channel 1 or channel 2, or the signal driving the vertical deflection plates can be used.

### Mechanical

Construction: Aluminum-alloy chassis.

### ACCESSORIES

Information on accessories for use with this instrument is included at the rear of the mechanical parts list.



# SECTION 2

## OPERATING INSTRUCTIONS

### Introduction

This section describes the operation of the front-panel controls and provides step-by-step instructions for displaying a signal. Measurements that can be made with the Type 3A2 are described in the Applications section of this manual.

### FUNCTIONS OF FRONT-PANEL CONTROLS

**AC-DC-GND** In the DC position, both the ac and dc components of input signals will be displayed. In the AC position, a capacitor blocks dc components of the signal. The low-frequency limit (3-db point) of the AC position is about 2 cps (0.2 cps when 10X probe is used). In the GND position, the Type 3A2 input circuit is grounded (it does not ground the signal).

**VOLTS/DIV** A ten-position switch that sets the vertical sensitivity of the Type 3A2. All positions are calibrated when the red VARIABLE knob is in the switch detent at the CALIB position. Range is from 0.01 to 10 volts/div (0.1 to 100 with 10X probe).

**VARIABLE VOLTS/DIV** Red knob concentric with the VOLTS/DIV switch provides continuously variable reduction in amplifier gain (uncalibrated) up to about 2.5 to 1 or more. For example, if the VOLTS/DIV switch is in the 1 position, the VARIABLE control will vary the sensitivity between 1 volt/div and about 2.5 volts/div. When used in conjunction with the oscilloscope calibrator voltage, this control can set any specific sensitivity within the range of the instrument.

**POSITION** Moves the trace vertically on the crt.

**POLARITY** A two-position switch that presents the signal in normal or inverted polarity.

**MODE** A five-position switch that sets the mode of operation. The positions are as follows:

CH 1: Connects the internal circuits to operate channel 1 only. The signal in channel 2 is still applied to the digital unit.

ADDED (OUTPUT ON CH 1): The algebraic sum of the channel 1 and channel 2 signals will be displayed with the MODE switch in this position. To measure the algebraic difference between signals, set one channel POLARITY switch to NORM; the other to INV. Only the channel 1 POSITION control will move the trace.

CH 2: Connects the internal circuits to operate channel 2 only. The signal in channel 1 is still applied to the digital unit.

ALTER: Sets the amplifier channels to display on alternate sweeps. For example, the first sweep would be the channel 1 signal; the second sweep the channel 2 signal. The flicker between channels depends on the sweep rate.

CHOP: Electronic switching changes the display between channels at a 30- to 50-kc rate. Each display segment lasts for about 10  $\mu$ sec.

**TRIG SOURCE** A three-position switch that selects the trigger signal to the time-base unit trigger circuits. Either channel 1, channel 2, or the signal driving the crt vertical deflection plates can be selected.

**GAIN ADJ** A screwdriver adjustment that sets the gain of the output amplifier.

**DC BAL** A screwdriver adjustment that balances the amplifier so that with no signal applied there is no vertical shift of the trace as the VARIABLE VOLTS/DIV control is turned.

### FIRST-TIME OPERATION

The Type 3A2 should be inserted into the left-hand (Y-axis) opening of the oscilloscope. A time-base unit such as the Type 3B2 should be inserted in the right-hand (X-axis) opening.

The following procedure will help you become familiar with the Type 3A2 operation:

1. Set the front-panel controls as follows:

AC-DC-GND	DC (both channels)
VOLTS/DIV	.02 (both channels)
VARIABLE	CALIB (both channels)
POSITION	Midrange (both channels)
MODE	CH 1
POLARITY	NORM (both channels)
TRIG SOURCE	CH 1

2. Apply a 0.05-volt signal from the oscilloscope calibrator to both Type 3A2 input connectors. Adjust the time-base controls for a stable display. Use ac internal trigger coupling. The display should be a rectangular waveform about 2.5 divisions in amplitude. With the channel 1 POSITION control, move the display above the graticule center-line.

3. Turn the MODE switch to CH 2. A similar 2.5 division waveform should be displayed. With the channel 2 POSITION control, move the display below the graticule center-line.

4. Set the MODE switch to ALTER. If necessary, adjust the time-base triggering for a stable display. Both signals

## Operating Instructions—Type 3A2

should be displayed. The switching rate depends on the sweep rate.

5. Set the MODE switch to CHOP. If necessary, adjust the time-base triggering for a stable display. Two separate traces should appear.

6. Set the MODE switch to ADDED. There should be one display 5 divisions in amplitude. This is the addition of the channel 1 and 2 waveforms (2.5 divisions each). Notice that only the channel 1 POSITION control moves the trace.

7. Turn the channel 1 POLARITY switch to INV. The display should be a straight line, indicating the algebraic difference between the two signals. Since both signals have equal amplitudes, disregarding spikes, the difference is zero. (It will be necessary to use free-run triggering on the Type 3B2 to see the trace.)

## Gain and Dc Balance

Before the Type 3A2 is used for accurate measurements, the GAIN ADJ and DC BAL controls (front-panel screwdriver adjustments) for each channel should be adjusted. Amplifier gain should also be adjusted each time the Type 3A2 is moved from one oscilloscope to another to compensate for differences in crt sensitivities.

Set the GAIN ADJ control as follows:

1. Set the channel 1 AC-DC-GND switch to DC and the MODE switch to CH 1.

2. Set the channel 1 VOLTS/DIV switch to 1 and the VARIABLE control to CALIB.

3. Set the triggering controls of the time-base plug-in unit for a free-running sweep.

4. Apply 5 volts from the oscilloscope calibrator to the channel 1 input connector.

5. Set the GAIN ADJ control (front-panel screwdriver adjustment) for exactly 5 major graticule divisions of deflection.

6. Set the MODE switch to CH 2 and apply the 5-volt calibrator signal to the channel 2 input connector. Set the

channel 2 VOLTS/DIV switch to 1. There should be 5 divisions of deflection. If not, refer to the channel 2 gain procedures in the Calibration section of this manual.

If the dc balance of a channel is not properly set, the position of a no-signal trace will shift vertically as the VARIABLE VOLTS/DIV control of that channel is turned. Adjust the DC BAL control as follows:

1. Set both AC-DC-GND switches to GND.

2. Set the MODE switch to CH 1 and position a free-running sweep to the center of the crt.

3. Adjust the channel 1 DC BAL control to a point where there is no trace shift as the VARIABLE VOLTS/DIV control is turned throughout its range.

4. Repeat the preceding steps for channel 2.

## Signal Connections

Observe the following precautions when applying a signal to the Type 3A2:

1. Use shielded leads to avoid stray pickup.

2. Watch for loading of the signal source due to the input circuit of the Type 3A2. The input impedance of the Type 3A2 is 1 megohm paralleled by approximately 47 pf. In most cases the effect of this impedance is negligible, however, it can be minimized by using attenuator probes.

## Use of Probes

High-impedance attenuator probes can be used with the Type 3A2 to reduce the capacitive and resistive loading effect of the unit, and at the same time attenuate the signal so larger signals can be displayed. Be careful when adjusting the probe compensation. A slight misadjustment at the 60-cps calibrator frequency will be accentuated at higher frequencies. If you use a square-wave signal source other than the oscilloscope calibrator for compensating the probe, do not use frequencies above 5 kc. At higher frequencies the waveform amplitude appears to change as the probe is compensated, making accurate adjustment for best transient and frequency response impossible.



# SECTION 3

## APPLICATIONS

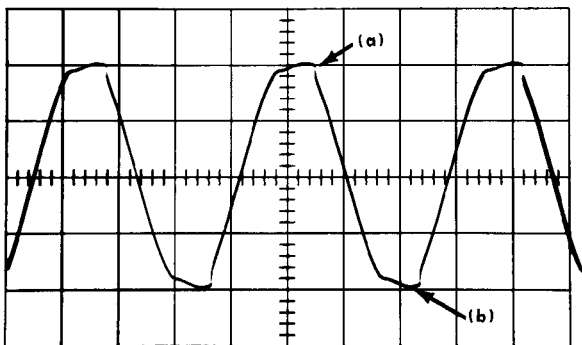
### Introduction

Since the Type 3A2 is designed to use with a digital readout unit, many applications are described in the digital readout unit instruction manual. However, in cases where the Type 3A2 is used without a digital readout unit, the applications in this section may be helpful.

### Voltage Measurements

To measure the voltage between two points on a signal (such as peak-to-peak ac volts), measure the vertical distance in graticule divisions between the two points and multiply by the setting of the VOLTS/DIV switch and the attenuation factor, if any, of the probe. Be sure the VARIABLE VOLTS/DIV control is in the CALIB position.

For example, assume you use a 10X probe with the VOLTS/DIV switch set to .02, and your display has a vertical deflection of 4 graticule divisions as shown between (a) and (b) in Fig. 3-1. In this case, 4 divisions X 0.05 volt/div equals 0.08 volt. This voltage times the probe attenuation factor of 10 shows a true peak-to-peak voltage of 0.8 volt.



Vertical deflection in div	×	VOLTS/DIV switch setting	×	Probe attenuation factor	=	peak-to-peak volts
4		0.02		10		0.8 volt

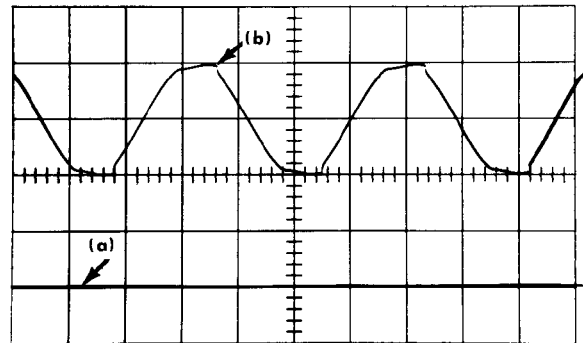
Fig. 3-1. Peak-to-peak voltage measurement.

To measure the dc level at a given point on a waveform, proceed as follows:

1. Set the VOLTS/DIV switch so that the expected voltage (at the input connector) is not more than six times the setting. Be sure the VARIABLE VOLTS/DIV control is in the CALIB position.
2. Set the time-base controls so that the sweep free-runs.
3. Set the AC-DC-GND switch to GND and use the POSITION control to align the trace with one of the graticule lines, such as (a) in Fig. 3-2. This line is a ground (or zero) reference. The position of this reference line depends on the

polarity and amplitude of the signal to be measured. Do not move the POSITION control once the reference line has been established.

4. Set the AC-DC-GND switch to DC.
5. Apply the signal to the input connector and set the time-base triggering controls for a stable display.
6. Measure the vertical distance, in graticule divisions, from the ground (zero) reference line to the point on the waveform that you wish to measure, such as (b) in Fig. 3-2.
7. Multiply this distance by the setting of the VOLTS/DIV switch and any probe attenuation factor. This is the instantaneous dc level of the point measured.



Vertical deflection × point(a)to(b)	×	VOLTS/DIV switch setting	×	Probe attenuation factor	=	Instantaneous voltage with respect to a ground reference
4		0.2		10		0.8 volt

Fig. 3-2. Measuring the dc level of a point on a waveform.

Check the zero reference line at any time by setting the AC-DC-GND switch to GND. It is not necessary to disconnect the signal probe from the Type 3A2. To use a reference other than zero, set the AC-DC-GND switch to DC and touch the signal probe to the reference voltage; then use the POSITION control to align the trace with a reference graticule line.

### Voltage Comparison Measurements

In some applications, a set of vertical sensitivity values other than those selected by the VOLTS/DIV switch can be used. This is convenient for comparing signals that are multiples of reference voltages between VOLTS/DIV switch positions. To establish a set of sensitivity values based on some specific voltage, use the following procedure:

1. Apply a known voltage reference signal to either Type 3A2 input connector. Set the VOLTS/DIV switch and the VARIABLE control so that the amplitude of the display covers an exact number of graticule divisions. Do not move the VARIABLE control after this setting has been made.

### Applications —Type 3A2

2. Divide the amplitude of the reference signal (in volts) by the product of the deflection established in step 1 (in graticule divisions) and the setting of the VOLTS/DIV switch. The result is the sensitivity conversion factor.

$$\text{Conversion Factor} = \frac{\text{Amplitude of reference signal (in volts)}}{\text{Amount of deflection X VOLTS/DIV switch setting}}$$

3. To calculate the true sensitivity at any setting of the VOLTS/DIV switch, multiply the switch setting by the sensitivity conversion factor.

True Sensitivity = VOLTS/DIV switch setting X Conversion Factor.

This new set of sensitivity values applies to this channel only, and only as long as the VARIABLE control is not moved.

# SECTION 4

## CIRCUIT DESCRIPTION

### General

The Type 3A2 Dual-Trace Amplifier contains two similar channels, two signal takeoff amplifiers, a switching circuit, and a common output amplifier. See Fig. 4-1. The output of either or both input channel amplifiers can be fed to the output amplifier, depending on the condition of the switching circuit. Thus, the switching circuit makes it possible to display one signal as a single trace, two signals simultaneously as a dual trace, or the algebraic sum or difference of two signals as a single trace.

### Input Channel Amplifier

Each channel consists of an attenuation network, an input cathode follower, and a two-stage amplifier with switched output. The input cathode followers (V113A in channel 1, and V213A in channel 2) isolate the attenuator and input circuitry from the two-stage amplifier. Since the two input channels are similar, the remainder of this description will refer to circuit components in channel 1 only.

The signal is applied to the grid circuit of input cathode follower V113A via the AC-DC-GND switch and the attenuator. The AC-DC-GND switch is a three-position slide switch that either bypasses C101 in the DC position, places

it in the circuit in the AC position, or grounds the input to the attenuator in the GND position. When C101 is in the circuit, the dc component of the signal is blocked and only the ac component reaches the grid of V113A. When C101 is bypassed, both the ac and dc components of the signal appear at the grid of V113A.

The input attenuators are resistive dividers with capacitive frequency compensation. Each attenuator presents an input impedance of approximately 1 megohm paralleled by 47 pf. In the .01 and .02 positions of the VOLTS/DIV switch, the signal does not pass through an attenuator but connects directly to the input cathode follower. The sensitivity of these two positions is set by the 10MV GAIN and 20MV GAIN adjustments in the first amplifier stage. In higher positions of the VOLTS/DIV switch (above .02) the attenuators are connected either singly or in series. The amplifier sensitivity remains at 20 mv/div.

The signal from the attenuator is applied to the grid of V113A, then coupled from the cathode of V113A to the base of Q134. Q134 together with Q144 forms an emitter-coupled paraphase amplifier that converts the signal to push-pull. D130 and D140 in the base circuit of these transistors protect them from negative voltages that are present during the warmup period of the input tubes. D131 limits

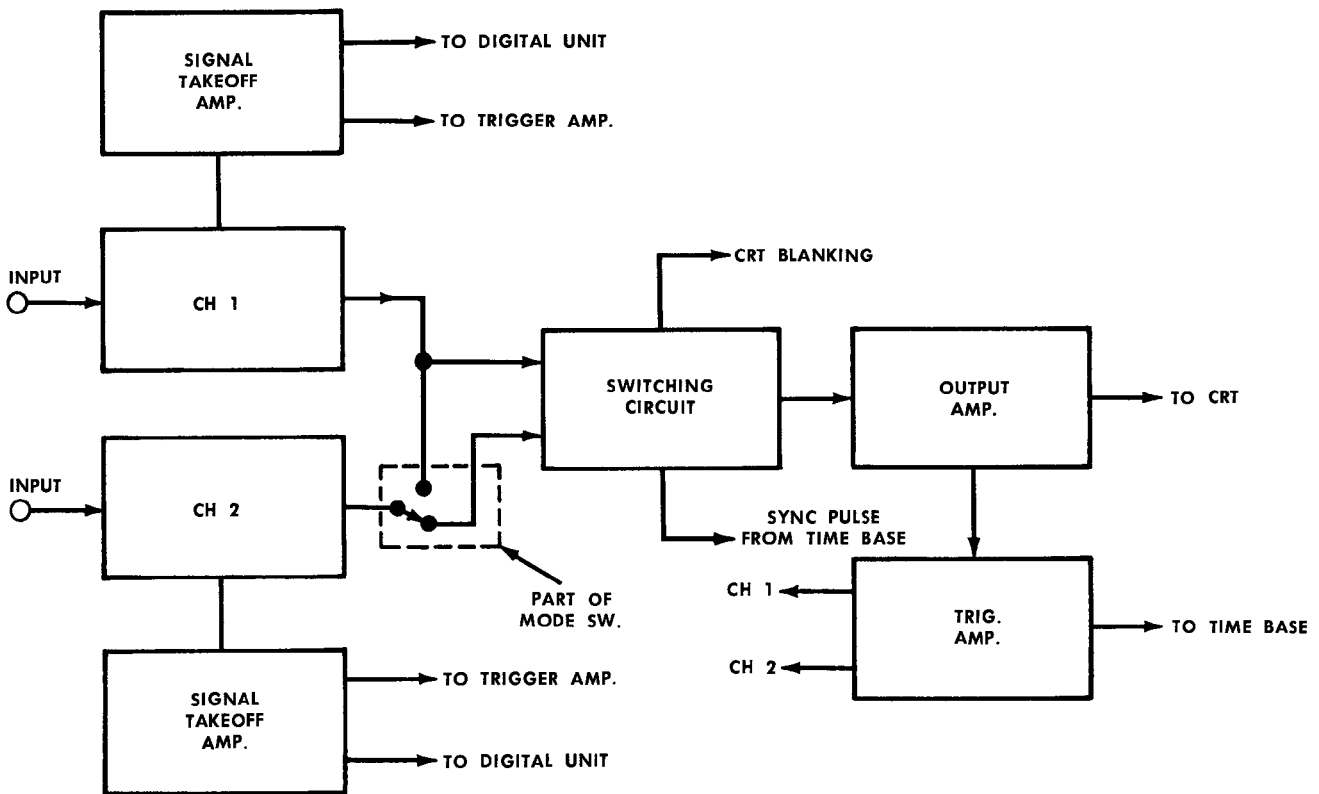


Fig. 4-1. Type 3A2 block diagram.

Circuit Description—Type 3A2

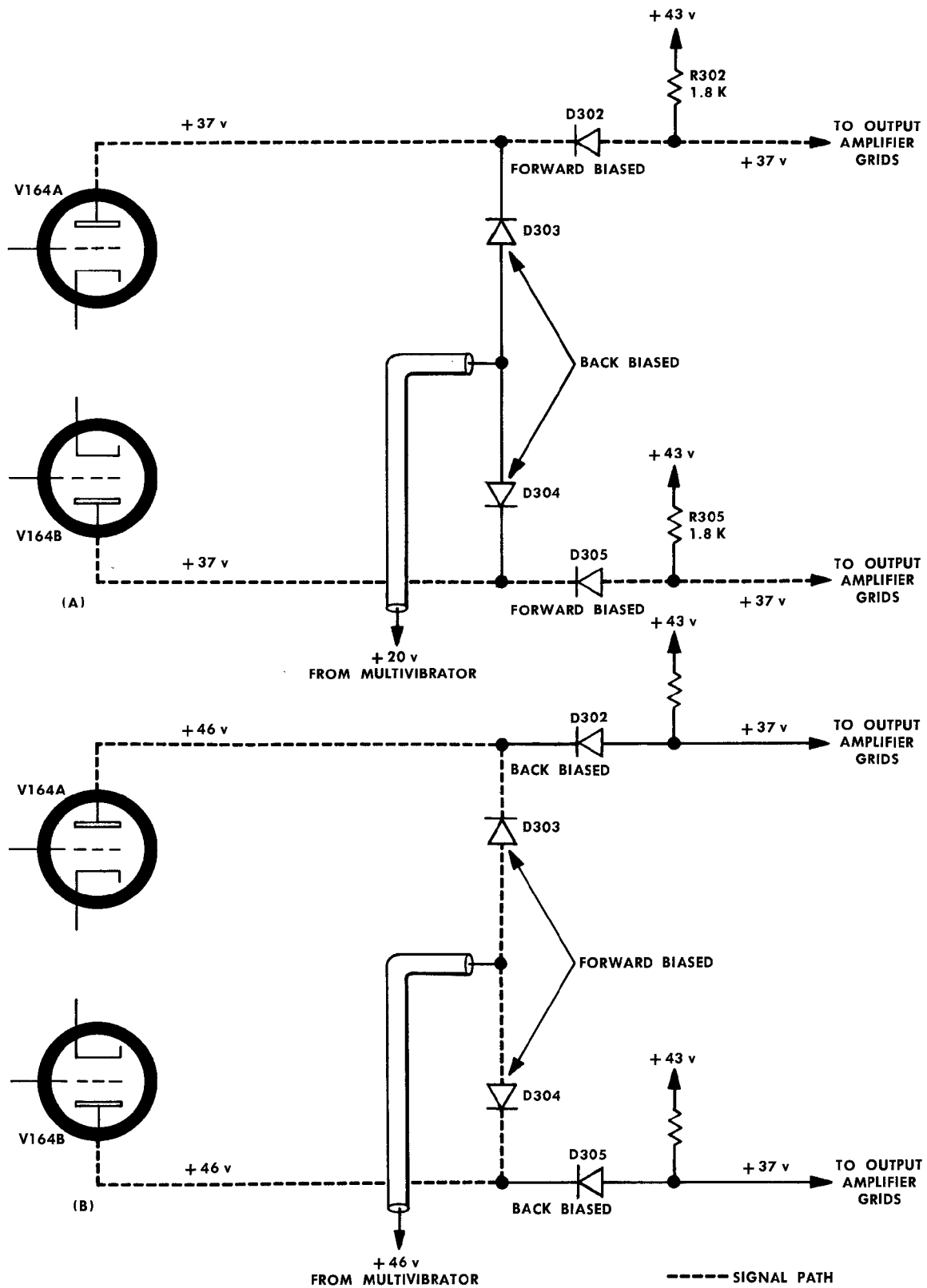


Fig. 4-2. (A) D302 and D305 are forward biased and signal can pass to output amplifier. (B) D302 and D305 are back biased and signal is blocked.

large reverse-bias signals on the base-emitter junction of Q134.

The input amplifier is balanced by a voltage from R119 (DC BAL) through V113B to the base of Q144. This voltage is adjusted for zero current between the emitters of Q134 and Q144 with no signal input. V113B, in the same tube envelope as V113A, compensates for changes in balance due to temperature.

The gain of the paraphase amplifier is set by emitter degeneration. R149 (CH 1 10 MV GAIN) sets the gain of the amplifier so that one division of deflection on the crt is caused by 10 mv of signal applied to the grid of V113A. This gain adjustment only applies to the .01 position of the VOLTS/DIV switch. In all other positions, the gain is set for 20 mv/div of vertical deflection. VARIABLE control R139 (front panel) is set at zero resistance (maximum gain) in the CALIB position, and can reduce the gain by about 2.5X when turned to the end of its range.

The push-pull signal passes from the collectors of Q134 and Q144 to the POLARITY switch. Since the signal is symmetrical, it can be passed straight through (NORM) or criss-crossed (INV) with the output of Q144 passing to V164A, and the output of Q134 passing to V164B.

The POSITION control adjusts the collector voltage of Q134 and Q144 with respect to each other. The changes in collector voltage are amplified and applied to the vertical deflection plates of the crt to move the electron beam vertically.

In the ADDED position of the MODE switch, the first amplifiers of both channels are paralleled (Q134 is paralleled with Q234, and Q144 with Q244). The signals from both channels then add at the collector load resistors of Q134 and Q144. The resultant signal is further amplified through the remainder of channel 1.

The push-pull signal from Q134 and Q144 is also applied to another paraphase amplifier (Q174 and Q184) for trigger and digital signals. The signal from the collector of Q174 drives the base of Q193, and the output signal couples from the emitter of Q193 to the digital readout. The signal for digital readout is set at 1 volt/div of crt signal. The signal from the other half of amplifier Q144 passes to the TRIG SOURCE switch.

V164A and B is a cathode-coupled paraphase amplifier that further amplifies the signal sent to the channel 1 diode gate. R163 (ADDED GAIN BAL) matches the gain of this stage to that of the corresponding stage in channel 2. It also prevents any change in channel 2 signals applied to the crt when the MODE switch is set to ADDED.

The diode gate is an electronic switch that opens or closes the signal path of each channel to the common output amplifier. Consider the plate voltage source of V164A. See Fig. 4-2 (A) and (B). If D303 and D304 are back biased, the source is from the +43-volt supply through D302 and D305 to the plates of V164. R302 and R305 are plate-load resistors and the signal passes from the plate side of these resistors to the grids of the output amplifier. In Fig. 4-2 (B) the voltage on the anodes of D303 and D304 is raised above +46 volts and both these diodes become forward biased. This effectively shorts the plates of V164A and B together and reduces the stage gain to near zero. The increase in voltage at the plates of V164 back biases

D302 and D305, which blocks any signal to the output amplifier. Thus, the gate switches.

The voltages that control the switching of the diode gate are set by multivibrator Q365 and Q375. The state of this multivibrator is set by the MODE switch as follows:

1. CH 1: Q365 is turned on by +20 volts connected to its emitter, which places its collector at about +21 volts. D303 and D304 (channel 1) are then back biased, and the channel 1 signal passes to the output amplifier. At the same time, Q375 has no emitter voltage and its collector is above +46 volts. This forward biases D313 and D314 which, in turn, back biases D312 and D315, blocking the channel 2 signal. Thus, only the channel 1 signal reaches the output amplifier.

2. ADDED: The condition of the diode gate is the same as in channel 1, since the two channels are combined just after the first amplifier.

3. CH 2: This is the reverse of the channel 1 condition. Q365 has no emitter voltage and its collector is above +46 volts, which biases the channel 1 diodes to block the signal. Q375 is turned on and its collector voltage is about +21 volts. D313 and D314 are back biased and the channel 2 signal couples through D312 and D315 to the output amplifier.

4. ALTER: Both multivibrator transistors are supplied with emitter voltage, and the multivibrator becomes bistable. It is switched by a pulse through steering diodes D369 and D379. Four-layer diodes D385 and D386 are biased just below their switching point by R395 and R387. A positive sync pulse from the time-base unit couples to the base of Q394 and turns this transistor on. C383 charges through R383 and R394, which increases the voltage across D385 and D386 until both diodes turn on. This discharges C383 rapidly and the sharp positive pulse developed across R383 is coupled through C379 and C369 to the input of the multivibrator. Since there is one sync pulse at the end of each sweep, the multivibrator switches the channels at the end of each sweep and the crt shows an alternate trace display.

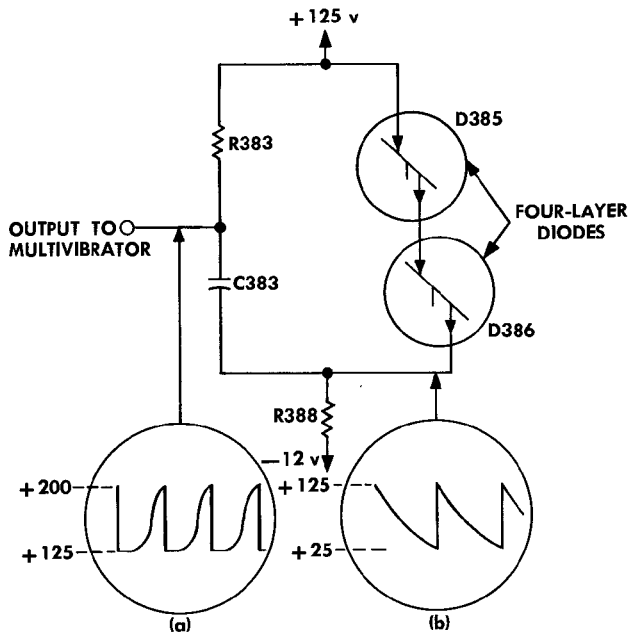
5. CHOP: The four-layer diodes, together with circuit components, operate as a relaxation oscillator that switches the multivibrator, and thus the channels, at a 30- to 50-kc rate. See Fig. 4-3 for a simplified illustration and description of the oscillator.

The dual-trace switching circuit also supplies two output signals for use in other parts of the oscilloscope. One output signal is the chopped-mode pulses from D385 and D386. C380 differentiates the pulse. These pulses couple through cathode follower V324B and are applied to the crt for blanking the chopping transients. The other output signal is from the collector of Q375 (multivibrator transistor). This signal passes to the digital unit and is used by the analog display circuit.

## Output Amplifier

Common output amplifier V324A and V334A is a push-pull amplifier that drives the vertical deflection plates of the crt. R327 (GAIN ADJ) controls cathode degeneration and is used to match the Type 3A2 to the sensitivity of the crt deflection plates.

## Circuit Description—Type 3A2



### HOW IT WORKS

1. When the Type 3A2 is turned on, the voltage at point (b) is about +125 volts and the diodes are turned off.
2. C383 starts to charge and the voltage at point (b) drops. When this voltage drops to +25 volts, the voltage across D385 and D386 is +100 volts and the diodes turn on.
3. When the four-layer diodes turn on, C383 discharges. This forms a sharp positive pulse across R383 that couples to the multivibrator.
4. The discharge of C383 ends the cycle, and the four-layer diodes turn off.
5. The pulse repetition rate depends mainly on the time constant of R383, R388, and C383.

Fig. 4-3. Relaxation oscillator.

D337 and D338 compensate for normal amplifier compression to maintain the amplifier linearity at the extremes of its dynamic range. At low signal levels (less than about 0.3 volt across the diodes) they are turned off. As the signal increases, or as the signal is positioned to the top or bottom of the crt, they turn on and shunt R337. The lowered impedance between the cathodes increases amplifier gain and compensates the tubes as they approach their nonlinear region.

The fixed inductors in the plate and output leads of the amplifier are high-frequency peaking coils.

The amplifier cathode current is used (regulated by Zener diode D326) as the +20-volt supply for other circuits in the Type 3A2.

## Supply Voltages

All of the voltages used by the Type 3A2 come from the oscilloscope power supply. However, two special voltages are developed in the Type 3A2 itself. One is the +20 volts developed in the output amplifier described previously; the other is the +43-volt supply developed by the series network of R399 and Zener diode D399 connected between the +125-volt supply and ground.

Input cathode followers V113 and V213 use -12.2 volts dc for filament voltage while all other tubes use 6.3 volts ac. Regulated filament voltage is used for the input cathode followers to reduce amplifier drift.

## Trigger Signals

There are three possible trigger signals that can be selected by the TRIG SOURCE switch. One is the channel 1 signal that is connected from the output of the first amplifier to the base of Q184. The signal is amplified and passed from the collector of Q184 to the TRIG SOURCE switch. If this switch is in the CH 1 position, the signal passes to the grid of V343A. V343A amplifies the signal again, then it is coupled through another section of the TRIG SOURCE switch to output cathode follower V343B. The output of V343B passes to the trigger circuits in the time-base unit.

The channel 2 signal is amplified by Q284 and passed to the TRIG SOURCE switch where it follows the same path described for channel 1.

In the CRT SIG position of the TRIG SOURCE switch, the triggering signal is taken from the output lead of V334A. The voltage level is reduced to near ground by a resistive divider and applied to the grid of trigger-output cathode follower V343B. Thus, the triggering signal will be the same as the signal driving the vertical deflection of the crt. V343A is not used in the CRT SIG position of the TRIG SOURCE switch.

## Digital Readout Circuits

### NOTE

**When using dual-trace digital readout, use Alternate or Added MODE only.**

These circuits supply information in the form of ground connections to the digital readout unit during voltage measurements. For example, when the digital readout unit is set for channel 1, pins 6 and 21 of interconnecting plug P12 are connected to the digital unit ground (see Attenuator Switches schematic diagram). This ground is switched among other leads that return to the digital readout unit. Two wafers of each VOLTS/DIV switch are used for this switching. The diodes prevent interaction of circuits within the digital readout unit. Note that the VARIABLE VOLTS/DIV control must be in the CALIB position; otherwise, the decimal and unit-of-measure indicators in the digital readout unit will not light.

# SECTION 5

## MAINTENANCE

### PREVENTIVE MAINTENANCE

#### Cleaning the Interior

Remove the instrument from the oscilloscope cabinet. Use low-velocity compressed air to remove free dust from inside the chassis. For stubborn dirt, use a soft brush and a mild detergent and water solution. Dry with compressed air.

#### Visual Inspection

Look for loose or broken connections, cracks in components, improperly seated tubes or transistors, and scorched wires or components. For most visual defects the repair method is obvious, but if you find scorched wires or components there may be other defects in the circuit. Find and correct the cause of overheating, then install new parts.

#### Checking Tubes and Transistors

Testers are not recommended for checking tubes or transistors in the Type 3A2. Testers often condemn good tubes or transistors, or fail to show defects that affect circuit operation. Check tubes or transistors by substitution. If a tube or transistor is good, return it to its socket.

#### Calibration

The Type 3A2 should be calibrated after each 500 hours of operation (or every six months if used intermittently). A step-by-step description of the calibration procedure is included in the rear of this manual.

### REMOVAL AND REPLACEMENT OF PARTS

#### General Information

Most parts in the Type 3A2 can be replaced without detailed instructions. Some parts, however, should be replaced by using definite procedures. These procedures are described in the following paragraphs.

A replaced part may affect instrument calibration. Recalibrate if necessary.

#### Soldering Precautions and Procedure

In Tektronix instruments, parts are connected to ceramic terminal-strip notches with solder containing about 3% silver. The bond between the solder and ceramic strip may be broken by repeated use of ordinary 60-40 tin-lead solder or by excessive heat. Therefore, when resoldering parts to a ceramic strip, use about 3% silver solder and do not overheat the solder joint. Occasional use of ordinary solder, however, will not break the bond.

Usually, 3% silver solder is available locally; if not, one-pound rolls may be purchased through your Tektronix Field Office by ordering Tektronix part number 251-514.

The following soldering procedure may be used to remove and replace parts on a ceramic terminal strip.

1. Use a 50- to 70-watt soldering iron with a wedge-shaped tip. (With this type tip, you can heat the solder joint without overheating the ceramic strip.)
2. Tin the soldering iron tip with silver-bearing solder.
3. Heat the part soldered to the ceramic strip just enough to make the solder flow freely. Do this by touching one corner of the soldering iron tip to the joint. (Be careful, excessive pressure may break the ceramic strip.)

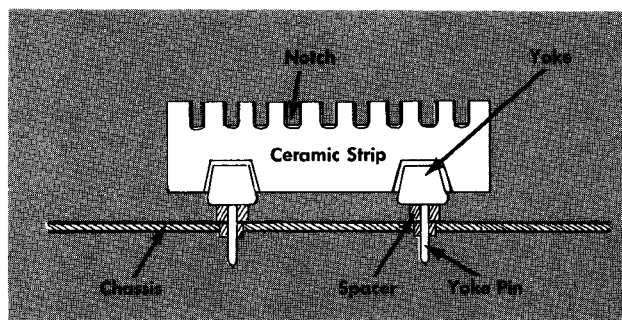


Fig. 5-1. Ceramic strip assembly.

4. When you remove a part, pull it out of the notch while the solder is hot.
5. When replacing a part, use only enough solder to cover the wires and form a small fillet in the notch.
6. Clip any excess leads and be sure to remove all clippings from the instrument.

#### Replacing Ceramic Terminal Strips

Damaged ceramic terminal strips can be replaced by the following procedure. Fig. 5-1 shows how ceramic strip parts are assembled.

1. Unsolder all connections to the damaged ceramic strip.
2. Cut off one side of each plastic yoke holding the old ceramic strip.
3. Remove old ceramic strip.
4. Remove remainder of old yokes from spacers.
5. Replace old spacers with new ones. (Undamaged spacers can be reused.)
6. Set new ceramic strip yoke pins into spacers.
7. Drive new yoke pins completely into spacers by pressing or lightly tapping the ceramic strip directly above the yokes. Be careful not to break the strips.
8. Cut off the portion of the new yoke pins protruding through the spacers on the side of the chassis opposite the ceramic strip.

## Maintenance—Type 3A2

9. Resolder connections to the new ceramic strip (follow the information under "Soldering Precautions and Procedure").

## TROUBLESHOOTING

### General Information

This portion of the manual includes information that will help you troubleshoot the Type 3A2 if trouble develops. While troubleshooting, you should compare information from this section with information from other parts of the manual; particularly, the circuit description and calibration sections.

If trouble develops, first check the control settings. Then operate the front-panel controls to see what effect they may have on the trouble. The normal or abnormal operation of each control will help you establish the trouble symptoms. The location of trouble that occurs only in certain control positions can usually be found immediately from the trouble symptoms.

Once the trouble symptoms are established, look for the obvious cause. Check to see that the power is on, feel for irregularities in control operation, listen for unusual sounds, and visually check the entire instrument. The type of trouble symptom should show the checks to make. Table 5-1 lists some symptoms and suggested checks to make while troubleshooting the Type 3A2.

### Switch Wafer Code

Switch wafers shown on the circuit diagrams are coded to indicate their position on the actual switches. The number portion of the code refers to the wafer number on the switch assembly. Wafers are numbered from the front of the switch to the rear. The letters F and R indicate whether the front or rear of the wafer is used.

### Equipment Required

1. Wideband oscilloscope, such as Tektronix Type 540-Series with Type K or L plug-in unit.
2. Voltmeter, 20,000 ohms per volt sensitivity.
3. Plug-in extension, Tektronix part number 013-034.

TABLE 5-1

SYMPTOM	CHECKS TO MAKE
1. No spot or trace on crt.	Short across the vertical deflection pins of the crt. If a trace appears, check V324 and V334.
2. No vertical signal on crt from either channel.	Check D326, V324, and V334.
3. Vertical signal only on one channel.	Check Q365, Q375 and diodes associated with faulty channel.
4. No vertical signal through channel 2 to crt.	Turn MODE switch to ADD-ED. If no signal, trouble is in channel 2 input amplifier. If signal is present, check V264 and channel 2 diode gate.
5. Sweep will not operate in alternate mode.	1. Check Q394, D385, and D386. 2. Check Q365 and Q375.
6. Sweep will not operate in chopped mode.	Check D385 and D386.
7. Sweep only with TRIG SOURCE switch in CRT SIG position.	Check Q184, D385 and D386.
8. Sweep will not trigger in any position of the TRIG SOURCE switch.	Check V343.
9. Switching transients not blanked in chopped mode.	Check V324.
10. Digital readout inoperative in voltage mode.	Check Q193 and Q293.
11. Digital readout decimal point indicator inoperative.	Check D196 and D296.
12. Digital readout unit-of-measure indicator inoperative.	Check D197, D198, D297, and D298.



# SECTION 6

## CALIBRATION

### Introduction

This section describes a calibration procedure for the Type 3A2 Dual-Trace Amplifier. The instrument calibration should be checked after each 500 hours of operation (or every 6 months if used intermittently). Also, when transistors, tubes, or other parts are changed, check the calibration of the circuit being repaired. Trouble in the instrument caused by changes in component values can often be found by checking the calibration of the suspected circuit.

The instructions that follow are in proper sequence to calibrate the instrument and avoid repetition of checks and adjustments.

### Equipment Required

1. Calibrated Tektronix Type 567 Oscilloscope with a digital readout plug-in unit.
2. Calibrated Tektronix Type 3B2 Time Base plug-in unit.
3. Test oscilloscope with differential amplifier plug-in unit to measure square-wave amplitude to  $\pm 1\%$ , (such as Tektronix Type 545 with a Type Z Plug-In Unit).
4. Dc voltmeter,  $\pm 1\%$  from 0 to 15 volts with at least 1 megohm input impedance.
5. 1-kc square-wave generator, such as Tektronix Type 105 Square-Wave Generator.
6. 47-pf Time-Constant Standardizer, Tektronix part number 011-053.
7. (2) 50  $\Omega$  Terminations, Tektronix part number 011-045.
8. 50  $\Omega$  10X attenuator, such as Tektronix part number 011-031.
9. 50  $\Omega$  coaxial cable, about 42 inches long, with either UHF or BNC connectors with appropriate adapters.
10. Two leads with banana plugs.

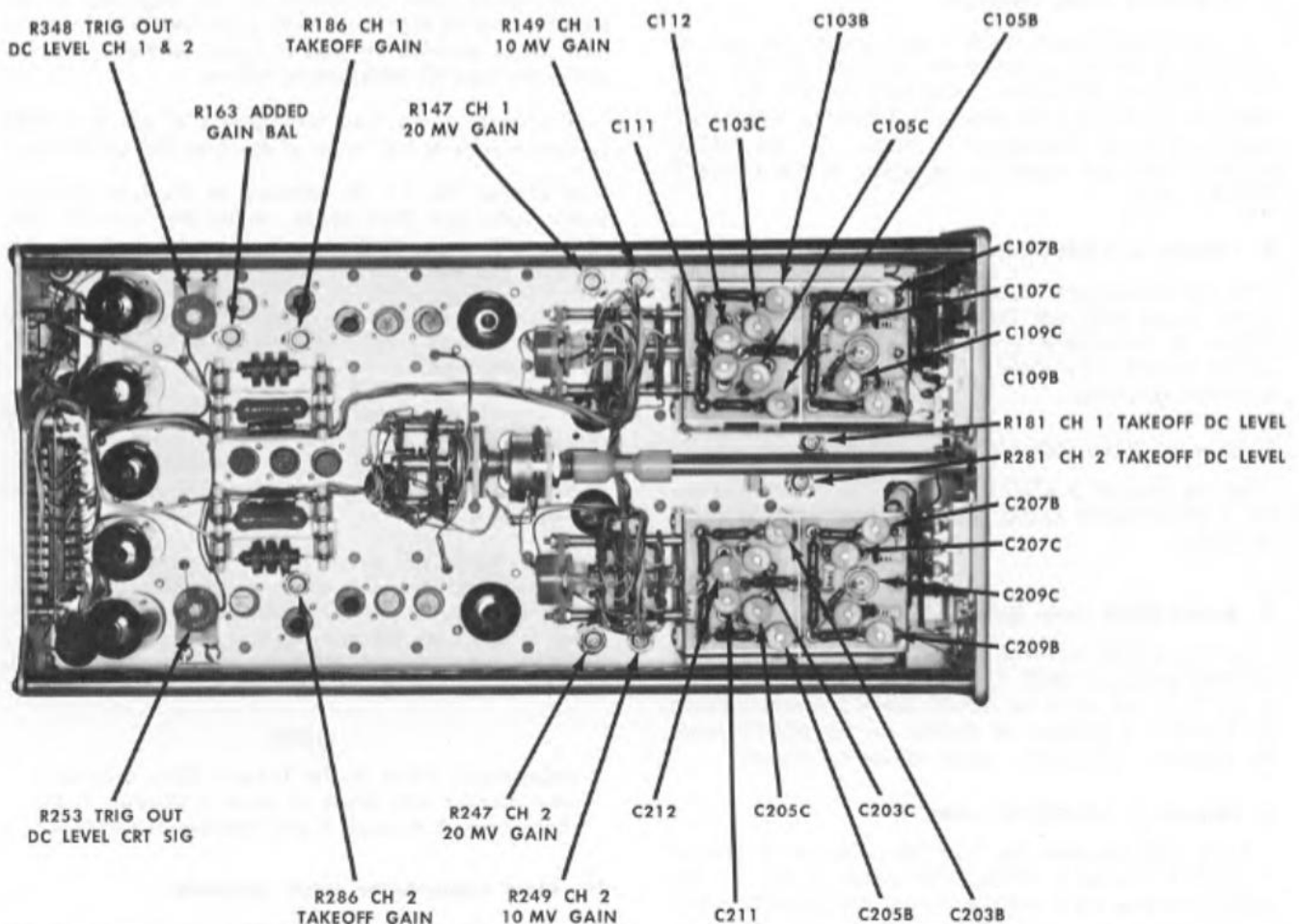


Fig. 6-1. Type 3A2 adjustment locations.

## Calibration—Type 3A2

11. Insulated screwdriver, such as 7-inch Jaco No. 15, Tektronix part number 003-001.
12. Small insulated slotted screwdriver.

## PROCEDURE

### Preliminary

Remove the side and top panels from the Type 567 Oscilloscope cabinet. All adjustments on the Type 3A2 can be made from the left side of the chassis. See Fig. 6-1 for adjustment locations.

Set front-panel controls for both channels as follows:

POSITION	Midrange
VOLTS/DIV	.01
VARIABLE	CALIB
AC-DC-GND	GND
MODE	CH 1
POLARITY	NORM
TRIG SOURCE	CH 1

Adjust the time-base plug-in unit for a free-running sweep at 1 msec/div.

### 1. Dc Balance (both channels)

Set the MODE switch to CH 1 and position the trace to the graticule centerline. Adjust the channel 1 DC BAL control (front-panel screwdriver adjustment) so that the trace does not move when the channel 1 VARIABLE VOLTS/DIV control is turned throughout its range. Set the MODE switch to CH 2 and repeat the adjustment for the channel 2 DC BAL control.

### 2. Channel 2 10-Millivolt Gain

Set the front-panel GAIN ADJ control to its mechanical center. Apply 0.05 volt from the Type 567 calibrator to channel 2. Set channel 2 AC-DC-GND switch to DC. Adjust the internal CH 2 10MV GAIN control (R249) for exactly 5 divisions of display.

### 3. Channel 2 20-Millivolt Gain

Set the channel 2 VOLTS/DIV switch to .02. Adjust the CH 2 20 MV GAIN control (R247) for exactly 2.5 divisions of display.

### 4. Added-Mode Gain Balance

Turn the MODE switch to ADDED and the channel 1 AC-DC-GND switch to GND. Use the same signal and settings as in step 3, and adjust the ADDED GAIN BAL control (R163) for exactly 2.5 divisions of display. (In the ADDED mode the channel 1 POSITION control moves the display.)

### 5. Channel 1 10-Millivolt Gain

Apply 0.05 volt from the Type 567 calibrator to channel 1. Set the channel 1 AC-DC-GND switch to DC. Set the MODE switch to CH 1 and the channel 1 VOLTS/DIV switch to .01. Adjust the CH 1 10MV GAIN control, (R149) for exactly 5 divisions of display.

### 6. Channel 1 20-Millivolt Gain

Turn the channel 1 VOLTS/DIV switch to .02 and adjust the CH 1 20MV GAIN control (R147) for exactly 2.5 divisions of display.

### 7. Takeoff Dc Levels

Set both AC-DC-GND switches to GND, and MODE switch to ALTER. Use the POSITION controls to move both traces even with the graticule centerline. Connect the dc meter to pin 1 of J12 (vertical connector at the rear of the Type 3A2 plug-in compartment). Adjust the CH 1 TAKEOFF DC LEVEL control (R181) for +10.0 volts dc,  $\pm 1$  volt.

### 8. Trigger Source Dc Output

Make sure both traces are even with the graticule centerline, and set the TRIG SOURCE switch to CH 1. Connect the dc voltmeter to pin 11 of J11 (above J12) and adjust the TRIG OUT DC LEVEL CH 1 & 2 control (R348) for zero volts. Set the TRIG SOURCE switch to CRT SIG and adjust the TRIG OUT DC LEVEL CRT SIG control (R253) for zero volts. Remove the voltmeter.

### 9. Takeoff Gain

The takeoff gain adjustments set the amplitude of the signal sent to the digital unit. This signal should be 1 volt for each major graticule division of signal on the crt. Standardize the Type 567 calibrator as follows:

(a) Connect a clip lead from ground to pin 8 of V884 (calibrator tube at top center of the Type 567 oscilloscope).

(b) Connect the 1% dc voltmeter to the Type 567 calibrator 5-volt jack (front panel). Adjust the Type 567 CAL. AMPL. control for exactly 5 volts dc on the voltmeter. Remove the clip lead.

(c) Apply 5 volts from the Type 567 calibrator to channel 1. Set the channel 1 VOLTS/DIV switch to 1 and the AC-DC-GND switch to DC.

(d) Connect one probe of the test-oscilloscope differential amplifier to pin 1 of J12 and the other probe to the calibrator 5-volt jack. Adjust the CH 1 TAKEOFF GAIN control (R186) for two equal signals (differential display on test oscilloscope is zero).

(e) Set the MODE switch to CH 2. Connect the 5-volt calibrator signal and one probe of the differential amplifier to the channel 2 input connector. Connect the other probe to pin 3 of J12 (see Fig. 6-1) and adjust the CH 2 TAKEOFF GAIN control (R286) for two equal signals (differential display on test oscilloscope is zero).

### NOTE

Adjustments made in the Takeoff Gain procedure may interact with those of steps 2 through 7, Re-check steps 2 through 7 and readjust if necessary.

### 10. Input Capacitance (both channels)

Connect the 47-pf Time-Constant Standardizer to the channel 1 input connector. Connect the 50  $\Omega$  Termination

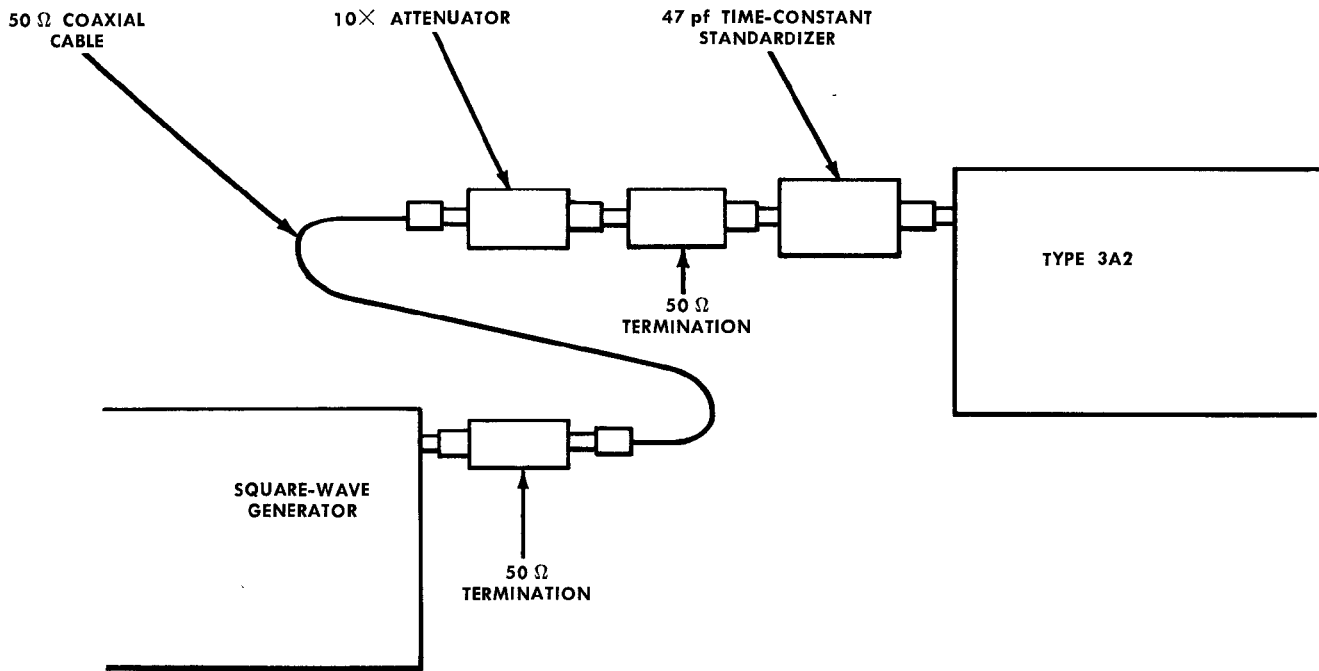


Fig. 6-2. Input capacitance standardization.

to the standardizer, and then connect the 50 Ω 10X attenuator to the termination. Connect the other 50 Ω Termination to the square-wave generator output connector, and join the generator and the Type 3A2 input system with a 50 Ω coaxial cable. Set the generator output frequency for 1 kc. See Fig. 6-2.

Set the channel 1 VOLTS/DIV switch to .01 and the VARIABLE control to CALIB. Set the Type 3B2 TIME/DIV switch to .2 mSEC, and adjust the controls for a stable display. Set the square-wave generator output for a display of about 4 major graticule divisions.

Use a plastic screwdriver and adjust C111 for the best flat-topped waveform. See Fig. 6-1 for location of capacitors.

Set the VOLTS/DIV switch to .02, increase the generator output, and adjust C112 for the best flat-topped waveform.

Move the Time-Constant Standardizer, and associated cables to channel 2 and make the following adjustments for the best flat-topped waveform.

VOLTS/DIV Switch Setting	Adjust
.01	C211
.02	C212

### 11. VOLTS/DIV Switch Attenuator Compensation (both channels)

Use the same test setup as in step 10. Make the adjustments shown in Table 6-1 for each channel. If necessary, remove the attenuators and terminations from the cable to

get sufficient signal (4 major divisions) at the higher VOLTS/DIV switch settings.

TABLE 6-1

VOLTS/DIV Switch Setting	Adjust for best square corners		Adjust for best flat top	
	CH 1	CH 2	CH 1	CH 2
.05	C103C	C203C	C103B	C203B
.1	C105C	C205C	C105B	C205B
.2	C107C	C207C	C107B	C207B
2	C109C	C209C	C109B	C209B

#### NOTE

The remainder of this section is checks that can be performed to verify proper instrument operation.

### 12. Gas Check

Set both VOLTS/DIV switches to .01, MODE switch to CH 1, and the Type 3B2 TIME/DIV switch to 1 mSEC. Set the channel 1 AC-DC-GND switch between DC and GND; the vertical shift of the trace should not exceed 1/2 major graticule division. Repeat this check for channel 2. If the trace shift is greater than 1/2 major division, replace V113 or V213.

### 13. VOLTS/DIV Switch Check (both channels)

Connect a cable from the Type 567 calibrator .05-volt jack to the input of channel 1. Set the channel 1 VOLTS/DIV switch to .01 and the VARIABLE control to CALIB. The display should have 5 major graticule divisions of amplitude. Continue to check each switch position as shown in Table 6-2.

## Calibration—Type 3A2

TABLE 6-2

VOLTS/DIV Switch Setting	Calibrator Voltage Output	Major Divisions of Amplitude
.02	.05	2.5
.05	.05	1.0
.1	.5	5.0
.2	.5	2.5
.5	.5	1.0
1	5	5.0
2	5	2.5
5	5	1.0
10	50	5.0

Repeat this check for channel 2.

### 14. VARIABLE VOLTS/DIV Control Check (both channels)

Set the channel 1 VOLTS/DIV switch to .01. Apply 0.05 volt from the Type 567 calibrator to the channel 1 input connector. The display should have 5 major graticule divisions of amplitude. Turn the VARIABLE VOLTS/DIV control

slightly clockwise to move it out of the CALIB position. The display should be under 2 major divisions of amplitude. Turn the control throughout its range to check for smooth electrical operation. Repeat this check for channel 2.

### 15. MODE Switch Check

Apply 0.5 volt from the Type 567 calibrator to the input connector of both channels. Set both VOLTS/DIV switches to .2.

(a) Set the MODE switch to ALTER. Adjust both POSITION controls until two signals are displayed. Turn the Type 3B2 TIME/DIV switch to .1 SEC. The display should alternate between channels at the end of each sweep.

(b) Set the MODE switch to CHOP. Set the Type 3B2 TIME/DIV switch to 1 mSEC. The signals from both channels should be seen at the same time.

(c) Set the MODE switch to ADDED and both channel POLARITY switches to NORM. Use the channel 1 POSITION control to adjust the display. There should be 5 major graticule divisions of amplitude. Turn the channel 2 POLARITY switch to INV. There should be a single trace of zero amplitude.

# SECTION 7

## PARTS LIST AND SCHEMATICS

### PARTS ORDERING INFORMATION

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


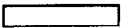
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, 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 Field Office will contact you concerning any change in part number.

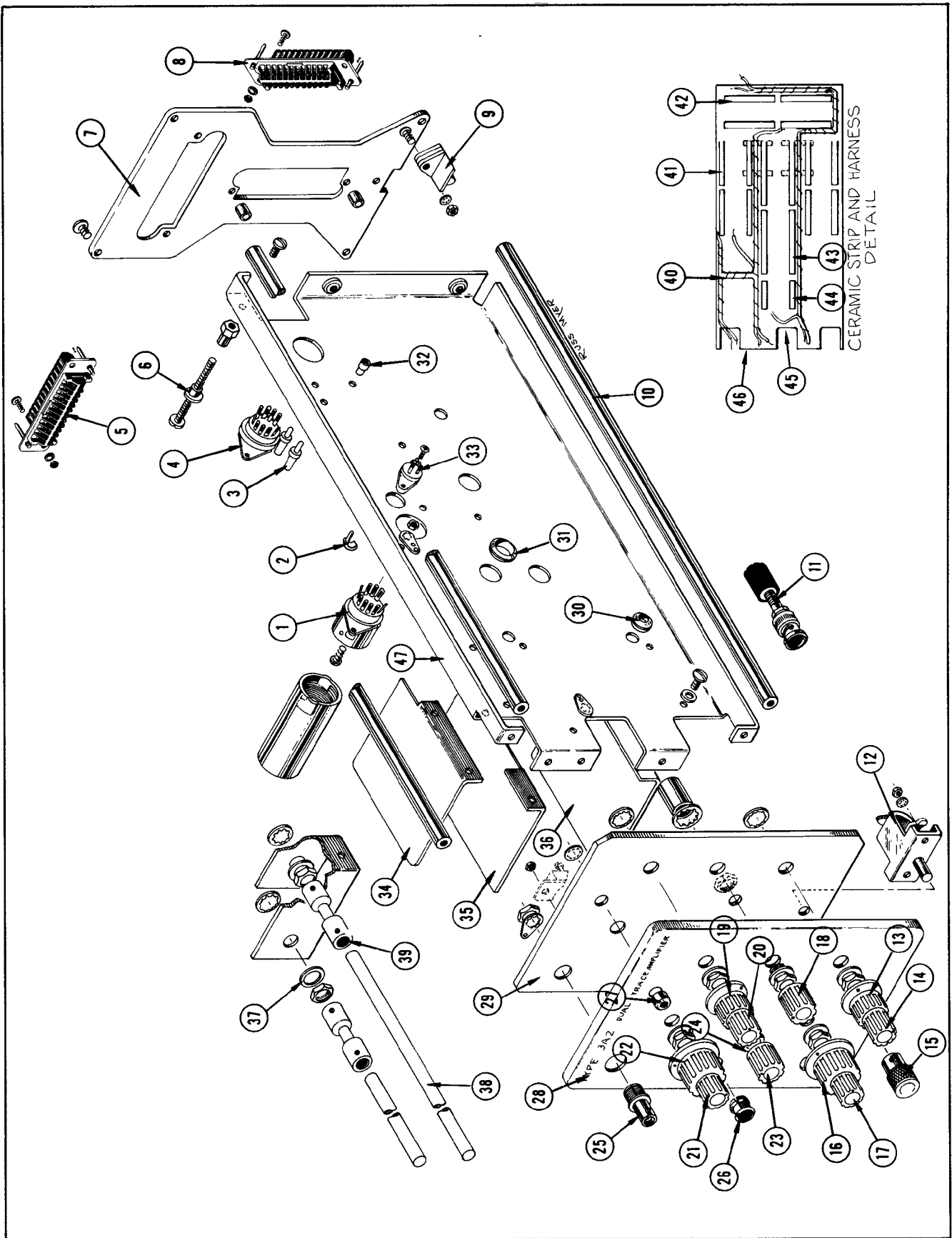
### ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega (10 <sup>6</sup> )
C	carbon	met.	metal
cer	ceramic	μ	micro, or 10 <sup>-6</sup>
cm	centimeter	n	nano, or 10 <sup>-9</sup>
comp	composition	Ω	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or 10 <sup>-12</sup>
dia	diameter	PHS	pan head steel
div	division	piv	peak inverse voltage
EMC	electrolytic, metal cased	plstc	plastic
EMT	electrolytic, metal tubular	PMC	paper, metal cased
ext	external	poly	polystyrene
f	farad	Prec	precision
F & I	focus and intensity	PT	paper tubular
FHS	flat head steel	PTM	paper or plastic, tubular, molded
Fil HS	fillister head steel	RHS	round head steel
g or G	giga, or 10 <sup>9</sup>	rms	root mean square
Ge	germanium	sec	second
GMV	guaranteed minimum value	Si	silicon
h	henry	S/N	serial number
hex	hexagonal	t or T	tera, or 10 <sup>12</sup>
HHS	hex head steel	TD	toroid
HSS	hex socket steel	THS	truss head steel
HV	high voltage	tub.	tubular
ID	inside diameter	v or V	volt
incd	incandescent	Var	variable
int	internal	w	watt
k or K	kilohms or kilo (10 <sup>3</sup> )	w/	with
kc	kilocycle	w/o	without
m	milli, or 10 <sup>-3</sup>	WW	wire-wound
mc	megacycle		

### SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

EXPLODED VIEW



## EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	136-0022-00			2	SOCKET, STM9S
	- - - - -			-	Mounting Hardware For Each: (not included)
	210-0201-00			1	LUG, solder, SE 4
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch PHS
	337-0008-00			1	SHIELD, 1 1/32 inch ID, with spring 1 5/16 inch high
2	343-0088-00			2	CLAMP, cable size, delrin snap in
3	214-0321-00			2	FASTENER, delrin, pot mounting
4	136-0015-00			5	SOCKET, STM9
	- - - - -			-	Mounting Hardware For Each: (not included)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch PHS
5	131-0149-00			1	CONNECTOR, chassis mount, 24 contact
	- - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, int, #4
	210-0201-00			1	LUG, solder, SE 4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	211-0008-00			2	SCREW, 4-40 x 1/4 inch BHS
6	- - - - -			-	Resistor Mounting Hardware:
	210-0478-00			1	NUT, hex, alum 5/16 x 2 1/32 inch long
	210-0601-00			1	EYELET, brass tapered barrel
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
	211-0553-00			1	SCREW, 6-32 x 1 1/2 inch RHS
7	387-0595-00			1	PLATE, rear panel, aluminum
8	131-0149-00			1	CONNECTOR, chassis mount, 24 contact
	- - - - -			-	Mounting Hardware: (not included)
	166-0031-00			2	TUBE, spacing, alum, 1/4 inch OD x 1/4 inch long
	210-0004-00			2	LOCKWASHER, int, #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	211-0016-00			2	SCREW, 4-40 x 5/8 inch RHS
9	351-0037-00			1	GUIDE, plug-in, delrin
	- - - - -			-	Mounting Hardware: (not included)
	210-0004-00			1	LOCKWASHER, int, #4
	210-0406-00			1	NUT, hex, 4-40 x 3/16 inch
	211-0013-00			1	SCREW, 4-40 x 3/8 inch RHS
10	384-0566-00	100	159	4	ROD, frame, spacing
	384-0615-00	160		4	ROD, frame, spacing
	- - - - -			-	Mounting Hardware For Each: (not included)
	212-0044-00			1	SCREW, 8-32 x 1/2 inch RHS
11	- - - - -			1	ADAPTER, BNC to binding post (see standard accessories)
12	214-0052-00			1	FASTENER, pawl right, with stop
	- - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, int, #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
13	366-0218-00			1	KNOB, POLARITY, charcoal
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
14	366-0081-00			1	KNOB, POSITION, red
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
15	366-0109-00			1	KNOB, plug-in securing, 9/16 inch aluminum
	- - - - -			-	Mounting Hardware: (not included)
	213-0005-00			1	SCREW, set, 8-32 x 1/8 inch HSS allen head
16	366-0142-00			1	KNOB, VOLTS/DIV, charcoal
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
17	366-0031-00			1	KNOB, VARIABLE, red
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
18	366-0148-00			1	KNOB, TRIG SOURCE, charcoal
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head

Parts List—Type 3A2

EXPLODED VIEW (Cont'd)

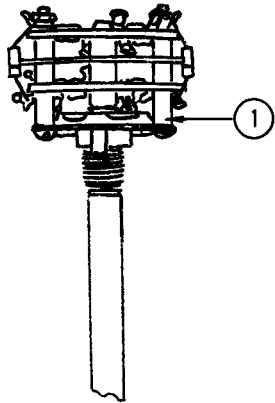
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
19	366-0218-00			1	KNOB, POLARITY, charcoal
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
20	366-0081-00			1	KNOB, POSITION, red
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
21	366-0031-00			1	KNOB, VARIABLE, red
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
22	366-0142-00			1	KNOB, VOLTS/DIV, charcoal
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
23	366-0148-00			1	KNOB, MODE, charcoal
	- - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS allen head
24	358-0029-00			1	BUSHING, brass, hex, 3/8-32 x 13/32 inch
	- - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, pot, flat
25	131-0106-00			2	CONNECTOR, chassis mount, 1 contact
	- - - - -			-	Mounting Hardware For Each: (not included)
	210-0255-00			1	LUG, solder, pot
26	358-0178-00	100	309	1	BUSHING, front panel, charcoal
	358-0216-00	310		1	BUSHING, front panel, gray
27	358-0075-00			2	BUSHING, brass, miniature pot mounting
28	333-0718-00			1	PANEL, front
29	387-0708-00			1	PLATE, subpanel front 4 3/32 x 6 3/32 inch
30	348-0003-00			3	GROMMET, rubber 1/4 inch
31	348-0005-00			5	GROMMET, rubber 1/2 inch
32	348-0031-00			6	GROMMET, polypropylene, snap-in
33	136-0095-00	100	209	13	SOCKET, 4 pin transistor
	136-0181-00	210		13	SOCKET, 3 pin transistor
	- - - - -			-	Mounting Hardware For Each: (not included)
	213-0113-00	100	209	2	SCREW, thread forming, 2-32 x 5/16 inch RHS
	354-0234-00	210		1	RING, locking, transistor socket
34	337-0544-00			1	SHIELD, attenuator, top
	- - - - -			-	Mounting Hardware: (not included)
	210-0803-00			2	WASHER, 6S x 3/8 inch flat
	211-0504-00			2	SCREW, 6-32 x 1/4 inch BHS
35	337-0542-00			1	SHIELD, attenuator, middle
	- - - - -			-	Mounting Hardware: (not included)
	210-0803-00			2	WASHER, 6S x 3/8 inch
	211-0504-00			2	SCREW, 6-32 x 1/4 inch BHS
36	337-0543-00			1	SHIELD, attenuator, bottom
	- - - - -			-	Mounting Hardware: (not included)
	210-0803-00			2	WASHER, 6S x 3/8 inch
	211-0504-00			2	SCREW, 6-32 x 1/4 inch BHS



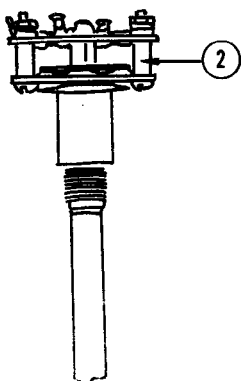
## EXPLODED VIEW (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
37	----- 210-0012-00 210-0413-00 210-0840-00 376-0011-00 384-0261-00 406-0856-00 ----- 211-0504-00			- 1 1 1 1 1 1 - 2	Pot Mounting Hardware: LOCKWASHER, pot, int $\frac{3}{8}$ x $\frac{1}{2}$ inch NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ inch WASHER, pot, flat COUPLING, insulating, nylon ROD, alum, $\frac{1}{4}$ inch x $4\frac{5}{16}$ long BRACKET, alum $1 \times 1\frac{1}{32} \times 1\frac{3}{8} \times 1\frac{7}{16}$ inch Mounting Hardware: (not included) SCREW, 6-32 x $\frac{1}{4}$ inch BHS
38	384-0010-00			1	ROD, alum, $\frac{1}{4}$ inch x $4\frac{5}{16}$ inch long
39	376-0011-00			1	COUPLING, insulating, nylon
40	179-0684-00			1	CABLE, chassis
41	124-0147-00 ----- 361-0009-00 124-0146-00 ----- 361-0009-00			4 - 2 8 - 2	STRIP, ceramic, 13 notches Mounting Hardware: (not included) SPACER, nylon STRIP, ceramic, 16 notches Mounting Hardware For Each: (not included) SPACER, nylon
43	124-0145-00 ----- 361-0009-00			4 - 2	STRIP, ceramic, 20 notches Mounting Hardware For Each: (not included) SPACER, nylon
44	124-0148-00 ----- 361-0009-00			2 - 2	STRIP, ceramic, 9 notches Mounting Hardware For Each: (not included) SPACER, nylon
45	124-0120-00 ----- 361-0009-00			4 - 2	STRIP, ceramic, 4 notches (not shown) Mounting Hardware For Each: (not included) SPACER, nylon
46	179-0685-00			1	CABLE, connector (not shown)
47	441-0453-00 ----- 210-0006-00 210-0407-00 211-0504-00 211-0538-00			1 - 2 2 3 5	CHASSIS, main Mounting Hardware: (not included) LOCKWASHER, int, #6 NUT, hex, 632 x $\frac{1}{4}$ inch SCREW, 6-32 x $\frac{1}{4}$ inch BHS SCREW, 6-32 x $\frac{5}{16}$ inch FHS 100° CSK

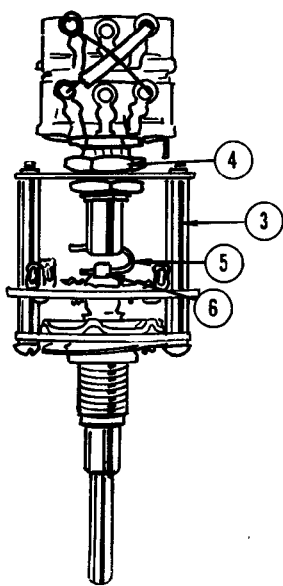
SWITCHES



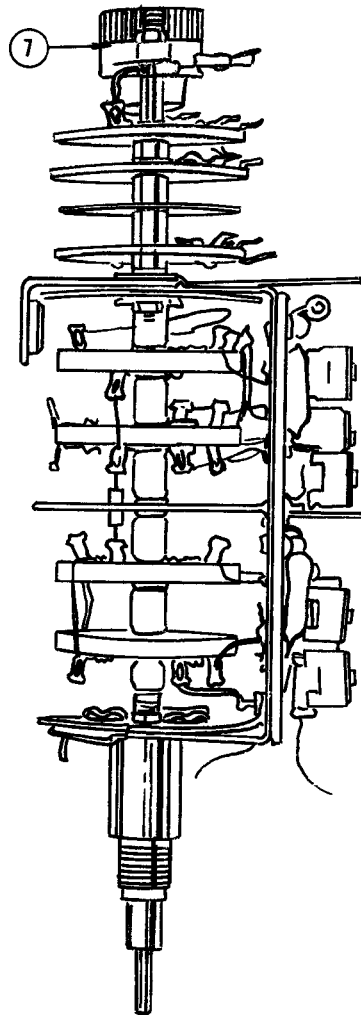
MODE



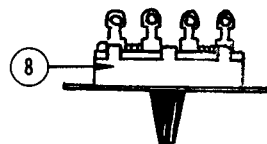
TRIG SOURCE



POLARITY



VOLTS/DIV

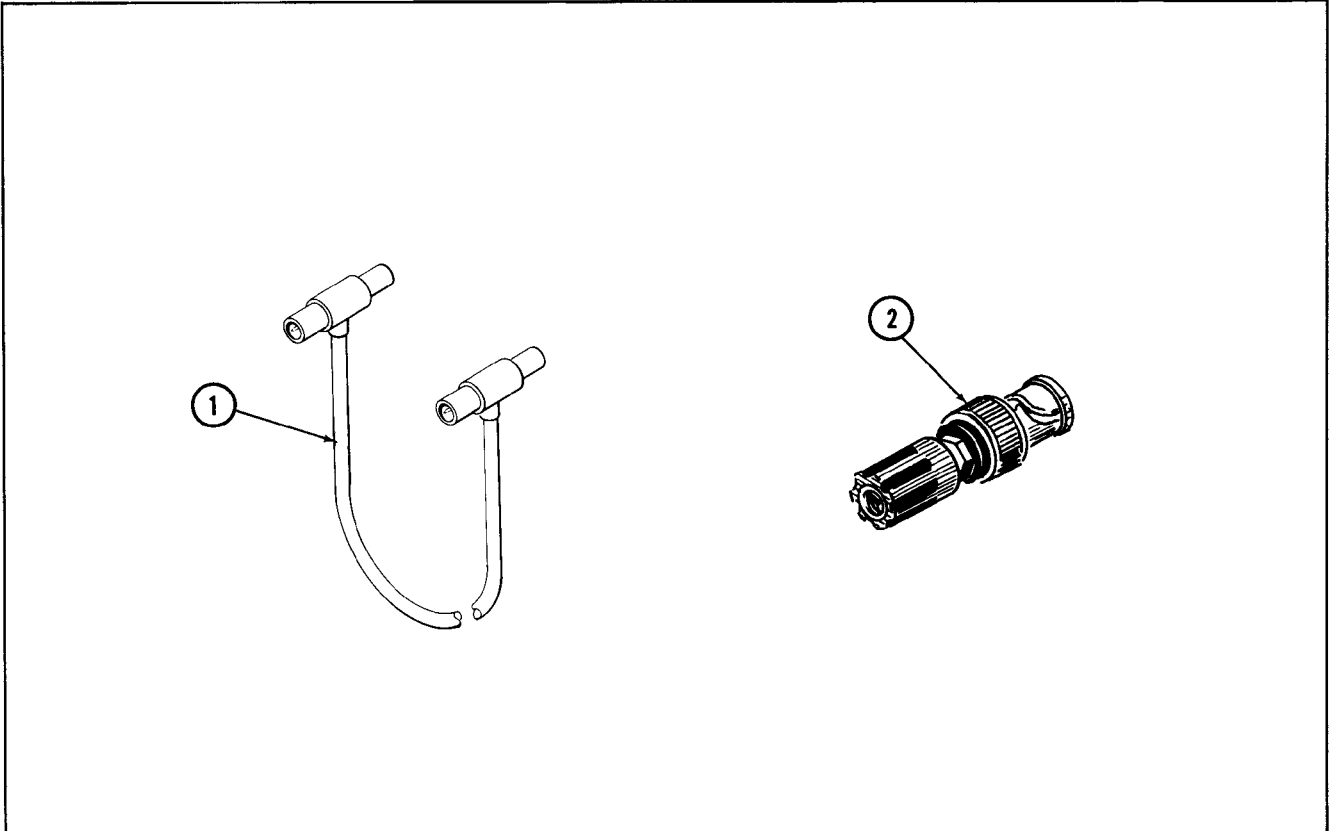


AC DC GND

## SWITCHES

REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	262-523			1	SWITCH, MODE, wired
	- - - -			-	Includes:
	260-487			1	SWITCH, MODE, unwired
	- - - -			-	Mounting Hardware: (not included)
	210-012			1	LOCKWASHER, pot, int, $\frac{3}{8} \times \frac{1}{2}$ inch
	210-413			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ inch
	210-840			1	WASHER, pot, flat
2	260-489			1	SWITCH, TRIG SOURCE, unwired
	- - - -			-	Mounting Hardware: (not included)
	210-013			1	LOCKWASHER, pot, int, $\frac{3}{8} \times 1\frac{1}{16}$ inch
	210-413			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ inch
3	262-524			2	SWITCH, POLARITY, wired
	- - - -			-	Each Includes:
	210-012			1	LOCKWASHER, pot, int, $\frac{3}{8} \times 1\frac{1}{16}$ inch
4	210-413			2	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ inch
5	376-014			1	COUPLING, pot, wire steel
6	384-269			1	ROD, shaft, steel, $1\frac{23}{32}$ inch long
	260-488			1	SWITCH, POLARITY, unwired
	- - - -			-	Mounting Hardware For Each: (not included)
	210-012			1	LOCKWASHER, pot, int, $\frac{3}{8} \times \frac{1}{2}$ inch
	210-413			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ inch
7	262-522			2	SWITCH, VOLTS/DIV, wired
	- - - -			-	Each Includes:
	131-182			1	CONNECTOR, terminal feed-thru
	210-004			5	LOCKWASHER, int, #4
	210-406			6	NUT, hex, 4-40 x $\frac{3}{16}$ inch
	211-008			2	SCREW, 4-40 x $\frac{1}{4}$ inch BHS
	211-011			2	SCREW, 4-40 x $\frac{5}{16}$ inch BHS
	337-505			1	SHIELD, brass $\frac{9}{16} \times 1\frac{7}{8}$ inch
	337-578			1	SHIELD, rear atten, aluminum
	358-135			1	BUSHING, teflon
	406-813			1	BRACKET, atten, $\frac{9}{16} \times 1\frac{1}{16}$ inch
	406-857			1	BRACKET, atten, $1\frac{7}{8}$ inch
	260-486			1	SWITCH, VOLTS/DIV, unwired
	- - - -			-	Mounting Hardware For Each: (not included)
	210-012			1	LOCKWASHER, pot, int, $\frac{3}{8} \times \frac{1}{2}$ inch
	210-413			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ inch
8	260-448			2	SWITCH, AC DC GND, charcoal, slide
	- - - -			-	Mounting Hardware For Each: (not included)
	210-004			2	LOCKWASHER, int, #4
	210-406			2	NUT, hex, 4-40 x $\frac{3}{16}$ inch

ACCESSORIES



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	012-0087-00	X229		1	CORD, patch, BNC to BNC, red, 18 inch
2	103-0033-00	101	228X	2	ADAPTER, BNC to binding post
	070-0354-00			2	MANUAL, instruction (not shown)

## ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
		<b>Bulbs</b>	
B391	150-025	Neon, NE-2E	100-369
B391	150-0030-00	Neon, NE-2V	370-up

## Capacitors

Tolerance  $\pm 20\%$  unless otherwise indicated.

C101	Use *285-0672-00	.1 $\mu$ f	MT		600 v	+5%, -15%	
C103B	281-061	5.5-18 pf	Cer	Var			
C103C	281-061	5.5-18 pf	Cer	Var			
C105B	281-061	5.5-18 pf	Cer	Var			
C105C	281-060	2-8 pf	Cer	Var			
C105E	281-503	8 pf	Cer		500 v	$\pm .5$ pf	
C107A	281-504	10 pf	Cer		500 v	10%	
C107B	281-061	5.5-18 pf	Cer	Var			
C107C	281-060	2-8 pf	Cer	Var			
C107E	281-579	21 pf	Cer		500 v	5%	
C109A	281-504	10 pf	Cer		500 v	10%	
C109B	281-061	5.5-18 pf	Cer	Var			
C109C	281-060	2-8 pf	Cer	Var			
C109E	283-541	500 pf	Mica		500 v	10%	
C111	281-061	5.5-18 pf	Cer	Var			
C112	281-060	2-8 pf	Cer	Var			
C113	283-003	.01 $\mu$ f	Disc Type		150 v		
C114	283-057	.1 $\mu$ f	Disc Type		200 v		
C123	283-010	.05 $\mu$ f	Disc Type		50 v		
C124	283-003	.01 $\mu$ f	Disc Type		150 v		
C143	283-059	1 $\mu$ f	Disc Type		25 v		
C163	281-525	470 pf	Cer		500 v		
C174	281-549	68 pf	Cer		500 v	10%	100-300X
C192	283-003	.01 $\mu$ f	Disc Type		150 v		
C196	283-002	.01 $\mu$ f	Disc Type		500 v		
C201	Use *285-0672-00	.1 $\mu$ f	MT		600 v	+5%, -15%	
C203B	281-061	5.5-18 pf	Cer	Var			
C203C	281-061	5.5-18 pf	Cer	Var			
C205B	281-061	5.5-18 pf	Cer	Var			
C205C	281-060	2-8 pf	Cer	Var			
C205E	281-503	8 pf	Cer		500 v	$\pm .5$ pf	
C207A	281-504	10 pf	Cer		500 v	10%	
C207B	281-061	5.5-18 pf	Cer	Var			
C207C	281-060	2-8 pf	Cer	Var			
C207E	281-579	21 pf	Cer		500 v	5%	
C209A	281-504	10 pf	Cer		500 v	10%	
C209B	281-061	5.5-18 pf	Cer	Var			
C209C	281-060	2-8 pf	Cer	Var			
C209E	283-541	500 pf	Mica		500 v	10%	

Parts List—Type 3A2

Capacitors (Cont'd.)

Ckt. No.	Tektronix Part No.	Description	S/N Range
C211	281-061	5.5-18 pf Cer	
C212	281-060	2-8 pf Cer	
C213	283-003	.01 $\mu$ f Disc Type	150 v
C214	283-057	.1 $\mu$ f Disc Type	200 v
C223	283-010	.05 $\mu$ f Disc Type	50 v
C224	283-003	.01 $\mu$ f Disc Type	150 v
C254	283-059	1 $\mu$ f Disc Type	25 v
C263	281-525	470 pf Cer	500 v
C274	281-549	68 pf Cer	500 v
C292	283-003	.01 $\mu$ f Disc Type	150 v
C296	283-002	.01 $\mu$ f Disc Type	500 v
C344	283-0103-00	180 pf Disc Type	500 v
C346	281-578	18 pf Cer	500 v
C346	281-0012-00	7-45 pf Cer	500 v
C351	281-503	8 pf Cer	500 v
C354	283-002	.01 $\mu$ f Disc Type	500 v
C363	283-003	.01 $\mu$ f Disc Type	150 v
C366	281-523	100 pf Cer	350 v
C369	281-517	39 pf Cer	500 v
C376	281-523	100 pf Cer	350 v
C379	281-517	39 pf Cer	500 v
C380	281-580	470 pf Cer	500 v
C380	281-0543-00	270 pf Cer	500 v
C383	281-580	470 pf Cer	500 v
C383	281-0543-00	270 pf Cer	500 v
C384	Selected		
C385	283-057	.1 $\mu$ f Disc Type	200 v
C390	283-001	.005 $\mu$ f Disc Type	500 v
C391	281-528	82 pf Cer	500 v
C393	281-525	470 pf Cer	500 v
C399	Use 283-057	.1 $\mu$ f Disc Type	200 v

Diodes

D130	*152-075	Germanium Tek Spec
D131	*152-075	Germanium Tek Spec
D140	*152-075	Germanium Tek Spec
D196	*152-107	Silicon Replaceable by 1N647
D197	*152-107	Silicon Replaceable by 1N647
D198	*152-107	Silicon Replaceable by 1N647
D230	*152-075	Germanium Tek Spec
D231	*152-075	Germanium Tek Spec
D240	*152-075	Germanium Tek Spec
D296	*152-107	Silicon Replaceable by 1N647
D297	*152-107	Silicon Replaceable by 1N647
D298	*152-107	Silicon Replaceable by 1N647
D302	152-025	Germanium 1N634
D303	152-025	Germanium 1N634
D304	152-025	Germanium 1N634
D305	152-025	Germanium 1N634
D312	152-025	Germanium 1N634
D313	152-025	Germanium 1N634
D314	152-025	Germanium 1N634
D315	152-025	Germanium 1N634

## Diodes (Cont'd)

Ckt. No.	Tektronix Part No.	Description	S/N Range
D326	152-060	Zener 1N3027A 20 V, 1 W, 10%	
D337	*152-075	Germanium Tek Spec	
D338	*152-075	Germanium Tek Spec	
D365	152-0008-00	Germanium	X250-up
D369	*152-075	Germanium Tek Spec	
D375	152-0008-00	Germanium	X250-up
D379	*152-075	Germanium Tek Spec	
D385	152-108	Four layer 4E5028	
D386	152-108	Four layer 4E5028	
D399	152-056	Zener 1N3804B 43 V, 1.5 W, 5%	

## Inductors

L173	276-507	Core, Ferramic Suppressor	
L183	276-507	Core, Ferramic Suppressor	
L273	276-507	Core, Ferramic Suppressor	X190-up
L274	276-507	Core, Ferramic Suppressor	X190-up
L283	276-507	Core, Ferramic Suppressor	X190-up
L284	276-507	Core, Ferramic Suppressor	X190-up
L323	276-507	Core, Ferramic Suppressor	
L324	108-225	.75 mh	
L329	*108-016	29 $\mu$ h	
L333	276-507	Core, Ferramic Suppressor	
L334	108-225	.75 mh	
L339	*108-016	29 $\mu$ h	

## Resistors

Resistors are fixed, composition,  $\pm 10\%$  unless otherwise indicated.

R103C	309-381	600 k	$\frac{1}{2}$ w	Prec	1%
R103E	309-382	666.6 k	$\frac{1}{2}$ w	Prec	1%
R105C	309-383	800 k	$\frac{1}{2}$ w	Prec	1%
R105E	309-380	250 k	$\frac{1}{2}$ w	Prec	1%
R107C	309-396	900 k	$\frac{1}{2}$ w	Prec	1%
R107E	309-379	11.1 k	$\frac{1}{2}$ w	Prec	1%
R109C	309-385	990 k	$\frac{1}{2}$ w	Prec	1%
R109E	309-378	10.1 k	$\frac{1}{2}$ w	Prec	1%
R109F	316-150	15 $\Omega$	$\frac{1}{4}$ w		
R110	315-100	10 $\Omega$	$\frac{1}{4}$ w		5%
R111	309-386	1 meg	$\frac{1}{2}$ w	Prec	1%
R113	316-105	1 meg	$\frac{1}{4}$ w		
R114	302-221	220 $\Omega$	$\frac{1}{2}$ w		
R116	302-392	3.9 k	$\frac{1}{2}$ w		
R119	311-068	500 k	.2 w	Var	DC BAL
R121	302-105	1 meg	$\frac{1}{2}$ w		
R123	302-472	4.7 k	$\frac{1}{2}$ w		
R124	302-101	100 $\Omega$	$\frac{1}{2}$ w		
R126	302-392	3.9 k	$\frac{1}{2}$ w		
R134	318-103	600 $\Omega$	$\frac{1}{8}$ w	Prec	1%

Parts List—Type 3A2

Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R135	310-052	10 k	1 w		Prec	1%
R136	304-822	8.2 k	1 w			
R138	302-391	390 Ω	1/2 w			
R139†	*311-334	375 Ω		Var	WW	VARIABLE
R143	315-821	820 Ω	1/4 w			5%
R144	318-103	600 Ω	1/8 w		Prec	1%
R145	310-052	10 k	1 w		Prec	1%
R146	Use 301-0121-00	120 Ω	1/2 w			5%
R147	311-258	100 Ω		Var		CH1 20 MV GAIN
R148	Use 301-0220-00	22 Ω	1/2 w			5%
R149	311-258	100 Ω		Var		CH1 10 MV GAIN
R150	315-181	180 Ω	1/4 w			5%
R156	302-153	15 k	1/2 w			
R157	302-473	47 k	1/2 w			
R158	311-114	2 × 250 k		Var		POSITION
R159	302-473	47 k	1/2 w			
R161	303-243	24 k	1 w			5%
R162	316-101	100 Ω	1/4 w			
R163	311-097	200 Ω	.5 w	Var		ADDED GAIN BAL
R165	303-243	24 k	1 w			5%
R174	301-272	2.7 k	1/2 w			5%
R175	309-418	18.7 k	1/2 w		Prec	1%
R176	302-151	150 Ω	1/2 w			
R181	311-326	10 k		Var		CH1 TAKEOFF DC LEVEL
R184	301-272	2.7 k	1/2 w			5%
R185	309-418	18.7 k	1/2 w		Prec	1%
R186	311-097	200 Ω	.5 w	Var		CH1 TAKEOFF GAIN
R189	316-470	47 Ω	1/4 w			
R192	315-511	510 Ω	1/4 w			5%
R193	302-472	4.7 k	1/2 w			
R196	315-152	1.5 k	1/4 w			5%
R203C	309-381	600 k	1/2 w		Prec	1%
R203E	309-382	666.6 k	1/2 w		Prec	1%
R205C	309-383	800 k	1/2 w		Prec	1%
R205E	309-380	250 k	1/2 w		Prec	1%
R207C	309-396	900 k	1/2 w		Prec	1%
R207E	309-379	11.1 k	1/2 w		Prec	1%
R209C	309-385	990 k	1/2 w		Prec	1%
R209E	309-378	10.1 k	1/2 w		Prec	1%
R209F	316-150	15 Ω	1/4 w			
R210	315-100	10 Ω	1/4 w			5%
R211	309-386	1 meg	1/2 w		Prec	1%
R213	316-105	1 meg	1/4 w			
R214	302-221	220 Ω	1/2 w			
R216	302-392	3.9 k	1/2 w			
R219	311-068	500 k	.2 w	Var		DC BALANCE

† Concentric with SW196. Furnished as a unit.



## Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R221	302-105	1 meg	1/2 w			
R223	302-472	4.7 k	1/2 w			
R224	302-101	100 Ω	1/2 w			
R226	302-392	3.9 k	1/2 w			
R235	310-052	10 k	1 w		Prec	1%
R236	304-822	8.2 k	1 w			
R238	302-391	390 Ω	1/2 w			
R239†	*311-334	375 Ω		Var	WW	VARIABLE
R245	310-052	10 k	1 w		Prec	1%
R246	Use 301-0121-00	120 Ω	1/2 w			5%
R247	311-258	100 Ω		Var		CH2 20 MV GAIN
R248	Use 301-0220-00	22 Ω	1/2 w			5%
R249	311-258	100 Ω		Var		CH2 10 MV GAIN
R251	316-150	15 Ω	1/4 w			
R252	316-150	15 Ω	1/4 w			
R253	318-103	600 Ω	1/8 w		Prec	1%
R254	315-821	820 Ω	1/4 w			5%
R255	318-103	600 Ω	1/8 w		Prec	1%
R256	302-153	15 k	1/2 w			
R257	302-473	47 k	1/2 w			
R258	311-114	2x250 k		Var		POSITION
R259	302-473	47 k	1/2 w			
R261	303-243	24 k	1 w			5%
R263	316-221	220 Ω	1/4 w			
R265	303-243	24 k	1 w			5%
R274	301-272	2.7 k	1/2 w			5%
R275	309-418	18.7 k	1/2 w		Prec	1%
R276	302-151	150 Ω	1/2 w			
R281	311-326	10 k		Var		CH2 TAKEOFF DC LEVEL
R284	301-272	2.7 k	1/2 w			5%
R285	309-418	18.7 k	1/2 w		Prec	1%
R286	311-097	200 Ω	.5 w	Var		CH2 TAKEOFF GAIN
R289	316-470	47 Ω	1/4 w			
R292	315-511	510 Ω	1/4 w			5%
R293	302-472	4.7 k	1/2 w			
R296	315-152	1.5 k	1/4 w			5%
R302	302-182	1.8 k	1/2 w			
R305	302-182	1.8 k	1/2 w			
R324	308-237	8.2 k	5 w		WW	5%
R326	301-112	1.1 k	1/2 w			5%
R327	311-246	500 Ω		Var		GAIN ADJ
R328	316-101	100 Ω	1/4 w			
R329	301-0564-00	560 k	1/2 w			5% X270-up
R334	308-237	8.2 k	5 w		WW	5%
R336	301-112	1.1 k	1/2 w			5%
R337	316-470	47 Ω	1/4 w			
R342	302-105	1 meg	1/2 w			X150-up
R343	303-393	39 k	1 w			5% 100-149
	305-393	39 k	2 w			5% 150-up
R344	302-682	6.8 k	1/2 w			100-149

† Concentric with SW296. Furnished as a unit.

Parts List—Type 3A2

Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R344	309-262	6.5 k	1/2 w	Prec	1%	150-399
R344	309-0132-00	5.6 k	1/2 w	Prec	1%	400-up
R346	301-155	1.5 meg	1/2 w		5%	100-399
R346	301-0135-00	1.3 meg	1/2 w		5%	400-up
R347	301-824	820 k	1/2 w		5%	100-149
R347	301-914	910 k	1/2 w		5%	150-399
R347	301-0824-00	820 k	1/2 w		5%	400-up
R348	311-106	200 k		Var		TRIG OUT DC LEVEL
R349	316-101	100 Ω	1/4 w			
R351	301-394	390 k	1/2 w		5%	
R352	316-154	150 k	1/4 w			
R353	311-078	50 k	.1 w	Var		TRIG OUT DC LEVEL CRT SIG
R354	302-222	2.2 k	1/2 w			
R356	Use 303-332	3.3 k	1 w		5%	100-399
R356	303-0473-00	47 k	1 w		5%	400-up
R363	302-151	150 Ω	1/2 w			
R365	308-237	8.2 k	5 w	WW	5%	
R366	301-473	47 k	1/2 w		5%	
R367	301-274	270 k	1/2 w		5%	
R369	302-473	47 k	1/2 w			
R371	302-563	56 k	1/2 w			
R372	302-472	4.7 k	1/2 w			100-300
R372	301-0622-00	6.2 k	1/2 W		5%	301-up
R373	302-224	220 k	1/2 w			100-300
R373	301-0184-00	180 k	1/2 w		5%	301-up
R375	308-237	8.2 k	5 w	WW	5%	
R376	301-473	47 k	1/2 w		5%	
R377	301-274	270 k	1/2 w		5%	
R379	302-473	47 k	1/2 w			
R380	302-102	1 k	1/2 w			100-249
R380	302-0182-00	1.8 k	1/2 w			250-up
R382	302-682	6.8 k	1/2 w			100-249
R382	302-0123-00	12 k	1/2 w			250-up
R383	302-102	1 k	1/2 w			100-249
R383	302-0182-00	1.8 k	1/2 w			250-up
R384	302-105	1 meg	1/2 w			100-249
R384	301-0204-00	200 k	1/2 w		5%	250-up
R385	302-221	220 Ω	1/2 w			
R386	305-0682-00	6.8 k	2 w		5%	X250-up
R387	309-392	20 k	1/2 w	Prec	1%	
R388	308-211	12 k	5 w	WW	5%	
R389	304-0122-00	1.2 k	1 w			X250-up
R390	302-471	470 Ω	1/2 w			
R391	302-224	220 k	1/2 w			
R392	316-101	100 Ω	1/4 w			
R393	302-103	10 k	1/2 w			
R394	301-222	2.2 k	1/2 w		5%	
R395	309-155	40 k	1/2 w	Prec	1%	
R396	306-152	1.5 k	2 w			
R397	306-152	1.5 k	2 w			
R398	308-023	10 k	10 w	WW	5%	
R399	306-822	8.2 k	2 w			100-249X

**Switches**

Ckt. No.	Tektronix Part No.		Description	S/N Range
	Unwired	Wired		
SW101	260-448		Slide AC/DC	
SW110	260-486	*262-522	Rotary VOLTS/DIV	
SW155	260-488	*262-524	Rotary POLARITY	
SW196†	*311-334		CALIB	
SW201	260-448		Slide AC/DC	
SW210	260-486	*262-522	Rotary VOLTS/DIV	
SW255	260-488	*262-524	Rotary POLARITY	
SW296††	*311-334		CALIB	
SW345	260-489		Rotary TRIG SOURCE	
SW360	260-487	*262-523	Rotary MODE	

**Transistors**

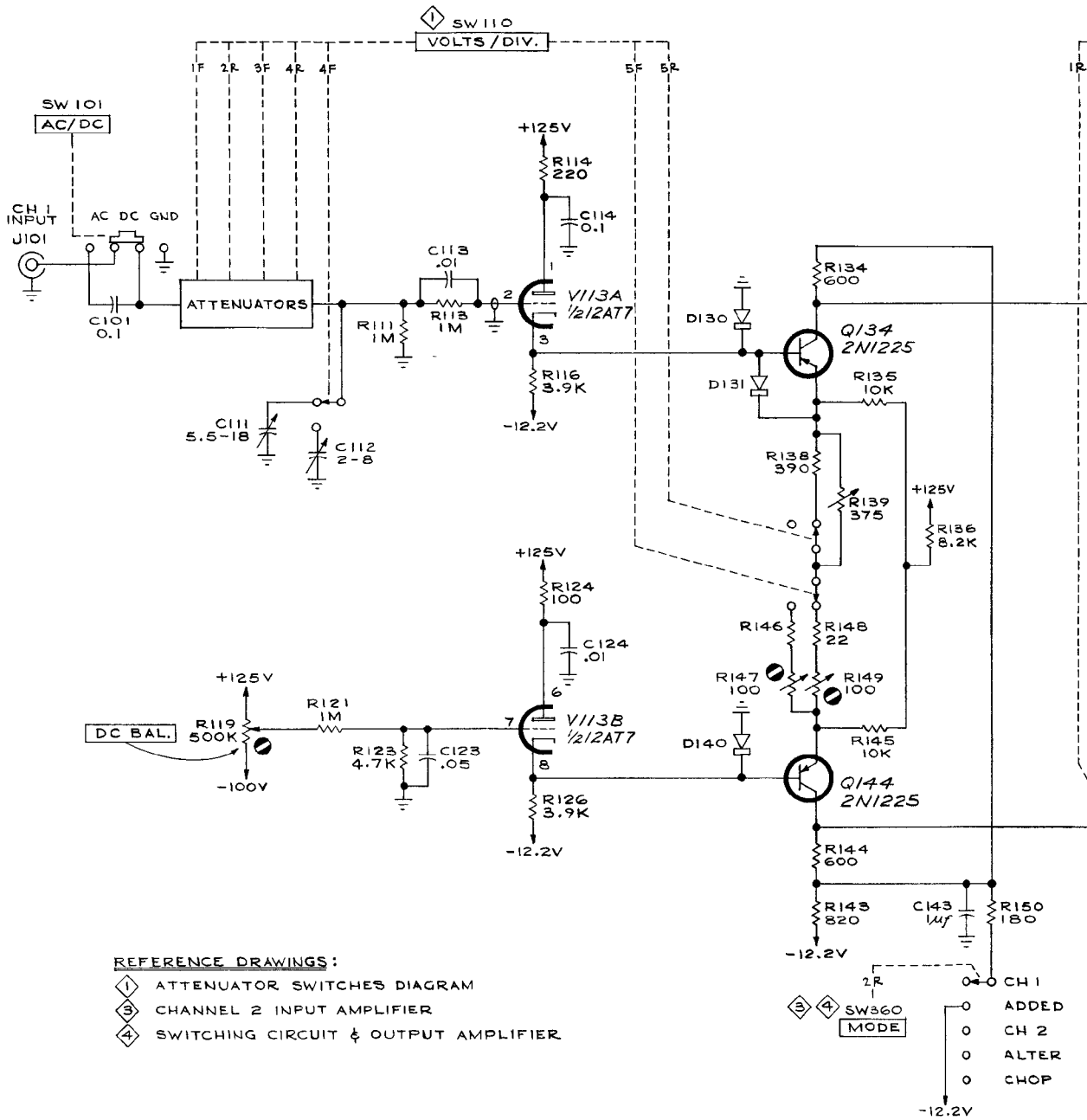
Q134	151-084	2N1225	
Q144	151-084	2N1225	
Q174	*151-103	Replaceable by 2N2219	
Q184	*151-103	Replaceable by 2N2219	
Q193	151-072	2N1308	
Q234	151-084	2N1225	
Q244	151-084	2N1225	
Q274	*151-103	Replaceable by 2N2219	
Q284	*151-103	Replaceable by 2N2219	
Q293	151-072	2N1308	
Q365	*151-0096-00	Selected from 2N1893	100-249
Q365	*151-0103-00	Replaceable by 2N2219	250 up
Q375	*151-0096-00	Selected from 2N1893	100-249
Q375	*151-0103-00	Replaceable by 2N2219	250 up
Q394	*151-0096-00	Selected from 2N1893	

**Electron Tubes**

V113	154-039	12AT7
V164	154-187	6DJ8
V213	154-039	12AT7
V264	154-187	6DJ8
V324	154-163	6BA8
V334	154-163	6BA8
V343	154-187	6DJ8

† Concentric with R139. Furnished as a unit.

†† Concentric with R239. Furnished as a unit.

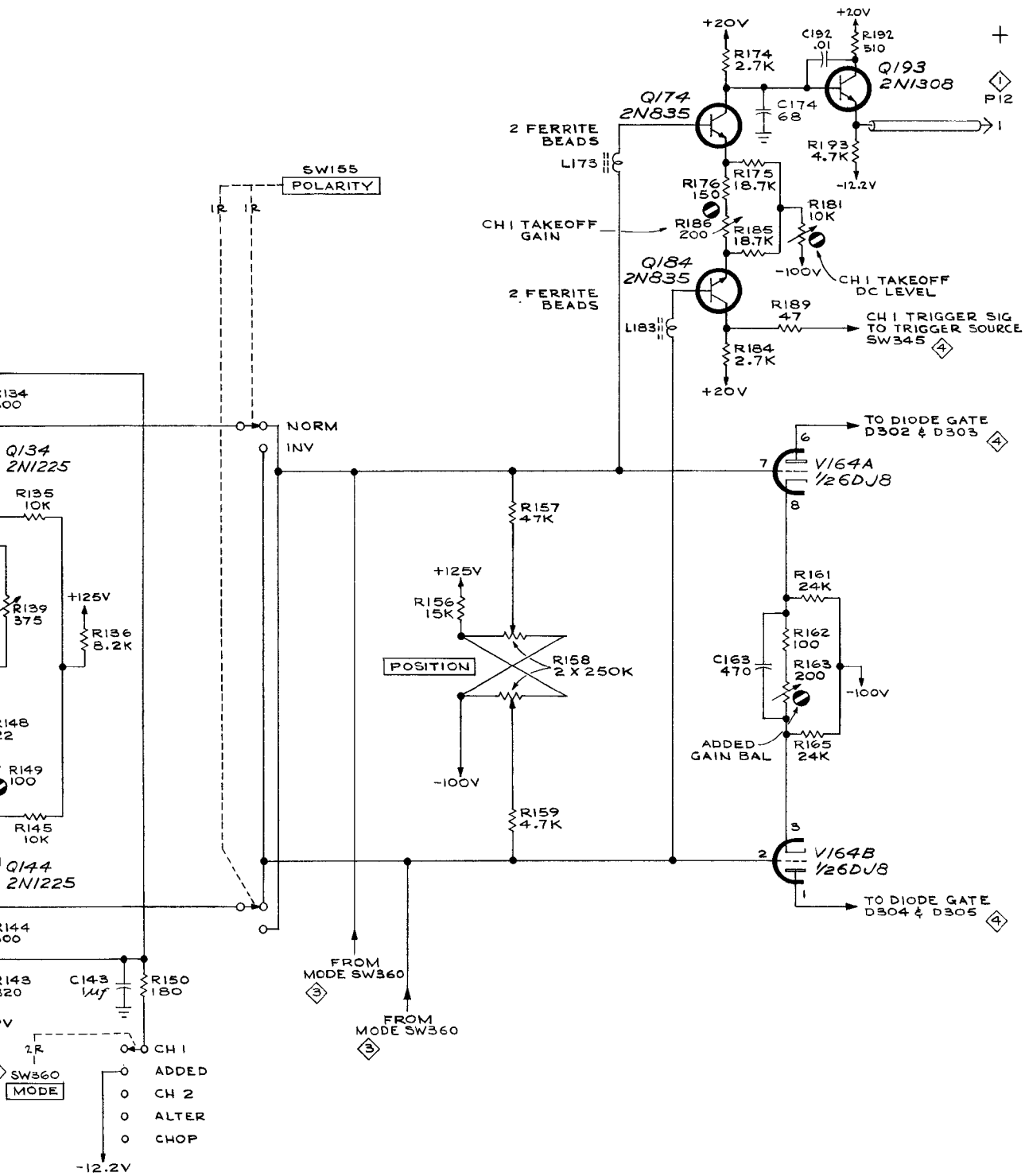


TYPE 3A2 PLUG-IN

B

SEE PARTS  
VALUES AND  
RANGES  
WITH BLU

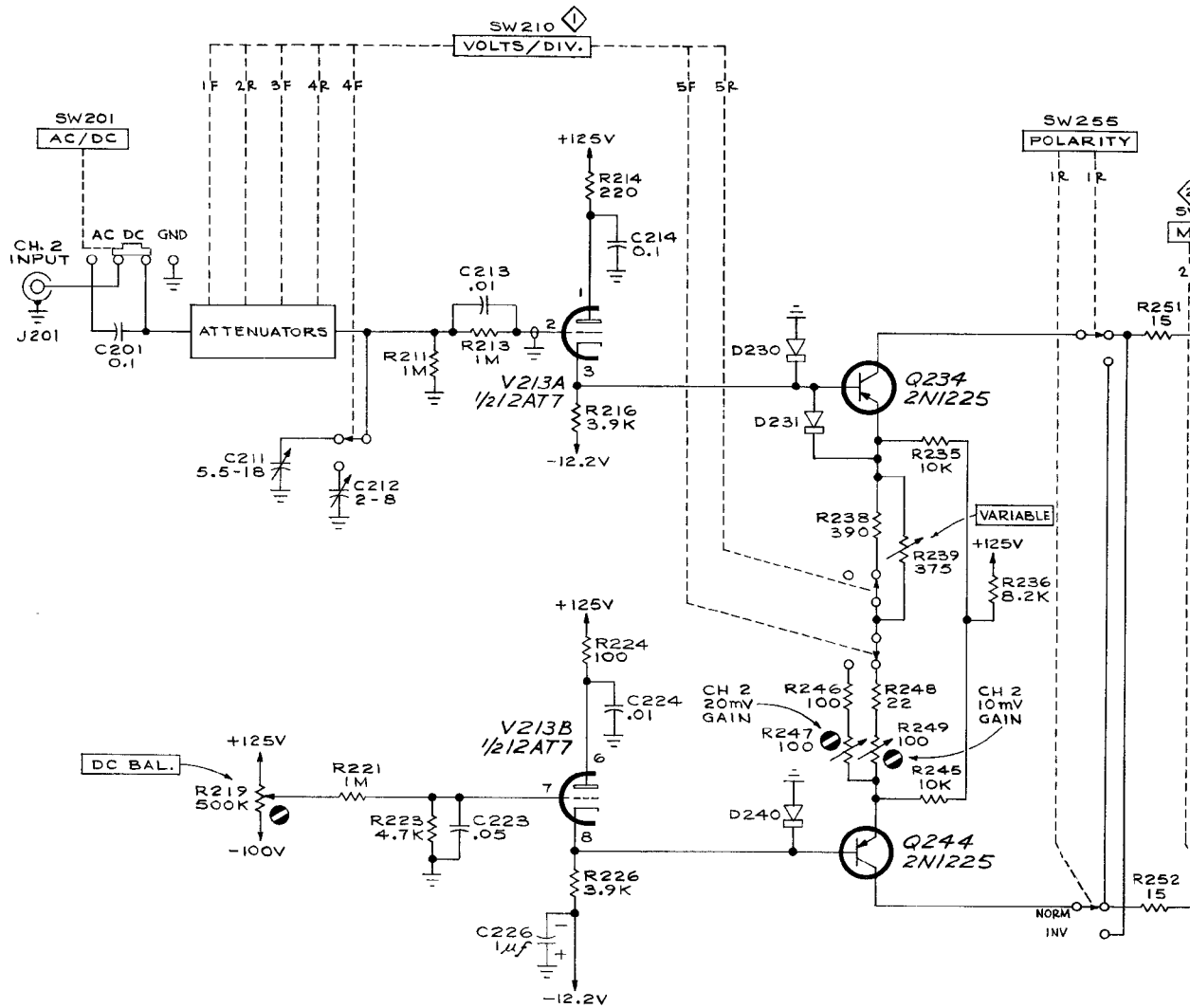
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SEE PARTS LIST FOR EARLIER  
VALUES AND SERIAL NUMBER  
RANGES OF PARTS MARKED  
WITH BLUE OUTLINE.

MRH  
467

CHANNEL 1 INPUT AMPLIFIER



REFERENCE DRAWINGS:

- ① ATTENUATOR SWITCHES DIAGRAM
- ② CHANNEL 1 INPUT AMPLIFIER
- ④ SWITCHING CIRCUIT & OUTPUT AMPLIFIER

TYPE 3A2 PLUG-IN

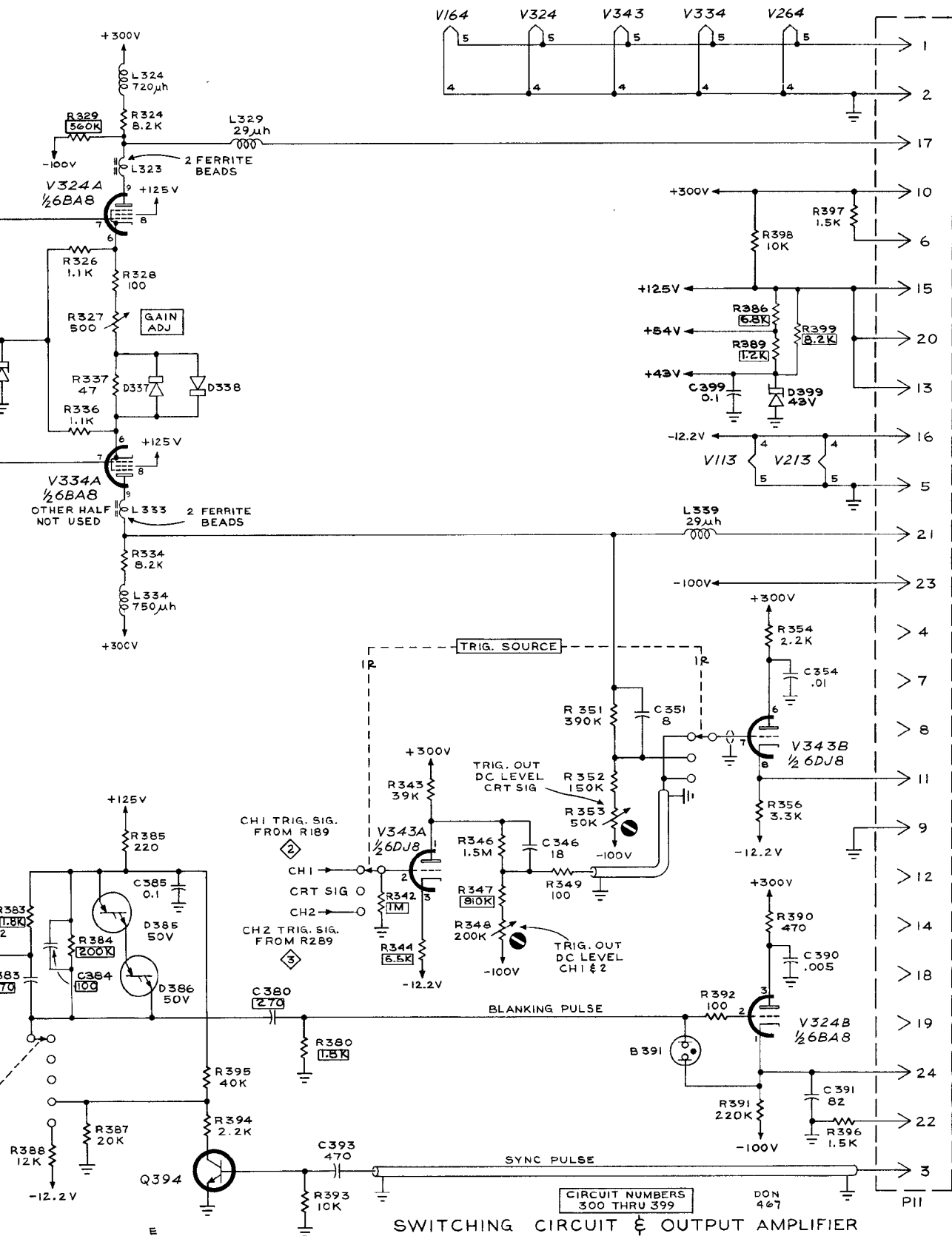
C

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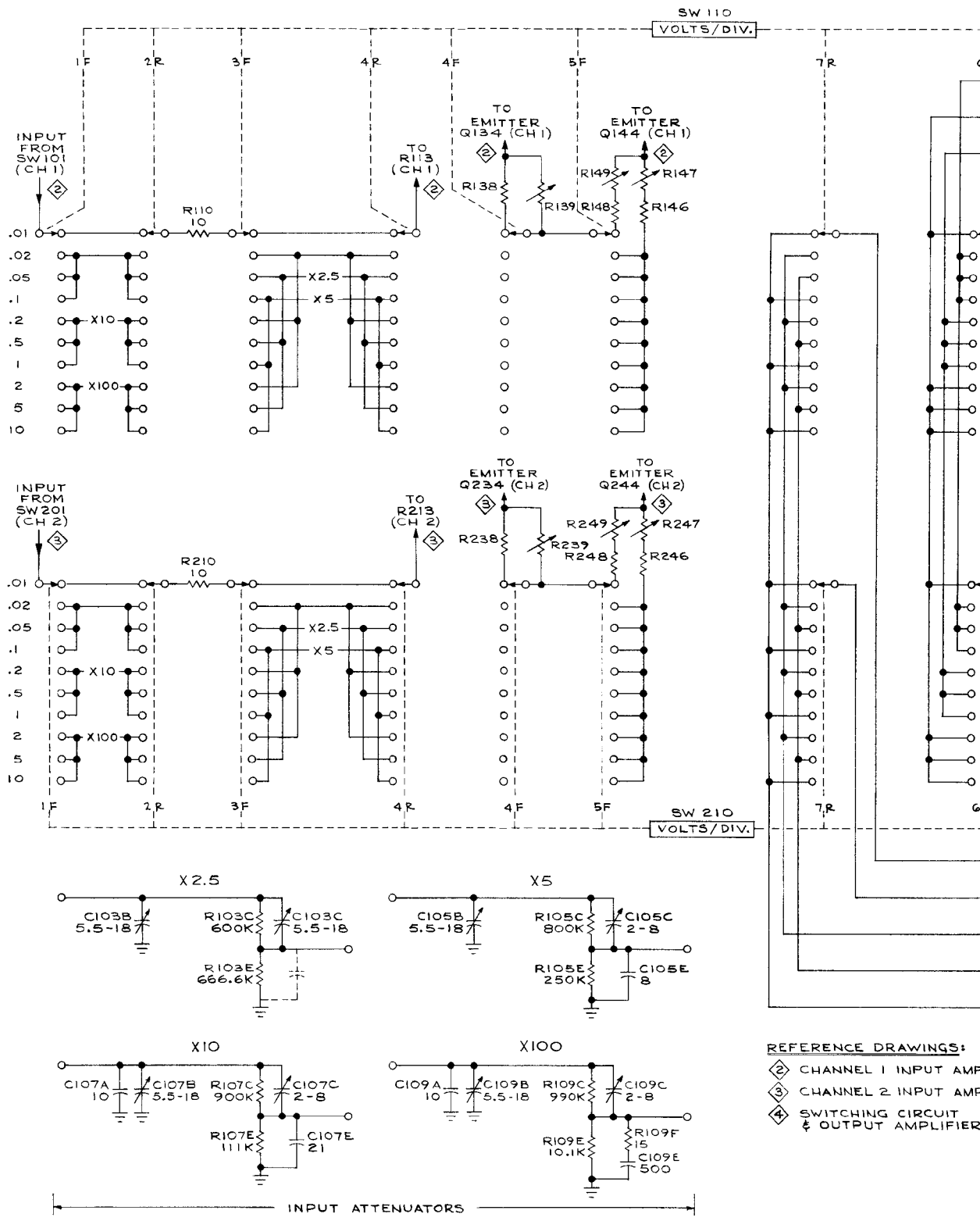




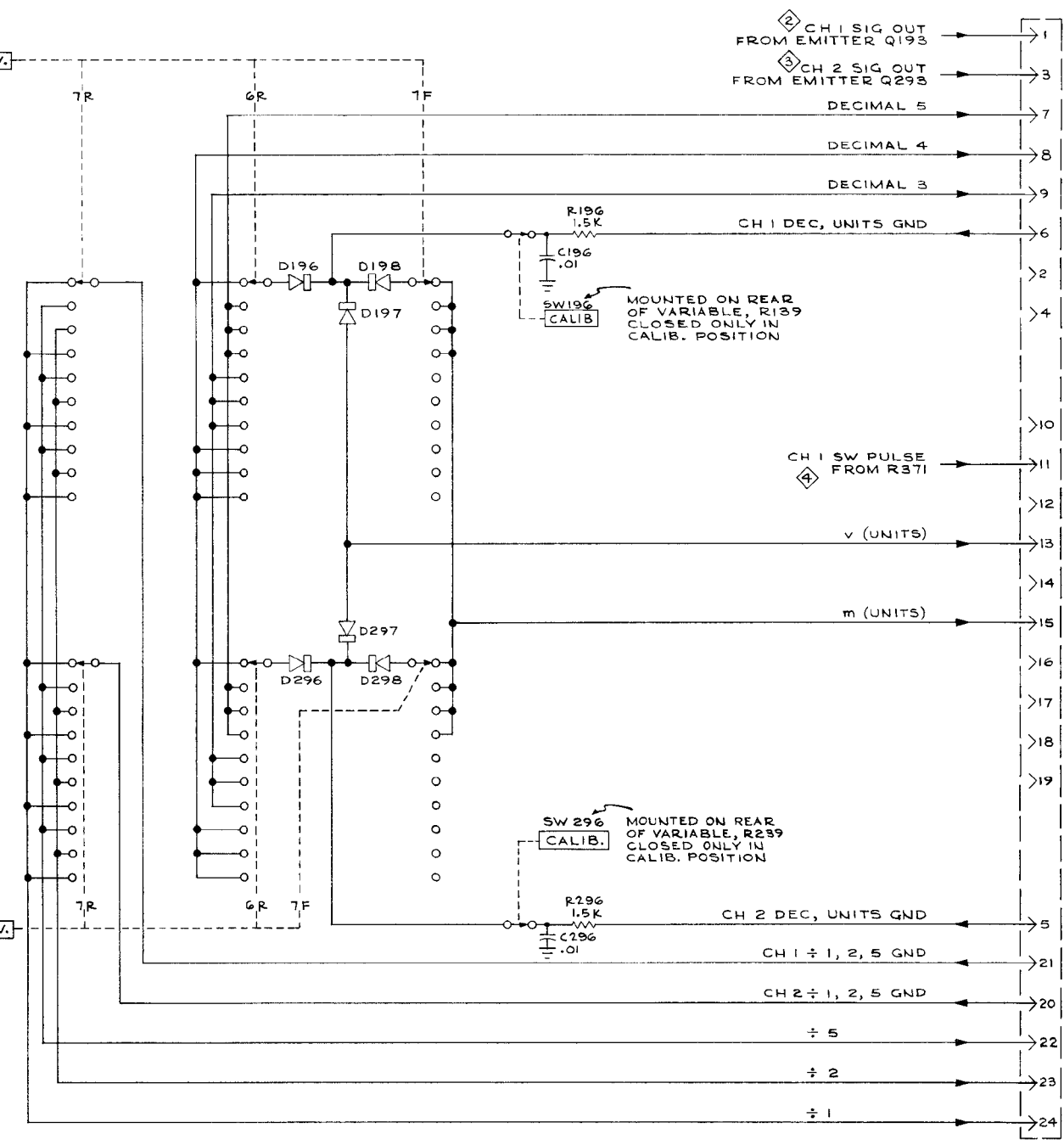




SWITCHING CIRCUIT & OUTPUT AMPLIFIER



TYPE 3A2 PLUG-IN



- REFERENCE DRAWINGS:
- ② CHANNEL 1 INPUT AMPLIFIER
  - ③ CHANNEL 2 INPUT AMPLIFIER
  - ④ SWITCHING CIRCUIT & OUTPUT AMPLIFIER

MRH  
963

ATTENUATOR SWITCHES

A

## **MANUAL CHANGE INFORMATION**

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

TYPE 3A2

TENT SN 370

PARTS LIST CORRECTION

CHANGE TO:

B391

150-0030-00

Neon, NE-2V

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

C346	281-0012-00	7 - 45 pF, Var			
R344	309-0132-00	5.6 kΩ	1/2 W	Prec	1%
R346	301-0135-00	1.3 MΩ	1/2 W		5%
R347	301-0824-00	820 kΩ	1/2 W		5%
R356	303-0473-00	47 kΩ	1 W		5%

ADD:

C344	283-0103-00	180 pF Disc	500 V		5%
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SCHEMATIC CORRECTION

