

INSTRUMENT REFERENCE BOOK

for the Tektronix type

**2B67**

time-base  
plug-in unit

For all serial numbers



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# MPI EXTRACT

MPI January 1964.

## 2B67 (also see 2B67 IRB)

Accessories included

\*American Tel and Tel procedures call out 560/60/67

Calibration procedure

\* 67

\* 2B67

\*Compatibility limitations of 2B67/3A1 combination

\*Compatibility with 560 Series

\*Designation change

Instruction Manual

67

2B67

Maintenance spares list

\*One-shot sweep feature added

Test specifications

FEN

FEN

FEN

SPR-131

SPR-131

061-499

3-30-62

061-206

061-627

1-25-63

5-11-62

8-15-62

070-267

070-366

061-325

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061-206

\*Included within IRB.



SALES

Inter-City Mfg. Co., Inc.  
St. Louis 11, Mo.

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# Section 1

## Characteristics

The Tektronix Type 2B67 Time-Base plug-in unit provides time-base deflection for Tektronix 560-Series oscilloscopes. It provides a triggered or free-running sweep, calibrated or continuously variable. The sweep may be triggered internally from either the vertical signal or the power line, or externally. Either repetitive or single-sweep operation may be selected. The Type 2B67 is normally used to provide the horizontal sweep for 560-Series oscilloscopes, but may be used to provide a vertical sweep, if desired. The unit is also provided with an input for external signals.

### Sweep Rates

1 microsecond to 5 seconds per division in 21 calibrated steps. An uncalibrated control provides continuously variable sweep rates to about 3 times the step-switch setting. Calibrated sweep rates are within 3% of step-switch setting; magnified rates are within 5%.

### Magnifier

Provides a 5-times expansion of the center 2 divisions of display, and extends the fastest sweep rate to 0.2 microsecond/division with 1% linearity after the first four divisions.

### Triggering Modes

Internal, External, and Line. Trigger coupling may be selected from AC slow, AC fast, and DC, and triggering level and polarity are continuously adjustable. Triggering level

may be set to provide free-running or automatically triggered sweeps.

### Triggering Signal Requirements

Internal Triggering: A signal producing two minor divisions of deflection.

External Triggering: A signal from 0.5 volt at dc to 2.0 volts at 2 mc. Sweep will trigger on larger signals, but LEVEL control limit is  $\pm 10$  volts.

### Single Sweep

Single sweep may be selected, allowing sweep to operate only after manual reset for either triggered or free-running operation.

### External Signal Input

Bandpass: Dc to about 750 kc,  $\pm 3$  db.

Sensitivity: About 1 volt/division.

### Construction

Aluminum-alloy chassis.

### Finish

Anodized aluminum front panel.

### ACCESSORIES

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



# CATALOG

## CHANGE IN PLUG-IN TYPE DESIGNATION

SPR-131 8-15-62

Sometime in the next few months: Type 67 will become Type 2B67 (and price increased to \$175)

The primary reason for the change is to make the type-designations consistent with the new system. Examples: 3S76, 3T77, 3A74, 3A1, 3B1, 3B3. Except for the 2B67, there will be no electrical differences. The 2B67 will have a one-shot sweep feature added, and its price will increase from

\$160 to \$175. Grey knobs instead of black knobs will be a distinguishing mechanical difference on all of the above.

All future advertising will refer to the new designations, and the 2B67 will be listed at the higher price. Currently estimated 2B67 availability is January 1963.

## 2B67 AS COMPANION TO 3A1

FEN 1-25-63

The only single (non-sweep delay) time base presently available for the 560 Series (real-time) is the 2B67. Because of the 560 compatibility requirement and the need for holding a moderate price on this plug-in, it does not seem practical to try to beef it up further to make it more compatible with the 10Mc bandwidth of the 3A1.

Customers should understand the limitations of the 3A1/2B67 combination before investing heavily. The chief limitations are:

1. Sweep range: Fastest sweep is  $1 \mu\text{sec}/\text{cm}$ , or  $0.2 \mu\text{sec}/\text{cm}$  when magnified. The risetime of the 3A1 at best, then, occupies only 1.75 mm horizontally.
2. Triggering frequency range: The 2B67 is spec'd to trigger on 2v of 2Mc externally. It's hard to spec "internal" on the instrument, since it all depends on the vertical plug-in. However, a 1 cm 2Mc display in the 3A1 will trigger the 2B67 nicely, and the

2B67 will follow a larger signal (2-4 cm) out to about 5Mc with a little operator skill. Beyond 5Mc, it's a matter of brute force and chance.

3. Fast Sweep Rep Rate: Because the holdoff is not shortened very much for the fastest three sweeps, the maximum duty cycle is pretty low (about 12%), providing a fairly dim magnified sweep at best. An IRS (6615) is under evaluation to see whether the duty cycle can be brought up to 25-30% without increasing cost.

Except for the limitations above, the 2B67 and 3A1 are fully compatible, and will be useful for many general-purpose applications. Presently, customers wishing to get maximum use from a 3A1, though, should use the 3B1 or 3B3. A single time base...more on the 3B1 pattern...is under consideration, but it will probably not be in the \$175 price class.



## DEMO

AMERICAN TELEPHONE AND TELEGRAPH PROCEDURES CALL OUT 560/60/67

FEN 3-30-62

Chuck Spencer (Detroit) reports that American Telephone and Telegraph's "Panel Unguarded Intervals Instruction Manual" distributed to telephone offices using panel machine switching equipment calls out use of the Type 560 with Type 60 and Type 67 Plug-ins as a test instrument.

Although the use of a scope (or American Tel and Tel's procedures) is optional with the operating company -- or the local maintenance engineer -- Chuck reports that use of the scope

provides much more accurate settings than were previously possible with mechanical gauges, etc., and hence more efficient operation of the local equipment.

Since the American Tel and Tel manual fails to mention Tek cameras in their "available equipment" listing, it might pay to haul one along if your local telco asks for 560 demo. A telephone company will need a scope camera of some kind for every 6 scopes or so.



# COMPATIBILITY

## COMPATIBILITY WITH 560 SERIES

FEN 5-11-62

The 2B67 is directly compatible with the following instruments (no sn exceptions):

560	RM561A	*RM567
561	565**	564
RM561	RM565**	
561A	*567	

\* The 2B67 doesn't provide digital readout in the 567 or RM567.

\*\*565 and RM565 have built-in time bases, and use plug-ins for vertical deflection only.

## 560-SERIES: 2B67, 3B1, 3B3 AND 3B4 MODS PROVIDE INTERNAL SAWTOOTH SIGNAL FOR 3L10

Geoff Gass, 8-11-65

Production modifications 9725-9726-9727-9728 provide a standardized sawtooth signal from 560-series time-base plug-ins for driving the 3L10 Spectrum Analyzer swept oscillator. The sawtooth signal is a standardized current ramp of  $66 \mu\text{A}/\text{cm}$  (nominal) fed from the sawtooth CF of the time base via a standardizing resistor (95.3 to 221 k $\Omega$ ) to pin 18 of the interconnecting plug, driving pin 18 of the opposite plug-in connector.

The current signal is intended to drive a low-impedance ( $\leq 2 \text{ k}\Omega$ ) circuit, such as the minus input of an operational amplifier or the emitter of a transistor, with a positive-going linear ramp of current. It cannot be used to drive two circuits (e.g., 3L10 and Sawtooth Out) at the same time, nor can it be used successfully as a "voltage" signal source, especially at faster sweep rates. The high source impedance of this signal prevents excessive crosstalk of sweep signal into vertical plug-ins in which pin 18 is open.

The modification (one resistor and one piece of co-ax per time-base) is easily done in the field, and 040-kits will be available for this purpose.

For 561 S/N 101-578 (with 18 scattered excep-

tions S/N 101//574), kit 040-0267-00 "Adaptation to 3S76-3T77" must also be installed for 3L-Series compatibility.

Function assignment for pins 18/19 in the 560-series indicators is now:

1. "Sample" command from 3T series to 3S series sampling plug-ins.
2. X-Y Pairing signal for 3A74/3A74 or 3A72/3A72.
3.  $66 \mu\text{A}/\text{cm}$  sawtooth signal from 2B67, 3B1-3-4 to opposite compartment.

In the 565-RM565, pins 18-19 remain unconnected, as multiple-trace X-Y pairing and sampling applications cannot be accommodated in this instrument, and the horizontal display switching between beams makes it difficult to have both accurate, stable drive to a 3L10 and foolproof connection of the proper time-base signal to the proper plug-in compartment. For a specific application (e.g., Time Base A always drives upper beam plug-in) the field mod would be similar to that for a 2B67.



## MODIFIED PRODUCTS

<u>Product</u>	<u>Mod</u>	<u>Description</u>
## 2B67	104C	Remote-actuated relay for single sweep reset via interconnecting plug pin 24.
2B67	115G	% variable horizontal input attenuator.
2B67	118R	Add. 5 $\mu$ s/cm. Delete slowest range. New panel.
2B67	118U	Remove 1 and 2 $\mu$ s/cm and add 12 and 24 s/cm.
2B67	119J	Rotan jack, panel.
2B67	119S	+ gate out and sawtooth out binding posts, rear.
## 2B67	120H	150V SAWTOOTH OUT, direct to front panel binding post.
2B67	157C	+ gate out with emitter follower.
## 2B67	157D	Front panel +GATE OUT, +20V, instead of EXT INPUT.
2B67	163B	RFI all conn. BNC/caps.
2B67	236G	Horizontal signal out cathode follower. Variable. Horizontal input sensitivity control.
2B67	237E	Letter of certification. Tek ident removed. Name plate, new panel.
2B67	237H	Remove Tek ident and serial number.
2B67	247E	Front connectors paralleled to rear. Tek ID removed. Special paint.
2B67	258B	Iridite subpanel. Paint iridite panel.
2B67/3A74 RM564	262C	Customer supplied panel and connectors. 3A74 has reed switches installed.
## 2B67	401T	Switchable rear EXT TRIG input; front panel EXT TRIG changed to BNC; Triggering switches changed to lever type.
## 2B67	401V	2V to 12V negative-going sawtooth output via rear panel connector holder; adjustable amplitude and offset; manual sweep with output.
2B67	405A	Mod 119S plus 2 rear pigtails for gate and sawtooth.
2B67	426K	Mod 118R and Mod 804B. Special panel.
2B67	504C	System. RM561A, 3A72, 3A74, 2B67.
2B67	504D	System. 561A, 3A72, 2B67. 5 cm time base. Channel one left half of screen. Channel two right half, selectable or alternate.
2B67	505B	Medical system for Ampex. RM561A, 3A7, 2B67.
2B67	505B	Medical system. RM564, 3A7, 2B67.
2B67	701C	Sawtooth out rear Delrin. Divider to provide one volt sawtooth.
## 2B67	787A	Adjustable average output DC level for X-Y matching.

## MODIFIED PRODUCTS

<u>Product</u>	<u>Mod</u>	<u>Description</u>
2B67	801U	One horizontal input paralleled to rear, BNC internal release.
## 2B67	802Q	EXT INPUT and EXT TRIG connectors changed to BNC.
2B67	803D	External horiz. paralleled to rear, Delrin.
## 2B67	803F	Parallel input to EXT TRIG and EXT INPUT from rear-panel connector holder.
## 2B67	803W	External trigger input paralleled to rear connector holder.
2B67	804B	Trigger input changed to BNC.
2B67	804D	External trigger binding post changed to UHF.



Inter-City Mfg. Co., Inc.  
St. Louis 11, Mo.

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# PERFORMANCE

## POWER REQUIRED BY 564/3A72/2B67

5-13-63

Ron Bell to Field Information

Will Marsh to Ron Bell

What is the exact power requirement for a 564/3A72/ 2B67 combination?

Power requirement 564/3A72/2B67 is 156 watts at 105 volts. 184 watts at 117 volts. 200 watts at 124 volts.

Singer needs information for system planning.

## POWER DRAIN -- 560 SERIES PLUG-INS

Geoff Gass, 5-21-65

The power supply loading indicated below will vary somewhat with line-voltage and front-panel control settings. Where series-regulator shunts are indicated, the shunt consists of 2k in the indicator unit in series with 0 to 6k in the plug-in, the series combination connected between the unregulated supply and the regulated supply (in the -100v supply, between the unregulated +supply and ground). The shunt supplies the extra current drawn by the plug-in beyond that which can be handled by the series regulator. The actual amount of shunt current varies with line-voltage, so if a positive power-supply bus in the plug-in is opened to take a current reading, the reading will be in error unless the bus is opened on the load side of the shunt connection (with the shunt still connected). The -100v bus carries the entire load current, so a current measurement at

the plug-in connector is always correct for this supply. There is no shunting for the -12.2v supply.

CAUTION: The values below should not be used to determine if there is any "extra" power available in the compartment for other purposes or plug-in modifications. The values of the shunts, the total dissipation in the plug-in, the limitations of the indicator (transformer and series regulators) and the characteristics of the other plug-ins with which a given plug-in may be used all limit the amount of power "available" in a given plug-in compartment; in most cases, there is little or no margin allowed for extra current drain without modification of the shunts or circuitry. See 040-0245-00 instructions and power drain discussion in PRB's for indicators.

Plug-In	-100 v, shunt	-12.2 v	+125 v, shunt	+300 v, shunt	6.3 v AC	117 v
(2B)67	50-70 FS	0	25-40 --	22-25 --	3.5 A	0

Performance - continued

ENVIRONMENTAL CHARACTERISTICS

The 2B67 was engineered before design goals for environmental characteristics were established. The performance requirements given in the environmental characteristic sheet are the most accurate figures available without performing extensive environmental tests. They are to be used as a guide not as an instrument specification.

Characteristic	Performance Requirement	Supplemental Information
<u>Temperature</u>		
Nonoperating	-40 to +65°C	Derate maximum operating temperature by 1°C/1000 ft above 5000 ft.
Operating	Same as oscilloscope used to display signal	
<u>Altitude</u>		
Nonoperating	50,000 ft.	
Operating	10,000 ft.	
<u>Vibration</u>		
Operating	0.015 inch pk-pk 10-50-10 cps (1.9G), 15 min each axis, three minutes at resonance or 50 cps, 55 minutes total	
<u>Shock</u>		
Nonoperating	30G's, 1/2 sine, 11ms; one shock in each direction of the three axes; total of six shocks	
<u>Humidity</u>		
Nonoperating		
<u>Transportation</u>		
Package Vibration Package Drop	Qualifies under NSTC test procedure 1A, Category II (24 inch drop)	

# CALL REPORT EXTRACTS PERFORMANCE

3A74 SEQUENCE SKIP

CUSTOMER <b>Douglas Aircraft Company</b>		FIELD ENGINEER <b>Dean Butts</b>	
CITY AND STATE <b>Santa Monica, California</b>		DATE <b>APR 9 1964</b>	MONTH-DAY-YEAR <b>3/26/64</b>
GROUP <b>Instrumentation</b>	GROUP FUNCTION		
NAMES <b>Tom Hornung - Engineer</b>			

PROBLEM

564 S/N 522, 3A74 S/N 968, 2B67 S/N 7713 - With the 3A74 set for four trace alternate operation and the 2B67 set for single sweep and free run, Tom showed me that the 3A74 didn't progress through the four traces in sequence when the reset switch was depressed. It might be ready to sweep on channel 3, and when the reset button was depressed and released, it might skip to #1 or #2. This skipping seemed to be entirely random. Later at the office, I tried this with two of our demos, and they did essentially the same thing. Can we assume that this is normal? (Copy sent to Geoff Gass - Product Information). They have an application where this feature would be very useful if it worked.

*It's normal — 2B67 switch noise is amplified by sweep multi and sends bursts of alt. sync pulses to 3A74. This only causes trouble with 3A74 in alternate and 2B67 in 'free-run'. No cures known (except "3B4"!)*

*—GG*



## Section 2

# Operating Instructions

In the following instructions it is assumed that the Type 2B67 is inserted in the right-hand (X-axis) opening of the oscilloscope, thereby providing horizontal deflection of the trace. If it is inserted in the left-hand (Y-axis) opening of the oscilloscope it will provide vertical deflection and the instructions must be interpreted accordingly. It is further assumed that there is an amplifier plug-in unit in the left-hand opening of the oscilloscope.

### Front-Panel Controls and Connectors

POSITION	Controls horizontal position of the crt display.
CALIBRATION	Adjusts amplifier gain to compensate for differences in crt deflection factors.
TIME/DIV.	Selects the desired sweep rate from a choice of 21 calibrated rates. In addition, an EXT. INPUT position is provided for connecting external signals.
VARIABLE	Provides a continuous range of sweep rates between the fixed steps of the TIME/DIV. switch. (The sweep rates are calibrated only when the VARIABLE control is set fully clockwise to the CALIBRATED position.) By pulling the VARIABLE control out, 5X magnification of the sweep is obtained.
UNCAL. Lamp	Lights when VARIABLE control is off CALIBRATED position to warn operator he is using an uncalibrated sweep rate.
EXT. INPUT	Input connector for application of external signals (TIME/DIV. switch must be in the EXT. INPUT position).
EXT. TRIG.	Input connector for external triggering signal.
STABILITY	Sets voltage level at input to Time-Base Generator to permit proper triggering by Time-Base Trigger.
LEVEL	Selects the voltage level on the triggering signal at which the sweep is triggered. This control also selects automatic triggering (AUTO. position) or allows the sweep to free run (FREE RUN position).
SLOPE	Selects whether the sweep starts on the positive-going portion (+ Slope) or negative-going portion (— Slope) of the triggering signal.
COUPLING	Selects AC Slow, AC Fast, or DC coupling of trigger input.
SOURCE	Selects the source of the triggering signal. INT. signal is obtained from the vertical plug-in unit. LINE signal triggers units at line frequency, and EXT. requires an externally-supplied signal.
MODE	Selects either normal triggered sweep or single sweep which must be reset with switch.

**READY Lamp** Lights when sweep is reset and ready to be triggered in the SINGLE SWEEP position of the MODE switch.

### Sweep Triggering

To obtain a stable display, it is necessary to begin each sweep by reference to the input signal, or by some signal which bears a fixed time relationship to the input signal. The following instructions tell you how to select and use the proper triggering signal for various applications.

### Selecting the Triggering Source

For most applications the sweep can be triggered by the input signal. The only requirement is that the display amplitude must be at least two minor graticule divisions. To trigger the sweep from the displayed signal, set the SOURCE switch to the INT. position.

Sometimes it is best to trigger the sweep with an external signal. To use an external signal for triggering the sweep, connect the trigger signal to the EXT. TRIG. connector and set the SOURCE switch to EXT. External triggering is especially useful where signals are measured from several different places within a device. By using external triggering, it is not necessary to reset the triggering controls each time a new waveform is shown. External triggering may also be used with a dual-trace amplifier in the alternate mode to show the proper time relationship between the two displayed signals. For a stable display, the external triggering signal should have an amplitude of at least one volt, peak-to-peak, and bear a fixed time relationship to the displayed signal.

To observe a signal that bears a fixed time relationship to the line frequency, you may wish to trigger the sweep from the line-frequency signal. To do this, place the SOURCE switch to the LINE position.

### Selecting the Trigger Coupling

For most recurrent waveforms satisfactory triggering will be obtained with the COUPLING switch in the AC SLOW position. However, when triggering from very low frequencies (below about 16 cps), greater triggering sensitivity will be obtained with the COUPLING switch in the DC position. The AC FAST position of the COUPLING switch should be used to trigger only on the high-frequency component of a signal containing both high- and low-frequency components, and when using a dual-trace plug-in unit in the alternate mode with internal triggering.

With ac coupling, the sweep is triggered when the signal reaches a given amplitude with respect to its dc average. With dc coupling, the sweep is triggered when the signal reaches a definite dc amplitude.

## Selecting the Trigger Slope

When the SLOPE switch is in the + position, the sweep is triggered on the positive slope of the triggering signal. When the SLOPE switch is in the — position, the sweep is triggered on the negative slope of the triggering signal (see Fig. 2-1).

## Selecting the Trigger Level

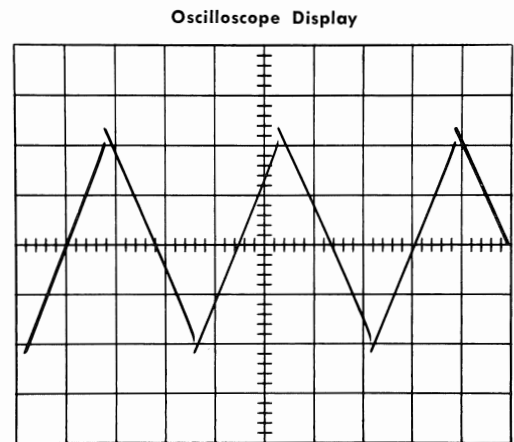
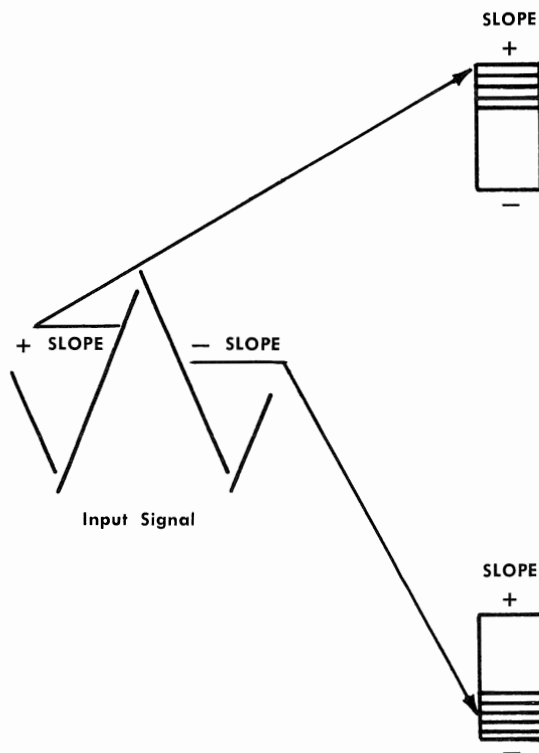
The LEVEL control determines the instantaneous voltage level (ac or dc, depending on the setting of the COUPLING switch) on the triggering signal at which the sweep is triggered. With the SLOPE switch in the + position, adjustment of the LEVEL control makes it possible to trigger the sweep at virtually any point on the positive slope of the triggering signal. Likewise, with the SLOPE switch in the — position,

adjustment of the LEVEL control makes it possible to trigger the sweep at virtually any point on the negative slope (see Fig. 2-2).

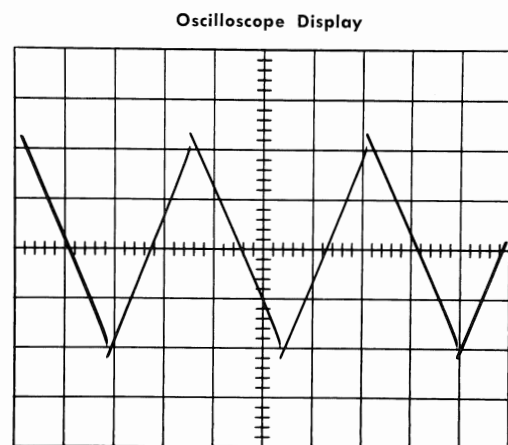
At the extreme ends of its range, the LEVEL control activates the FREE RUN and AUTO switches. The effects of these switches are discussed in the following paragraphs.

## Automatic Mode of Operation

With the LEVEL control set to AUTO., the Type 2B67 will trigger automatically on most signals. In this mode the triggering signal is ac-coupled, and the triggering level is automatically set. Normal amplitude internal or external triggering signals will trigger the sweep. In the absence of a triggering signal, the sweep triggers automatically at about a 50-cps rate.



Sweep Triggered On + Slope



Sweep Triggered On — Slope

Fig. 2-1. Effect of SLOPE switch on display.

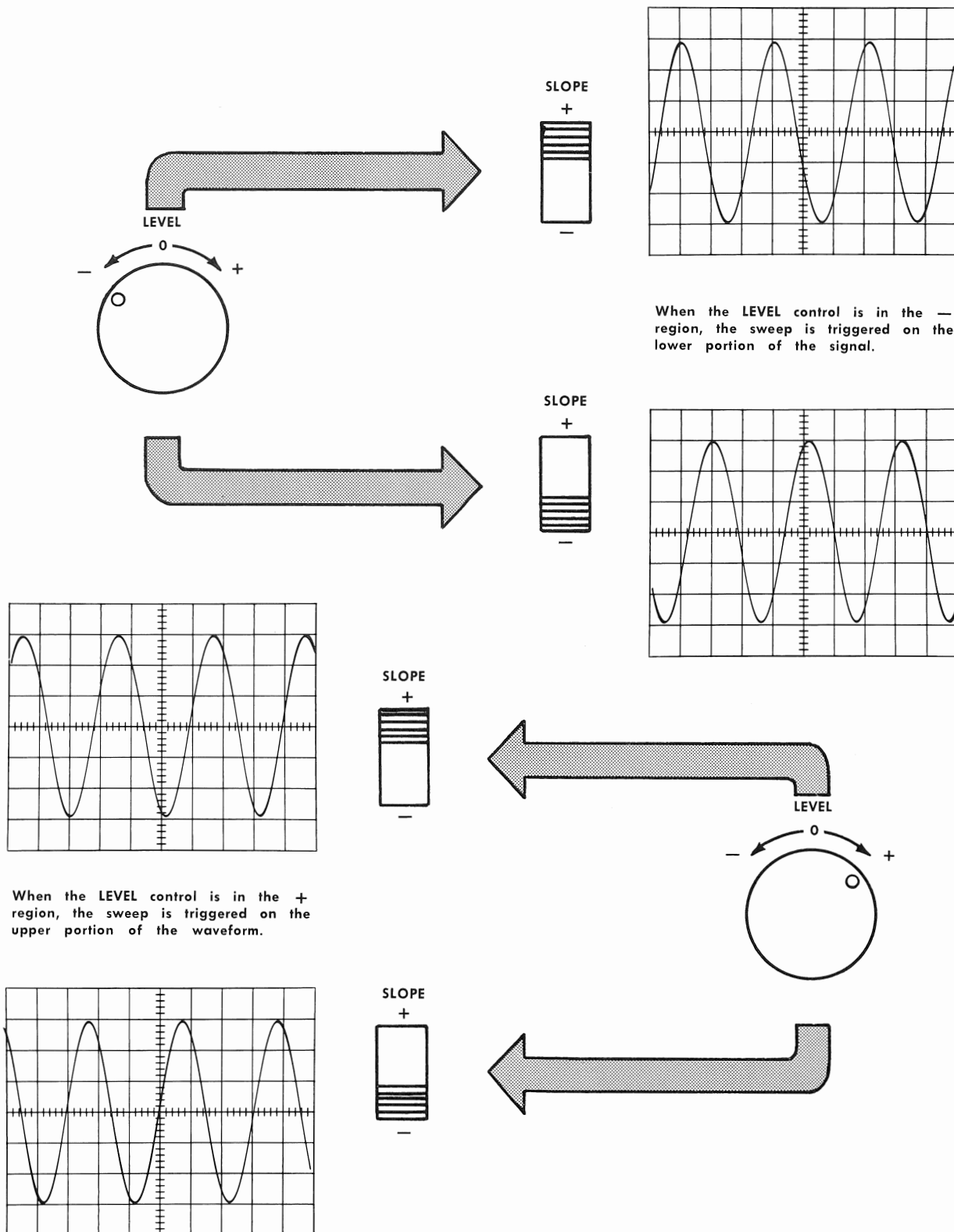


Fig. 2-2. Effect of the LEVEL control and SLOPE switch.

## Free-Running Mode of Operation

Setting the LEVEL control to FREE RUN produces a free-running sweep, independent of any trigger signal. Frequency of the free-running sweep depends on the setting of the TIME/DIV. switch. A free-running trace is useful as a base line for making dc measurements.

## Single Sweep Operation

The usual repetitive display is best for most applications. However, in applications where the displayed waveform is not repetitive in amplitude, slope, or time, a repetitive sweep produces a jumbled display. When observing a waveform of this type, it is usually advantageous to use a single-sweep presentation.

The Type 2B67 provides single-sweep operation so information can be recorded without confusion that could result from multiple traces. Single-sweep operation is selected by placing the MODE switch to SINGLE SWEEP.

When the LEVEL control is set to FREE RUN, a single sweep occurs immediately each time the MODE switch is pressed to the RESET position and released. With the LEVEL control set for triggered sweep, the single sweep does not occur until the first triggering signal after momentarily pressing the switch to RESET. The READY lamp lights after the sweep has been reset, indicating that the sweep is ready to be triggered. When a trigger signal occurs, the sweep runs, the READY light goes out, and the sweep waits until the switch is again pressed to RESET and released. Each time the sweep runs and the switch is pressed to RESET, the procedure is repeated.

When operating the Type 2B67 in the single-sweep mode, the apparent brilliance of the trace will be less than that during repetitive sweep operation. This is because the crt phosphor persistence makes a repetitive sweep look brighter than each individual sweep. In an attempt to increase the single-sweep brilliance you may increase the intensity too much. There is a point of maximum intensity above which a proper focus cannot be obtained. To get the best resolution

during single-sweep work, first be sure that the intensity is within the range where a small spot can be sharply focused.

## Magnification of the Sweep

Any portion of the trace can be expanded horizontally five times by pulling the VARIABLE control knob out. To expand any portion of the trace, move the portion to be expanded to the center of the graticule with the POSITION control, and pull the VARIABLE control knob out.

To determine the true sweep rate in magnified sweep operation, divide the setting of the TIME/DIV. switch by five. (The VARIABLE control must be turned fully clockwise.)

## Setting the CALIBRATION Adjustment

Any time you move the Type 2B67 from one oscilloscope opening to another, you must adjust the CALIBRATION adjustment to compensate for differences in crt deflection-plate sensitivities.

To properly set the Type 2B67 CALIBRATION adjustment in an oscilloscope with a line-frequency Calibrator, proceed as follows:

1. Set the TIME/DIV. switch to 5 mSEC and display a Calibrator signal on the crt.
2. Set the CALIBRATION adjustment so the number of cycles of Calibrator signal in 10 graticule divisions is equal to the line frequency times 50 milliseconds. (If the line frequency is 60 cps, there will be 3 cycles displayed in 10 divisions.)

If your oscilloscope does not have a line-frequency Calibrator, you can display a line-frequency waveform and set the CALIBRATION adjustment for the proper number of cycles.

In the Calibration instructions in this manual, there is another method of setting the CALIBRATION adjustment which is more accurate, but requires the use of a time-mark generator.

## Section 3

# Applications

### Time Measurements

The calibrated sweep rates of the Type 2B67 Time Base make any horizontal distance on the crt represent a known time interval. This allows you to accurately measure the time between two displayed events directly from the crt. The following method is useful for most applications.

1. Measure the horizontal distance (on the graticule) between the two displayed events whose time interval you wish to find.

2. Multiply the distance measured by the setting of the TIME/DIV. switch to obtain the apparent time interval. (The VARIABLE control must be in the CALIBRATED position.)

3. Divide the apparent time interval by 5 if the 5X MAG. is on to obtain the actual time interval.

For example, assume the TIME/DIV. switch setting is 1 mSEC, the magnifier is on, and you measure 5 divisions between events. The 5 divisions multiplied by 1 millisecond per division equals an apparent time interval of 5 milliseconds. The apparent time divided by 5 then equals the actual time interval of 1 millisecond.

### Frequency Measurements

Using the method described for time measurements, you can measure the period (time required for one cycle) of a recurrent waveform. The frequency of the waveform can then be calculated, since frequency is the reciprocal of the period. For example, if the period of a recurrent waveform is found to be 0.2 microsecond, the frequency is the reciprocal of 0.2 microsecond, or 5 mc.

At any given sweep rate, the number of cycles of the input signal displayed in 10 graticule divisions is dependent on the frequency of the signal. At a sweep rate of 1 microsecond per division, for example, 6 cycles are displayed for a 600-kc signal, 5 cycles for a 500-kc signal, and 4 cycles for a 400-kc signal. The frequency of a signal can usually be measured quicker, however, by the following method.

The frequency of a repetitive signal is equal to the reciprocal of the time (in seconds) for one cycle. Greater accuracy is possible by counting the total number of cycles for a 10-division display. Since the TIME/DIV. switch indicates the time for 1 division, multiply this setting by 10 to find the time required for 10 divisions.

To obtain the frequency of a repetitive input signal, perform the following steps:

1. Set the TIME/DIV. switch to display several cycles of the signal. Be sure the VARIABLE control is in the CALIBRATED position.

2. Count the number of waveform cycles shown in the 10 graticule divisions.

3. Divide this number by 10 times the TIME/DIV. switch setting. This equals the frequency of the signal.

For example, assume you are using a sweep rate of 50 milliseconds per division, and you count 7.2 cycles in 10 divisions. The frequency is equal to 7.2 cycles divided by 0.5 second (500 milliseconds), or 14.4 cycles per second.

### Phase Measurements

Phase measurements can be obtained directly from the crt display. A complete cycle of a sinusoidal waveform is 360 degrees; therefore, it is possible to calibrate the oscilloscope display directly in degrees per division by means of the TIME/DIV. controls. For example, if the TIME/DIV. controls are adjusted so one cycle of the displayed waveform covers 9 divisions (see Fig. 3-1), each division corresponds to 40 degrees and the display is calibrated to 40 degrees per division.

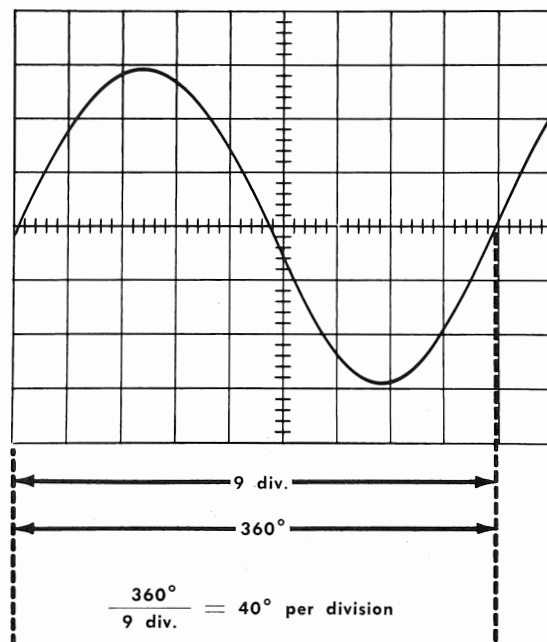


Fig. 3-1. One method for calibrating the oscilloscope display in degrees per division.

It is therefore possible to measure phase angles by: (1) calibrating the display in degrees per division; (2) measuring the displacement between corresponding points on the two phases; and (3) multiplying the displacement by the

## Applications—Type 2B67

number of degrees per division. This is the method illustrated in Fig. 3-2. Note that the relative amplitude of the two signals does not affect the phase measurement when both signals are centered vertically about the graticule centerline. It is important to note that the two waveforms shown in the illustration do not appear simultaneously on the oscilloscope crt. The first waveform is displayed and positioned to a convenient reference point. The second waveform is then displayed and compared to the reference point.

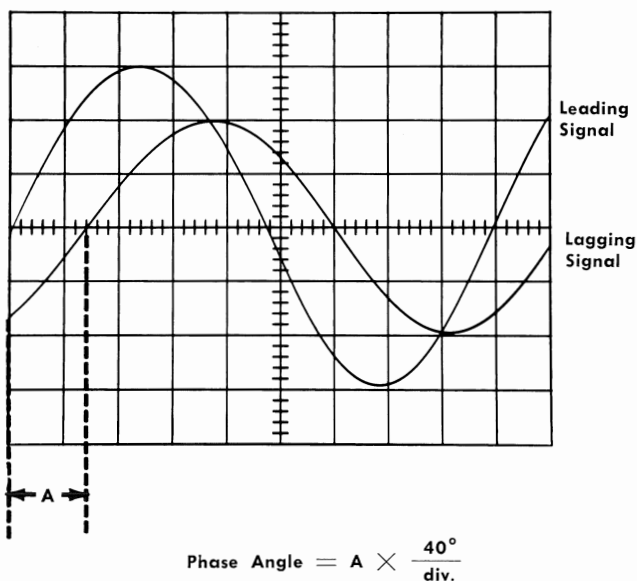


Fig. 3-2. Measurement of the phase angle between two electrical signals.

When using the Type 2B67 for phase measurements, it is necessary to supply an external triggering signal. This triggering signal serves, in a sense, as a reference signal. The two input signals are compared indirectly to the reference, and directly to each other. Consequently, the triggering stability must be maintained to permit accurate phase measurements. The external triggering signal must have sufficient amplitude to insure stable triggering, and it must be related in frequency to the signal on which phase measurements are to be made. If you wish, you can use one of the signals to be measured as the external triggering signal. Once the triggering conditions are established, they must not be changed during any phase measurement.

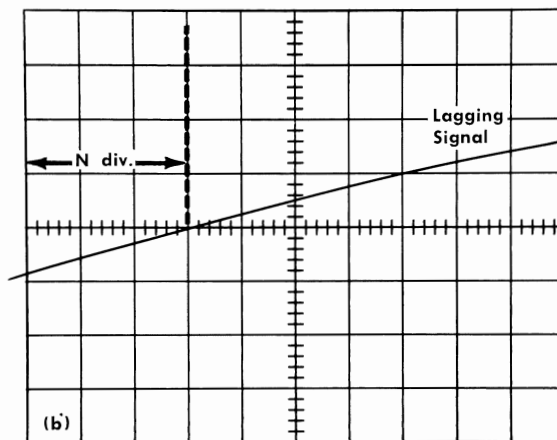
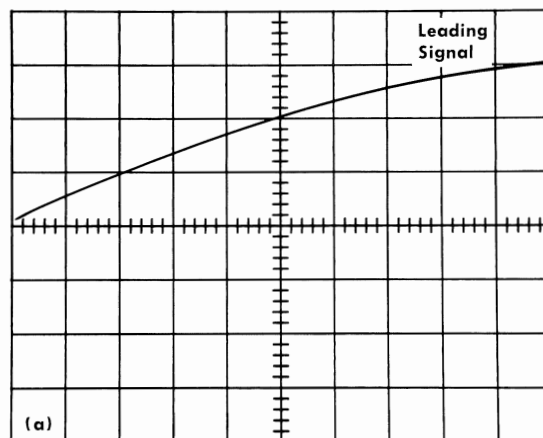
In most measurements it is very important that the width of the trace is not included. For best accuracy, the height of the display should be as large as possible, and the waveforms should be centered vertically about the centerline of the graticule.

A method for making phase measurements follows:

1. Connect the external triggering signal to the EXT. TRIG. connector. Set the SOURCE switch to EXT. and adjust the LEVEL control for a stable display.

2. Connect the first (leading) signal to the oscilloscope input. Adjust the TIME/DIV. controls so one cycle of the waveform covers exactly 9 graticule divisions. This corresponds to 40 degrees per division (as in Fig. 3-1).

3. Carefully center the displayed waveform about the graticule centerline using the Vertical Position control. Switch on the 5X MAG. and adjust the horizontal position of the trace so the displayed curve crosses the centerline vertically at the extreme left of the graticule. (See Fig. 3-3a.) The calibration now corresponds to 8 degrees per division.



$$\text{Phase Angle} = N \text{ div.} \times \frac{8^\circ}{\text{div.}}$$

Fig. 3-3. (a) Establishing the reference point with the leading signal, and (b) computing the phase angle.

4. Disconnect the first signal and connect the second (lagging) one to the vertical amplifier input. The number of divisions to the right of the first waveform (at the point

where the curve crosses the centerline; see Fig. 3-3b), times 8 (the number of degrees per division), is the number of degrees of phase difference.

5. If a multitrace plug-in unit is used in the vertical circuit, the reference signal may be fed to Channel 1 and the lagging signal to Channel 2. Set up the horizontal position, using the Channel 1 signal, as in step 3, and set the mode for alternate display. The phase difference between the signals may be read directly since both signals are displayed simul-

taneously. Multitrace plug-in units allow the Channel 1 signal to trigger the Type 2B67 without an external connection, and therefore may be used to trigger the Type 2B67 internally in this application. Refer to the plug-in unit instruction manual for information.

6. If the phase difference between signals exceeds  $80^\circ$ , steps 3 and 4 must be performed with the 5X MAG. off, and the calibration will therefore correspond to 40 degrees per division.



## Section 4

### Circuit Description

#### Block Diagram

A block diagram of the Type 2B67 Time Base plug-in is shown in Fig. 4-1. In general, the Type 2B67 operates as follows:

A triggering signal (internal, external, or line) is applied to the Time-Base Trigger circuit. The Time-Base Trigger generates a negative trigger pulse coincident with a selected point on each cycle of the triggering signal. The negative pulse triggers the Time-Base Generator which generates a positive-going sawtooth. The sawtooth is amplified by the Horizontal Amplifier and applied push-pull to the crt deflection plates to sweep the beam across the screen. After the beam has travelled across the screen, the Time-Base Generator resets itself and awaits the next trigger. In single-sweep operation, the Time-Base Generator must be reset manually.

In the EXT. INPUT position of the TIME/DIV. switch, the Time-Base Generator is disabled and the output stage of the Horizontal Amplifier is connected to the front-panel EXT. INPUT jack.

#### TIME-BASE TRIGGER

The Time-Base Trigger (see schematic) consists of Trigger Input Amplifier V24 and the Trigger Multivibrator V45. The Trigger Input Amplifier amplifies (and, when desired, inverts) the incoming triggering signal and applies it to the Trigger Multivibrator. The Trigger Multivibrator is a Schmitt circuit that is switched from one state to the other by the signal at its input. Its square-wave output is differentiated to form negative and positive pulses that are applied to the Time-Base Generator. The negative pulses trigger the Time-Base Generator to start the sweep; the positive pulses are clipped by diode action and are not used.

#### Trigger Input Amplifier

The input to Trigger Input Amplifier V24 may be selected from one of three sources by means of SOURCE switch SW5. When the SOURCE switch is in the INT. position, the signal is obtained from the plug-in unit in the left-hand opening of the oscilloscope. When the SOURCE switch is in the EXT. position, the signal may be obtained from an external source through the EXT. TRIG. connector on the front panel. When the SOURCE switch is in the LINE position, the signal is obtained from one side of the 6.3-volt circuit supplying heater current to the tubes.

The negative pulse at the output of the Time-Base Trigger occurs only when there is a negative-going signal at the input of the Trigger Multivibrator (output of the Trigger Input Amplifier). To start the sweep during either a positive-going or negative-going portion of the incoming triggering signal, SLOPE switch SW20 provides either inverted or in-phase amplification of the triggering signal.

When the SLOPE switch is in the — position, the incoming signal is applied to the grid of V24A, and V24 operates as a cathode-coupled amplifier (output in phase with input). The negative pulse at the output of the Time-Base Trigger will therefore occur during a time when the triggering signal is moving in a negative direction.

When the SLOPE switch is in the + position, the incoming triggering signal is applied to the grid of V24B, and V24B operates as a plate-loaded amplifier (output opposite in polarity to input). The negative pulse at the output of the Time-Base Trigger now occurs during a time when the triggering signal is moving in a positive direction.

LEVEL control R17 varies the average dc level at the plate of V24B from about +102 volts to +123 volts. This is true whether the SLOPE switch is in the — or + position. The voltage at the plate of V24B must shift through the

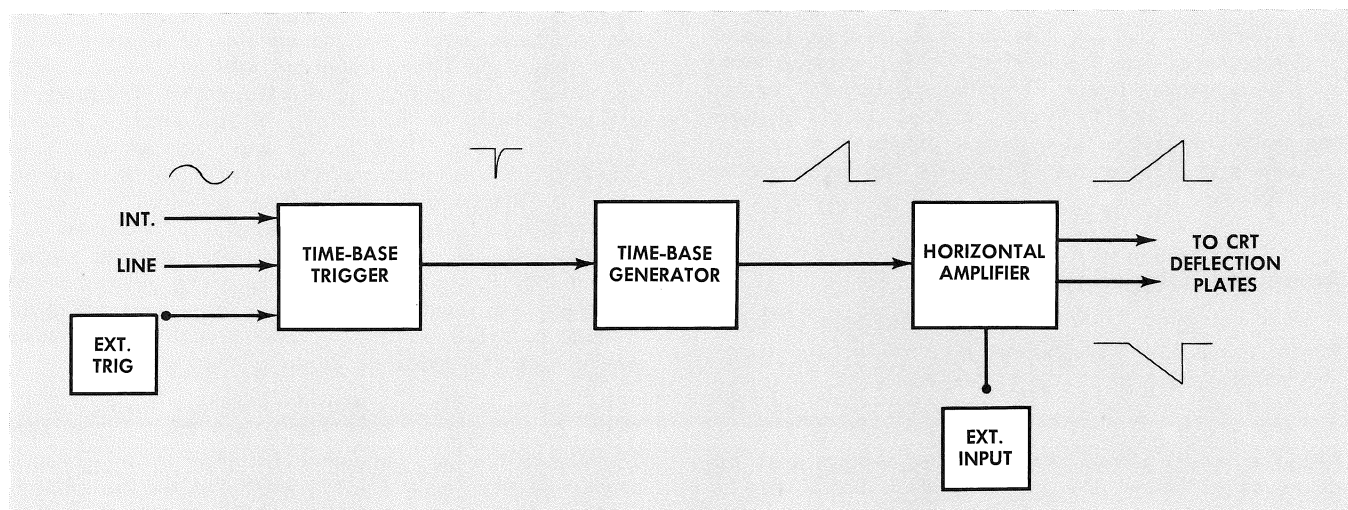


Fig. 4-1. Type 2B67 block diagram.

## Circuit Description—Type 2B67

approximate center of this range (between about 111 and 113 volts) to force the Trigger Multivibrator to change states.

For small triggering signals, R17 is set so the average dc level at the plate of V24B is close to the center of its range. Then a small triggering signal, amplified by V24, is sufficient to carry the plate voltage through the approximate 112-volt point. When a large triggering signal is applied, and it is desired to trigger on an extreme positive or negative point of it, R17 is set so V24B is well into saturation, or cutoff, depending on whether triggering is desired on a negative or positive point on the signal and on a negative or positive slope. In this case, the triggering signal must be large enough to overcome the saturation or cutoff of V24B and produce an additional 10.5 volts of swing at the plate of V24B to force the Trigger Multivibrator to change states.

It should be noted that the voltages given in the foregoing discussion are nominal only, and will vary somewhat between instruments and with use.

### Trigger Multivibrator

Trigger Multivibrator V45 is a two-state Schmitt circuit. When the voltage at the grid of V45A exceeds a certain level (about 113 volts) V45A conducts and V45B cuts off. In this state, the voltage at the output (plate of V45B) is +300 volts. When the voltage at the grid of V45A drops below a lower level (about 111 volts) V45A cuts off and V45B conducts. In this state, the voltage at the output is about +280 volts. The transition from one state to the other occurs very rapidly, regardless of how slowly the voltage at the input passes the critical levels (111 and 113 volts). The output of the Trigger Multivibrator is a 20-volt square wave. The negative-going portion of the square wave occurs when the voltage at the grid of V45A passes the lower critical level in a negative direction; the positive-going portion of the square wave occurs when the voltage at the grid of V45A passes the upper critical level in a positive direction. Only the negative-going portion of the square wave is used by the Time-Base Generator. By means of the SLOPE switch and the LEVEL control, this portion can be made to coincide with nearly any point on the incoming triggering signal.

The voltage level at the grid of V45A at which the Trigger Multivibrator changes states on a negative-going signal is slightly lower than the level at which it changes states on a positive-going signal. The difference between the two levels is called the "hysteresis" of the circuit. To maintain stable triggering, the incoming triggering signal must be large enough (after amplification in V24) to exceed the hysteresis.

### Automatic Triggering Mode

When the LEVEL control is turned fully counterclockwise, AUTO. switch SW17 is activated and converts the Trigger Multivibrator from a bistable configuration to an astable (free-running) configuration. This is accomplished by coupling the grid circuit of V45A to the grid circuit of V45B via R40. The resulting time constant, in the absence of a triggering signal, causes the Trigger Multivibrator to free-run at about 50 cps. However, since signals from the Trigger Input Amplifier are still coupled to the Trigger Multivibrator through C31, any signal over 50 cps and of sufficient ampli-

tude will synchronize the Trigger Multivibrator at the signal frequency. In the absence of a triggering signal, the sweep continues to be triggered at a 50-cps rate.

## TIME-BASE GENERATOR

The square-wave output of the Trigger Multivibrator is differentiated by C130-R130 to form negative and positive pulses. The negative pulses are the triggers which generate the sweep; the positive pulses are clipped by D130.

When the Time-Base Generator receives a trigger, it produces a linearly rising sawtooth voltage which is applied through the Horizontal Amplifier to the crt deflection plates. This deflects the electron beam across the screen and forms the sweep. The amplitude of the sawtooth is about 150 volts. Its rate of rise is controlled by the values of the Timing Capacitor and Timing Resistor.

The main circuits in the Time-Base Generator are the Sweep-Gating Multivibrator V135-V145A, the Miller Runup Circuit V161, and the Hold-Off Circuit V145B.

### Sweep Generation

In the quiescent state—that is, when no sweep is being generated—V135A is conducting and V145A is cut off (MODE switch in NORM. position). The plate of V145A is at about -3 volts with respect to ground. Disconnect Diodes V152 are conducting and clamp the Timing Capacitor in the sweep discharged condition. The plate of V161A is at about +28 volts.

A negative trigger applied to the grid of V135A, from the Time-Base Trigger, will force the Sweep-Gating Multivibrator to rapidly switch states. That is, V135A cuts off and V145A conducts. This is similar to the operation of the Trigger Multivibrator. Subsequent triggers arriving at the grid of V135A have no effect on the circuit until after the sweep is completed and the multivibrator switches back to its original state.

As V145A conducts, its plate voltage drops, cutting off the Disconnect Diodes. The Timing Capacitor then starts to charge toward the instantaneous potential difference between the -100-volt supply and the cathode of V161B. As the lower side of the Timing Capacitor starts to move in a negative direction, the grid of V161A moves with it. This produces a positive swing at the plate of V161A which is coupled through B167 and V161B to the upper side of the Timing Capacitor. This tends to prevent the lower side from moving negative, and increases the voltage to which the Timing Capacitor is trying to charge. The effect is to "straighten out" the charging curve by maintaining the charging current through the Timing Resistor with increasing charge on the capacitor. The result is an essentially linear sawtooth at the cathode of V161B, which is applied through the Horizontal Amplifier to the deflection plates of the crt.

The values of Timing Capacitor C160 and Timing Resistor R160 are selected by TIME/DIV. switch SW160. VARIABLE control R160Y allows additional resistance to be inserted in series with the Timing Resistor, which reduces the charging current and decreases the slope of the sawtooth. UNCAL. lamp B160W lights whenever the VARIABLE control is moved from the CALIBRATED position.

## Sweep Length

The length of the sweep (the distance the spot moves across the crt) is determined by the setting of the SWP. LENGTH control R176. As the sweep voltage rises linearly at the cathode of V161B there will be a linear rise in voltage at the arm of the SWP. LENGTH control. This will increase the voltage at the plate and cathode of V152C and at the grid and cathode of V145B. As the voltage at the cathode of V145B rises, the voltage at the grid of V135A also rises. When the voltage at this point is sufficient to bring V135A out of cutoff, the Sweep-Gating Multivibrator will rapidly revert to its original state with V135A conducting and V145A cutoff. The voltage at the plate of V145A then rises, carrying with it the voltage at the plates of the Disconnect Diodes. As V152B conducts it provides a discharge path for C160 through R147 and the resistance in the cathode circuit of V161B. The plate voltage of the Miller Tube then falls linearly, under feedback conditions essentially the same as when it generated the sweep except for a reversal of direction. The resistance through which C160 discharges is much less than that of the Timing Resistor (through which it charges). The capacitor current for this period will therefore be much larger than during the sweep portion, and the plate of the Miller Tube will return rapidly to its quiescent voltage. This produces the retrace portion of the sweep sawtooth during which time the crt beam returns rapidly to its starting point.

## Hold-Off

The Hold-Off Circuit prevents the Time-Base Generator from being triggered during the retrace interval. That is, the hold-off allows a finite time for the circuits to regain a state of equilibrium after the completion of a sweep.

During the trace portion of the sweep sawtooth the Hold-Off Capacitor charge through V152C as a result of the rise in voltage at the cathode of V161B. At the same time the grid of V135A is being pulled up, through V145B, until V135A starts conducting. This is the action that initiates the retrace. At the start of the retrace interval the Hold-Off Capacitor starts discharging through Hold-Off Resistor R181. The time constant of this circuit is long enough, however, so that during the retrace interval (and for a short period after the completion of the retrace) the Hold-Off Capacitor holds the grid of V135A high enough so that it cannot be triggered. However, when the Hold-Off Capacitor discharges to the point that V145B cuts off, it loses control over the grid of V135A and this grid returns to the level established by the STABILITY control. The hold-off time required is determined by the size of the Timing Capacitor. For this reason the TIME/DIV. switch changes the time constant of the Hold-Off Circuit simultaneously with the change of Timing Capacitors.

## Sweep Stability

The divider consisting of the STABILITY control R111, R112, and R113 sets the quiescent dc level at the grid of V135A. R111 is adjusted so that the quiescent voltage at the grid of V135A is just high enough (with the FREE RUN switch open) to hold V135A in conduction. In this case, a sweep can be produced only when a negative trigger drives V135A into cutoff. Turning the LEVEL control fully clockwise

closes the FREE RUN switch and shorts out R111. This places a more negative voltage on the grid of V135A such that this tube cuts off upon decay of the hold-off voltage and the next sweep is initiated immediately (no trigger is necessary). The result is a free-running sweep whose period is the total of the sweep time plus the hold-off time at any given setting of the TIME/DIV. switch. (This is compared to a fixed repetition rate of about 50 cps when the LEVEL control is turned fully counterclockwise to the AUTO. position to make the Trigger Multivibrator free run.)

## Sweep Lockout

The Sweep Lockout circuit consists of transistor Q124 and associated components.

With the MODE switch at NORM., the base of Q124 and the anode of D126 are grounded. The emitter of Q124 has no ground return, and both emitter and collector are negative with respect to the base. Some current (about 0.4 ma) flows through the base-collector junction of Q124, setting the collector at about  $-80$  volts. This reverse biases D124, since the grid of V135A runs between about  $-25$  and  $-58$  volts. When V135A conducts (grid at about  $-25$  volts) the plate voltage is about  $+14$  volts.

Placing the MODE switch to SINGLE SWEEP changes Q124 from a grounded-base to a grounded-emitter configuration. READY lamp B124 conducts and holds the collector of Q124 at about  $-55$  to  $-60$  volts. Conduction through R126 forward biases D126 and connects the base of Q124 to the plate of V135A. This reverse biases Q124 and "arms" the sweep . . . that is, V135A is ready to be triggered.

The next trigger to arrive at the grid of V135A will force the Sweep-Gating Multivibrator to switch states (V135A cut off; V145A conducting) and start a sweep. At the completion of the sweep, V135A again conducts and its plate voltage drops below ground. This forward biases Q124 (through D126) and drives it into saturation. Collector current then pulls up the collector of Q124 and the grid of V135A (through D124) to near ground. This extinguishes READY lamp B124 and drives V135A hard into saturation. With V135A in saturation, it is insensitive to incoming triggers and the sweep is "locked out".

Depressing the MODE switch to RESET transfers V135A plate current from the base of Q124 to ground. Current through R126 and D126 raises the base of Q124 slightly positive, which reverse biases Q124. The reduction in collector current then lets the grid of V135A fall to its "ready-to-be-triggered" level. The READY lamp then fires to indicate the sweep is again "armed", waiting for a trigger.

## Unblanking

The positive rectangular pulse appearing at the cathode of V135B during sweep time is applied as an unblanking pulse to the crt. Action of this pulse on the crt circuit is discussed in detail in the oscilloscope instruction manuals. Blanking and unblanking is controlled only by the plug-in in the right-hand oscilloscope opening. Thus, if the Type 2B67 is inserted in the left-hand opening (producing a vertical trace), the trace will not be blanked between sweeps.

## Circuit Description—Type 2B67

When the TIME/DIV. switch is in the EXT. INPUT position, the Sweep-Gating Multivibrator is disabled. The cathode of V135B rests at about +125 volts and the crt is continuously unblanked.

### HORIZONTAL AMPLIFIER

The Horizontal Amplifier consists of the Input CF V333A, the Second CF V333B, Driver CF V353A, and the Output Amplifier V374.

The sweep sawtooth from the Time-Base Generator is coupled to the grid of V333A via the frequency-compensated voltage divider R320-R321. POSITION control R323 supplies a manually adjustable dc voltage to the grid of V333A for positioning the trace on the crt.

CALIBRATION adjustment R334 varies the sawtooth amplitude at the grid of V333B and provides a means for calibrating the sweep rate.

The output of V333B is coupled through R341 and R342 (in parallel with C341) to the grid of V353A. The cathode of V353A, in turn, drives the grid of V374A. V374 is a cathode-coupled paraphase amplifier that converts the single-

ended input to a push-pull output. The push-pull output is applied through pins 17 and 21 of the interconnecting plug to the crt deflection plates.

Negative feedback from the plate of V374A to the grid circuit of V353A develops a voltage across R341 and R342 that attenuates the signal from the cathode of V333B by a factor of five. When SW341 is closed (5X MAG. on), R341 and R342 are shorted out and the sweep rate, as seen at the crt deflection plates, is effectively magnified five times.

SWP./MAG. REGIS. adjustment R346 is adjusted to set the voltage at the grid of V353A equal to the voltage at the cathode of V333B when the electron beam is in the center of the crt and the 5X MAG. switch is open. With this configuration the center of the trace will not move as SW341 is opened and closed (5X MAG. turned off and on).

The EXT. INPUT position of the TIME/DIV. switch allows the application of external signals through the EXT. INPUT connector on the front panel. The external signal is applied directly to the Output Amplifier. When the TIME/DIV. switch is in the EXT. INPUT position, the POSITION control varies the dc voltage at the grid of V353B. This, in turn, sets the grid level of V374B.

# CALL REPORT EXTRACTS

## TECHNIQUES

2B67 3V RAMP OUTPUT

CUSTOMER		FIELD ENGINEER	
Hughes Microelectronic Division		Lou Broadbent	
CITY AND STATE		MONTH-DAY-YEAR	
Newport Beach, California		AUG 25 1964	
GROUP		MONTH-DAY-YEAR	
Crystal Filter Production Test		8/17/64	
GROUP FUNCTION		CALL #	
Dick Wrench - Filter Eng.		CALL MADE WITH JOHN ROSS - GENERAL RADIO	
<u>564 APPLICATION WITH FREQUENCY SYNTHESIZER</u>			

Demo'd 564 with GR synthesizer type 1161A for use in production testing of narrow band crystal filters. Hughes is producing prototype crystal filters for the TFX fire control systems being built by Hughes, Culver City.

The frequency of the synthesizer was swept by externally introducing the ramp voltage from the 2B67, as modified by Doug Cure' to have a 3 v ramp output fed to the rear panel of the 564. This is dc coupled as is the external control input circuit to the synthesizer. Thus, the synthesizer performed the function of a swept frequency oscillator and a counter, but with better accuracy, stability, and convenience. The amplitude vs frequency display was traced out on the 564 with the 2B67 operating at very slow sweep speeds, down to 5 sec/cm.



## AS SWEPT-FREQUENCY GENERATOR

ORANGE

To: Geoff Gass  
Product Information

From: Doug Cure

Hi Geoff,

John Ross of General Radio and I worked out a simple scheme for providing a useful application of their new synthesizer and our 564. Basically, the lash up functions as a voltage controllable oscillator driven by the scope time base. The 564 is used to display the transfer versus frequency through the device or system under test.

John has sold several synthesizers in my area on the strength of this application above. As a result, we sell or put to use in more applications a 564. Man, that's almost reciprocity!

The synthesizer can be set up for dispersion as small as .01 cycles per cm up to 100 kc per cm. One of the beauties of the synthesizer lies in the ability to dial in a given frequency and make any decade VCO controllable. The storage scope is the <sup>per</sup> dial indicator to accommodate the wide range of sweep rates required for ~~different~~ different dispersion rates.

The memo from John Ross contains the basic modifications required in the time base. Many ways could have been worked out to bring out a sample of the sweep. The advantage of this configuration is that the horizontal position control does not affect calibration and center frequency versus CRT graticule center. The range control adjusts dispersion so that each cm can represent exactly 1 division of the decade chosen to be sweep driven. The centering control establishes CRT center as center frequency by providing a negative bias to the sweep. [The T12G and 7.8k act as a linearizing network to make up for a similar, but opposite non linear load in the early version of the synthesizer.] The whole lash up is self calibratable through use of their internal standard, works like a dream.

Perhaps some mention of the application to the field might spur some additional 564 sales along with General Radio synthesizer sales.

Best wishes,

  
Doug Cure

Dear Doug:

Thanks very much for your IOC on the 2B67/GR Synthesizer combo. I think we'll just print the stuff verbatim in the 564 and 2B67 IRB's, adding a few words in your IOC to indicate that the linearizer network probably wouldn't be needed with the production 1161-1162 boxes.

Best regards,

  
Geoff

They probably  
won't be re-  
quired with  
G.R.'s production  
1161 or 1162.

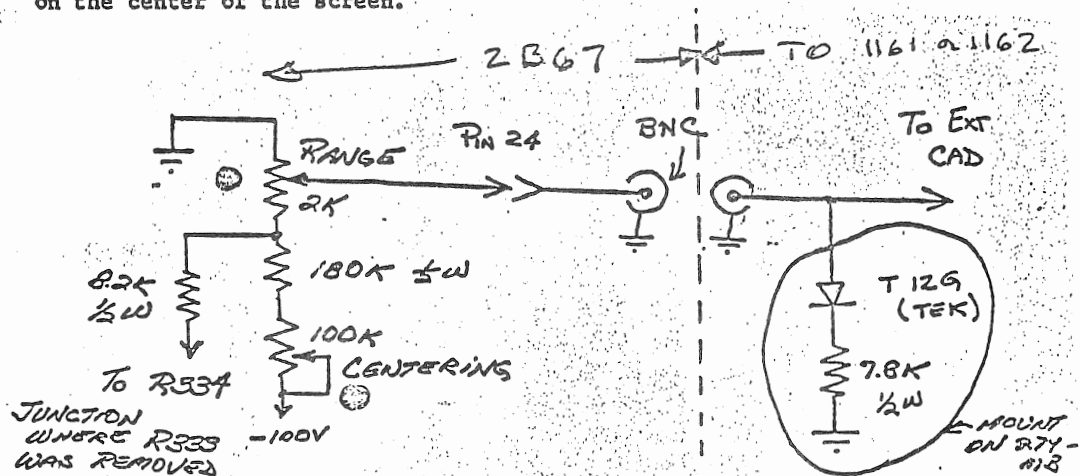
MEMORANDUM TO ALL DISTRICT OFFICES

**SUBJECT:** Tektronix Scope Modification  
to Connect the 1161 and 1162 Synthesizer

There have been several questions as to the circuit used in modifying the Tektronix Scope to drive the CAD dial of the synthesizer directly from the sweep voltage of the scope. The following circuit is a modification made to a Tektronix Type 2B67 Time Base Horizontal Amplifier. There is conveniently one pin on the plug-in unit that is not used, which can be used to run the lead to the back of the scope. A BNC will fit in the knockout. The circuit and modification are as follows:

## HORIZONTAL AMPLIFIER

- 1 - Remove R333 (10K 1/2 watt) and replace with the circuit shown.
- 2 - For calibration set the synthesizer to 10 Kc and observe zero beat on the center of the screen.



The linearizing network enclosed in the circle is only necessary on our first few demo units. Engineering is modifying the CAD dial so that it will shift plus 5 divisions when a minus 1-1/2 volts is applied and a minus 5 divisions when a plus 1-1/2 volts is applied. To calibrate the modification, install an 874-MR in the synthesizer output. Connect the beat output of the CAD dial to the local oscillator input. Connect the scope to the output of the MR. The centering control may now be adjusted so that zero frequency change will appear at 5 cm, or in the center of the screen, and the range can be adjusted so that 1 division deviation of the CAD dial will represent 1 cm displacement on the X axis. The CAD dial may now be substituted for any DI unit and the presentation on the scope will be the fundamental frequency in the middle of the screen with a deviation of  $\pm 5$  divisions.

If there are any further questions with regard to the modification of the Tektronix scope, contact your local Tektronix man. Doug Curé of the Orange Office is the Tektronix Field Engineer who worked with me to obtain this circuit.

Sincerely,

John Ross - LAC



below any chosen rank and thereby provide wide, single-dial frequency coverage, remotely controlled, if desired.

By virtue of the self-calibrating feature for the CAD, explained in detail later, the partially equipped models, such as the Type 1162-A4C illustrated in Figure 2, can set frequencies to more significant figures than the number of dials would suggest. Thus the Type 1162-A4C can be set to four figures on the digit dials and four more on the CAD, calibrated against the digit dials, for a total of eight significant figures.

#### Swept-Frequency Generation with Frequency Markers

The CAD dial is direct-reading; the numbered major divisions correspond to the digits on the step-adjustable dials. As an additional unique and very useful feature, built-in monitor circuits make it possible to set the CAD dial precisely to three or more significant figures, in terms of the digit dials. Provisions are also included for varying the frequency of the continuous unit in accordance with an electrical control input. These monitoring and calibrating circuits assist in the generation of accurate frequency markers, at the center frequency defined by the digit dials and at independently chosen side

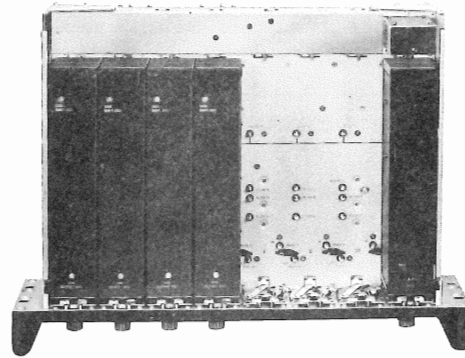
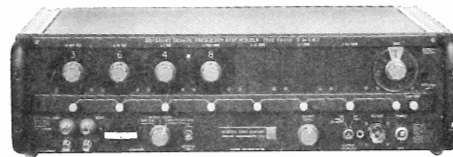


Figure 2. A partially equipped instrument, Type 1162-A4C, top and panel views.



frequencies. The synthesizers thus become sweep-frequency generators, capable of being swept with precision over frequency bands ranging from a fraction of a cycle to many kilocycles. Figure 3, which will be discussed in more detail later, is an example of this sort of application. The 3-, 10-, and 50-cycle passbands of the GR Type 1900-A Wave Analyzer are shown displayed on a storage oscilloscope, with accompanying center frequency and side markers at small and precise intervals.

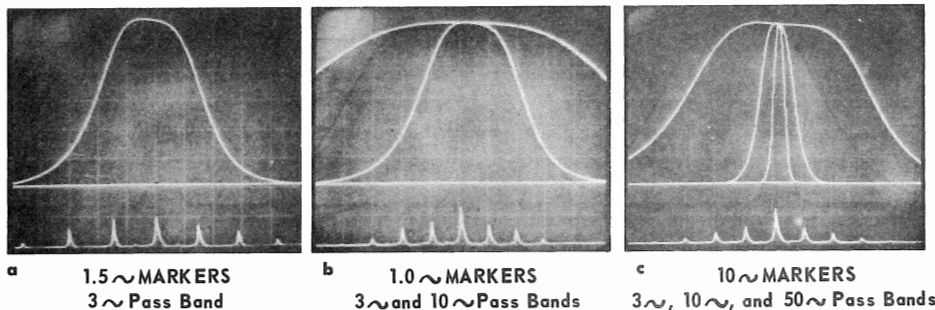


Figure 3. Pass bands of the Type 1900-A Wave Analyzer, with simultaneously generated frequency markers. The signal source for this measurement was a Type 1161-A Synthesizer.







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- Low sweep speed timing error from V152, 6BC7, 4-23-64
- Alternate sync problem with 3A1, 10-12-65

- Mod 9976 -- erroneous mod insert sheets, 11-12-65
- "Troubleshooting" ....section of manual

## PARTS

## CALIBRATION

- Manual calibration procedure

## SCHEMATICS



# MODIFICATION SUMMARY

# 2B67



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SWEEP CIRCUIT FAILURE  
TO 'FREE RUN' PREVENTED

INFORMATION ONLY

M6922

Effective Prod SN 5600

DESCRIPTION:

In some plug-ins the sweep circuit will not free run because resistor tolerances are too great in one direction. Decreasing the value of Stability control divider resistor, R112, will correct this problem.

Parts Removed:

R112      15k 1/2W 5%    301-0153-00

Parts Added:

R112      12k 1/2W 5%    301-0123-00

TIME-BASE GENERATOR RESISTOR  
PAIR REPLACED WITH SINGLE UNIT

INFORMATION ONLY

M7316

Effective Prod SN 7450

DESCRIPTION:

Replaces resistor R144, consisting of 56k and 15k resistors in parallel, with a single resistor to eliminate the parallel resistor combination.

Parts Removed:

R144      56k 1/2W 10%    302-0563-00  
          15k    1W ±1%    310-0115-00

Parts Added:

R144      11.8k 1W ±1%    324-0296-00

PLUG-IN SPACER RODS STANDARDIZED

INFORMATION ONLY

M7457

Effective Prod NS 7840

DESCRIPTION:

Install new plug-in spacer rods which have hex shape near one end to allow better tightening. This will insure more positive grounding of the plug-in to Indicator (via the spacer rods).

Parts Removed:

Rod, spacer      (4)      384-0566-00

Parts Added:

Rod, spacer      (4)      384-0615-00

SINGLE SWEEP TRANSISTOR Q124  
OPERATING POINT CHANGED

See SQB

M7909.

Effective Prod SN 10630

Usable in field instruments SN 5001-10629

DESCRIPTION:

Brings optimum preset stability setting for single sweep closer to normal sweep stability setting by increasing the value of R126. Original value of R126 was to compensate for a "spec" level of Q124 leakage which was never approached in actual transistors. Resulting overcompensation upset V135 DC levels in SINGLE SWEEP mode.

Also see M9976.

Parts Removed:

R126      220 k 1/2 W 10%    302-0224-00

Parts Added:

R126      680 k 1/2 W 10%    302-0684-00

INSTALLATION INSTRUCTIONS:

See MI - 7909.

SWEEP JITTER AND TIMING ERROR  
REDUCED BY REWIRING AND RE-  
PLACING DISCONNECT DIODE V152

INFORMATION ONLY

M8116

Effective Prod SN 10810

DESCRIPTION:

Eliminates sweep jitter and slow speed timing error by replacing V152 with an improved type and electrically interchanging diodes V152B and V152C. Also reduces heater-to-cathode hum modulation by adding a 1Ω resistor in series with the filament to shift filament AC ground point. Superseded by M10189.

Parts Removed:

V152      6BC7                      154-0232-00

Parts Added:

V152      6BJ7                      154-0453-00  
R392      1Ω 1/2 W ±5%            308-0141-00

SAWTOOTH SIGNAL TO INTERCONNECTING  
PLUG ADDED TO ALLOW USE WITH  
SPECTRUM ANALYZERS

See SQB

M9728

Effective Prod SN 15180

Usable in field instruments SN 5001-15179

FRONT PANEL SYMPTOM: 3L Series spectrum Analyzers will not operate with unmodified time base plug-ins.

PROBLEM: Sawtooth signal was not originally provided and is needed for operation of 3L Series spectrum analyzers.

PRODUCTION CHANGE: A 221 k 1/2 W 1% resistor was added between pin 8 of V161B and pin 18 of the interconnecting plug to provide a normalized sawtooth signal of about 66  $\mu$ A/cm to a low impedance load in the 3L Series spectrum analyzer. Pin 19 of the interconnector plug was grounded.

Parts Removed: None

Parts Added: Resistor, prec, MF, 221 k 1/2 W 1%  
Cable, coax, 50  $\Omega$  12 in. 175-0284-00

INSTALLATION INSTRUCTIONS:

Parts Required: Field Modification Kit 040-0413-00

Installation Procedure: Refer to Modification Kit 040-0413-00.

For Type 561 SN 102-578:

NOTE: If 040-0413-00 is installed in a time-base plug-in which will be used in a Type 561 Oscilloscope SN 102-578, then the following changes must be made to the Type 561.

The following changes are included in 040-0267-00.

Parts Required:	1 ea	Cable, coaxial, 50 $\Omega$ RG/174,	6 in.	175-0068-00
	1 ea	Cable, coaxial, 50 $\Omega$ RG/174,	5-3/4 in.	175-0068-00

- a) Unsolder and remove the white-yellow and white-orange wires connected between pins 3 and 4 of the two interconnecting sockets at the rear of the plug-in housings.

continued

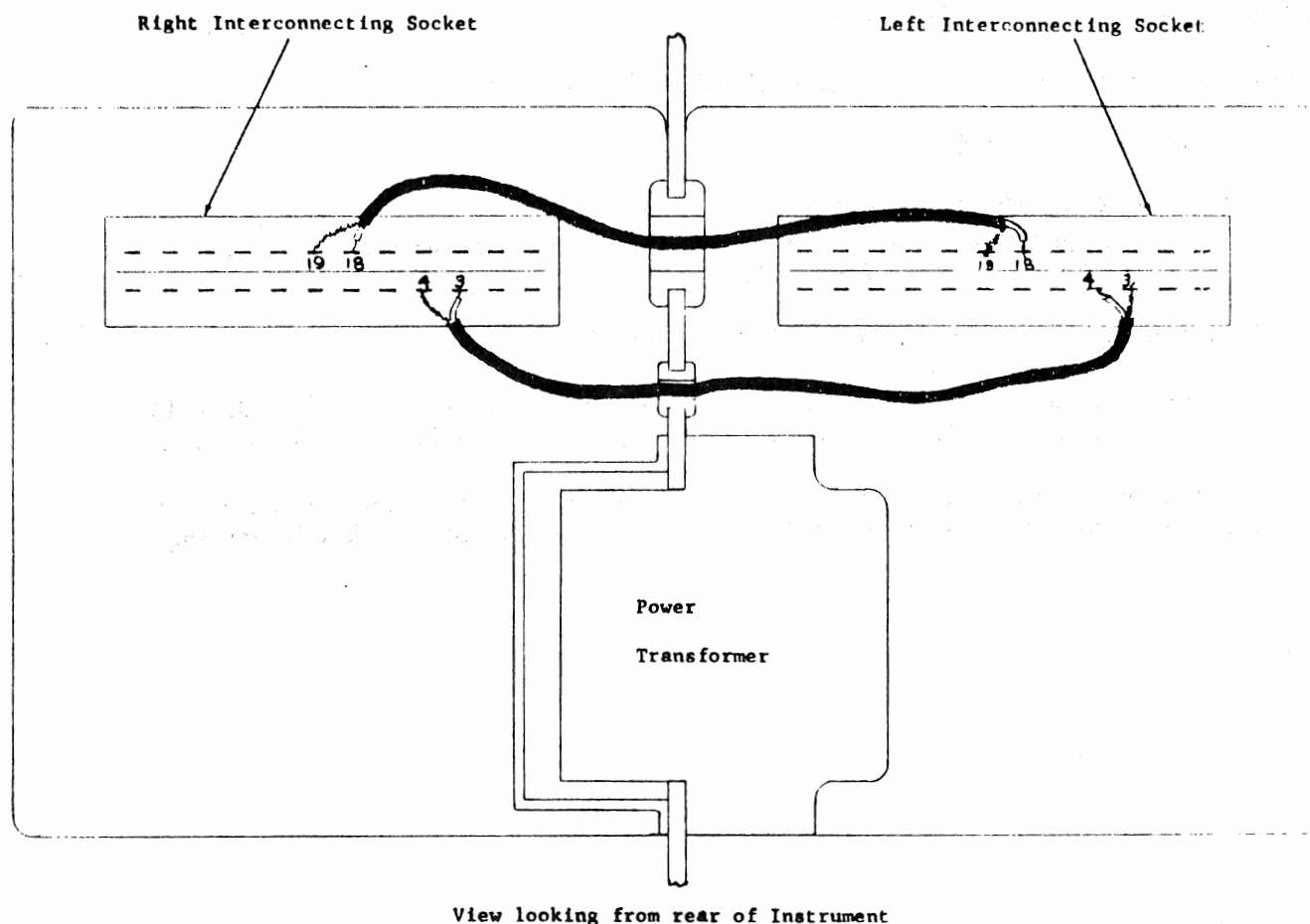
# Installation Procedure:

- b) Dress the 6 in. length of coaxial cable from the left socket, through the grommet vacated in step a, to the right socket (see drawing).

Solder the center conductor of the coaxial cable to pin 4 of the left socket and to pin 3 of the right socket, and solder the shield to pin 3 of the left socket and to pin 4 of the right socket.

- c) Unsolder the two white-black-red wires from pin 18 of the right socket.
- d) Unsolder the white-black-red wire from pin 18 of the left socket.
- e) Trim and tape the wires, unsoldered in steps 3 and 4, to prevent shorting.
- f) Dress the 5-3/4 in. length of coaxial cable from the left socket through the large grommet hole to the right socket (see drawing).

Solder the center conductors to pins 18, and the shields to pins 19 of the two sockets.



LEVER KNOB MATERIAL CHANGED  
TO ELIMINATE DEFORMITY UNDER  
CERTAIN ENVIRONMENTAL CONDITIONS

INFORMATION ONLY

M9262

Effective Prod s/n 15220

DESCRIPTION:

Changes the type of material used in the manufacture of the lever knob from a charcoal gray cycolac X7 styrene to charcoal gray delrin 500. The delrin 500 lever knobs will not deform when subjected to environmental conditions.

Parts Removed:

Knob

366-0215-00

Parts Added:

Knob, lever, delrin 500

366-0215-01

SWEEP LOCKOUT DIODE, D126  
PROTECTED BY CHANGING  
R137 FROM 100Ω TO 200K

See SQB

M9660

Effective Prod s/n 15380

Usable in field instruments s/n 5001-15379

FRONT PANEL SYMPTOM: If diode is open, the sweep will not lock out in single sweep mode. If diode is shorted, the sweep will not run.

PROBLEM: Momentary grid-plate short in V135B causes D126 to dissipate excessive power, usually destroying it.

PRODUCTION CHANGE: R137 was changed from a 100Ω to a 220k resistor. A 'speed-up' capacitor C137 (68pF) was also added in parallel with R137.

Parts Removed:

R137

Resistor, comp, 100Ω 1/2W 10%

302-0101-00

Parts Added:

R137  
C137

Resistor, comp, 220k 1/2W 10%  
Capacitor, cer, 68pF 500V

302-0224-00  
281-0549-00

INSTALLATION INSTRUCTIONS:

See MI - 9660.

TIME/DIV SWITCH CHANGED TO ELIMINATE  
VARIABLE POTENTIOMETER BINDING

INFORMATION ONLY

M9484

Effective Prod SN 15740

FRONT PANEL SYMPTOM: VARIABLE TIME/DIV potentiometer binds.

PROBLEM: The VARIABLE control would bind due to misalignment of the switch-mounted rear wafer (which rotates with the VARIABLE potentiometer) and the bracket-mounted potentiometer.

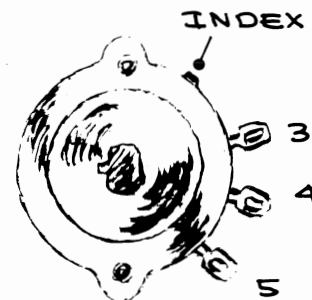
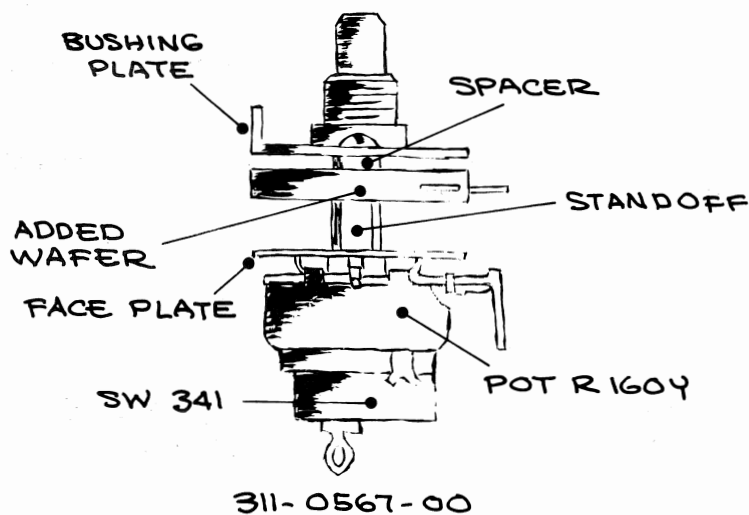
PRODUCTION CHANGE: The rear wafer was removed from the TIME/DIV switch and a new switch was added to the potentiometer (see drawings).

Parts Removed:

SW160A	Switch, TIME/DIV	262-0371-00
SW160B	20k potentiometer/switch	311-0166-00

Parts Added:

SW160A	Switch, TIME/DIV	262-0371-01
SW160B	20k potentiometer/switch	311-0567-00



ROTARY SWITCH  
TERMINAL ORIENTATION  
(VIEWED FROM SHAFT END)

**READY LIGHT OPERATION ASSURED  
BY MODIFICATION OF SINGLE  
SWEEP LOCKOUT CIRCUIT**

INFORMATION ONLY

M9976-1

Effective Prod SN 15920

FRONT PANEL SYMPTOM: READY neon fails to light when sweep is armed.

PROBLEM: Because of leakage in Q124 and tolerances of B124, it was necessary to select READY neon, B124, for reliable firing.

PRODUCTION CHANGE: To assure firing of the READY neon, the single sweep lockout circuit was modified as shown in schematic below.

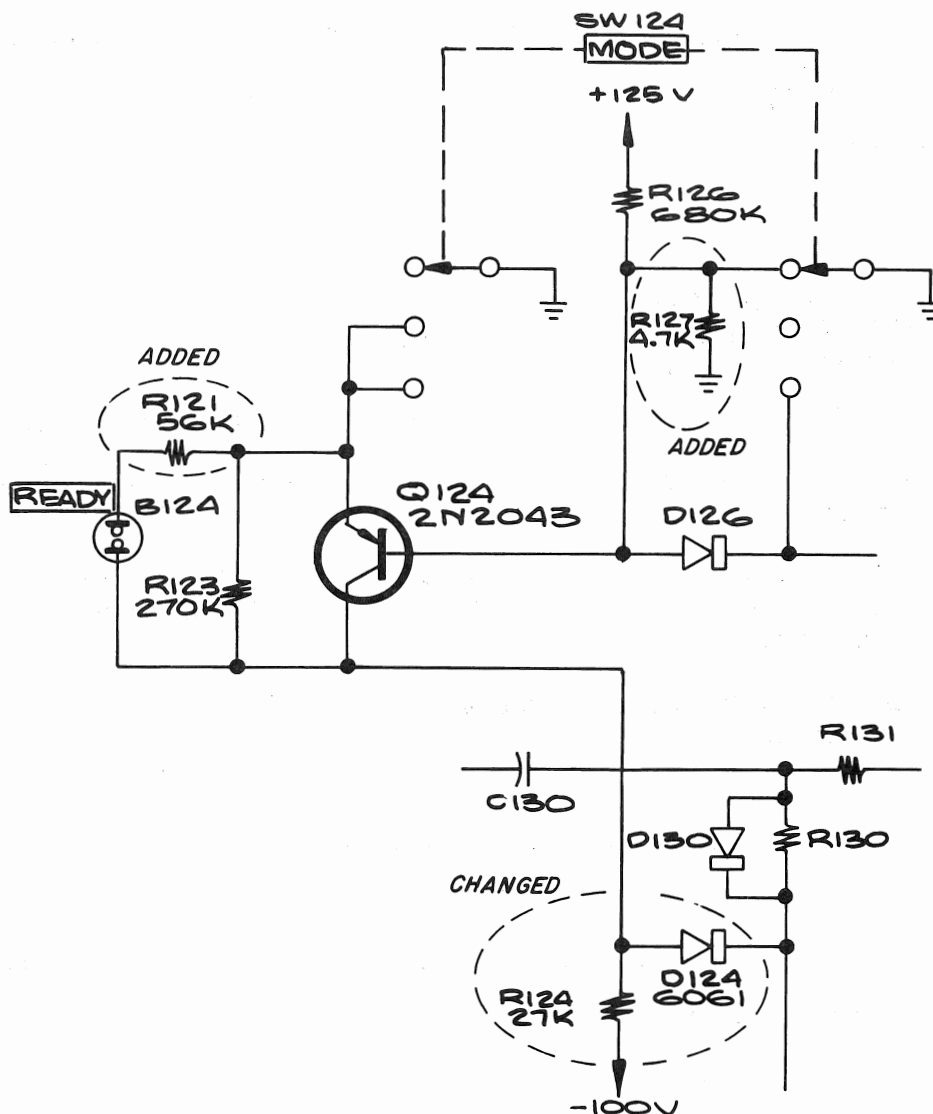
Neon selection is quicker and easier if problem arises in the field. If Mod is installed, put in R125 also (M9976-2).

**Parts Removed:**

D124	Diode, Germanium, T12G	152-0008-00
R124	Resistor, comp, 47k 1/2W 10%	302-0473-00

**Parts Added:**

D124	Diode, silicon, 6061	152-0061-00
R124	Resistor, comp, 27k 1/2W 5%	301-0273-00
R121	Resistor, comp, 56k 1/2W 10%	302-0563-00
R127	Resistor, comp, 4.7k 1/4W 10%	316-0472-00



SINGLE SWEEP ARMING DURING  
FIRST TWO SECONDS ASSURED  
BY ADDED RESISTOR

See SQB

M9976-2

Effective Prod SN 15920

Usable in field instruments SN 10629-15919\*

FRONT PANEL SYMPTOM: Failure of single sweep circuit to arm during first 1 or 2 seconds after switching from NORMAL.

PROBLEM: In the NORMAL mode, Q124 was operated in the emitter-to-base breakdown mode. This resulted in failure of the circuit to arm for 1 or 2 seconds after switching from NORMAL until Q124B-E junction cooled down.

PRODUCTION CHANGE: A 330k 1/4W 10% resistor was added between the base and emitter of Q124 to keep the emitter-base voltage from exceeding the  $BV_{ebo}$  of Q124.

\* Mod directly applicable to SN 10629-15919 only. SN 5001-10628 should change R126 from 220k to 680k (see M7909).

Parts Removed: None

Parts Added:

R125	Resistor, comp, 330k 1/4W 10%	316-0334-00
------	-------------------------------	-------------

INSTALLATION INSTRUCTIONS

See MI - 9976-2.

HORIZONTAL AMPLIFIER POSITION  
RANGE SHIFTED TO RIGHT TO  
REDUCE COMPONENT SELECTION

See SQB

M10422

Effective Prod SN 16920

Usable in field instruments SN

FRONT PANEL SYMPTOM: Start of sweep can't be positioned to the right of CRT electrical center.

PROBLEM: In order to obtain proper horizontal position range (to the right), it was sometimes necessary to select V333, V353, V374, and R323, the Horizontal Position potentiometer.

PRODUCTION CHANGE: R324 was changed from 20k, 1W 5% to 18k 1W 5% to eliminate selection of components.

Parts Removed:

R324	Resistor, comp, 20k 1W 5%	303-0203-00
------	---------------------------	-------------

Parts Added:

R324	Resistor, comp, 18k 1W 5%	303-0183-00
------	---------------------------	-------------

INSTALLATION INSTRUCTIONS:

See MI - 10422.

NEON INDICATING LAMPS  
AND HOLDERS REPLACED  
WITH IMPROVED TYPE

INFORMATION ONLY

M8002

Effective Prod SN 17170

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The indicating neon holders were replaced with a type which increased wide-angle visibility and is neater in appearance. The new holders, being slightly shorter, require a type NE-2V neon bulb and a shorter mounting screw.

Parts Removed:

B124, B160	Bulb, neon, NE-23	150-0027-00
	Holder, neon, single	352-0008-00
	Screw, 4-40 x 1 FHS	211-0031-00

Parts Added:

B124, B160	Bulb, neon, NE-2V	150-0030-00
	Holder, neon, single	352-0067-00
	Filter, lens, neon indicator	378-0541-00
	Screw, 4-40 x 7/8 FHS	211-0109-00

SWEEP GENERATOR SILICON DIODE  
ADDED TO REDUCE SELECTION OF  
VACUUM TUBE DISCONNECT DIODE

See SQB

M10189

Effective Prod SN 18100

Usable in field instruments SN 5001-18099

FRONT PANEL SYMPTOM: Slow speed timing error and jitter.

PROBLEM: Excessive leakage of the Miller disconnect diode was causing slow speed timing error and jitter.

PRODUCTION CHANGE: A low leakage semiconductor diode was added in series with the Miller tube control grid disconnect diode. This combines the low leakage characteristics of the semiconductor with the fast turn-off capability of the vacuum diode. Also, the 1  $\Omega$  resistor (R392) in series with V152 filament was removed.

Parts Removed:

R392	Resistor, 1 $\Omega$ 1/2 W WW	308-0141-00
------	-------------------------------	-------------

Parts Added:

D152	Diode, low leakage silicon	152-0246-00
------	----------------------------	-------------

INSTALLATION INSTRUCTIONS:

See MI - 10189.

SINGLE SWEEP LOCKOUT  
TRANSISTOR COVER REMOVED

INFORMATION ONLY

M11671

Effective Prod SN 19520

FRONT PANEL SYMPTOM: None.

PROBLEM: Insulating transistor covers were serving little or no useful purpose and required time and material to install.

PRODUCTION CHANGE: The two-piece Thermofit\* transistor cover was removed from Q124, and transistor Q124 was relocated to eliminate the possibility of shorting to R176.

Parts Removed:

Cover, transistor, Thermofit

200-0385-00

\* Raychem Corp Registered Trademark

TIME-BASE GENERATOR RESISTOR ADDED  
TO ELIMINATE 50 $\mu$ s VARIABLE JITTER

See SQB

M11796

Effective Prod SN 20010

Usable in field instruments SN 18100-20009

FRONT PANEL SYMPTOM: Horizontal jitter at 50 $\mu$ s sweep speed with VARIABLE Time/div potentiometer rotated full counter-clockwise.

PROBLEM: Addition of the silicon diode in series with the Miller tube control grid disconnect diode did not totally eliminate the problem.

PRODUCTION CHANGE: A 22 M 1/4 W 10% resistor was installed in parallel with the Miller tube control grid disconnect diode V152. This added resistor shunted the heater to cathode leakage around the tube, allowing the silicon diode to stay off when V152 is turned off.

Parts Removed: None

Parts Added:

R152

Resistor, comp, 22 M 1/4 W 10%

316-0226-00

INSTALLATION INSTRUCTIONS:

Installation Procedure: See MI - 11796.

SWEEP TIMING CAPACITORS  
REPLACED WITH MORE RELIABLE  
AND LOWER COST SETS

INFORMATION ONLY

M12347

Effective Prod SN 22840

FRONT PANEL SYMPTOM: None.

PROBLEM: Encapsulated type timing capacitors are expensive and difficult to manufacture.  
A large in-process inventory is required to produce matched tolerance capacitors.

If a single section of the capacitor failed, the entire assembly must be replaced.

PRODUCTION CHANGE: The three timing capacitors normally mounted in a can, the  
0.01  $\mu$ F, 0.1  $\mu$ F and the 1.0  $\mu$ F, are now made as individual components and mounted  
on ceramic strips.

BE:fb



# MODIFICATION SUMMARY

67



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# INDEX

## MODIFICATION SUMMARY

### TIME BASE

<u>Mod No.</u>	<u>Description</u>	<u>Kit/MI No.</u>	<u>Eff SN</u>	<u>Page</u>
M3337	C160D, E, F, G Tolerances Cahnge to $\pm 1/2\%$	Info Only	none	3
M3404	C160B Changed to Reduce Error	MI-3404	300	3
M3637	R178 Changed to Eliminate Sweep Failure	MI-3637	580	4
M3868	New TIME/DIV Switch Eliminates Grounding of V161 Grid	Info Only	none	4



MYLAR TIMING CAPACITOR  
PART NUMBERS CHANGED

INFORMATION ONLY

M3337

Effective Prod SN not given

DESCRIPTION:

To reduce rejects by customers who purchase timing capacitors as spare parts, the tolerance specification is changed from  $\pm 1/4\%$  or  $-1/4\%$  to a straight  $\pm 1/2\%$ . The printed tolerance is removed on capacitors and the "A" or "B" suffix deleted on part numbers. (This change will not cause difficulty in the timing of instruments.)

Parts Removed:

C160E, F, G	(1 x 0.1 x	291-0029-01	
	(0.01 $\mu$ F $\pm 1/4\%$		
	(1 x 0.1 x 0.01		
	(0.01 $\mu$ F $-1/4\%$	291-0029-02	
C160D	(0.001 $\mu$ F $\pm 1/4\%$	291-0008-01	
	( (white end)		
	(0.001 $\mu$ F $-1/4\%$		291-0008-02
	( (black end)		

Parts Added:

C160E, F, G	(1 x 0.1 x 0.01 $\mu$ F	291-0029-00
	( $\pm 1/2\%$	
C160D	0.001 $\mu$ F $\pm 1/2\%$	291-0008-00

SWEEP TIMING ERROR REDUCED

See SQB

M3404

Effective Prod SN 301

Usable in field instruments SN 101-300

w/exceptions: 238    259    261    263    280

DESCRIPTION:

Changes in sweep timing error caused by capacity variation of timing capacitor C160B with changes in temperature when operated in the 10  $\mu$ SEC, 20  $\mu$ SEC, and 50  $\mu$ SEC TIME/DIV positions is reduced by changing C160B to an NPO type.

Parts Removed:

C160B	82 pF $\pm 10\%$ GP1A	281-0528-00
-------	-----------------------	-------------

Parts Added:

C160B	82 pF $\pm 10\%$ NPO	281-0574-00
-------	----------------------	-------------

INSTALLATION INSTRUCTIONS:

See MI - 3404

TIME-BASE GEN FAILURE ELIMINATED  
BY INCREASING VALUE OF SAWTOOTH  
CF CATHODE DIVIDER RESISTOR, R178

See SQB

M3637

Effective Prod SN 580

Usable in field instruments SN 101-579

DESCRIPTION:

Prevents the Time-Base Generator from becoming inoperative when the Sweep Length potentiometer center arm is adjusted toward the -100V supply, by increasing the value of divider resistor R178.

Parts Removed:

Parts Added:

R178	10k 1/2W 10%	302-0103-00	R178	11k 1/2W 5%	301-0113-00
------	--------------	-------------	------	-------------	-------------

INSTALLATION INSTRUCTIONS:

See MI - 3637

TIME/DIV SWITCH CHANGED

INFORMATION ONLY

M3868

Effective Prod SN not available  
Starting date 1-1-62

DESCRIPTION:

TIME/DIV switch rotors changed to 'break-before-make' type on wafers 3, 4, 5, and 6 to eliminate grounding control grid of V161. Part number of switch did not change.

Parts Removed:

Parts Added:

SW160A	TIME/DIV	260-0352-00	SW160A	TIME/DIV	260-0352-00
--------	----------	-------------	--------	----------	-------------

BE:pm



# MODIFICATION INSTRUCTIONS

MI - 3404

Type 67 Time-Base Unit

Serial Numbers 101-300

## TIMING ACCURACY AND STABILITY IMPROVED

Timing accuracy stability in the 10, 20 and 50  $\mu$ SEC/DIV positions, with changes in temperature, can be improved by replacing timing capacitor, C160B, with an NPO type capacitor.

## PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	281-0574-00	Capacitor, cer, 82 pF $\pm$ 10% NPO

## INSTALLATION

Replace C160B, 82 pF  $\pm$ 10% GP1A capacitor located on the TIME/DIV switch in parallel with C160C (4.5 pF-25 pF variable capacitor), with an 82 pF  $\pm$ 10% NPO capacitor.

DF:ls





# MODIFICATION INSTRUCTIONS

MI - 3637

Type 67 Time-Base Unit

Serial Numbers 101-579

## TIME BASE GENERATOR RELIABILITY IMPROVED

The reliability of the Time Base Generator can be improved by increasing the value of the Sweep Length potentiometer divider resistor, R178. This assures that the Time Base Generator will continue to operate when the Sweep Length control is adjusted near the end connected to -100V.

## PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	301-0113-00	Resistor, comp, 11k 1/2W 5%

## INSTALLATION

Replace R178, 10k 1/2W 10% resistor located between ceramic strips above the R176 Sweep Length potentiometer, with an 11k 1/2W 5% resistor.

DF:ls





# MODIFICATION INSTRUCTIONS

MI - 11796

Instr. Type	Serial numbers
2B67	18100-20009
3B1	4090- 4199
3B3	6030- 7199
310A	21500-21879
502A	26160-26869
504	1640- 1899
RM504	2071- 2299
533A/RM	3001- 5399
570	5570- 5599

## SWEEP GENERATOR MODIFIED TO ELIMINATE SELECTION OF VACUUM TUBE DISCONNECT DIODES

Heater to cathode leakage in the Miller tube control grid disconnect diode can occasionally cause high sweep speed jitter and/or slow sweep speed timing error.

This modification installs a high value resistance in parallel with the Miller tube control grid disconnect diode to shunt the diode heater to cathode leakage around the tube. This permits the silicon diode, installed by an earlier modification in series with the disconnect diode, to remain off when the vacuum tube disconnect diode is turned off.

This modification also installs the low leakage silicon diode in the 533A/RM instruments.

The parallel resistor should only be installed in instruments having the silicon diode in series with the Miller tube control grid disconnect diode.

## PARTS REQUIRED

Instrument	Quantity	Tektronix Part Number	Description
2B67, 3B1, 310A, 502A, 504, RM504, 570	1 ea	316-0226-00	Resistor, comp, 22 M 1/4 W 10%
3B3	2 ea	316-0226-00	Resistor, comp, 22 M 1/4 W 10%
533A/RM	1 ea	152-0246-00	Diode, low leakage silicon
	1 ea	316-0106-00	Resistor, comp, 10 M 1/4 W 10%
	1 ea	(175-0522-00)	Wire, #22 solid, white-green, 4-1/2"

continued

## INSTALLATION

Install 22 M 1/4 W 10% resistor in the following instruments in the locations shown in the chart.

Instrument	Circuit Number	Location
2B67	R152	Between pins 2 and 9 of V152
3B1	R255	Between pins 2 and 5 of V252
3B3	R155	Between pins 2 and 5 of V152
3B3	R255	Between pins 2 and 5 of V252
310A	R150	Between pins 2 and 5 of V150
502A	R152	Between pins 1 and 7 of V152
504	R152	Between pin 9 of V152 and CSB-17
RM504	R152	Between pin 9 of V152 and pin 6 of V145
570	R77	Between pins 1 and 7 of V76

The following steps apply only to Type 533A/RM Oscilloscopes.

- 1) Remove the white-green wire between pin 1 of V161 and pin 5 of V152.
- 2) Install a 4-1/2" piece of #22 solid insulated white-green wire between pin 1 of V161 and CSD-25.
- 3) Install a 10 M 1/4 W 10% resistor between pins 2 and 5 of V152.
- 4) Install a 152-0246-00 diode between pin 5 of V152 and CSD-25, with the cathode (striped) lead in CSD-25.

# MODIFICATION KIT

## SWEEP LOCKOUT

For Tektronix Type 67 Time Base Units  
Serial numbers 101 -5000

### DESCRIPTION

This modification adds a sweep lockout feature which allows the electron beam to sweep once after receiving a triggering pulse. The lock-out circuitry then prevents any subsequent triggering pulses from producing another sweep. The sweep circuit may be reset by depressing the lever arm of the MODE switch. This feature will allow the study of 'one-shot' phenomena.

The modification is accomplished by adding a sweep lockout transistor circuit, a new front panel, and a MODE switch.



040-0318-00

Publication:  
Instructions for 040-0318-00  
February 1966

Supersedes:  
October 1964

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040-0318-00

Page 1 of 6

## PARTS LIST

Quantity	Description	Part Number
1 ea	Assembly, Subpanel, consisting of:	
2 ea	Bulb, NE 2V GE	150-0030-00
1 ea	Diode, silicon, 6061	152-0061-00
1 ea	Lockwasher, int #4	210-0004-00
1 ea	Lug, solder, SE4	210-0201-00
6 ea	Nut, hex, 4-40 x 3/16	210-0406-00
2 ea	Screw, 4-40 x 7/8" FHS, 100° Phillips slot	211-0109-00
1 ea	Switch, lever, 3-position	260-0501-00
2 ea	Holder, neon bulb, single	352-0067-00
1 ea	Knob, lever, (push-on)	366-0215-01
2 ea	Filter; lens, neon indicator 0.300 dia x 0.383 long	378-0541-00
1 ea	Plate, front subpanel	387-0731-00
1 ea	Wire, #22 solid, 4 in. white-red	(175-0522-00)
1 ea	Wire, #22 solid, 12 in. white-yellow	(175-0522-00)
1 ea	Wire, #22 solid, 4 in. white-green	(175-0522-00)
1 ea	Wire, #22 solid, 5 in. white-blue	(175-0522-00)
1 ea	Assembly, Transistor, consisting of:	
1 ea	Transistor, 2N2043	151-0093-00
1 ea	Cover, transistor, thermo-fit, teflon TO-5	200-0385-00
1 ea	Post, binding	129-0020-00
2 ea	Post, binding, miniature, 5-way, charcoal gray	129-0064-00
1 ea	Diode, T12G	152-0008-00
2 ea	Lug, solder, SE6	210-0202-00
1 ea	Lug, solder, SE10, long	210-0206-00
8 ea	Nut, hex, 4-40 x 3/16	210-0406-00
1 ea	Nut, hex, 10-32 x 5/16	210-0410-00
2 ea	Nut, Keps, 6-32 x 5/16	210-0457-00
4 ea	Screw, 8-32 x 1/2 RHS, Phillips slot	212-0044-00
1 ea	Spool, solder, w/3 ft. silver-bearing solder	214-0210-00
1 ea	Resistor, comp, 270 k 1/2W 5%	301-0274-00
2 ea	Resistor, comp, 1 M 1/2W 10%	302-0105-00
1 ea	Resistor, comp, 47 k 1/2W 10%	302-0473-00
1 ea	Resistor, comp, 680 k 1/2W 10%	302-0684-00
1 ea	Resistor, prec, 11.8 k 1W 1%	324-0296-00
1 ea	Panel, front (for Type 67 Mod 040-318)	333-0835-00
1 ea	Tag, front panel insert ("040-318")	334-0679-00
2 ea	Bushing, nylon, charcoal	358-0181-00
1 ea	Spacer, nylon molded	361-0007-00
1 ea	Rod, delrin, 5/16 x 2-1/4 w/3 cross holes	385-0137-00
1 ea	Wire, #22 solid, 3 in. white-green	(175-0522-00)
1 ea	Wire, #22 solid, 9 in. white-orange	(175-0522-00)
1 ea	Wire, #22 solid, 12 in. bare	(176-0122-00)
1 ea	Tag, MODIFIED INSTRUMENT, gummed back	1-910D

## INSTRUCTIONS

**IMPORTANT:** When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

Do not discard any parts until the modification is completed, since some parts may be re-used.

### A. TO REMOVE THE FRONT PANEL:

- ( ) 1. Remove the bushings securing the STABILITY and CALIBRATION controls.
- ( ) 2. Remove all knobs.
- ( ) 3. Unsolder and remove the following wires and resistors:
  - ( ) Bare wire between EXT INPUT binding post and first wafer of TIME/DIV switch (mark location of switch contact).
  - ( ) 1 meg resistor between EXT INPUT post and ground post.
  - ( ) 1 meg resistor between ground post and TRIGGERING COUPLING switch.
  - ( ) Bare wire between EXT TRIG binding post and TRIGGERING SOURCE switch.
- ( ) 4. Remove the three binding posts.
- ( ) 5. Remove the POSITION and TRIGGERING LEVEL potentiometer mounting nuts; remove the front panel.
- ( ) 6. Remove the serial insert tag from the old panel. SAVE FOR STEP 7.
- ( ) 7. Install and tape the serial insert tag in the new front panel from the kit.

### B. TO REMOVE THE FRONT SUBPANEL:

- ( ) 1. Remove the four Phillips screws on the rear of the plug-in.
- ( ) 2. Unscrew and remove the four frame rods.
- ( ) 3. Unsolder the white-red wire and 47k resistor from the UNCAL neon holder.

- ( ) 4. Remove the 1/2 in. nut securing the TIME/DIV switch.
- ( ) 5. Remove the 4-40 nuts securing the following TRIGGERING switches:
  - ( ) SOURCE
  - ( ) COUPLING
  - ( ) SLOPE
- ( ) 6. Remove the 4-40 nuts securing the plug-in fastener; remove the front subpanel.

### C. TO INSTALL SPACER ON PLUG-IN CHASSIS:

- ( ) 1. Drill a 5/32 in. hole in the plug-in chassis near V135 (see Fig. 1).
- ( ) 2. Insert a nylon spacer (from kit) in the hole drilled above.

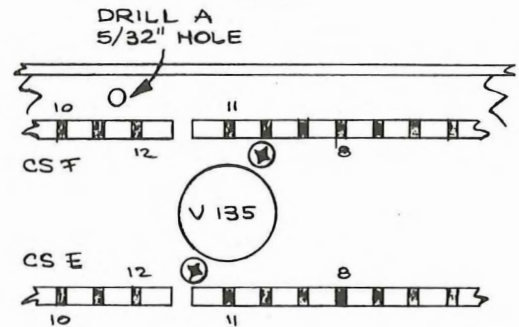


Fig. 1

- ### D. TO INSTALL THE DELRIN ROD: DO NOT PERFORM THIS SECTION IF THE DELRIN ROD NEAR V24 ALREADY HAS THREE PARALLEL CROSS HOLES.
- ( ) 1. Temporarily unsolder the white-orange wire connected to the top terminal of the TRIGGERING SOURCE switch.
  - ( ) 2. Replace the one-hole delrin rod near V24 with the 3-hole rod from the kit.
  - ( ) 3. Place the white-orange wire through the top hole in the delrin rod. Resolder the white-orange wire to the TRIGGERING SOURCE switch.

## INSTRUCTIONS (con'd)

### E. TO MOUNT THE NEW FRONT SUBPANEL:

- ( ) 1. Place the new subpanel assembly (from kit) against the front of the plug-in.
- ( ) 2. Replace the four frame rods removed in step B-2. Refasten the rods to the rear plate with the four Phillips screws from the kit.
- 3. Remount the following TRIGGERING switches with 4-40 nuts from the kit. The switches will be in the same relative positions as before, but closer together; therefore, it may be necessary to shorten or bend some of the leads:
  - ( ) SLOPE
  - ( ) COUPLING
  - ( ) SOURCE

- ( ) 4. Remount the plug-in fastener, with the 4-40 nuts from the kit.
- ( ) 5. Re-install the 1/2 in. nut to secure the TIME/DIV switch.
- ( ) 6. Resolder the white-red wire (see step B-3) to the 'inside' terminal of the UNCAL neon holder.
- ( ) Resolder the 47k resistor to the 'outside' terminal of the UNCAL neon holder.

### F. TO INSTALL THE NEW FRONT PANEL:

- ( ) 1. Place the new front panel over the new subpanel (remove the lever switch knob first).
- ( ) 2. Re-install the STABILITY and CALIBRATION control bushings removed in step A-1.

- ( ) 3. Install the EXT INPUT and EXT TRIG binding posts from the kit. Use a nylon bushing, SE6 solder lug and 6-32 Keps nut from the kit.
- ( ) 4. Install the ground binding post (from kit), using a SE10 solder lug (from kit) under the nut.
- ( ) 5. Replace the POSITION and TRIGGERING LEVEL mounting nuts.
- ( ) 6. Install the push-on knob on the MODE switch from the kit.
- ( ) 7. Re-install the knobs removed in step A-2.

### G. TO INSTALL THE SINGLE SWEEP CIRCUITRY:

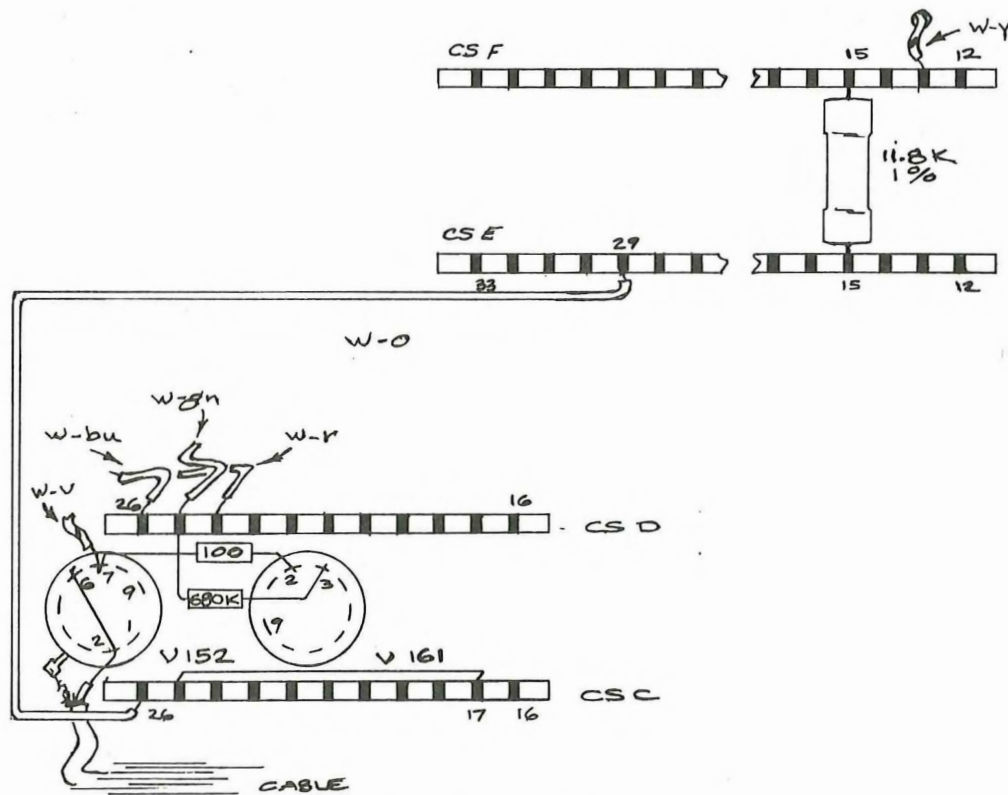
- ( ) 1. Solder a 1 meg resistor (from kit) between the EXT INPUT binding post lug and the ground post lug. Reposition these lugs as necessary.
- ( ) 2. Solder a 1 meg resistor (from kit) between the bottom terminal of the TRIGGERING COUPLING switch and ground post lug.
- ( ) 3. Solder a 3 in. length of white-green wire (from kit) between the EXT INPUT lug and the TIME/DIV switch contact noted in step A-3.
- ( ) 4. Solder a length of bare wire (from kit) between the lower right terminal (looking at the rear of the subpanel) of the TRIGGERING SOURCE switch and the EXT TRIG binding post lug.

# INSTRUCTIONS (con'd)

## Section G continued

REFER TO FIG. 2 FOR STEPS G-5 THROUGH G-15

- ( ) 5. Remove the bare wire between CSD-26 and V152, pin 7.
- ( ) 6. Move the white-violet wire and the end of the 100 $\Omega$  resistor from CSD-26 to V152, pin 7.
- ( ) 7. Remove the bare wire between CSC-26 and V152, pin 2.
- ( ) 8. Move the center conductor of the coax cable from CSC-26 to V152, pin 2.
- ( ) 9. Solder the white-green wire from the MODE switch to CSD-25.
- ( ) 10. Solder the white-red wire from the MODE switch to CSD-24.
- ( ) 11. Solder the white-blue wire from the READY light to CSD-26.
- ( ) 12. Solder a length of #22 bare wire (from kit) between CSC-17 and CSC-25.
- ( ) 13. Solder the white-orange wire (from kit) from CSC-26 to CSE-29.
- ( ) 14. Replace R144 (15k, 1w precision) between CSE-15 and CSF-15, with the 11.8k 1w precision resistor from kit.
- ( ) 15. Solder the 680k resistor (R126, from kit) from pin 3 of V161 to CSD-25. Dress the lead down so that other components may be added to the strip above R126.



← Front of Instrument  
Fig. 2

## INSTRUCTIONS (con'd)

### Step G continued

REFER TO FIG. 3 FOR STEPS G-16 THROUGH G-19

- ( ) 16. Solder the 270k resistor (R123, from kit) between CSD-24 and CSD-26. Mount the resistor on the inward side of CSD and bend down out of the way.

CAUTION: When soldering diodes or transistors, use a pair of pliers between the soldering iron and the components, as a heat sink.

- ( ) 17. Solder the diode (D124, from kit) between CSC-26 (cathode or banded end) and CSD-26 (anode end).
- ( ) 18. Solder the 47k resistor (R124, from kit) between CSC-25 and CSD-26.

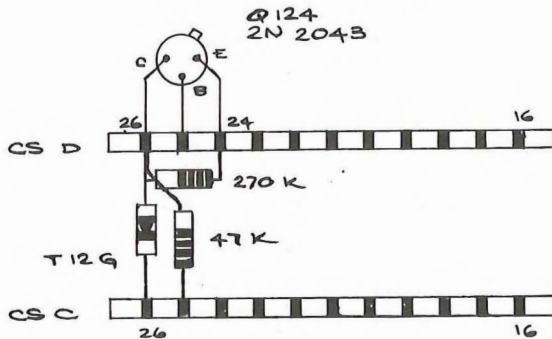


Fig. 3

19. Solder the 2N2043 transistor (Q124, from kit) as follows:

( )	EMITTER	to	CSD-24
( )	BASE	to	CSD-25
( )	COLLECTOR	to	CSD-26

20. Route the white-yellow wire from the MODE switch as follows:

- ( ) through the middle hole in the delrin rod installed in step D-2.
- ( ) through the nylon spacer, installed in step C-2.
- ( ) 21. Solder the free end of the white-yellow wire to CSF-13 (see Fig. 2).

THIS COMPLETES THE INSTALLATION.

- ( ) Check wiring for accuracy.
- ( ) Check the calibration of the plug-in as indicated in your Instruction Manual.
- ( ) Moisten the back of the MODIFIED INSTRUMENT tag (from kit) and place it on the Manual schematic page affected by this modification.
- ( ) Fasten the Insert pages in your Instruction Manual.

JB:ls

# **SWEEP LOCKOUT**

Type 67 -- All Serial Numbers  
Installed in Type 67 s/n \_\_\_\_\_

## **GENERAL INFORMATION**

This modification adds a sweep lockout feature which allows the electron beam to sweep once after receiving a triggering pulse. The lockout circuitry then prevents any subsequent triggering pulses from producing another sweep. The sweep circuit may be reset by depressing the lever arm of the MODE switch. This feature will allow the study of 'one-shot' phenomena.

The modification is accomplished by adding a sweep lockout transistor circuit, new front panel, and a MODE switch.

The information on these pages supplements, or supersedes the information in your Manual.

## **OPERATING INSTRUCTIONS**

To display a single-shot phenomenon:

1. Set the TRIGGERING COUPLING switch to AC SLOW or DC.
2. Set the MODE lever switch, SW124, to NORMAL.
3. Adjust the STABILITY and TRIGGERING LEVEL controls for triggering operation. To do this, display successive trial single traces of the desired waveform or of a waveform having similar characteristics. Alternatively, you can use the CALIBRATOR waveform for a trial display.
4. Set the rest of the front panel controls for settings suited to the waveform to be observed.
5. Remove the signal source from the INPUT or CHANNEL connector. Set the lever switch to SINGLE SWEEP.
6. If the READY lamp is not lighted, push the lever switch to RESET. The lamp should now be lighted.
7. Connect the source of the expected signal to the INPUT or CHANNEL connector.

When a signal is received to trigger the sweep, a single sweep will occur. Following this, the READY lamp will be extinguished and subsequent signals will not trigger the sweep. The sweep circuits can be prepared for another sweep by pushing the lever switch to RESET.

## **CIRCUIT DESCRIPTION**

The Sweep Lockout circuit consists of transistor Q124 and associated components.

With the MODE switch at NORM, the base of Q124 and the anode of D126 are grounded. The emitter of Q124 has no ground return, and both emitter and collector are negative with respect to the base. Some current (about 0.4 ma) flows through the base-collector junction of Q124, setting the collector at about -80 volts. This reverse biases D124, since the grid of V135A runs between about -25 and -58 volts. When V135A conducts (grid at about -25 v) the plate voltage is about +14 volts.

Placing the MODE switch to SINGLE SWEEP changes Q124 from a grounded-base to a grounded-emitter configuration. READY lamp B124 conducts and holds the collector of Q124 at about -55 to -60 volts. Conduction through R126 forward biases D126 and connects the base of Q124 to the plate of V135A. This reverse biases Q124 and 'arms' the sweep . . . that is, V135A is ready to be triggered.

The next trigger to arrive at the grid of V135A will force the Sweep-Gating Multivibrator to switch states (V135A cut off; V145A conducting) and start a sweep. At the completion of the sweep, V135A again conducts and its plate voltage drops below ground. This forward biases Q124 (through D126) and drives it into saturation. Collector current then pulls up the collector of Q124 and the grid of V135A (through D124) to near ground. This extinguishes READY lamp B124 and drives V135A hard into saturation. With V135A in saturation, it is insensitive to incoming triggers and the sweep is 'locked out'.

Depressing the MODE switch to RESET transfers V135A plate current from the base of Q124 to ground. Current through R126 and D126 raises the base of Q124 slightly positive, which reverse biases Q124. The reduction in collector current then lets the grid of V135A fall to its 'ready-to-be-triggered' level. The READY lamp then fires to indicate the sweep is again 'armed', waiting for a trigger.

## ELECTRICAL PARTS LIST

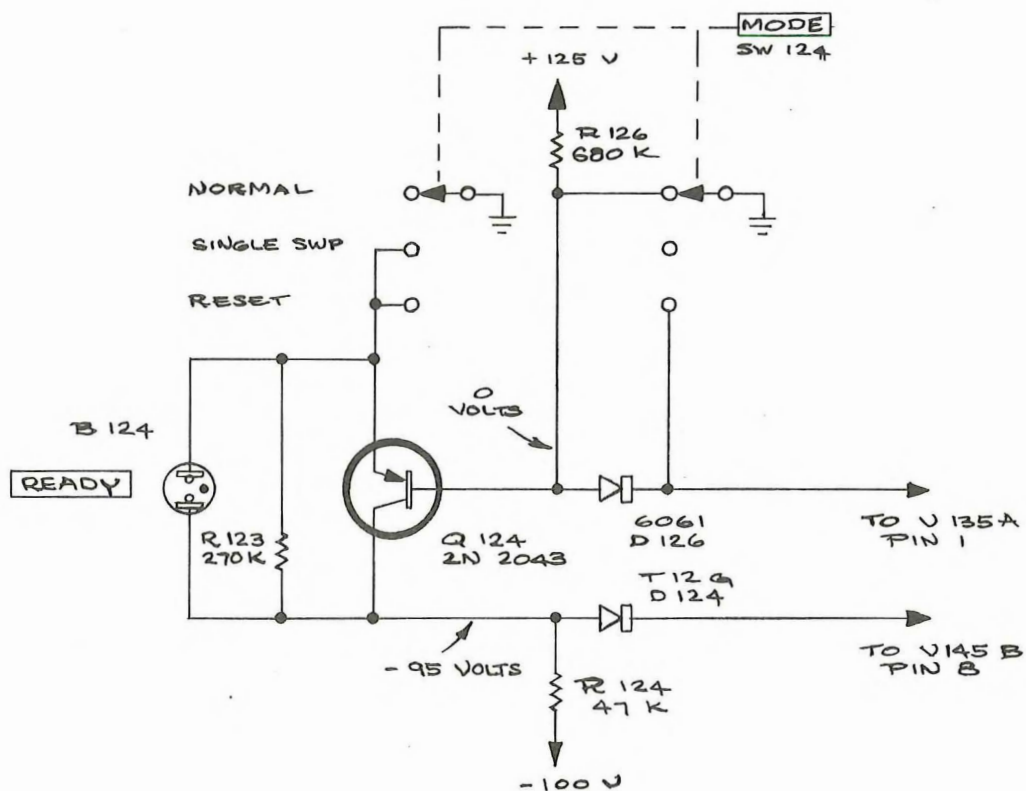
Values fixed unless marked Variable.

Ckt. No.	Part Number	Description		
BULBS				
B124	150-0030-00	Neon, NE	2V	GE
B160W	150-0030-00	Neon, NE	2V	GE
DIODES				
D124	152-0008-00	Germanium	T12G	
D126	152-0061-00	Silicon	6061	
RESISTORS				
Resistors are 10% composition 1/2 watt unless otherwise noted.				
R123	301-0274-00	270 k		5%
R124	302-0473-00	47 k		
R126	302-0684-00	680 k		
R144	324-0296-00	11.8 k	1W	1%
SWITCHES				
SW124	260-0501-00	Lever	MODE	
TRANSISTORS				
Q124	151-0093-00	2N2043		

## MECHANICAL PARTS LIST

	Part Number
Bushing, nylon, charcoal	358-0181-00
Cover, transistor, thermo-fit	200-0385-00
Filter, lens, neon ind cator 0.300 dia x 0.383 long	378-0541-00
Holder, neon bulb, single	352-0067-00
Knob, lever	366-0215-01
Lockwasher, int #4, cad plated	210-0004-00
Lug, solder, SE4, w/2 wire holes	210-0201-00
Lug, solder, SE6, w/2 wire holes	210-0202-00
Lug, solder, SE10, long	210-0206-00
Nut, hex, brass, 4-40 x 3/16, cad plated	210-0406-00
Nut, Keps, steel, 6-32 x 5/16	210-0457-00
Nut, hex, brass, 10-32 x 5/16	210-0410-00
Panel, front	333-0835-00
Plate, front subpanel	387-0731-00
Post, binding	129-0020-00
Post, binding, miniature, 5-way fluted cap, charcoal gray	129-0064-00
Rod, delrin, 5/16 x 2-1/4 in., w/3 cross holes	385-0137-00
Screw, 4-40 x 7/8 in. FHS, cad plated 100° Phillips slot	211-0109-00
Screw, 8-32 x 1/2 RHS, Phillips slot	212-0044-00
Spacer, nylon molded	361-0007-00
Tag, front panel insert ("040-318")	334-0679-00

SCHEMATIC:



PARTIAL DIAGRAM, TIME-BASE GENERATOR

Also make the following changes in your Manual Schematics:

- Change R144 to 11.8k (TIME-BASE GENERATOR)
- Change B160w to NE-23 (TIMING SWITCH)





# MODIFICATION INSTRUCTIONS

MI - 7909

Type 2B67 Time-Base Unit  
Serial numbers 5001-10629 \*

## SINGLE SWEEP RELIABILITY IMPROVED

The reliability of the single sweep operation can be improved by bringing the STABILITY setting for the single sweep closer to the STABILITY setting for normal sweep by increasing the value of R126.

In the NORMAL sweep mode Q124 may be operating in the emitter-to-base breakdown region. If it is operating in this region it can take 1 to 2 seconds for Q124 to cool before the single sweep circuit can be armed after switching the MODE switch to SINGLE SWEEP.

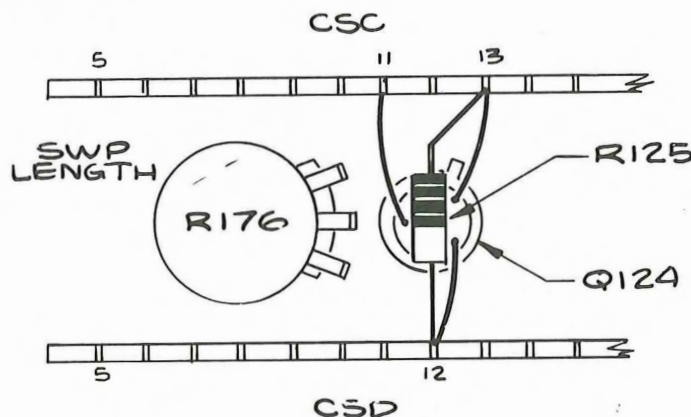
The problem is corrected by adding a 330k 1/4 W 10% resistor between the base and the emitter of Q124.

## PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	302-0684-00	Resistor, comp, 680k 1/2 W 10%
1 ea	316-0334-00	Resistor, comp, 330k 1/4 W 10%

## INSTALLATION

- 1) Replace R126, a 220k 1/2 W 10% resistor located on the ceramic strips between R176 (Sweep Length control) and the tube socket of V161, with a 680k 1/2 W 10% resistor.
- 2) Add a 330k 1/4 W 10% resistor, R125, between CSC-13 and CSD-12, above Q124. See drawing.



\* For serial numbers 10630-15919 see MI -9976-2.





# MODIFICATION INSTRUCTIONS

MI - 9660

Type 2B67 Time-Base Unit  
Serial numbers 5001-15379

## SWEEP LOCKOUT DIODE PROTECTED

Diode D126 may short or open due to a momentary grid-plate short in V135B causing the sweep or SINGLE SWEEP to become inoperative. Changing R137 to 220k will prevent D126 from being destroyed. A "speed-up" capacitor, C137, is also added in parallel with R137.

## PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	302-0224-00	Resistor, comp, 220 k 1/2W 10%
1 ea	281-0549-00	Capacitor, cer, 68 pF 500 V

## INSTALLATION

- 1) Solder a 68 pF ceramic capacitor (C137) in parallel with a 220k 1/2W 10% resistor (R137).
- 2) Replace R137 (100 $\Omega$  1/2W resistor between pins 1 and 7 of V135) with the above combination of C137-R137.

DF:ls





# MODIFICATION INSTRUCTIONS

MI - 9976-2

Type 2B67 Time-Base Unit  
Serial numbers 10630-15919 \*

## SINGLE SWEEP ARMING DURING FIRST TWO SECONDS ASSURED

In the NORMAL sweep mode, Q124 may be operating in the emitter-to-base breakdown region. If it is operating in this region it can take 1 to 2 seconds for Q124 to cool before the single sweep circuit can be armed after switching the MODE switch to SINGLE SWEEP.

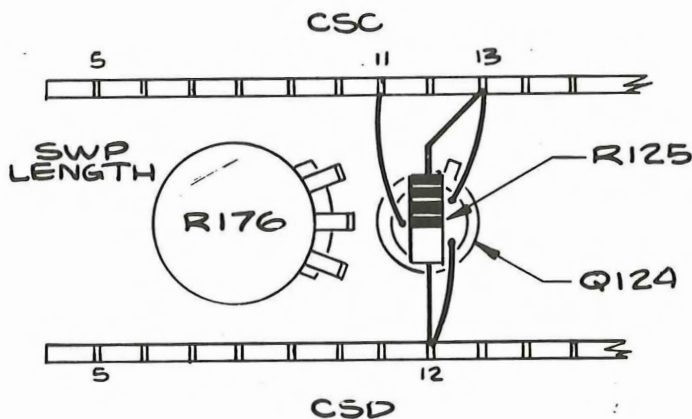
The problem is corrected by adding a 330k 1/4W 10% resistor between the base and emitter of Q124.

## PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	316-0334-00	Resistor, comp, 330k 1/4W 10%

## INSTALLATION

Add a 330k 1/4W 10% resistor, R125, between CSC-13 and CSD-12 above Q124.  
See drawing.



\* For instruments serial numbers 5001-10628 see MI - 7909.

DF:ls

12-26-67





# MODIFICATION INSTRUCTIONS

MI - 10189

Type 2B67 Time-Base Unit  
Serial numbers 5001-18099

## REDUCES TIMING ERROR AND HORIZONTAL JITTER AT SLOW SWEEP SPEEDS

Certain type 6BJ7 diodes used as the Miller disconnect diode, V152B, exhibit excessive leakage which causes slow sweep timing error and horizontal jitter.

The problem is eliminated by adding a low leakage silicon diode (D152) in series with V152, adding a 22M 1/4W resistor in parallel with V152, and removing R392, a 1  $\Omega$  1/2W wirewound resistor (serial numbers 10810-18099 only) from in series with the V152 filament.

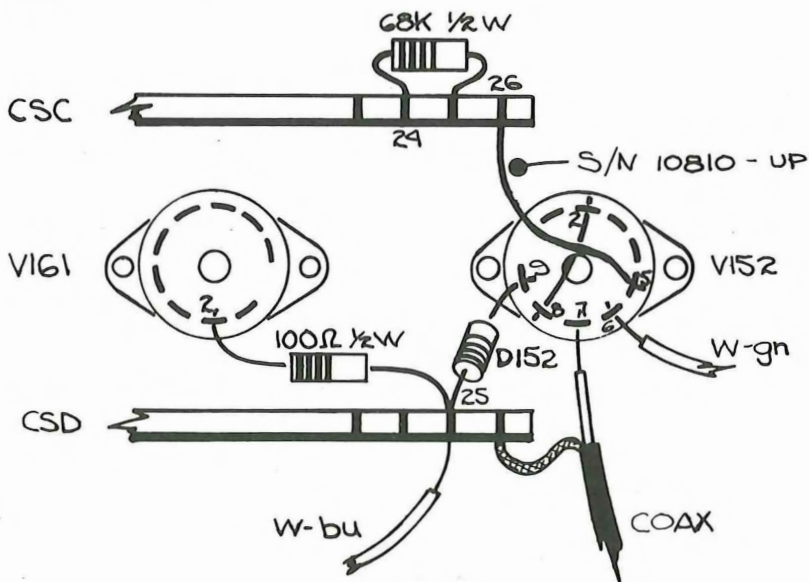
## PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	152-0246-00	Diode, silicon, low leakage
1 ea	316-0226-00	Resistor, comp, 22M 1/4W 10%

## INSTALLATION

### ALL SERIAL NUMBERS

- 1) Remove the bare wire between CSC-24 and CSD-25 (see drawing below).
- 2) Relocate the 68k 1/2W resistor (R165) from CSC-25/CSD-25 to CSC-24/CSC-25.
- 3) Move the 100 $\Omega$  resistor (R161) lead and white-blue wire from pin 9 (or pin 7) of V152 to CSD-25.



continued

INSTALLATION (cont)

SERIAL NUMBERS 5001-10809

- 1) Move the coax center conductor from pin 9 to pin 7 of V152.
- 2) Remove the bare wire between pins 2 and 6 of V152.
- 3) Move the white-green wire from pin 8 to pin 6 of V152.
- 4) Add a #22 bare wire between pins 2 and 8 of V152.

SERIAL NUMBERS 10810-UP

Replace the  $1\Omega$  1/2 W wirewound resistor (R392) between CSC-26 and pin 5 of V152 with a #22 bare wire.

ALL SERIAL NUMBERS

- 1) Add diode D152 between CSD-25 (banded end) and pin 9 of V152.
- 2) Add a 22 M  $1/4$  W 10% resistor between pins 2 and 9 of V152.

DF:ls



# MODIFICATION INSTRUCTIONS

MI - 10422

Type 2B67 Time-Base Unit  
Serial numbers 5001-16919

## HORIZONTAL POSITIONING RANGE SHIFTED TO THE RIGHT TO ELIMINATE NECESSITY OF SELECTING CERTAIN COMPONENTS

In order to obtain proper range of the HORIZONTAL position control in the right hand direction, it was sometimes necessary to select V333, V353, V374, and R323 (Horizontal POSITION potentiometer).

Changing R324 (Horizontal POSITION control series resistor) from 20k 1W 5% to 18k 1W 5%, shifts the range to the right and eliminates the need to select these components.

## PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	303-0183-00	Resistor, comp, 18k 1W 5%

## INSTALLATION

Replace R324 (20k 1W 5% resistor located on ceramic strips near R176 Sweep Length potentiometer) with an 18k 1W 5% resistor.

DF:ls





# MODIFICATION INSTRUCTIONS

MI - 11796

Instr. Type	Serial numbers
2B67	18100-20009
3B1	4090- 4199
3B3	6030- 7199
310A	21500-21879
502A	26160-26869
504	1640- 1899
RM504	2071- 2299
533A/RM	3001- 5399
570	5570- 5599

## SWEEP GENERATOR MODIFIED TO ELIMINATE SELECTION OF VACUUM TUBE DISCONNECT DIODES

Heater to cathode leakage in the Miller tube control grid disconnect diode occasionally can cause high sweep speed jitter and/or slow sweep speed timing error.

This modification installs a high value resistance in parallel with the Miller tube control grid disconnect diode to shunt the diode heater to cathode leakage around the tube. This permits the silicon diode, installed by an earlier modification in series with the disconnect diode, to remain off when the vacuum tube disconnect diode is turned off.

This modification also installs the low leakage silicon diode in the 533A/RM instruments.

The parallel resistor should only be installed in instruments having the silicon diode in series with the Miller tube control grid disconnect diode.

## PARTS REQUIRED

Instrument	Quantity	Tektronix Part Number	Description
2B67, 3B1, 310A, 502A, 504, RM504, 570	1 ea	316-0226-00	Resistor, comp, 22 M 1/4 W 10%
3B3	2 ea	316-0226-00	Resistor, comp, 22 M 1/4 W 10%
533A/RM	1 ea	152-0246-00	Diode, low leakage silicon
	1 ea	316-0106-00	Resistor, comp, 10 M 1/4 W 10%
	1 ea	(175-0522-00)	Wire, #22 solid, white-green, 4-1/2"

## INSTALLATION

Install 22M 1/4W 10% resistor in the following instruments in the locations shown in the chart.

Instrument	Circuit Number	Location
2B67	R152	Between pins 2 and 9 of V152
3B1	R255	Between pins 2 and 5 of V252
3B3	R155	Between pins 2 and 5 of V152
3B3	R255	Between pins 2 and 5 of V252
310A	R150	Between pins 2 and 5 of V150
502A	R152	Between pins 1 and 7 of V152
504	R152	Between pin 9 of V152 and CSB-17
RM504	R152	Between pin 9 of V152 and pin 6 of V145
570	R77	Between pins 1 and 7 of V76

The following steps apply only to Type 533A/RM Oscilloscopes.

- 1) Remove the white-green wire between pin 1 of V161 and pin 5 of V152.
- 2) Install a 4-1/2" piece of #22 solid insulated white-green wire between pin 1 of V161 and CSD-25.
- 3) Install a 10M 1/4W 10% resistor between pins 2 and 5 of V152.
- 4) Install a 152-0246-00 diode between pin 5 of V152 and CSD-25, with the cathode (striped) lead in CSD-25.

# MODIFICATION KIT

## PARALLEL REAR CONNECTOR

For the following Tektronix Plug-in Units:

Type 60 SN 101 - 819	Type 75 SN 101 - 1119
Type 2A60 SN 820 - up	Type 3A75 SN 1120 - up
Type 67 SN 101 - 5000	Type 3B1 SN 101 - up
Type 2B67 SN 5001 - up	Type 3B3 SN 101 - up
	Type 3B4 SN 101 - up

### DESCRIPTION

This modification provides one coaxial line to a BNC connector on the rear panel of the instrument, paralleling the front panel input connector or binding post. The plug-in/indicator interface is fitted with a pair of mating holders for miniature coaxial connectors, which permit withdrawal of the plug-in without unsoldering the cable.

To complete the modification, you must install one of the following Modification Kits in an RM561, RM561A, or RM564 indicator: 040-0409-00 provides one coaxial line for either right or left plug-in compartment (but not both); 040-0410-00 provides two coaxial lines for either right or left plug-in compartment; 040-0411-00 provides four coaxial lines for either right or left plug-in compartment.

Additional kits are available to install two or four coaxial lines (depending upon plug-in type) in 2- and 3-series plug-ins.\* The connector holders are the same whether they hold one, two, or four connectors, so the plug-ins having various numbers of connectors are interchangeable. However, to insure electrical continuity from front to rear panel, the plug-in and indicator coaxial lines must 'match'.

NOTE: The Types 67, 2B67, 3B1, 3B3, and 3B4 have two front panel inputs, either of which may be connected to the rear via 040-0406-00. The remaining input may later be connected to the rear by installing a second 040-0406-00.

\*040-0407-00 provides two coaxial lines in Types 2A61, 63, 2A63, 67, 2B67, 3A1, 3A6, 72, 3A72, 3B1, 3B3, and 3B4. 040-0408-00 provides four coaxial lines in Types 3A3 and 3A74.

See LIMITATIONS on page 2.



040-0406-00

Publication:  
Instructions for 040-0406-00  
June 1966  
Supersedes May 1966

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040-0406-00

Page 1 of 19

## LIMITATIONS:

### 1. Compatibility

Modified plug-ins will not fit in the following indicators: Types 560, 561, 561A, 564, 567, and RM567. In the Types 567 and RM567, the digital readout connector blocks insertion. In the others, the solid back wall of the plug-in compartment prevents sufficient insertion of the plug-in to 'mate' the 24-pin connectors on the plug-in and indicator.

Modified plug-ins may be used in the Types RM561, RM561A, RM564, 565, RM565, and 129, although no kits are available to equip the 565, RM565, or 129 with rear input connectors. Also, there could be noise problems with one of the more sensitive plug-in units having an open input connector facing into an indicator power supply.

### 2. Changes in Electrical Characteristics

The system is basically incompatible with conventional X10 or X100 high-impedance probes. This is because the input capacitance of the plug-in is raised to approximately 100pF, plus the capacitance of the circuitry attached to the rear connector.

Optimum transient response for 10MHz instruments may be preserved by terminating at the front-panel connector for signals applied to the rear-panel connector. There will be some degradation of transient response in 10 MHz instruments for signals applied to the front panel input or terminated at the rear panel. For lower bandwidth instruments, the only noticeable effect will be that of the increased cable capacitance on signals from sources greater than 50  $\Omega$ .

## PARTS LIST

Quantity	Part Number	Description
(1 ea)		Assembly, coax-connector, consisting of:
1 ea	131-0409-00	Connector, coax, Cannon DM53743-5001
1 ea	(162-0531-00)	Tubing, plastic, #12 black (heat-shrinkable) 3/4 in.
1 ea	(175-0068-00)	Cable, coax, RG-174/U gray 21 in.
2 ea	210-0457-00	Nut, Keps, 6-32 x 5/16
2 ea	211-0507-00	Screw, 6-32 x 5/16 PHS, Phillips
2 ea	211-0512-00	Screw, 6-32 x 1/2 FHS 100°, Phillips
1 ea	334-1070-00	Plate, information, 1/4 x 1
3 ea	343-0088-00	Clamp, cable, size C
1 ea	348-0003-00	Grommet, rubber, 5/16 in.
1 ea	352-0094-00	Holder, coax connector, Delrin*
2 ea	385-0113-00	Rod, nylon, 5/16 x 1-1/8, tap 6-32 w/2 #27 holes
1 ea	385-0138-01	Rod, Delrin, 5/16 x 1-9/16, tap 6-32 w/4 #31 holes

\*Du Pont registered trademark.

## INSTRUCTIONS

### A. TO MODIFY TYPE 60 OR 2A60

- ( ) 1. Mount the coax connector holder (from kit) on the rear plate of the plug-in, using the 6-32 flathead screws and Keps nuts from the kit (see Fig. 1).
- ( ) 2. Install the coax-connector assembly (from kit) in position J-1 on the holder, as shown in Fig. 1.
- ( ) 3. Drill two 1/8 in. holes as shown in Fig. 2 (on following page).
- ( ) 4. Dress the coax along the chassis to the INPUT connector (see Fig. 2). Solder the center conductor to the connector and the shield to the ground lug.
- ( ) Secure the cable to the chassis by pressing cable clamps (from kit) into the holes drilled in step A-3.

### THIS COMPLETES THE INSTALLATION FOR THE TYPE 60 OR 2A60

- ( ) Remove the tape backing from the information plate (from kit) and attach the plate to the front panel just beneath the words "TYPE 60 (2A60) AMPLIFIER".
- ( ) Fasten the insert page in your Instruction Manual.

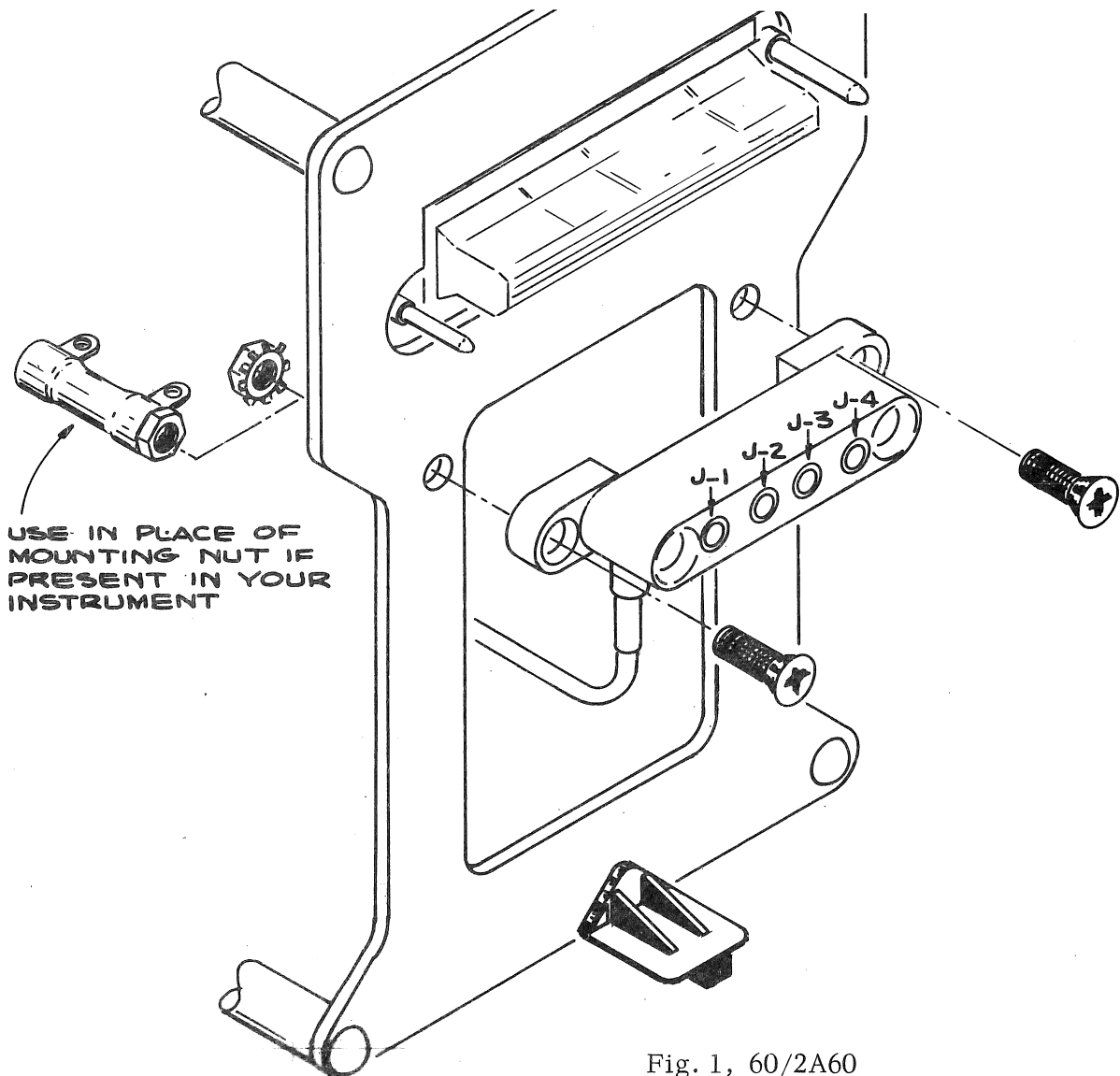


Fig. 1, 60/2A60

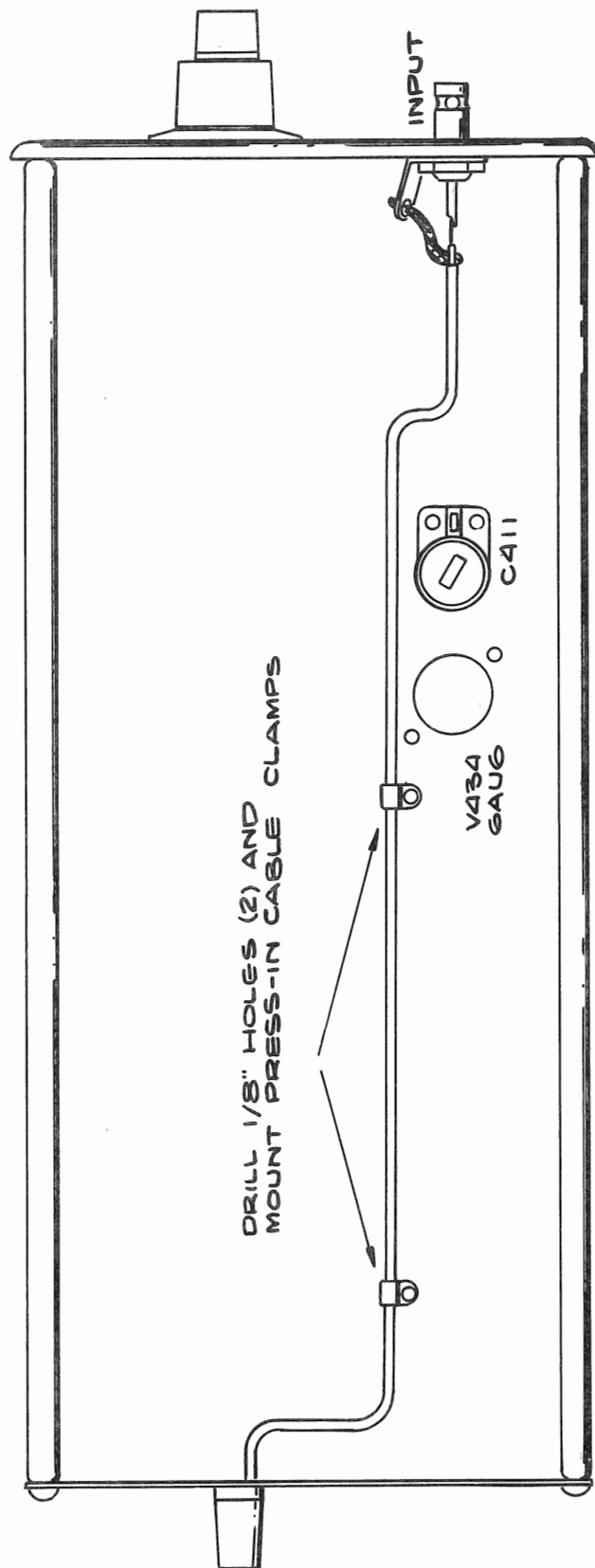


Fig. 2, 60/2A60



## INSTRUCTIONS (cont)

### B. TO MODIFY TYPE 75 OR 3A75

- ( ) 1. Locate the center chassis-mounting screw in the rear plate of the plug-in.
- ( ) Loosen this screw, but do not remove it.
- ( ) 2. Strike the screw head lightly with a hammer to loosen the Pem nut from the chassis.
- ( ) Remove the screw and Pem nut.
- ( ) 3. With a 5/32 (#23) drill, drill a hole in the chassis in line with the hole in the rear plate immediately below the one from which the screw was removed.

CAUTION: Move the cable harness first to avoid damage.

- ( ) 4. Mount the coax connector holder (from kit) on the rear plate, using the 6-32 flathead screws and Keps nuts from the kit (see Fig. 3).
- ( ) 5. Install the coax-connector assembly (from kit) in position J-1 on the holder, as shown in Fig. 3.

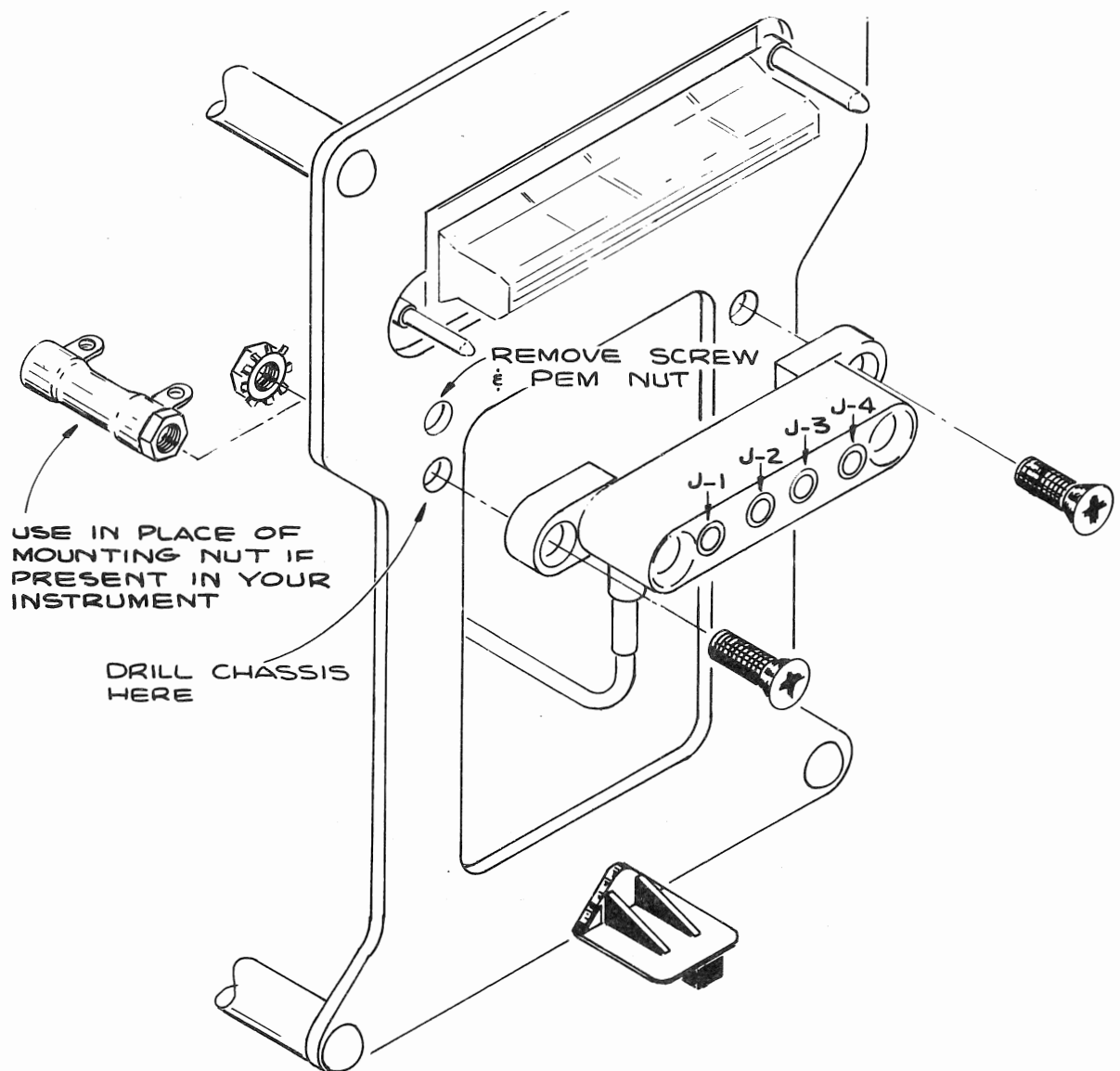


Fig. 3, 75/3A75

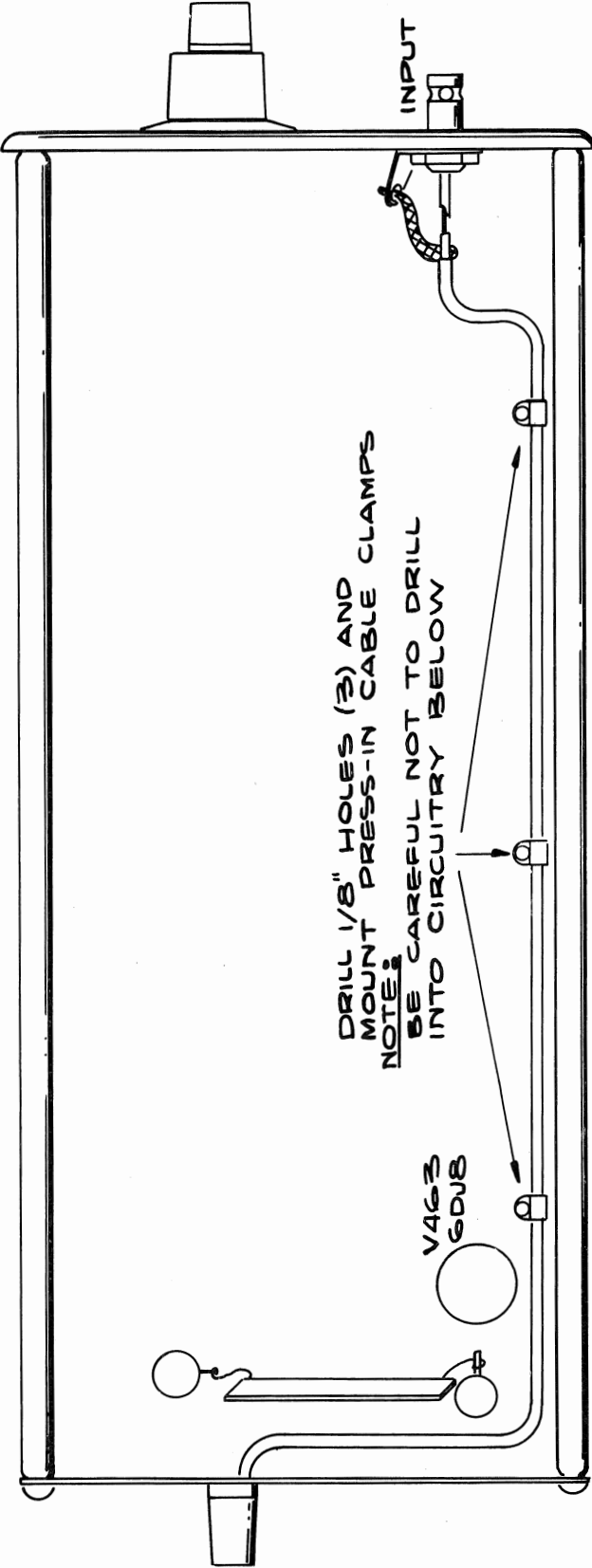


Fig. 4, 75/3A75

## INSTRUCTIONS (cont)

### B. TO MODIFY TYPE 75 OR 3A75 (cont)

- ( ) 6. Drill three 1/8 in. holes as shown in Fig. 4.
- ( ) 7. Dress the coax along the chassis to the INPUT connector (see Fig. 4). Solder the center conductor to the connector and the shield to the ground lug.
- ( ) Secure the cable to the chassis by pressing cable clamps (from kit) into the holes drilled in step B-6.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 75 OR 3A75.

- ( ) Remove the tape backing from the information plate (from kit) and attach the plate to the front panel just beneath the words "TYPE 75 (3A75) AMPLIFIER".
- ( ) Fasten the insert page in your Instruction Manual.

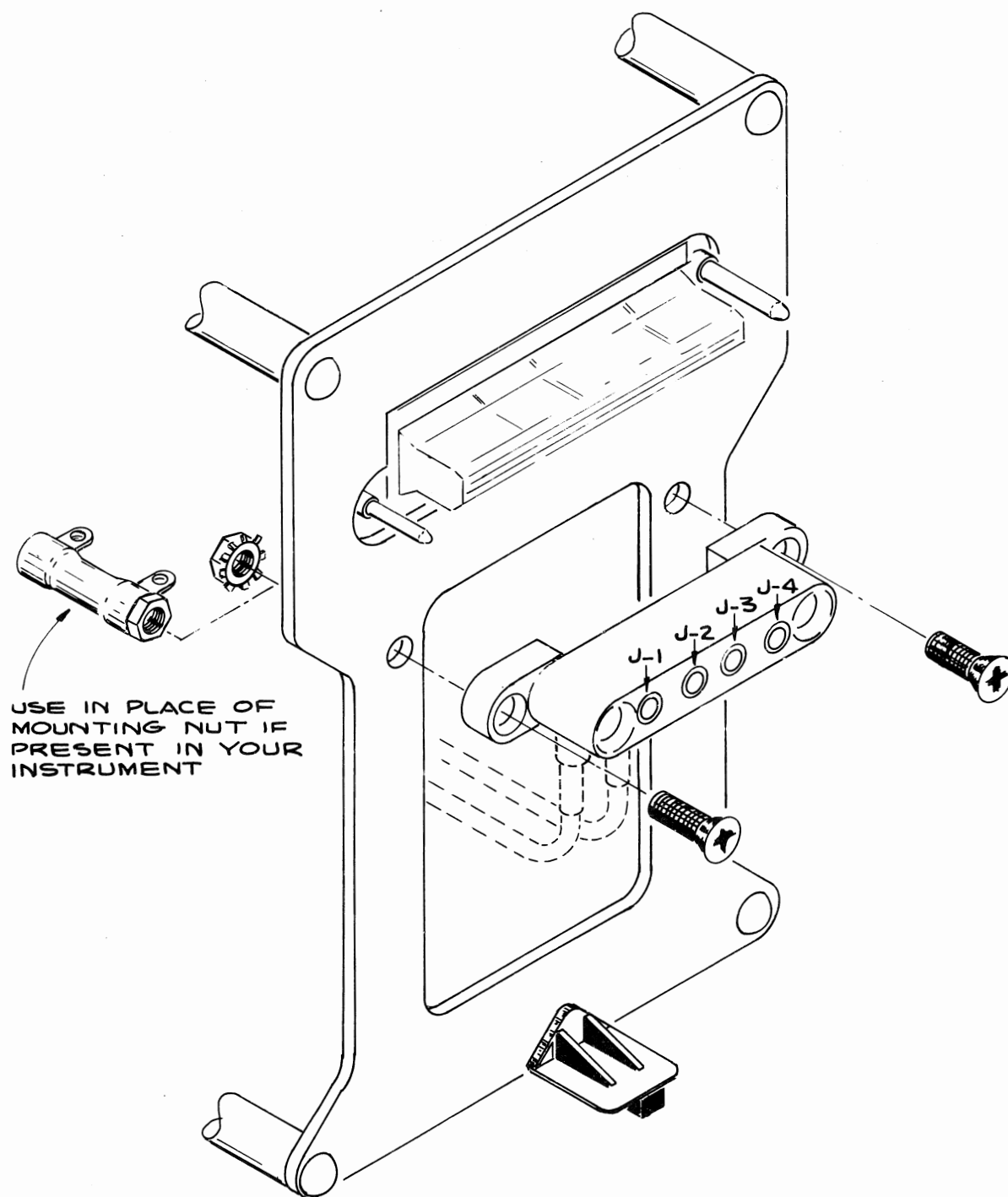


Fig. 5

## INSTRUCTIONS (cont)

### C. TO INSTALL COAX CONNECTOR HOLDER (TYPES 67, 2B67, 3B1, 3B3, and 3B4)

- ( ) 1. Mount the coax connector holder (from kit) on the rear plate of the plug-in, using the 6-32 flathead screws and Keps nuts from the kit (see Fig. 5).

NOTE: On some instruments the mounting hole must be drilled through the chassis lip, in line with the hole in the rear plate.

- ( ) 2. Install the coax-connector assembly (from kit) in position J-1 or J-2 on the holder (see Fig. 5), referring to the table below for the proper position.

<u>Plug-in Type</u>	<u>Front Panel Connector</u>	<u>Position</u>
67/2B67	EXT INPUT	J-1
67/2B67	EXT TRIG	J-2
3B1	Delayed EXT TRIG	J-1
3B1	Normal EXT TRIG	J-2
3B3	Delayed EXT TRIG	J-1
3B3	Normal EXT TRIG	J-2
3B4	EXT HORIZ IN	J-1
3B4	EXT TRIG IN	J-2

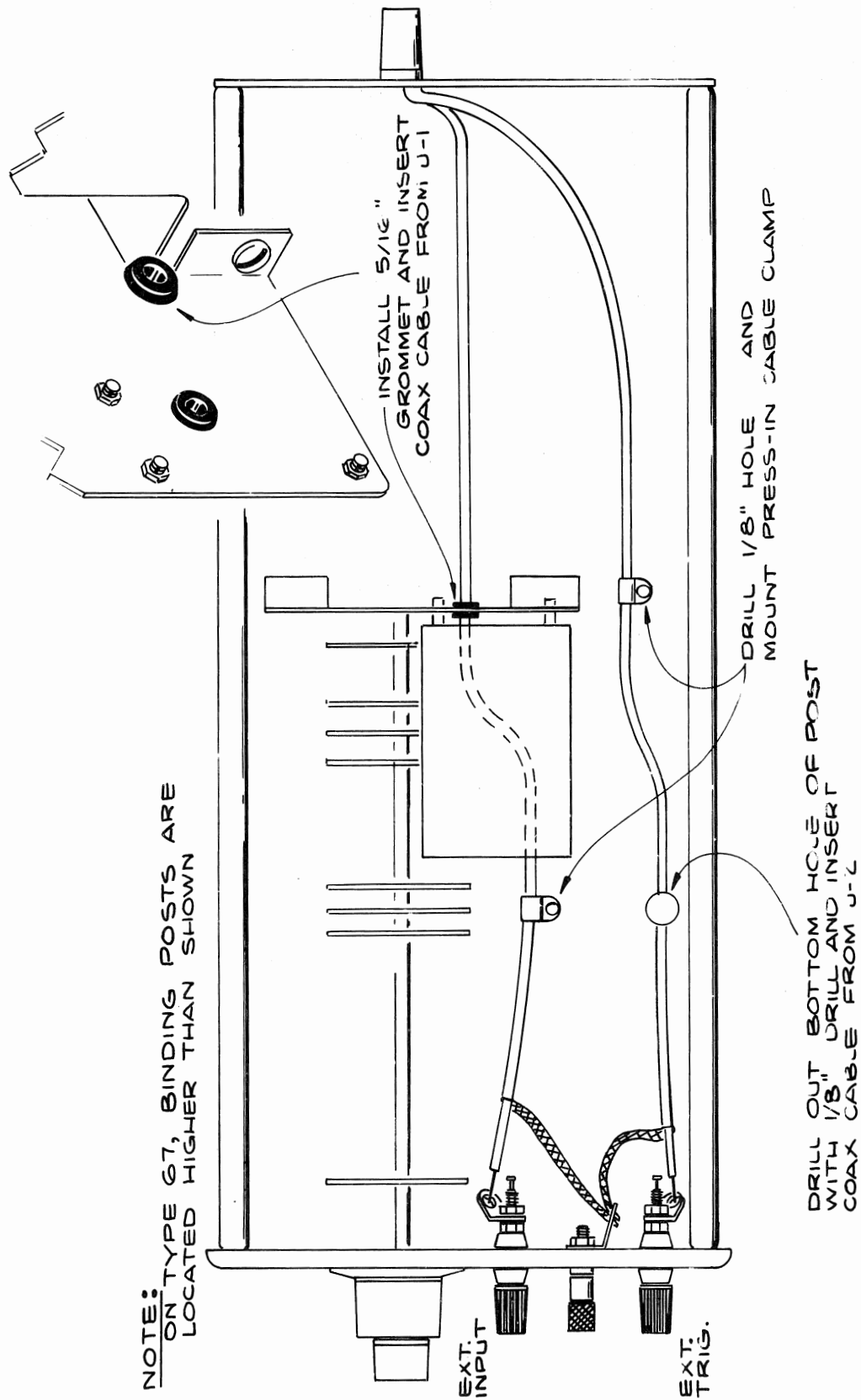


Fig. 6, 67/2B67

## INSTRUCTIONS (cont)

### D. TO MODIFY TYPE 67 OR 2B67

**IMPORTANT:** Select the proper step below, plus the portion of Fig. 6 which applies, to connect either the EXT INPUT or the EXT TRIG binding post to the rear panel.

#### 1. EXT INPUT (see top portion of Fig. 6):

- ( ) a) Install the 5/16 in. grommet (from kit) in the cutout in the TIME/DIV switch bracket.
- ( ) b) Drill a 1/8 in. hole in the chassis, just above V24.
- ( ) c) Dress the coax cable (from J-1) through the grommet installed in step D-1-a.
- ( ) d) Secure the cable to the chassis by pressing a snap-in cable clamp (from kit) into the hole drilled in step D-1-b.
- ( ) e) Solder the coax center conductor to the EXT INPUT binding post and the shield to the ground post.

#### 2. EXT TRIG (see bottom portion of Fig. 6):

- ( ) a) Drill a 1/8 in. hole in the chassis, midway between V45 and V135.
- ( ) b) Drill out the 'bottom' hole in the support post, near V24, to 1/8 in.
- ( ) c) Dress the coax cable (from J-2) through the post hole drilled out in step D-2-b.
- ( ) d) Secure the cable to the chassis by pressing a snap-in cable clamp (from kit) into the hole drilled in step D-2-a.
- ( ) e) Solder the coax center conductor to the EXT TRIG binding post and the shield to the ground post.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 67 OR 2B67.

- ( ) Fasten the insert page in your Instruction Manual.

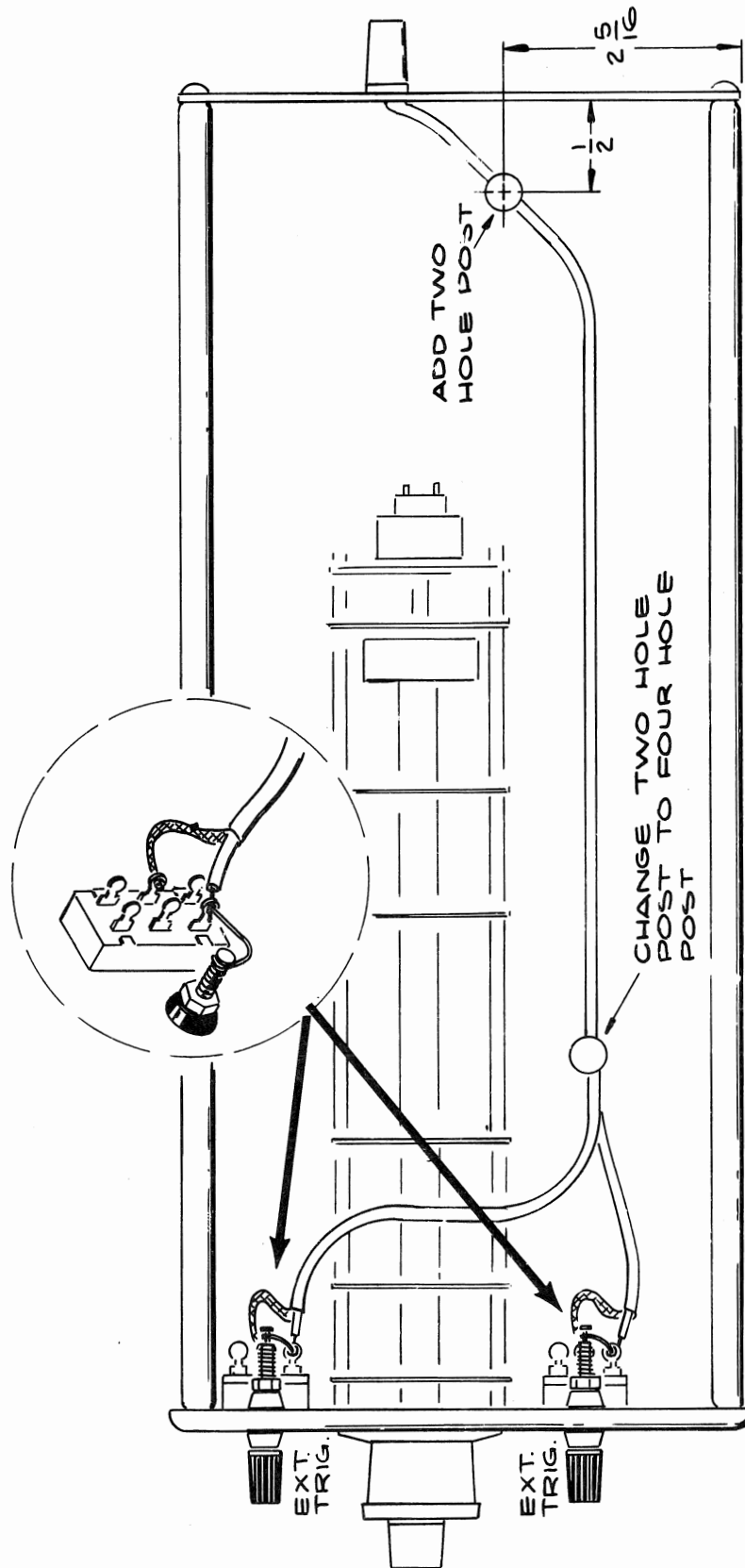


Fig. 7, 3B1

## INSTRUCTIONS (cont)

### E. TO MODIFY TYPE 3B1

IMPORTANT: Select the proper steps below, plus the portion of Fig. 7 which applies, to connect either the Delayed EXT TRIG or the Normal EXT TRIG binding post to the rear panel.

#### 1. Delayed or Normal EXT TRIG:

- ( ) a) Unsolder, from the TIME/DIV switch, the coax cable which passes through the support post near Q23
- ( ) b) Replace the support post with a 4-hole post (rod) from the kit.
- ( ) c) Dress the coax cable (unsoldered in step E-1-a) through the 'bottom' hole in the new post and resolder to the TIME/DIV switch.
- ( ) d) Drill a 5/32 in. hole at the rear of the chassis, as shown in Fig. 7.  
CAUTION: Look out for the wiring cable on the other side of the chassis.
- ( ) e) In this hole, mount a 2-hole support post (rod) from the kit. Use a 6-32 x 5/16 PHS screw from the kit.

#### 2. Delayed EXT TRIG:

- ( ) a) Dress the coax cable (from J-1) through the 'top' holes in both the 2-hole and the 4-hole posts.
- ( ) b) Solder the coax center conductor to the Delayed SOURCE switch (lug connected to EXT TRIG binding post). Solder the shield to the middle grounded lug of the switch.

#### 3. Normal EXT TRIG:

- ( ) a) Dress the coax cable (from J-2) through the 'bottom' hole in the 2-hole post and the second hole from the 'top' in the 4-hole post.
- ( ) b) Solder the coax center conductor to the Normal SOURCE switch (lug connected to EXT TRIG binding post). Solder the shield to the grounded lug of the switch.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 3B1.

- ( ) Fasten the insert page in your Instruction Manual.

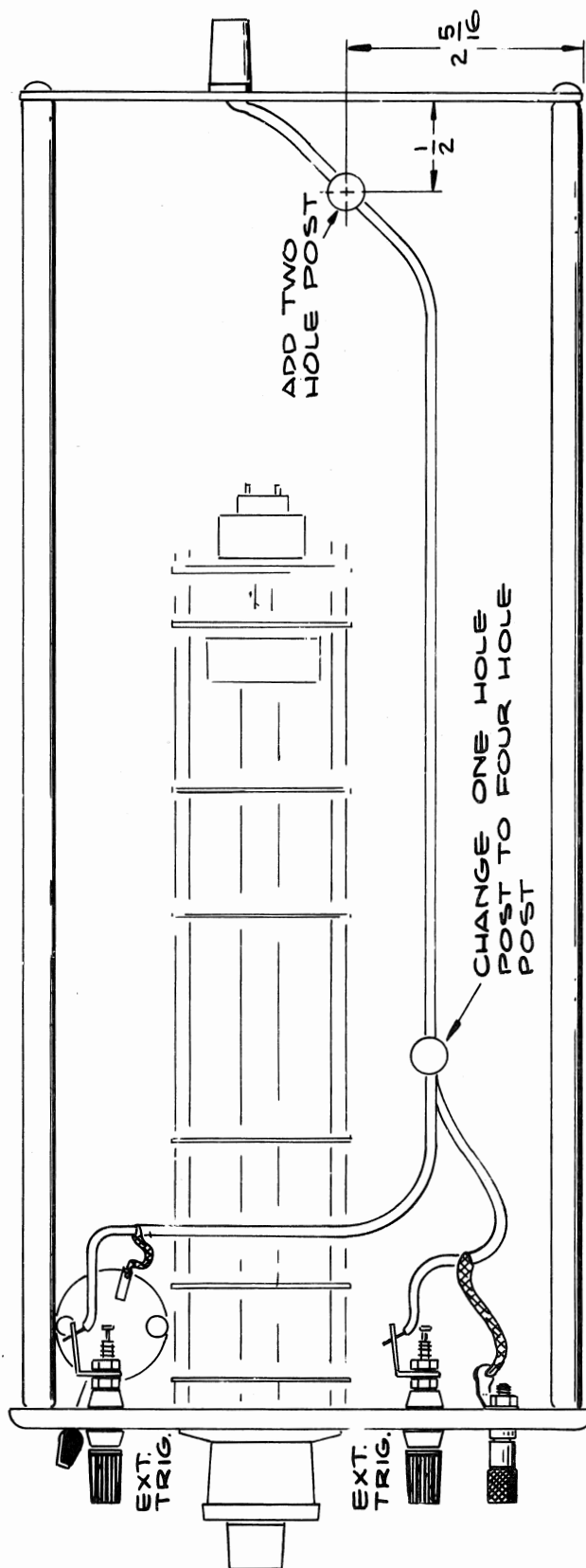


Fig. 8, 3B3

## INSTRUCTIONS (cont)

### F. TO MODIFY TYPE 3B3:

**IMPORTANT:** Select the proper steps below, plus the portion of Fig. 8 which applies, to connect either the Delayed EXT TRIG or the Normal EXT TRIG binding post to the rear panel.

#### 1. Delayed or Normal EXT TRIG:

- ( ) a) Unsolder, from the TIME/DIV switch, the coax cable which passes through the support post near Q23.
- ( ) b) Replace the support post with a 4-hole post (rod) from the kit.
- ( ) c) Dress the coax cable (unsoldered in step F-1-a) through the 'bottom' hole in the new post and resolder to the TIME /DIV switch.
- ( ) d) Drill a 5-32 in. hole at the rear of the chassis, as shown in Fig. 8.  
CAUTION: Look out for the wiring cable on the other side of the chassis.
- ( ) e) In this hole, mount a 2-hole support post (rod) from the kit. Use a 6-32 x 5/16 PHS screw from the kit.

#### 2. Delayed EXT TRIG:

- ( ) a) Dress the coax cable (from J-1) through the 'top' holes in both the 2-hole and the 4-hole posts.
- ( ) b) Solder the coax center conductor to the Delayed EXT TRIG binding post and the shield to the grounded SOURCE switch terminal.

#### 3. Normal EXT TRIG:

- ( ) a) Dress the coax cable (from J-2) through the 'bottom' hole in the 2-hole post and the second hole from the 'top' in the 4-hole post.
- ( ) b) Solder the coax center conductor to the Normal EXT TRIG binding post and the shield to the ground post.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 3B3.

- ( ) Fasten the insert page in your Instruction Manual.

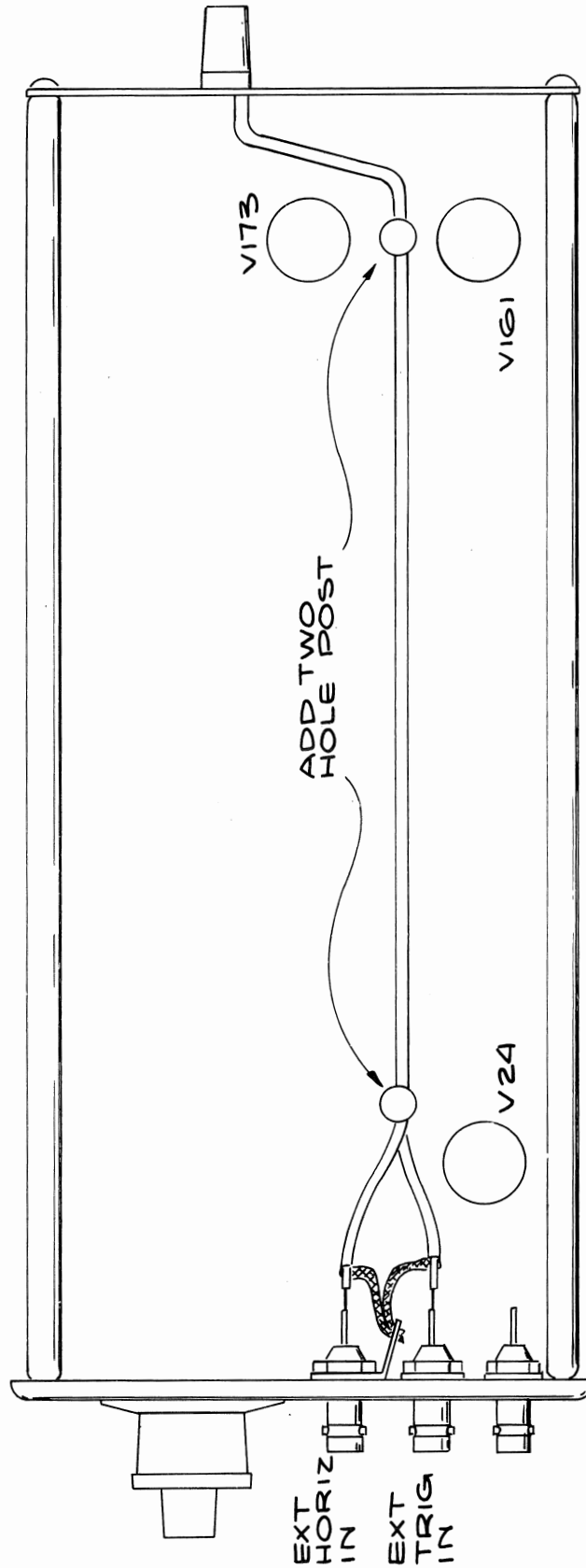


Fig. 9, 3B4

## INSTRUCTIONS (cont)

### G. TO MODIFY TYPE 3B4:

IMPORTANT: Select the proper steps below, plus the portion of Fig. 9 which applies, to connect either the EXT HORIZ IN or EXT TRIG IN connector to the rear panel.

#### 1. EXT HORIZ IN or EXT TRIG IN:

- ( ) a) Drill a 5/32 in. hole in the chassis, slightly above and to the rear of V24.  
CAUTION: Look out for the wiring cable on the other side of the chassis.
- ( ) b) Drill a 5/32 in. hole in the chassis, between V161 and V173.
- ( ) c) In each of the holes drilled above, mount a 2-hole support post (rod) from the kit. Use 6-32 x 5/16 PHS screws from the kit.

#### 2. EXT HORIZ IN:

- ( ) a) Dress the coax cable (from J-1) through the 'top' holes in the support posts.
- ( ) b) Solder the coax center conductor to the EXT HORIZ IN connector and the shield to the ground lug.

#### 3. EXT TRIG IN:

- ( ) a) Dress the coax cable (from J-2) through the 'bottom' holes in the support posts.
- ( ) b) Solder the coax center conductor to the EXT TRIG IN connector and the shield to the ground lug.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 3B4.

- ( ) Fasten the insert page in your Instruction Manual.

CH:cet



## PARALLEL REAR CONNECTOR

Types 60, 2A60, 67, 2B67, 75, 3A75, 3B1, 3B3, and 3B4 -- All serial numbers

Installed in Type \_\_\_\_\_ SN \_\_\_\_\_ Date \_\_\_\_\_

### GENERAL INFORMATION

This modification provides one coaxial line to a BNC connector on the rear panel of the instrument, paralleling the front panel input connector or binding post. The plug-in/indicator interface is fitted with a pair of mating holders for miniature coaxial connectors, which permit withdrawal of the plug-in without unsoldering the cable.

To complete the modification, you must install one of the following Modification Kits in an RM561, RM561A, or RM564 indicator: 040-0409-00 provides one coaxial line for either right or left plug-in compartment (but not both); 040-0410-00 provides two coaxial lines for either right or left plug-in compartment; 040-0411-00 provides four coaxial lines for either right or left plug-in compartment.

Additional kits are available to install two or four coaxial lines (depending upon plug-in type) in 2- and 3-series plug-ins. The connector holders are the same whether they hold one, two, or four connectors, so the plug-ins having various numbers of connectors are interchangeable. However, to insure electrical continuity from front to rear panel, the plug-in and indicator coaxial lines must 'match'.

The following chart shows the proper connector on the indicator rear panel for each front panel input, whether the plug-in is used in the left (vertical) or right (horizontal) compartment.

<u>Instrument</u>	<u>Front Panel Input</u>	<u>Using Left Compartment</u>	<u>Using Right Compartment</u>
60, 2A60	INPUT	J-1	J-5
75, 3A75	INPUT	J-1	J-5
67, 2B67	EXT INPUT	J-1	J-5
	EXT TRIG	J-2	J-6
3B1	Delayed EXT TRIG	J-1	J-5
	Normal EXT TRIG	J-2	J-6
3B3	Delayed EXT TRIG	J-1	J-5
	Normal EXT TRIG	J-2	J-6
3B4	EXT HORIZ IN	J-1	J-5
	EXT TRIG IN	J-2	J-6

NOTE: The Types 67, 2B67, 3B1, 3B3, and 3B4 have two front panel inputs, either of which may be connected to the rear via 040-0406-00. The remaining input may later be connected to the rear by installing a second 040-0406-00.

## LIMITATIONS:

### 1. Compatibility

Modified plug-ins will not fit in the following indicators: Types 560, 561, 561A, 564, 567, and RM567. In the Types 567 and RM567, the digital readout connector blocks insertion. In the others, the solid back wall of the plug-in compartment prevents sufficient insertion of the plug-in to 'mate' the 24-pin connectors on the plug-in and indicator.

Modified plug-ins may be used in the Types RM561, RM561A, RM564, 565, RM565, and 129, although no kits are available to equip the 565, RM565, or 129 with rear input connectors. Also, there could be noise problems with one of the more sensitive plug-in units having an open input connector facing into an indicator power supply.

### 2. Changes in Electrical Characteristics

The system is basically incompatible with conventional X10 or X100 high-impedance probes. This is because the input capacitance of the plug-in is raised to approximately 100pF, plus the capacitance of the circuitry attached to the rear connector.

Optimum transient response for 10MHz instruments may be preserved by terminating at the front-panel connector for signals applied to the rear-panel connector. There will be some degradation of transient response in 10 MHz instruments for signals applied to the front panel input or terminated at the rear panel. For lower bandwidth instruments, the only noticeable effect will be that of the increased cable capacitance on signals from sources greater than 50  $\Omega$ .

## MECHANICAL PARTS LIST

	Part Number
Clamp, cable, size C	343-0088-00
Connector, coax, Cannon DM53743-5001	131-0409-00
Grommet, rubber, 5/16 in.	348-0003-00
Holder, coax connector, Delrin	352-0094-00
Nut, Keps, 6-32 x 5/16	210-0457-00
Plate, information, 1/4 x 1	334-1070-00
Rod, Delrin, 5/16 x 1-9/16 w/4 #31 holes	385-0138-01
Rod, nylon, 5/16 x 1-1/8 w/2 #27 holes	385-0113-00
Screw, 6-32 x 5/16 PHS, Phillips	211-0507-00
Screw, 6-32 x 1/2 FHS 100°, Phillips	211-0512-00

# MODIFICATION KIT

## PARALLEL REAR CONNECTORS

For the following Tektronix Plug-in Units:

2A61 SN 100- up	3A6 SN 100- up
63 SN 101-1319	72 SN 101-1419
2A63 SN 1320- up	3A72 SN 1420- up
67 SN 101-5000	3B1 SN 101- up
2B67 SN 5001- up	3B3 SN 100- up
3A1 SN 101- up	3B4 SN 100- up

### DESCRIPTION

This modification provides two coaxial lines to a corresponding number of BNC connectors on the rear panel of the instrument, paralleling the front panel input connectors or binding posts. The plug-in/indicator interface is fitted with a pair of mating holders for miniature coaxial connectors, which permit withdrawal of plug-in without unsoldering cables.

To complete the modification, you must install one of the following Modification Kits in an RM561, RM561A, or RM564 indicator: 040-0410-00 provides two coaxial lines for either right or left plug-in compartment (but not both); 040-0411-00 provides four coaxial lines for either right or left plug-in compartment.

Additional kits are available to install one or four coaxial lines (depending upon plug-in type) in 2- and 3-series plug-ins.\* The connector holders are the same whether they hold one, two, or four connectors, so the plug-ins having various numbers of connectors are interchangeable. However, to insure electrical continuity from front to rear panel, the plug-in and indicator coaxial lines must 'match'.

\* 040-0406-00 provides one coaxial line in Types 60, 2A60, 75, 3A75, 67, 2B67, 3B1, 3B3, and 3B4.

040-0408-00 provides four coaxial lines in Types 3A3 and 3A74.

See LIMITATIONS on page 2.



040-0407-00

Publication:  
Instructions for 040-0407-00  
March 1967

Supersedes:  
July 1966

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**040-0407-00**

## LIMITATIONS:

### 1. Compatibility

Modified plug-ins will not fit in the following indicators: Types 560, 561, 561A, 564, 567, and RM567. In the Types 567 and RM567 the digital readout connector blocks insertion. In the others the solid back wall of the plug-in compartment prevents sufficient insertion of the plug-in to 'mate' the 24-pin connectors on the plug-in and indicator.

Modified plug-ins may be used in the Types RM561, RM561A, RM564, 565, RM565 and 129, although no kits are available to equip the 565, RM565 or 129 with rear input connectors. Also, there could be noise problems with one of the more sensitive plug-in units having an open input connector facing into an indicator power supply.

### 2. Changes in Electrical Characteristics

The system is basically incompatible with conventional X10 or X100 high-impedance probes. This is because the input capacitance of the plug-in is raised to approximately 100 pF, plus the capacitance of the circuitry attached to the rear connector.

Optimum transient response for 10 MHz instruments may be preserved by terminating at the front panel connector for signals applied to the rear panel connector. There will be some degradation of transient response in 10 MHz instruments for signals applied to the front panel input or terminated at the rear panel. For lower bandwidth instruments, the only noticeable effect will be that of the increased cable capacitance on signals from sources greater than 50  $\Omega$ .

## ## CONNECTOR EXTRACTION

The Cannon DM series miniature connectors may be removed from their Delrin<sup>\*</sup> holders by using a special tool available from Cannon Electric Company. Order connector extractor CET-C6B.

To use the extractor, plunge the tubing down over the connector as far as it will go, then push the connector out with the inner shaft of the tool.

### PARTS LIST

Quantity	Part Number	Description
(1 ea)		Assembly, connector, consisting of:
2 ea	131-0409-00	Connector, coax, Cannon DM53743-5001
1 ea	352-0094-00	Holder, coax connector, Delrin <sup>*</sup>
2 ea	(162-0531-00)	Tubing, plastic, #12 3/4 in. black (heat-shrinkable)
1 ea	(175-0068-00)	Cable, coax, RG-174/U 21 in. gray-orange-orange
1 ea	(175-0068-00)	Cable, coax, RG-174/U 21 in. gray-yellow-yellow
3 ea	006-0531-00	Tie, cable, nylon, blue
4 ea	210-0457-00	Nut, Keps, 6-32 x 5/16
2 ea	210-0802-00	Washer, steel, flat, 6S
2 ea	211-0507-00	Screw, 6-32 x 5/16 PHS, Phillips
2 ea	211-0512-00	Screw, 6-32 x 1/2 FHS 100°, Phillips
2 ea	316-0151-00	Resistor, comp, 150 $\Omega$ 1/4W 10%
1 ea	334-1070-00	Plate, information, 1/4 x 1
2 ea	343-0002-00	Clamp, cable, plastic, 3/16 in.
2 ea	343-0088-00	Clamp, cable, size C
1 ea	348-0003-00	Grommet, rubber, 5/16 in.
2 ea	361-0007-00	Spacer, nylon molded, 0.063
2 ea	385-0113-00	Rod, nylon, 5/16 x 1-1/8, tap 6-32 w/2 #27 holes
1 ea	385-0138-01	Rod, Delrin, 5/16 x 1-9/16, tap 6-32 w/4 #31 holes

\*Du Pont Registered Trademark.

## INSTRUCTIONS

A. TO INSTALL CONNECTOR ASSEMBLY (ALL PLUG-INS): Refer to Fig. 1.

- ( ) 1. Mount the connector assembly (from kit) using the existing holes on the rear plate of the plug-in. Use the 6-32 x 1/2 flat head screws and Keps nuts from the kit. Make sure the coax cables are in positions J-1 and J-2 as shown.

NOTE: On some instruments, one mounting hole must be drilled through the chassis lip, in line with the hole in the rear plate.

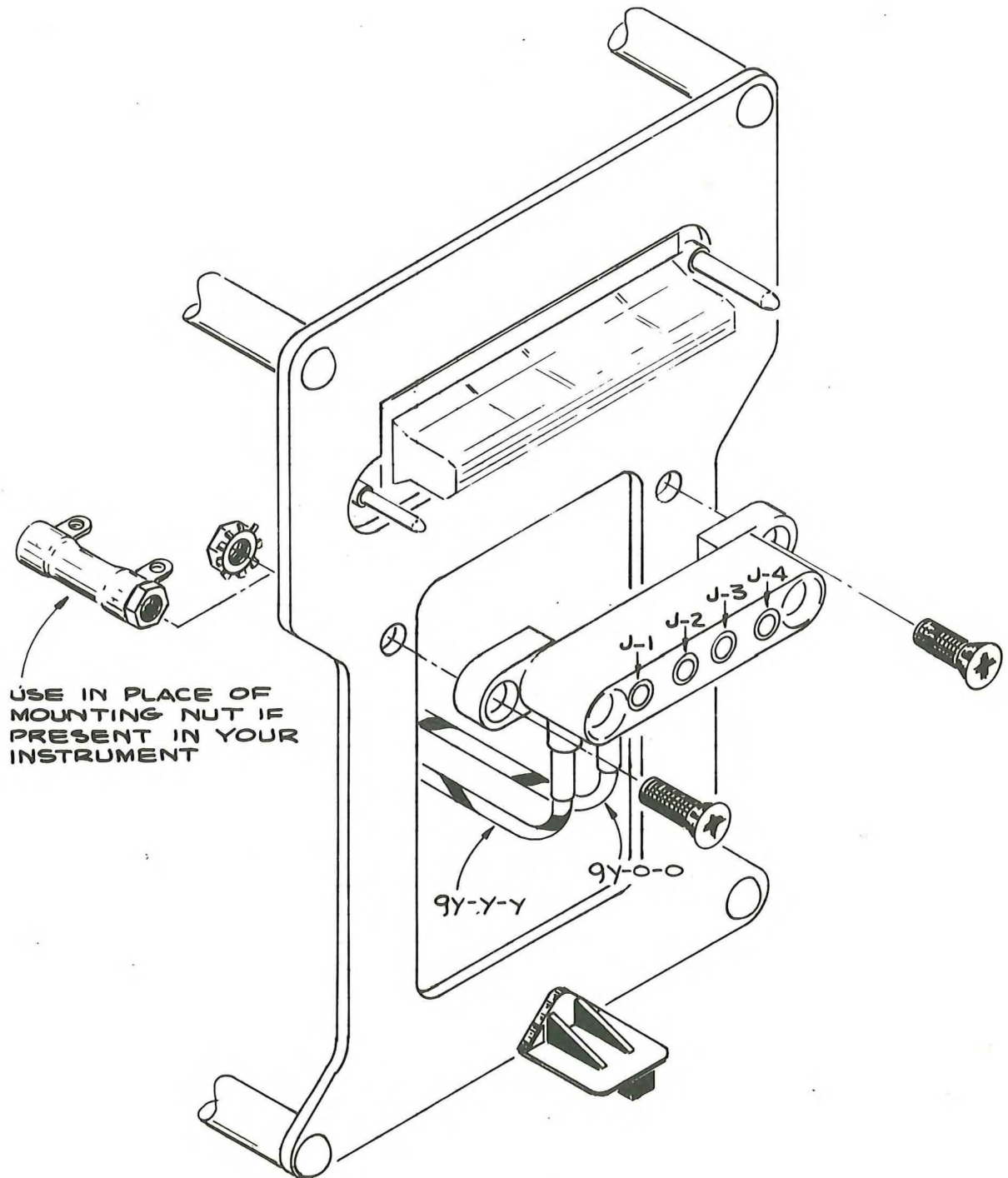


Fig. 1

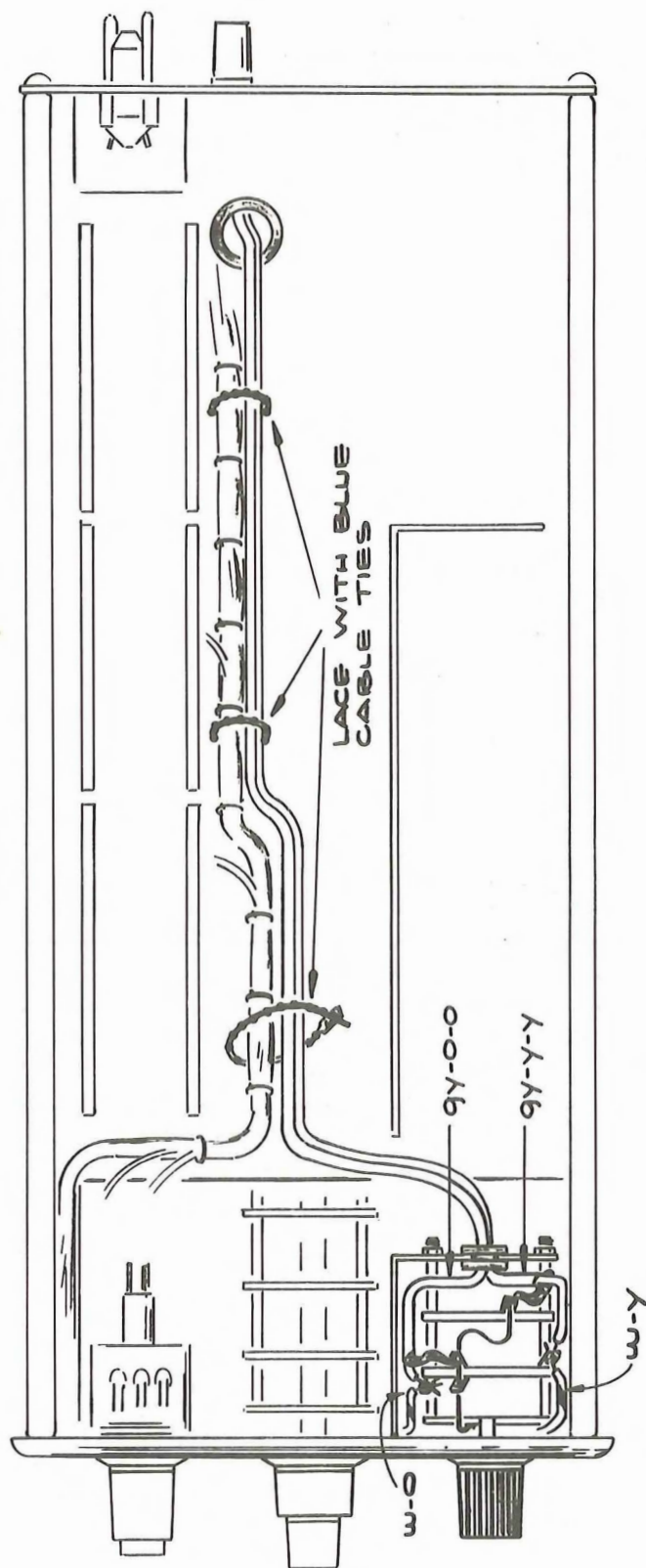


Fig. 2 2A61

## INSTRUCTIONS (cont)

### B. TO MODIFY TYPE 2A61:

Refer to Fig. 2.

- ( ) 1. Dress the coax cables (from connector assembly) through the grommet at the rear of the chassis, along the wiring cable, and through the grommet in the INPUT SELECTOR switch shield.
- ( ) Fasten the coax cables to the wiring cable with blue cable ties from the kit.
- ( ) 2. Solder the center conductor of the gray-yellow-yellow coax to the same switch contact as the white-yellow wire (from pin 'A' of INPUT connector).
- ( ) Solder the coax shield to a ground point on the switch.
- ( ) 3. Solder the center conductor of the gray-orange-orange coax to the same switch contact as the white-orange wire (from pin 'B' of INPUT connector).
- ( ) Solder the coax shield to a ground point on the switch.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 2A61.

- ( ) Remove the tape backing from the information plate (from kit) and attach the plate to the front panel just beneath the words "Type 2A61 DIFFERENTIAL . . ."
- ( ) Fasten the insert page in your Instruction Manual.

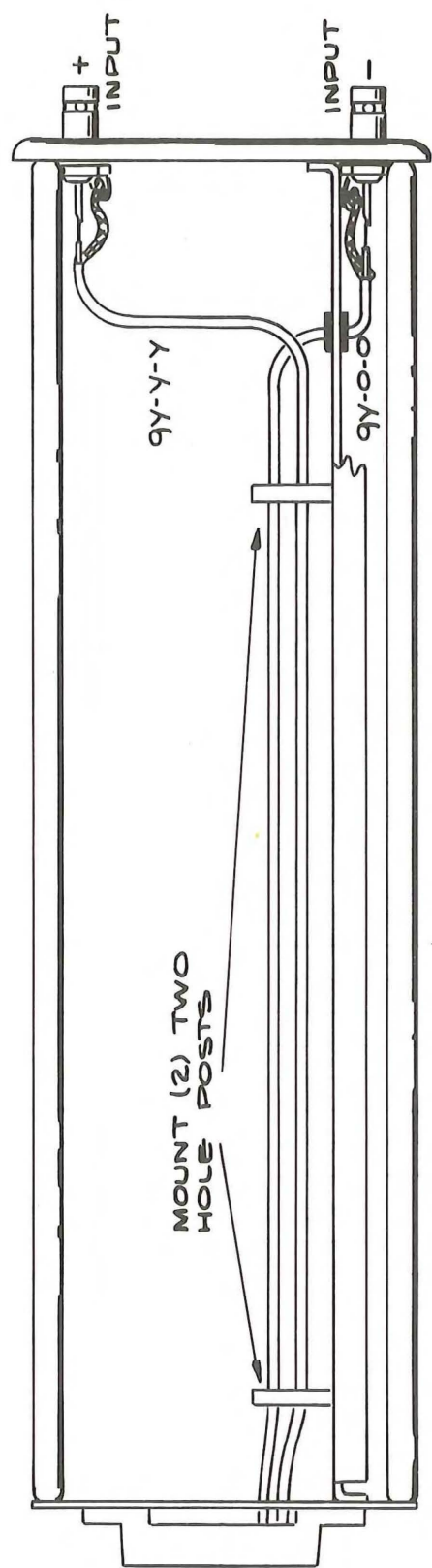


Fig. 3 63/2A63

## INSTRUCTIONS (cont)

### C. TO MODIFY TYPE 63 or 2A63:

Refer to Fig. 3.

- ( ) 1. Drill two 5/32 in. holes and mount the 2-hole nylon posts (rods) from the kit at convenient locations near each end of the chassis. Use the 6-32 x 5/16 PHS screws from the kit.
- ( ) 2. Dress the coax cables (from connector assembly) through the nylon posts. Pass the gray-orange-orange wire through the grommet in the chassis.
- ( ) 3. Solder the center conductor of the gray-yellow-yellow coax to the +INPUT connector.  
( ) Solder the coax shield to the ground lug.
- ( ) 4. Solder the center conductor of the gray-orange-orange coax to the -INPUT connector.  
( ) Solder the coax shield to the ground lug.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 63 OR 2A63.

- ( ) Remove the tape backing from the information plate (from kit) and attach the plate to the front panel just beneath the words "DIFFERENTIAL AMPLIFIER".
- ( ) Fasten the insert page in your Instruction Manual.

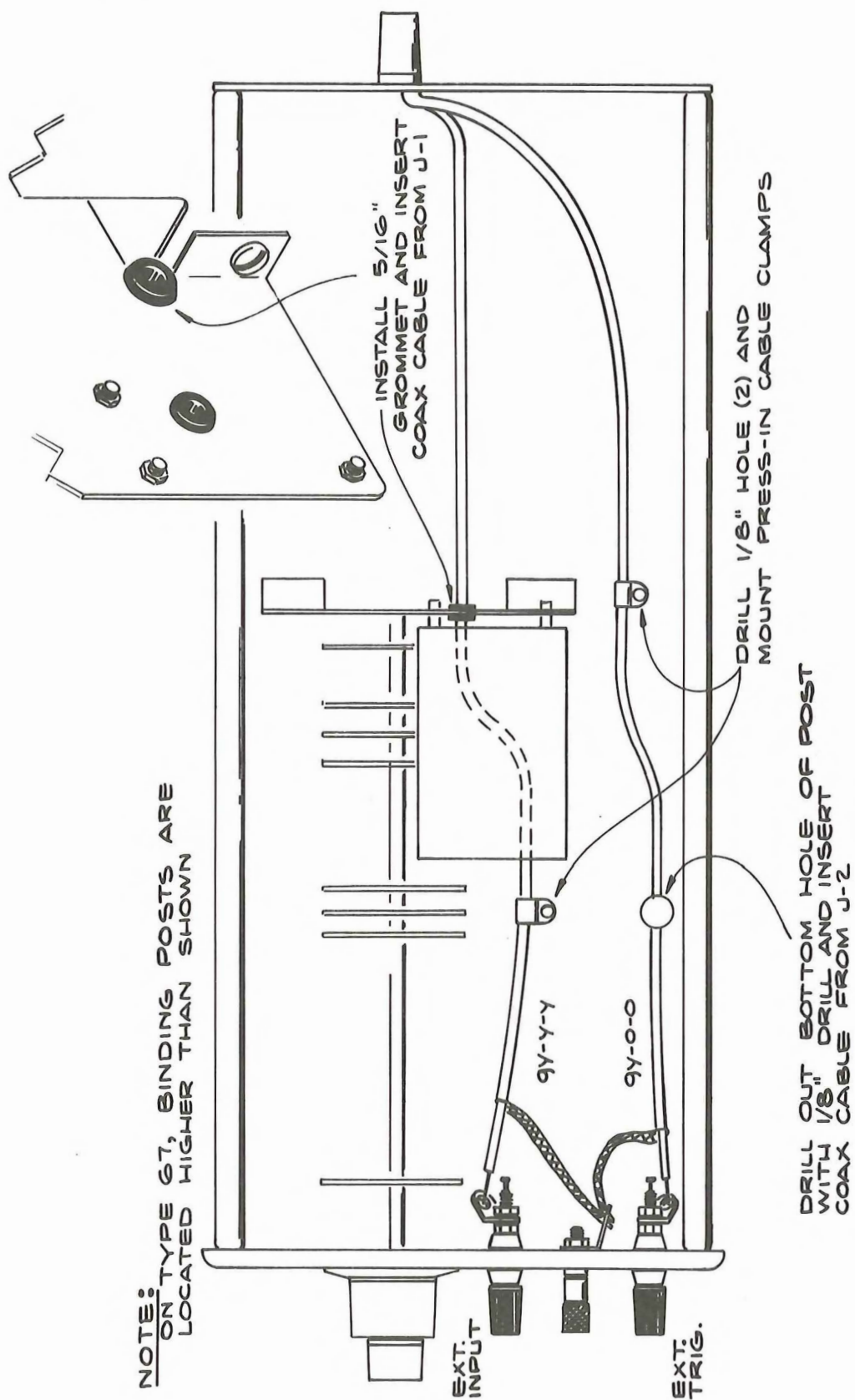


Fig. 4 67/2B67

## INSTRUCTIONS (cont)

### D. TO MODIFY THE TYPE 67 or 2B67:

Refer to Fig. 4.

- ( ) 1. Install the 5/16 in. grommet (from kit) in the cutout in the TIME/DIV switch bracket.
- ( ) 2. Drill two 1/8 in. holes in the chassis, one just above V24 and the other midway between V45 and V135.
- ( ) 3. Dress the gray-yellow-yellow coax (from connector assembly) through the grommet installed in step D-1.
- ( ) 4. Solder the center conductor of the gray-yellow-yellow coax to the EXT INPUT binding post and the shield to the ground post.
- ( ) 5. Drill out the 'bottom' hole in the support post, near V24, to 1/8 in.
- ( ) 6. Dress the gray-orange-orange coax (from connector assembly) through the post hole drilled out in step D-5.
- ( ) 7. Solder the center conductor of the gray-orange-orange coax to the EXT TRIG binding post and the shield to the ground post.
- ( ) 8. Secure the coax cables to the chassis by pressing snap-in cable clamps (from kit) into the holes drilled in step D-2.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 67 OR 2B67.

- ( ) Fasten the insert page in your Instruction Manual.

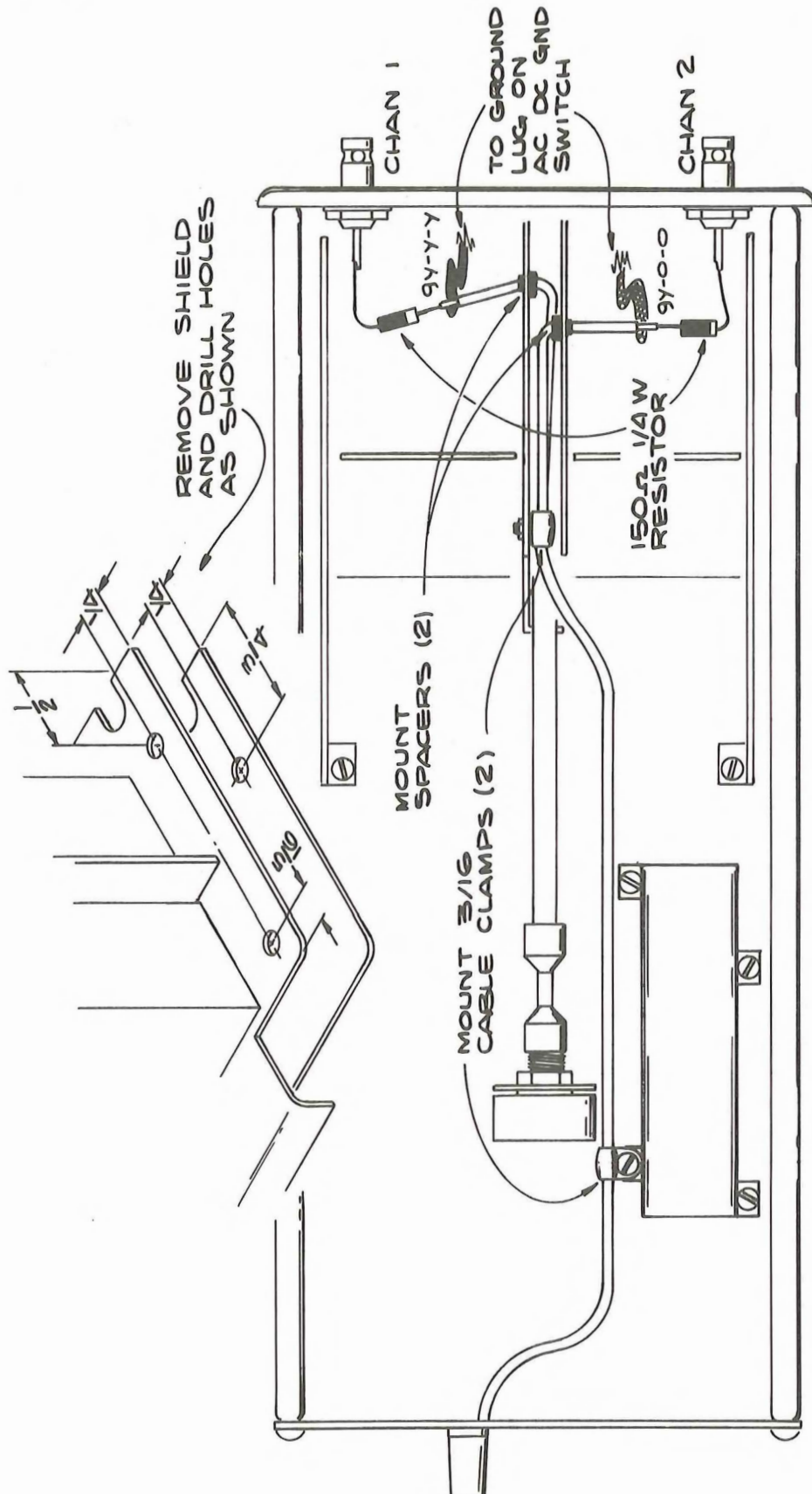


Fig. 5 3A1, 3A6

## INSTRUCTIONS (cont)

### E. TO MODIFY TYPES 3A1 AND 3A6:

Refer to Figs. 5, 6, and 7.

- ( ) 1. Temporarily remove the extension shaft which couples the CALIB potentiometer to the front panel.
- ( ) 2. Remove the shield between the two VOLTS/DIV switches.
3. Type 3A1 SN 101-5049
  - ( ) Drill two 5/32 in. holes in the shield as indicated in Fig. 6.
  - ( ) Mount a nylon molded spacer (from kit) in the front-most hole in the shield.
4. Type 3A1 SN 5050-up and Type 3A6
  - ( ) Drill three 5/32 in. holes in the shield as indicated in Fig. 5.
  - ( ) Mount nylon molded spacers (from kit) in the two front-most holes in the shield.
5. All Instruments
  - ( ) Mount a 3/16 in. cable clamp (from kit) in the rear-most of the holes drilled in step A-3 or A-4 (see Fig. 5). Use a 6-32 x 5/16 PHS screw, flat washer and Keps nut from the kit.
- ( ) 6. Replace the shield and the extension shaft (removed in step E-1).
7. Type 3A1
  - ( ) Drill a 5/32 in. hole in the chassis as indicated in Fig. 7.
  - ( ) Mount a 3/16 in. cable clamp (from kit) in this hole, using a 6-32 x 5/16 PHS screw, flat washer and Keps nut from the kit.
8. Type 3A6
  - ( ) Mount a 3/16 in. cable clamp (from kit) under one delay line cover mounting screw, as shown in Fig. 5. Use a new 6-32 x 5/16 PHS screw and a flat washer from the kit.

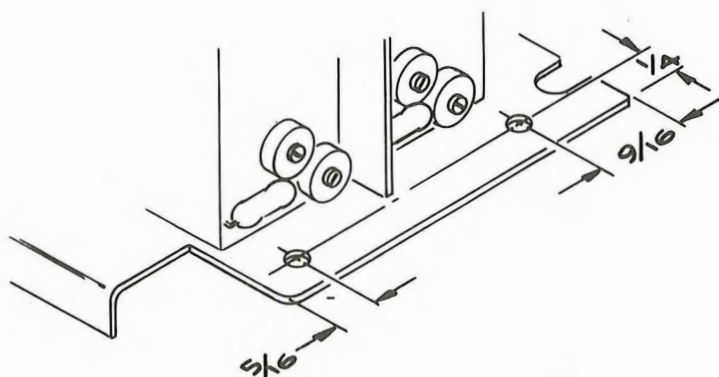


Fig. 6 3A1

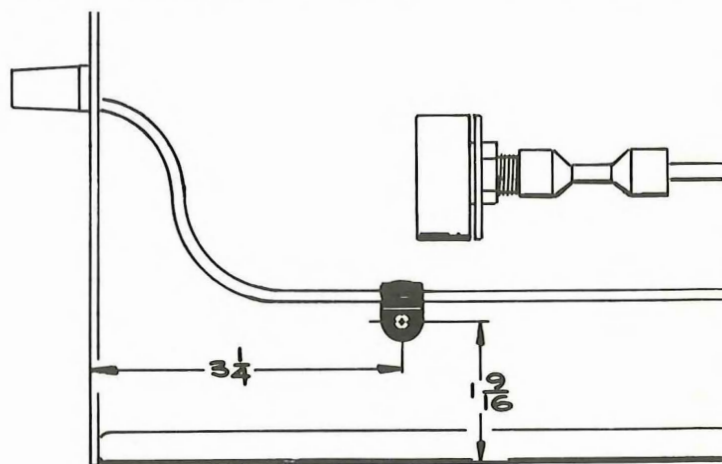


Fig. 7 3A1

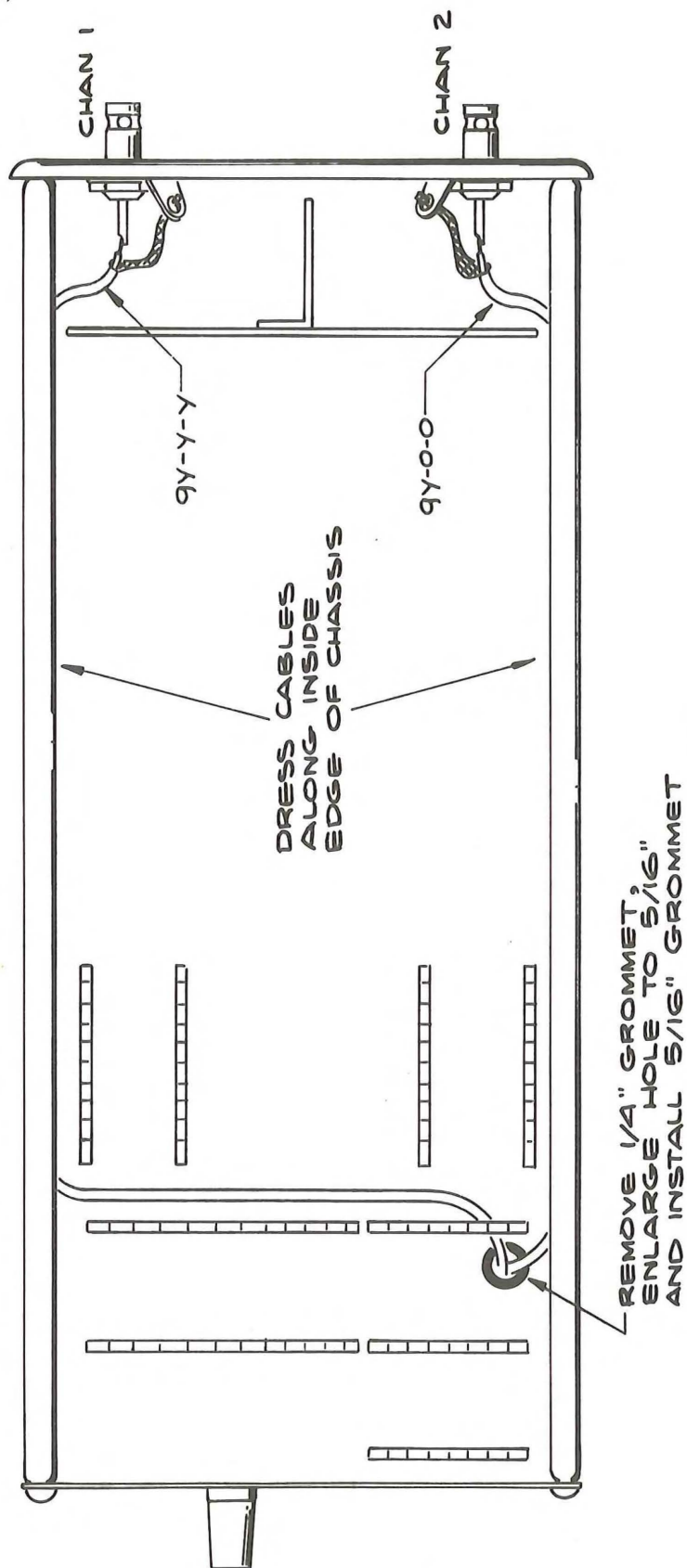


Fig. 8 72/3A72

## INSTRUCTIONS (cont)

### 9. All Instruments

- ( ) Dress the coax cables (from connector assembly) through the cable clamps installed in steps E-5, E-7, or E-8.
- ( ) 10. Dress the gray-yellow-yellow coax through the nylon molded spacer in the shield, solder a  $150\ \Omega$  1/4W resistor (from kit) to the coax center conductor, and solder the other end of the resistor to the Ch 1 Input connector. Keep resistor leads short.
- ( ) Solder the coax shield to the grounded lug on the AC-DC-GND switch (or to the connector ground lug, if present).

NOTE: Dress the coax and resistor as far away from the VOLTS/DIV switch variable capacitors as possible.

- ( ) 11. Dress the gray-orange-orange coax through the nylon molded spacer (if present), solder a  $150\ \Omega$  1/4W resistor (from kit) to the center conductor, and solder the other end of the resistor to the Ch 2 Input connector.
- ( ) Solder the coax shield to the grounded lug on the AC-DC-GND switch (or to the connector ground lug, if present).

THIS COMPLETES THE INSTALLATION FOR THE TYPE 3A1 OR 3A6.

- ( ) Remove the tape backing from the information plate (from kit) and attach the plate in the upper right corner of the front panel.
- ( ) Fasten the insert page in your Instruction Manual.

### F. TO MODIFY TYPE 72 or 3A72:

Refer to Fig. 8.

- ( ) 1. Temporarily unsolder the white-brown and white-orange wires passing through the grommet near V593.
- ( ) 2. Remove the grommet and enlarge the hole to 5/16 in.
- ( ) 3. Install a 5/16 in. grommet (from kit) in the above hole.
- ( ) 4. Redress the white-brown and white-orange wires (unsoldered in step F-1) through the grommet and resolder to their original locations.
- ( ) 5. Dress the coax cables (from connector assembly) through the 5/16 in. grommet.
- ( ) 6. Dress the gray-yellow-yellow coax beneath the wiring cable which runs 'vertically' up the chassis, then along the 'top' edge of the chassis to the front.
- ( ) Solder the coax center conductor to the Ch 1 Input connector, and the coax shield to the ground lug.

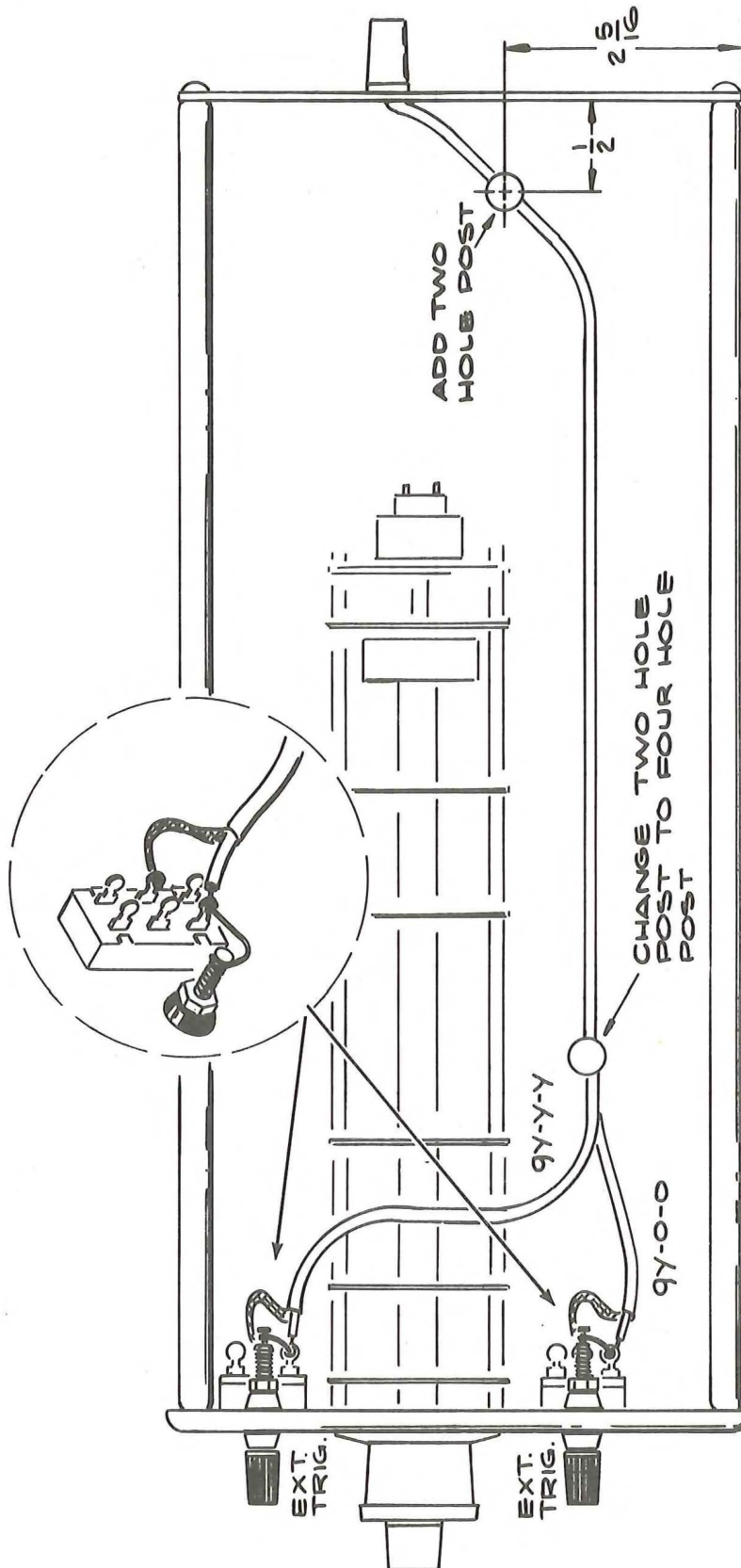


Fig. 9 3B1

## INSTRUCTIONS (cont)

### F. TO MODIFY TYPE 72 or 3A72 (cont):

- ( ) 7. Dress the gray-orange-orange coax beneath the wiring cable along the 'bottom' edge of the chassis toward the front.
- ( ) Solder the coax center conductor to the Ch 2 Input connector, and the coax shield to the ground lug.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 72 OR 3A72.

- ( ) Remove the tape backing from the information plate (from kit) and attach the plate in the upper right corner of the front panel.
- ( ) Fasten the insert page in your Instruction Manual.

### G. TO MODIFY TYPE 3B1:

Refer to Fig. 9.

- ( ) 1. Unsolder, from the TIME/DV switch, the coax cable which passes through the support post near Q23.
- ( ) 2. Replace the support post with a 4-hole post (rod) from the kit.
- ( ) 3. Dress the coax cable (unsoldered in step G-1) through the 'bottom' hole in the new post and resolder to the TIME/DIV switch.
- ( ) 4. Drill a 5/32 in. hole at the rear of the chassis, as shown in Fig. 9.  
CAUTION: Look out for the wiring cable on the other side of the chassis.
- ( ) 5. In the above hole, mount a 2-hole support post (rod) from the kit. Use a 6-32 x 5/16 PHS screw from the kit.
- ( ) 6. Dress the gray-yellow-yellow coax cable (from connector assembly) through the 'top' holes in both the 2-hole and the 4-hole posts.
- ( ) Solder the coax center conductor to the Delayed SOURCE switch (lug connected to EXT TRIG binding post). Solder the coax shield to the middle grounded lug of the switch.
- ( ) 7. Dress the gray-orange-orange coax cable (from connector assembly) through the 'bottom' hole in the 2-hole post and the second hole from the 'top' in the 4-hole post.
- ( ) Solder the coax center conductor to the Normal SOURCE switch (lug connected to EXT TRIG binding post). Solder the shield to the ground lug of the switch.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 3B1.

- ( ) Fasten the insert page in your Instruction Manual.

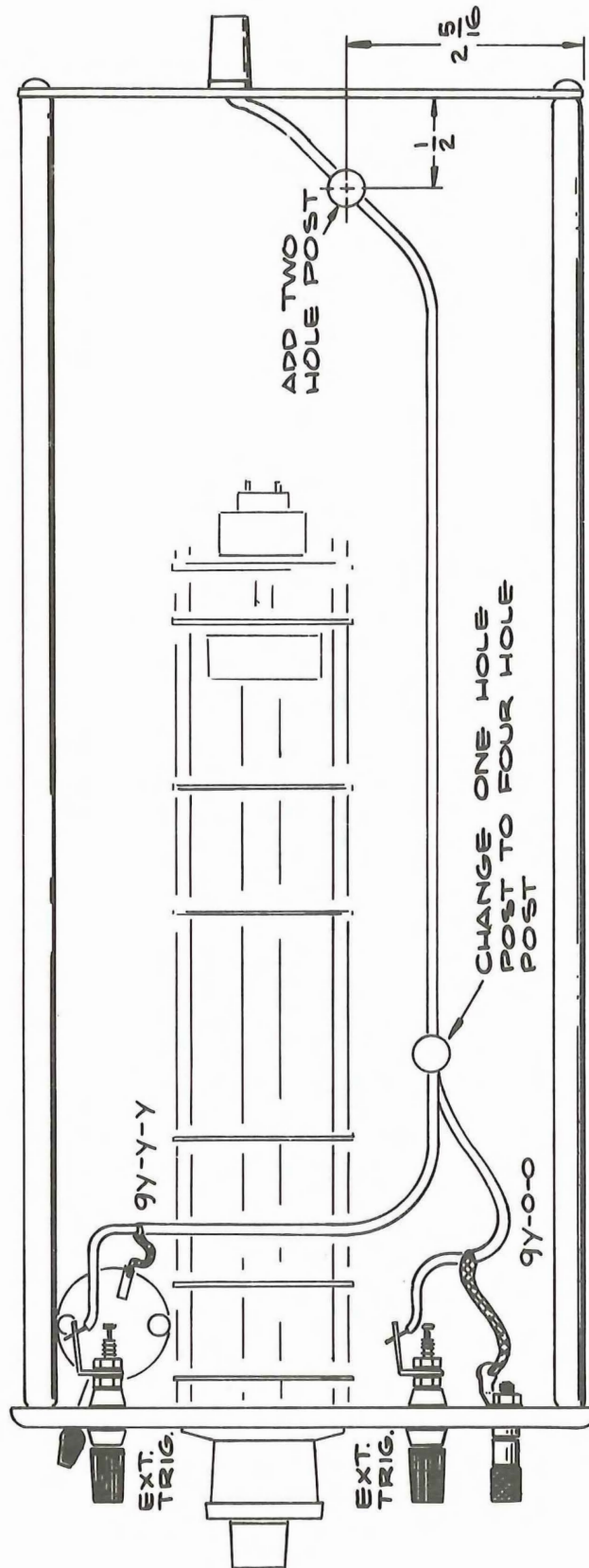


Fig. 10 3B3

## INSTRUCTIONS (cont)

### H. TO MODIFY TYPE 3B3

Refer to Fig. 10.

- ( ) 1. Unsolder, from the TIME/DIV switch, the coax cable which passes through the support post near Q23.
- ( ) 2. Replace the support post with a 4-hole post (rod) from the kit.
- ( ) 3. Dress the coax cable (unsoldered in step H-1) through the 'bottom' hole in the new post and resolder to the TIME/DIV switch.
- ( ) 4. Drill a 5/32 in. hole at the rear of the chassis, as shown in Fig. 10.  
CAUTION: Look out for the wiring cable on the other side of the chassis.
- ( ) 5. In the above hole, mount a 2-hole support post (rod) from the kit. Use a 6-32 x 5/16 PHS screw from the kit.
- ( ) 6. Dress the gray-yellow-yellow coax cable (from connector assembly) through the 'top' holes in both the 2-hole and the 4-hole posts.
- ( ) Solder the coax center conductor to the Delayed EXT TRIG binding post and the shield to the grounded SOURCE switch terminal.
- ( ) 7. Dress the gray-orange-orange coax cable (from connector assembly) through the 'bottom' hole in the 2-hole post and the second hole from the 'top' in the 4-hole post.
- ( ) Solder the coax center conductor to the Normal EXT TRIG binding post and the shield to the ground post.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 3B3.

- ( ) Fasten the insert page in your Instruction Manual.

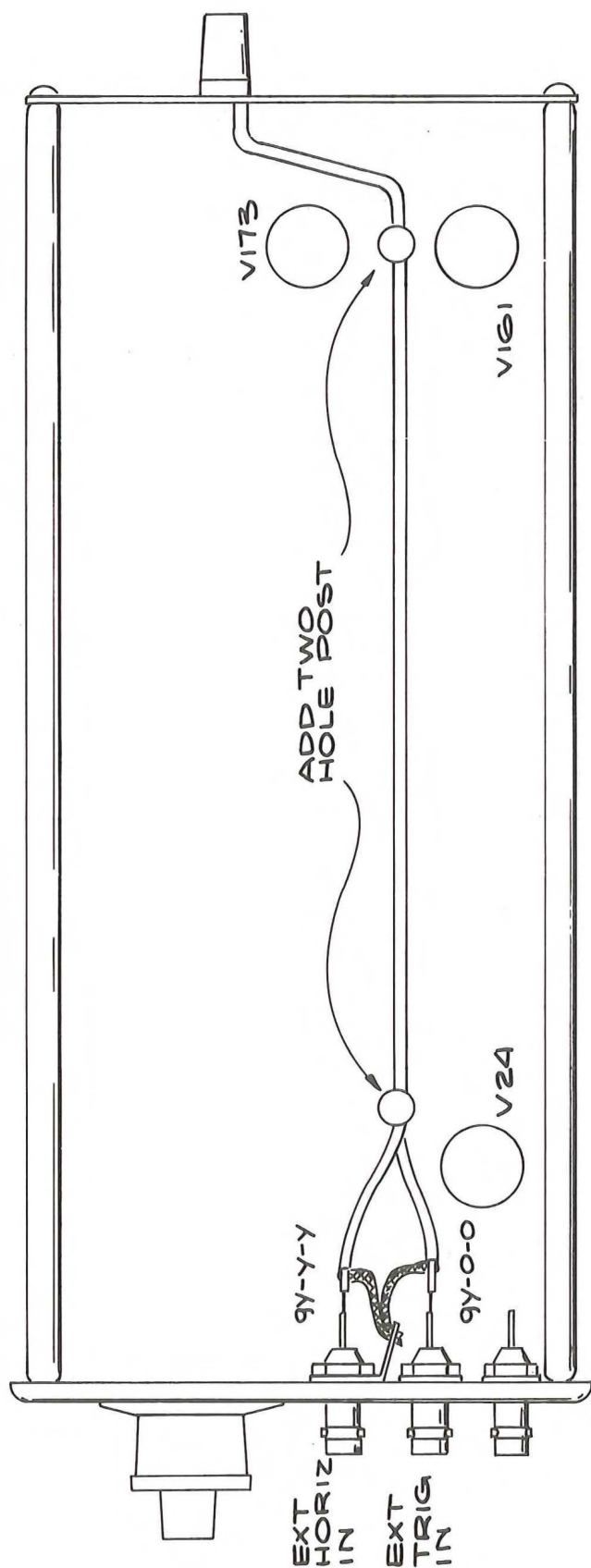


Fig. 11 3B4

## INSTRUCTIONS (cont)

### J. TO MODIFY TYPE 3B4:

Refer to Fig. 11.

- ( ) 1. Drill a 5/32 in. hole in the chassis, slightly above and to the rear of V24.  
CAUTION: Look out for the wiring cable on the other side of the chassis.
- ( ) 2. Drill a 5/32 in. hole in the chassis between V161 and V173.
- ( ) 3. In each of the holes drilled above, mount a 2-hole support post (rod) from the kit.  
Use 6-32 x 5/16 PHS screws from the kit.
- ( ) 4. Dress the gray-yellow-yellow coax cable (from connector assembly) through the 'top' holes in the support posts.
- ( ) Solder the coax center conductor to the EXT HORIZ IN connector and the shield to the ground lug.
- ( ) 5. Dress the gray-orange-orange coax cable (from connector assembly) through the 'bottom' holes in the support posts.
- ( ) Solder the coax center conductor to the EXT TRIG IN connector and the shield to the ground lug.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 3B4.

- ( ) Fasten the insert page in your Instruction Manual.

DW:ls



## PARALLEL REAR CONNECTORS

Types 2A61, 63, 2A63, 67, 2B67, 3A1, 3A6, 72, 3A72, 3B1, 3B3, 3B4 -- All serial numbers

Installed in Type \_\_\_\_\_ SN \_\_\_\_\_ Date \_\_\_\_\_

### GENERAL INFORMATION

This modification provides two coaxial lines to a corresponding number of BNC connectors on the rear panel of the instrument, paralleling the front panel input connectors or binding posts.

The plug-in/indicator interface is fitted with a pair of mating holders for miniature coaxial connectors, which permit withdrawal of plug-in without unsoldering cables.

To complete the modification, you must install one of the following Modification Kits in an RM561, RM561A, or RM564 indicator: 040-0410-00 provides two coaxial lines for either right or left plug-in compartment (but not both); 040-0411-00 provides four coaxial lines for either right or left plug-in compartment.

Additional kits are available to install one or four coaxial lines (depending upon plug-in type) in 2- and 3-series plug-ins. The connector holders are the same whether they hold one, two, or four connectors, so the plug-ins having various numbers of connectors are interchangeable. However, to insure electrical continuity from front to rear panel, the plug-in and indicator coaxial lines must 'match'.

The following chart shows the proper connector on the indicator rear panel for each front panel input, whether the plug-in is used in the left (vertical) or right (horizontal) compartment:

<u>Instrument</u>	<u>Front Panel Input</u>	<u>Using Left Compartment</u>	<u>Using Right Compartment</u>
2A61	A INPUT	J-1	J-5
	B INPUT	J-2	J-6
63/2A63	+ INPUT	J-1	J-5
	- INPUT	J-2	J-6
67/2B67	EXT INPUT	J-1	J-5
	EXT TRIG	J-2	J-6
3A1	Ch 1 Input	J-1	J-5
	Ch 2 Input	J-2	J-6
3A6	Ch 1 Input	J-1	J-5
	Ch 2 Input	J-2	J-6
72/3A72	Ch 1 Input	J-1	J-5
	Ch 2 Input	J-2	J-6
3B1	Delayed EXT TRIG	J-1	J-5
	Normal EXT TRIG	J-2	J-6
3B3	Delayed EXT TRIG	J-1	J-5
	Normal EXT TRIG	J-2	J-6
3B4	EXT HORIZ IN	J-1	J-5
	EXT TRIG IN	J-2	J-6

## LIMITATIONS:

### 1. Compatibility

Modified plug-ins will not fit in the following indicators: Types 560, 561, 561A, 564, 567 and RM567. In the Types 567 and RM567 the digital readout connector blocks insertion. In the others the solid back wall of the plug-in compartment prevents sufficient insertion of the plug-in to 'mate' the 24-pin connectors on the plug-in and indicator.

Modified plug-ins may be used in the Types RM561, RM561A, RM564, 565, RM565 and 129, although no kits are available to equip the 565, RM565, or 129 with rear input connectors. Also, there could be noise problems with one of the more sensitive plug-in units having an open input connector facing into an indicator power supply.

### 2. Changes in Electrical Characteristics

The system is basically incompatible with conventional X10 or X100 high-impedance probes. This is because the input capacitance of the plug-in is raised to approximately 100 pF, plus the capacitance of the circuitry attached to the rear connector.

Optimum transient response for 10 MHz instruments may be preserved by terminating at the front panel connector for signals applied to the rear panel connector. There will be some degradation of transient response in 10 MHz instruments for signals applied to the front panel input or terminated at the rear panel. For lower bandwidth instruments, the only noticeable effect will be that of the increased cable capacitance on signals from sources greater than 50  $\Omega$ .

## ## CONNECTOR EXTRACTION

The Cannon DM series miniature connectors may be removed from their Delrin holders by using a special tool available from Cannon Electric Company. Order connector extractor CET-C6B.

To use the extractor, plunge the tubing down over the connector as far as it will go, then push the connector out with the inner shaft of the tool.

## ELECTRICAL PARTS LIST

The following parts list applies only to the Type 3A1 or 3A6.

Ckt. No.	Part Number	Description
RESISTORS		
R102-S (Ch 1)	316-0151-00	150 $\Omega$ 1/4W comp 10%
R202-S (Ch 2)	316-0151-00	150 $\Omega$ 1/4W comp 10%

## MECHANICAL PARTS LIST

343-0088-00	Clamp, cable, size C
343-0002-00	Clamp, cable, plastic, 3/16
131-0409-00	Connector, coax, Cannon DM53743-5001
348-0003-00	Grommet, rubber, 5/16
352-0094-00	Holder, coax connector, Delrin
210-0457-00	Nut, Keps, 6-32 x 5/16
334-1070-00	Plate, information, 1/4 x 1
385-0138-01	Rod, Delrin, 5/16 x 1-9/16, tap 6-32 w/4 #31 holes
385-0113-00	Rod, nylon, 5/16 x 1-1/8, tap 6-32 w/2 #27 holes
211-0507-00	Screw, 6-32 x 5/16 PHS, Phillips
211-0512-00	Screw, 6-32 x 1/2 FHS 100°, Phillips
361-0007-00	Spacer, nylon molded, 0.063
210-0802-00	Washer, steel, flat, 6S

# MODIFICATION KIT

## SAWTOOTH DRIVE FOR 3L5 AND 3L10

For the following Tektronix Time-Base Plug-ins:

Type	67	serial numbers	101- 5000
	2B67	serial numbers	5001-15179
	3B1	serial numbers	101- 4039
	3B3	serial numbers	100- 4269
	3B4	serial numbers	100- 739



### DESCRIPTION

This modification provides a sawtooth drive in the above listed instruments for compatibility with the 3L5 and 3L10 (and future '3' series Spectrum Analyzer plug-in units).

The sawtooth signal, required by the Spectrum Analyzer sweep oscillator, is a standardized current ramp of  $66\mu\text{A}/\text{cm}$  (nominal) fed from the sawtooth CF of the time base via a standardizing resistor to pin 18 of the interconnecting plug.

The current signal is intended to drive a low-impedance circuit, such as the minus input of an operational amplifier or the emitter of a transistor, with a positive-going linear ramp of current. It cannot be used to drive two circuits (e.g., 3L10 and sawtooth out) at the same time, nor can it be used successfully as a 'voltage' signal source, especially at faster sweep rates. The high source impedance of this signal prevents excessive cross-talk of sweep signal into vertical plug-ins in which pin 18 is open.

The sawtooth signal is provided by adding the standardizing resistor to the ceramic strips above the Sawtooth Cathode Follower, where it is connected between the CF cathode and a coax cable. The other end of the coax is connected to the interconnecting plug, pins 18 and 19.

## NOTE: If the plug-in unit being modified by this kit will be used in a Type 561 below SN 579, the Type 561 must be modified by the installation of Modification Kit 040-0267-00.

040-0413-00

Publication:  
Instructions for 040-0413-00  
December 1967

Supersedes:  
September 1967

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040-0413-00

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## PARTS LIST

Quantity	Part Number	Description
1 ea	214-0210-00	Spool, w/3 ft. silver-bearing solder
1 ea	323-0383-00	Resistor, prec, MF, 95.3 k 1/2 W 1%
1 ea	323-0386-00	Resistor, prec, MF, 102 k 1/2 W 1%
1 ea	323-0418-00	Resistor, prec, MF, 221 k 1/2 W 1%
1 ea	(1-910D)	Tag, MODIFIED INSTRUMENT, gummed back
1 ea		Cable, coax, 175-0284-00, 50Ω 4 in.
1 ea		Cable, coax, 175-0284-00, 50Ω 10 in.
1 ea		Cable, coax, 175-0284-00, 50Ω 12 in.
1 ea		Wire, #22 solid, 176-0122-00, bare 2 in.

**IMPORTANT:** When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

## INSTRUCTIONS

**NOTE:** The metal-film resistors used in this kit are color-coded similar to a composition resistor, except that they have three significant figures instead of two. For example, a metal-film resistor coded brown-red-violet-orange-brown is a 127 k 1% resistor.

### A. FOR TYPE 67 PLUG-INS:

Use these parts (from kit) in the following steps: 221 k resistor (323-0418-00), 10 in. coax cable, and 2 in. bare wire.

- ( ) 1. Locate the ceramic strip notch to which is soldered a wire from pin 8 of V161 and a B161 neon bulb lead. This is CSC-16.
- ( ) Unsolder the B161 bulb tip holder from the opposite ceramic strip notch (CSC-16). Save holder for later use.
- ( ) 2. Solder the longer stripped center conductor of the coax to CSC-16.
- ( ) 3. Solder the coax shield to the vacant end notch on the adjacent strip (CSC-15).
- ( ) 4. Solder the bare wire from grounded terminal of C321 (located near R176) to CSC-15.
- ( ) 5. Solder the resistor between CSC-16 and CSD-16.
- ( ) 6. Replace the B161 tip holder at CSC-16.
- ( ) 7. Dress the coax along the cable to the plug-in rear connector.
- ( ) Solder the coax center conductor to connector pin 18 and the shield to pin 19.

## INSTRUCTIONS (cont)

### B. FOR TYPE 2B67 PLUG-INS:

Use these parts (from kit) in the following steps: 221 k resistor (323-0418-00) and 12 in. coax cable.

- ( ) 1. Locate the front neon bulb (B161) on the ceramic strip near V161 socket.
- ( ) Unsolder the B161 bulb tip holder (from ceramic strip notch CSC-23). Save the holder for later use.
- ( ) 2. Solder the longer stripped center conductor of the coax to CSC-23.
- ( ) Solder the shield to a ground lug on the V161 socket, dressing it beneath the ceramic strip.
- ( ) 3. Solder the resistor between CSC-23 and the opposite strip notch (to which is soldered a B161 lead and a white-yellow wire).
- ( ) 4. Replace the B161 tip holder at CSC-23.
- ( ) 5. Dress the coax along the cable to the plug-in rear connector.
- ( ) Solder the coax center conductor to connector pin 18 and the shield to pin 19.

### C. FOR TYPE 3B1 PLUG-INS:

Use these parts (from kit) in the following steps: 95.3 k resistor (323-0383-00) and 10 in. coax cable.

- ( ) 1. Locate the neon bulb (B164) on the ceramic strips near V161 socket.
- ( ) Unsolder the B164 bulb tip holder (from ceramic strip notch CSM-23). Save the holder for later use.
- ( ) 2. Solder the longer stripped center conductor of the coax to CSM-23.
- ( ) Solder the shield to a ground lug on the V161 socket.
- ( ) 3. Solder the resistor between CSM-23 and the opposite ceramic strip notch (to which is soldered a B164 lead and a white-black-violet wire).
- ( ) 4. Replace the B164 tip holder at CSM-23.
- ( ) 5. Dress the coax along the cable to the plug-in rear connector.
- ( ) Solder the coax center conductor to connector pin 18 and the shield to pin 19.

## INSTRUCTIONS (con'd)

### D. FOR TYPE 3B3 PLUG-INS:

Use these parts (from kit) in the following steps: 102 k resistor (323-0386-00) and 10 in. coax cable.

- ( ) 1. Locate the neon bulb (B164) on the ceramic strips near V161 socket.
- ( ) Unsolder the B164 bulb tip holder (from ceramic strip notch CSN-19). Save holder for later use.
- ( ) 2. Solder the longer stripped center conductor of the coax to CSN-19.
- ( ) Solder the shield to a ground lug on the V161 socket.
- ( ) 3. Solder the resistor between CSN-19 and the opposite ceramic strip notch (to which is soldered a B164 lead and a white-black-violet wire).
- ( ) 4. Replace the B164 tip holder at CSN-19.
- ( ) 5. Dress the coax along the cable to the plug-in rear connector.
- ( ) Solder the coax center conductor to connector pin 18 and the shield to pin 19.

### E. FOR TYPE 3B4 PLUG-INS:

Use these parts (from kit) in the following steps: 102 k resistor (323-0386-00) and 4 in. coax cable.

- ( ) 1. Locate the ceramic strip notch (CSF-6) to which is connected the bare wire from pin 3 of V173 and the opposite vacant notch (CSE-6) near pin 7 of V173.
- ( ) 2. Solder the longer stripped end of the coax to CSE-6.
- ( ) Solder the shield to a ground lug on the V173 socket.
- ( ) 3. Solder the resistor between CSE-6 and CSF-6.
- ( ) 4. Dress the coax along the cable to the plug-in rear connector.
- ( ) Solder the coax center conductor to connector pin 18 and the shield to pin 19.

THIS COMPLETES THE INSTALLATION.

- ( ) Check wiring for accuracy.
- ( ) Moisten the back of the MODIFIED INSTRUMENT tag (from kit) and place it on the Manual Sweep Generator schematic.
- ( ) Fasten the insert pages in your Instruction Manual.

BE:ls

# SAWTOOTH DRIVE FOR 3L5 AND 3L10

Type 67 SN 101- 5000  
Type 2B67 SN 5001-15179  
Type 3B1 SN 101- 4039  
Type 3B3 SN 100- 4269  
Type 3B4 SN 100- 739

Installed in Type \_\_\_\_\_ SN \_\_\_\_\_ Date \_\_\_\_\_

## GENERAL INFORMATION

This modification provides a sawtooth drive in the above listed instruments for compatibility with the 3L5 and 3L10 (and future '3' series Spectrum Analyzer plug-in units).

The sawtooth signal, required by the Spectrum Analyzer sweep oscillator, is a standardized current ramp of  $66\mu\text{A}/\text{cm}$  (nominal) fed from the sawtooth CF of the time base via a standardizing resistor to pin 18 of the interconnecting plug.

The current signal is intended to drive a low impedance circuit, such as the minur input of an operational amplifier or the emitter of a transistor, with a positive-going linear ramp of current. It cannot be used to drive two circuits (e.g., 3L10 and sawtooth out) at the same time, nor can it be used successfully as a 'voltage' signal source, especially at faster sweep rates. The high source impedance of this signal prevents excessive crosstalk of sweep signal into vertical plug-ins in which pin 18 is open.

The sawtooth signal is provided by adding the standardizing resistor to the ceramic strips above the Sawtooth Cathode Follower, where it is connected between the CF cathode and a coax cable. The other end of the coax is connected to the interconnecting plug, pins 18 and 19.

The information on these pages supplements the information in your Manual.

## NOTE: If the plug-in unit being modified by this kit will be used in a Type 561 below SN 579, the Type 561 must be modified by the installation of Modification Kit 040-0267-00.

## ELECTRICAL PARTS LIST

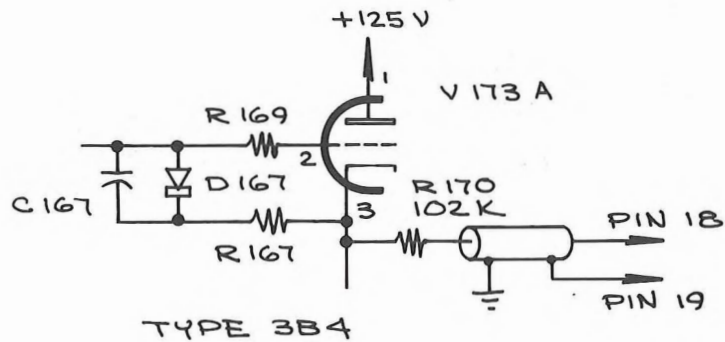
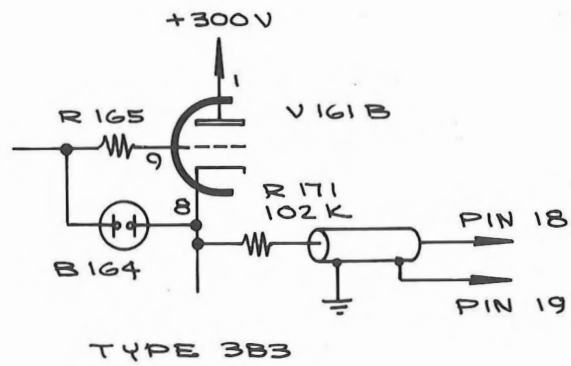
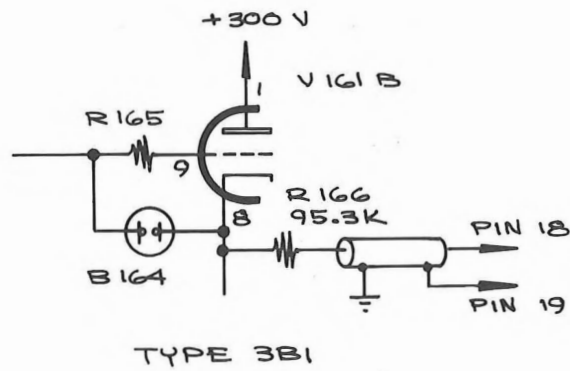
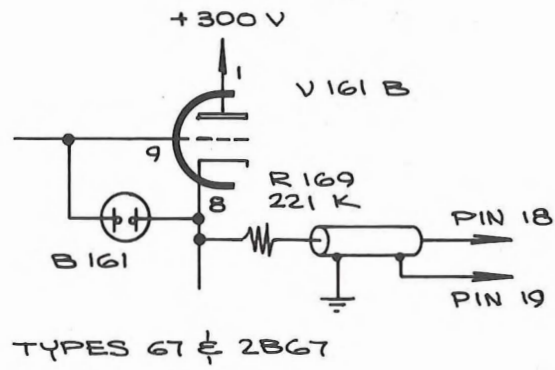
Ckt.No.	Part Number	Description
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### RESISTORS

Resistors are fixed precision metal-film  $\pm 1\%$ .

R166	323-0383-00	95.3 k	1/2 W	Type 3B1 only
R169	323-0418-00	221 k	1/2 W	Types 67 and 2B67 only
R170	323-0386-00	102 k	1/2 W	Type 3B4 only
R171	323-0386-00	102 k	1/2 W	Type 3B3 only

# SCHEMATICS







# MAINTENANCE NOTES

## ROUGH ROTATION TIME/CM VARIABLE CONTROL

GS 8-15-63

Rough rotation due to friction is mainly caused by misalignment of the pot shaft and the last section of switch 260-352.

SOLUTION: Another way of mounting the pot to the end bracket will be used soon in production.

If you encounter a binding control needing attention you might work it out using the above mentioned information. This is all that can be offered at this time, but we will let you know as soon as definite information is available.

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## 2B67 -- COMPROMISE STABILITY SETTING CRITICAL

FEN 2-7-64

The setting of the 2B67 stability control for proper operation in both normal and single sweep modes may be quite critical because of current drawn through R126 in the single sweep mode. This resistor, which functions to keep Q124 turned off in the "ready" condition, may pull the plate of V135A enough positive in the "ready" mode to shift the multivibrator's triggerable range considerably. In a typical instrument, the compromise setting of the stability control may have only a range of 0.5 volt or so.

The value of R126 was selected to prevent Q124 from turning itself on with collector-base leakage, which can be  $500 \mu\text{a}$  at  $+71^\circ\text{C}$  according to the spec sheet. The typical value of leakage in this tran-

sistor is so much smaller, that most of the current from R126 simply goes to upset the sweep gating multivibrator's hysteresis range.

If the quiescent (ready) value of plate voltage at V135A (pin 1) changes by more than about 5 volts between the Normal and Single Sweep modes, changing R126 from 220k to a value between 470k and 1M will usually help considerable in making the compromise stability setting easier to find and more stable. A production mod is under consideration.

Our thanks to Bob Nagler (Toronto) for pointing up this problem.

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## WRONG SPRING-RETURN ACTION IN SINGLE SWEEP SWITCH

FEN 4-24-64

A small number of 2B67's in the 9000 serial range may have been shipped with spring-return action in the Normal as well as the Single Sweep position of the front-panel MODE switch. Of a hundred instruments checked in the warehouse, two had this defect. Although probably not noticeable at first, with gradual wear, the spring pressure could overcome the detent action, making it difficult to keep

the switch in Normal.

The defect is an extra dog on the switch detent plate, which engages the return spring. This would be difficult to file or clip off; the better solution would be switch replacement if the problem is encountered in the field.

---

## LOW SWEEP SPEED TIMING ERROR FROM V152, 6BC7

GS 4-23-64

Excessive inter-element ohmic leakage and heater cathode hum modulation, especially in the center\* diode, causes a slow sweep speed timing error, and sweep jitter on faster sweeps.

V152 will be changed to a 6BJ7 by Mod 8116, and by reversing pins 6 with 8, and 7 with 9, thus placing V152B to use on outside section of the tube. R392, a  $1 \Omega$  resistor (308-141), is then added in series with pin 5 filament to reduce heater cathode leakage.

\*This is a three element diode.

The new part number for the 6BJ7 is 154-453.

#### ALTERNATE SYNC PROBLEM WITH 3A1

Geoff Gass, 10-12-65

Type 3A1 plug-ins in the serial range 7070-8569 tend to double-trigger in the alternate mode when used with 2B67. The problem may also be noticed in earlier 3A1's field-modified to use a 2N2207

transistor as Q260. The problem is in the 3A1 and is solved by addition of a damping diode D263 across the T263 collector winding in the 3A1 (Mod 8956). See 3A1 PRB for details.

---

#### MOD 9976 -- ERRONEOUS MOD INSERT SHEETS

Geoff Gass, 11-15-65

The mod insert sheet for production mod 9976 was put into the manual long before the mod was actually effective. As it turns out, the schematic on the change notice is in error (as was the original mod notice).

There are an unknown number of 2B67 manuals -- probably around 200 of them -- shipped with un-modified instruments in the 15,000 S/N range -- including a change notice for circuitry that won't work.

If a customer tries to put this mod in himself and gets in trouble, he should be advised to leave out R125, or wire it from base to emitter (not collector) of Q124. Purpose of mod 9976 was to assure reliable B124 operation without neon selection, and to eliminate the lag (up to 1-2 sec) in circuit operation after switching from "Normal" to "Single Sweep" caused by Q124 thermal shifts due to dissipation while in B-E breakdown. R125 keeps Q124 from going into B-E breakdown during Normal operation.

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## Section 5

### Troubleshooting

General maintenance and troubleshooting information is contained in the oscilloscope instruction manual. In the following discussion, it is assumed that you have read that information and have definitely isolated trouble to the Type 2B67.

First, remove the side panels of the oscilloscope and check for heater glow in all tubes. Replace tubes that have no heater glow. If there is still no heater glow in any tube, trace out the heater circuit to find the trouble.

If there is a heater glow in all tubes, remove the Type 2B67 and inspect it closely for damaged or burned components, loose wires, broken switches, etc. If visual inspection does not reveal the trouble, insert the Type 2B67 in the left-hand opening of the oscilloscope to obtain access to the wiring and components.

The Type 2B67 will produce a vertical sweep when it is inserted in the left-hand opening of the oscilloscope. For troubleshooting purposes you do not need a plug-in in the

right-hand opening (except to check triggering and blanking circuits). If you do not wish to exchange the position of the plug-in units, you may use a plug-in extension (Tektronix Part No. 013-034) which allows a plug-in to be operated while extended partially out of the oscilloscope.

The troubleshooting information in this section is contained in two tables. We suggest that you refer first to Table 5-1 to determine the major circuit (Time-Base Trigger, Time-Base Generator, or Horizontal Amplifier) the trouble is in. Then refer to Table 5-2 for instructions on troubleshooting that particular circuit. In each case, the information is further divided according to the symptoms the trouble presents to the operator.

#### NOTE

In case of insufficient horizontal deflection, non-linear sweep, or improper sweep timing, check the supply voltages in the oscilloscope first, especially the high voltage.

**TABLE 5-1**  
**CIRCUIT ISOLATION**

TROUBLE	PROBABLE CAUSE	TESTS TO MAKE	NOTES
1. No sweep or insufficient horizontal deflection.	a. Time-Base Generator inoperative.	Set LEVEL to FREE RUN, MODE to NORM., POSITION to mid-range, TIME/DIV. to 10 mSEC, VARIABLE to CALIBRATED. B167 should glow, with definite periodic flicker.	No glow, or steady glow without flicker, indicates Time-Base Generator is not functioning; refer to Table 5-2, Part 2.
	b. Horizontal Amplifier	Set TIME/DIV. to EXT. INPUT. A spot should appear on crt. Connect a 2-volt signal from calibrator to EXT. INPUT connector and check for about 2 div. of deflection. If deflection is normal, check V333-V353 sections of Horizontal Amplifier, Table 5-2, Part 1.	If a 2-div. deflection (which will appear as 2 dots 2 div. apart) is not seen, check V353-V374 section of Horizontal Amplifier, Table 5-2, Part 1.
2. Sweep operates with LEVEL control in FREE RUN only.	a. STABILITY control out of adjustment.	Readjust STABILITY control (see Calibration, Section 6).	If sweep still only operates with LEVEL in FREE RUN, check trigger circuits in next step and refer to Table 5-2, Part 3.
	b. Trigger circuits inoperative.	Connect 20-volt signal from calibrator to EXT. TRIG. connector. Set SOURCE to EXT. Sweep should trigger with LEVEL control anywhere in $\pm 90^\circ$ range of O, with any combination of SLOPE and COUPLING switches except — LEVEL and DC COUPLING combination.	If sweep triggers, but not over $90^\circ$ range of LEVEL control, or if sweep cannot be triggered, refer to Table 5-2, Part 3.
3. Single Sweep does not function properly.	STABILITY control out of adjustment.	Readjust STABILITY control; see Calibration, Section 6.	Check Sweep-Lockout circuit, Table 5-2, Part 4.

**TABLE 5-2**  
**CIRCUIT TROUBLESHOOTING**  
**Part 1. Horizontal Amplifier**

TROUBLE	PROBABLE CAUSE	TESTS TO MAKE	NOTES
1. No trace.	Dc unbalance.	<p>a. If Time-Base Generator is working normally, try to position trace on screen with POSITION control. If still no trace, set TIME/DIV. switch to EXT. INPUT. If spot can be positioned on crt, trouble is between Time-Base Generator and cathode of V353A.</p> <p>b. If spot did not appear in last test, short together grids (pins 2 and 7) of V374. If spot now appears, trouble is in V353B circuit.</p>	<p>If no spot, set TIME/DIV. switch to 1 <math>\mu</math>SEC and MODE switch to SINGLE SWEEP. Turn POSITION control maximum cw. Ground following points in sequence: pin 7, V353; pin 3, V333; pin 2, V333; pin 8, V333; pin 7, V333. Components between last point checked which causes spot to appear on crt and point where no spot appears should be checked.</p> <p>If no spot appears, trouble is in V374 circuit.</p>
2. Insufficient or no deflection.	Low or no gain.	<p>a. If gain is low, check according to Calibration section of this manual. Change in gain will affect sweep timing, and recalibration will be necessary under any circumstances.</p> <p>b. Check components that can affect gain but not balance. Substitute known good tubes for V333, V353, V374 for test. Check R334, R342, R375.</p>	If unit can be recalibrated, no further tests are necessary.
3. Nonlinear amplification.	Nonlinear stage.	<p>a. Use 10X probe to couple signal to vertical amplifier plug-in unit, and set VOLTS/DIV. switch to 5 (deflection factor with probe: 50 volts/div.). Set LEVEL control to FREE RUN and connect probe to following points, in turn. Check for diagonal straight line on crt (slope is not important): Pin 8, V353; pin 3, V333, pin 8, V333.</p>	At one of the points, the trace should become nonlinear. The trouble lies between this point and the previous point checked. If trace is linear at all points checked, trouble is in Time-Base Generator.
<b>Part 2. Time-Base Generator</b>			
1. No Sweep	Miller Runup Circuit held at one point.	<p>a. Check voltage at pin 6, V161. If near +250 volts, refer to step b. If near +30 volts, refer to step c.</p> <p>b. Plate voltage near +250 volts. Ground grid of V161A (pin 2). Plate voltage should drop to about +6 volts. If plate voltage does not drop, replace V161 and check circuit of V161A. If plate voltage drops, replace V152.</p> <p>c. Plate voltage near +30 volts. Remove V152. If voltage runs up, runup circuit is okay. If voltage stays fixed, replace V161. If problem still exists, check plate circuit of V161A to determine cause of voltage drop.</p>	<p>If plate voltage is not near either +30 or +250 volts, press MODE switch to RESET. If plate voltage drops to +30 volts, remove V152. Plate should now run up near +250 volts. Replace V152 with a new tube and recheck.</p> <p>If replacing V152 does not fix trouble, check V161B circuit and Sweep-Gating Multivibrator V135-V145.</p> <p>If removing V152 allows plate voltage of V161A to run up, replace V152. If trouble persists, check Sweep-Gating Multivibrator V135-V145.</p>

TROUBLE	PROBABLE CAUSE	TESTS TO MAKE	NOTES
	<p>Cathode follower V161B inoperative.</p> <p>Sweep-Gating Multivibrator faulty.</p>	<p>Check that B167 is lit and that that B161 is not. Check voltage at cathode of V161B (pin 8). It should be about 50 volts lower than the plate voltage of V161A at all times.</p> <p>a. If sweep is being held run up (plate voltage of V161A about +250 volts), and preceding tests show Runup circuit to be okay, monitor plate voltage at V145A (pin 6). Ground the grid (pin 2) of V135A. The V145A plate voltage should rise to about -3 volts. If it rises to 0 volts, replace V152. If grounding the grid of V135A allows the sweep to run down and then run up again, check feedback path through V152C and V145B. Ground plate of V152C (pin 7) and grid of V145B (pin 9). Sweep should reset.</p> <p>b. If sweep is being held run down, set LEVEL control to FREE RUN. Check grid voltage at V135A (pin 2). If it is -55 volts or more, plate of V145A should be -7 volts or more. If grid of V135A or plate of V145A does not meet conditions specified, remove V152 and recheck.</p>	<p>If B167 is not lit, replace it. If B161 is lit, V161B is not operating. Replace V161.</p> <p>If grounding grid of V135A does not raise plate of V145A to about -3 volts, replace V135 and V145 and recheck. Check supply voltages and component values in Sweep-Gating Multivibrator.</p> <p>If conditions are not met, and removing V152 allows conditions to be met, replace V152. If conditions still are not met with V152 removed, try replacing V135 and V145 and check supply voltages and components of Sweep-Gating Multivibrator.</p>
2. Sweep does not retrace completely.	Hold-Off Capacitor not connected.	Check connections through TIME/DIV. switch which connect Hold-Off Capacitor (see Timing Switch diagram).	
<b>Part 3. Time-Base Trigger</b>			
1. Sweep runs only when LEVEL control in AUTO. or FREE RUN.	Trigger Input Amplifier inoperative.	Monitor plate voltage of V24B (pin 6). Set triggering controls for +/DC/EXT. triggering. Run LEVEL control back and forth over its range (not to AUTO. or FREE RUN). Plate voltage of V24B should range from about +102 volts with the LEVEL control near AUTO. to about +122 volts with the LEVEL control near FREE RUN.	If range is apparent, but voltages are out of about 102- to 122-volt region, check supply voltages and resistances in V24 circuit. If voltage does not move over about 20-volt range, but remains steady or nearly steady, replace V24 and check LEVEL control and SLOPE switch.
2. Sweep runs only with LEVEL in FREE RUN.	Trigger Multivibrator inoperative.	Monitor plate voltage of V45B (pin 6). With triggering controls set for $\pm$ /DC/EXT. triggering, and the LEVEL control near (but not in) FREE RUN, plate voltage of V45B should be about +295 volts. Move LEVEL control toward AUTO. As control moves through 0, the plate voltage of V45B should drop to about +275 volts. This change should be abrupt, indicating the the circuit has switched. Moving LEVEL control back near FREE RUN should cause a sharp rise to +295 volts again.	If voltage remains near +275 or +295 volts, and circuit does not switch, check V24 circuit (according to last step). Plate voltage of V24B must operate between about +102 and +122 volts for multivibrator to operate properly. Then, replace V45 and check supply voltages and components in V45 circuit.

**Part 4. Sweep Lockout**

TROUBLE	PROBABLE CAUSE	TESTS TO MAKE	NOTES
1. Sweep does not lock out.	D125 open. Q124 inoperative.	Monitor base voltage of Q124. Set triggering controls so there is no triggering, and set the TIME/DIV. switch to .1 SEC. Set MODE switch to SINGLE SWEEP after first pressing it to RESET. Base of Q124 should be at about +16 volts. Move LEVEL controls momentarily to FREE RUN and return to former position after allowing sweep to start. Base of Q124 should rise to about +110 volts. When sweep ends, base of Q124 should drop to 0 volts.	If base of Q124 stays near +125 volts with MODE switch in SINGLE SWEEP, replace D126. If base of Q124 drops to +16 volts when sweep retraces, Q124 or D124 is at fault. To check D124, start the sweep again and connect a jumper across D124 while the sweep is running. If sweep locks out at end of trace, D124 is open. If lockout still does not operate, replace Q124.
2. Sweep runs as soon as MODE switch is returned from RESET to SINGLE SWEEP.	LEVEL or STABILITY control improperly set.	Check setting of LEVEL and STABILITY controls according to Calibration section of this manual.	





# Section 7

## Parts List and Schematics

### PARTS ORDERING INFORMATION

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


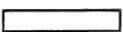
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information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

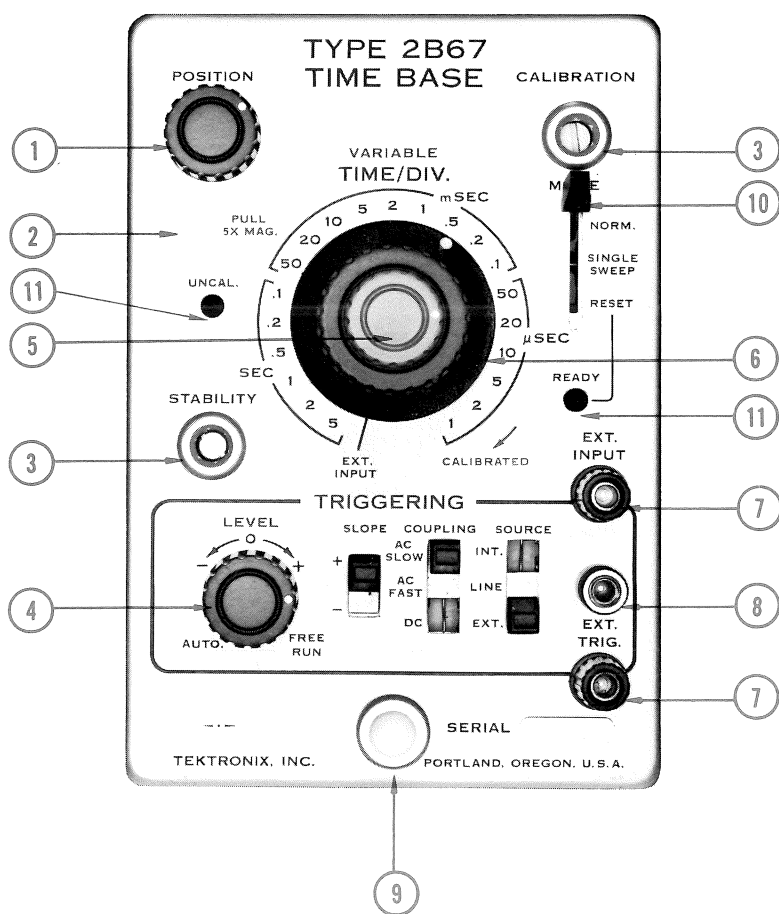
### ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega ( $10^6$ )
C	carbon	met.	metal
cer	ceramic	$\mu$	micro, or $10^{-6}$
cm	centimeter	n	nano, or $10^{-9}$
comp	composition	$\Omega$	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or $10^{-12}$
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 $10^9$	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 $10^{12}$
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 ( $10^3$ )	w/	with
kc	kilocycle	w/o	without
m	milli, or $10^{-3}$	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.

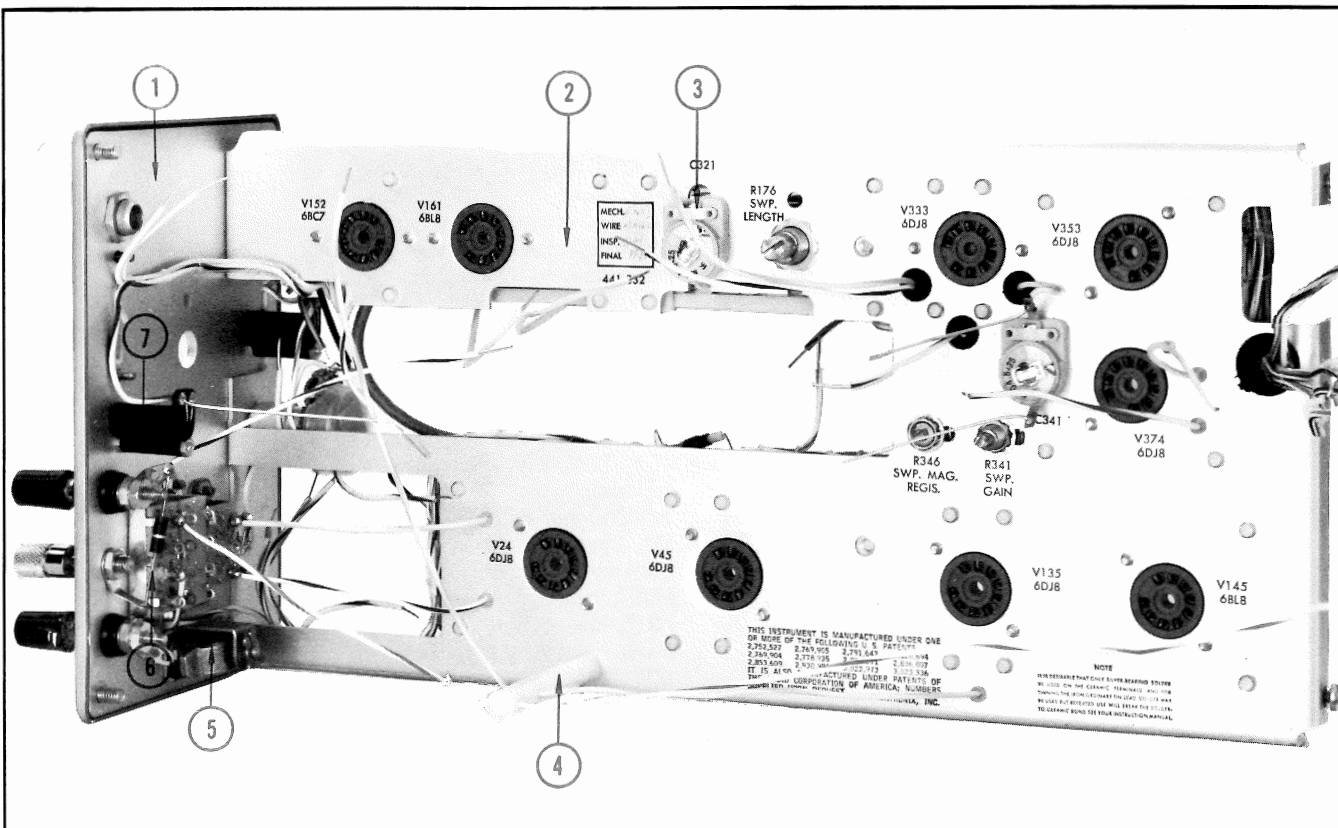
FRONT GROUP



## FRONT GROUP

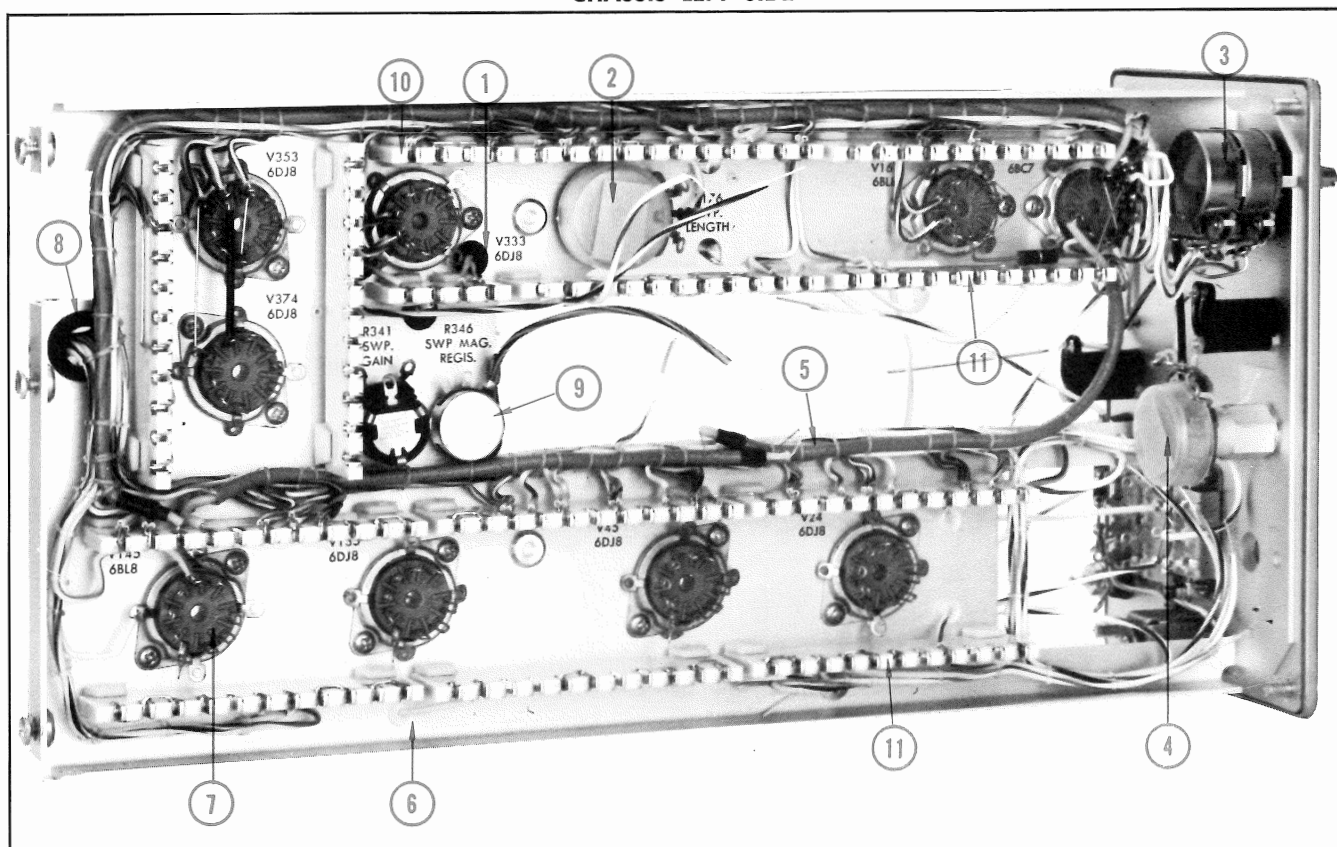
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	366-0113-00			1	KNOB, POSITION, charcoal Includes: SCREW, set, 6-32 x $\frac{3}{16}$ in. HHS, allen head
	213-0004-00			1	PANEL, front
2	333-0727-00			1	BUSHING, alum. $\frac{3}{8}$ -32 x $\frac{9}{16}$ in.
3	358-0010-00			2	Mounting Hardware: (not included)
	210-0590-00			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{7}{16}$ in.
4	366-0113-00			1	KNOB, LEVEL, charcoal Includes: SCREW, set, 6-32 x $\frac{3}{16}$ in. HHS, allen head
	213-0004-00			1	KNOB, VARIABLE, red Includes: SCREW, set, 6-32 x $\frac{3}{16}$ in. HHS, allen head
5	366-0038-00			1	KNOB, TIME/DIV. charcoal Includes: SCREW, set, 6-32 x $\frac{3}{16}$ in. HHS, allen head
	213-0004-00			1	POST, binding, assembly Each consisting of:
6	366-0144-00			1	POST, binding, miniature, 5 way, fluted cap
	213-0004-00			2	NUT, hex, 6-32 x $\frac{5}{16}$ in.
7	129-0065-00			1	NUT, keps, 6-32 x $\frac{5}{16}$ inch
	129-0064-00	5001	7539	1	LOCKWASHER, internal, #6
	210-0408-00	7540		1	LUG, solder, SE #6, long
	210-0457-00	5001	7539X	1	BUSHING, nylon, charcoal
	210-0006-00	5001	7539X	1	POST, binding, assembly Consisting of:
	210-0203-00			1	CAP, brass, $\frac{3}{8}$ x $\frac{5}{8}$ in.
	358-0181-00			1	NUT, hex, 10-32 x $\frac{5}{16}$ in.
8	129-0020-00			1	STEM, nickel plated
	200-0072-00			1	KNOB, PLUG-IN SECURING, $\frac{9}{16}$ in. alum. x $\frac{5}{8}$ in. Includes: SCREW, set, 8-32 x $\frac{1}{8}$ in. HSS, allen head
	210-0410-00			1	KNOB, lever switch
	355-0503-00			1	KNOB, lever switch
9	366-0109-00			2	FILTER, lens, neon
	213-0005-00				
10	366-0215-00	5001	15219		
	366-0215-01	15220			
11	378-0541-00	X17170			

## CHASSIS RIGHT SIDE



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	387-0731-00			1	PLATE, subpanel
2	441-0332-00			1	CHASSIS, 12 $\frac{1}{4}$ x 5 $\frac{5}{16}$ in. Mounting Hardware: (not included)
	211-0504-00			3	SCREW, 6-32 x $\frac{1}{4}$ in. BHS
3	- - - - -			-	Capacitor Mounting Hardware:
	214-0153-00			1	FASTENER, snap, double pronged, delrin
4	385-0137-00			1	ROD, delrin, $\frac{5}{16}$ x 2 $\frac{1}{4}$ in. with 3 cross holes Mounting Hardware: (not included)
	213-0041-00			1	SCREW, thread forming, 6-32 x $\frac{3}{8}$ in. THS
5	214-0052-00			1	FASTENER, pawl right, with stop Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x $\frac{3}{16}$ in.
6	Pg. 7-8				Switches
7	352-0008-00	5001	17169	2	HOLDER, neon bulb, single, black
	352-0067-00	17170		2	HOLDER, neon bulb, single, gray Mounting Hardware for Each: (not included)
	211-0031-00	5001	17169	1	SCREW, 4-40 x 1 in. FHS
	211-0109-00	17170		1	SCREW, 4-40 x $\frac{7}{8}$ inch FHS
	210-0406-00			2	NUT, hex, 4-40 x $\frac{3}{16}$ in.

## CHASSIS LEFT SIDE

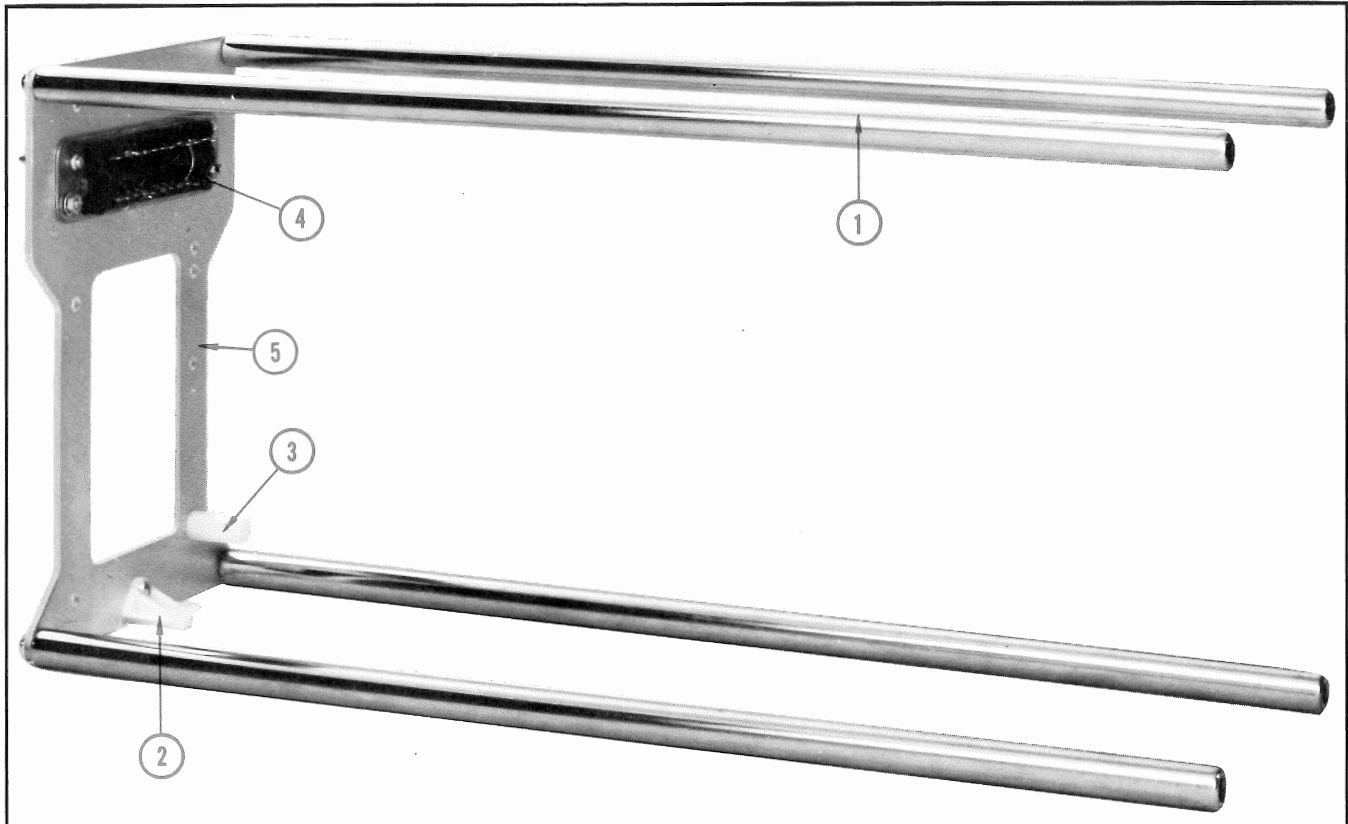


REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	348-0002-00	5001	13509X	3	GROMMET, rubber, 1/4 in.
2	200-0247-00			1	CAP, pot, polyethylene, 1 in. dia.
	- - - - -			-	Mounting Hardware for pot: (not included)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 in.
	210-0840-00			1	WASHER, pot, flat
3	- - - - -	5001	13509X	-	Pot Mounting Hardware:
	210-0255-00			1	LUG, solder, pot
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 in.
	210-0840-00			1	WASHER, pot, flat
4	200-0247-00			1	CAP, pot, polyethylene, 1 in. dia.
	- - - - -	5001	13509X	-	Mounting Hardware for pot: (not included)
	210-0494-00			1	NUT, hex, 3/8-32 x 1/2 x 11/16 in.
	210-0012-00			1	LOCKWASHER, pot, internal, 3/8 x 1/2 in.
5	179-0697-00			1	CABLE, harness, chassis
6	348-0031-00			5	GROMMET, polypropylene, snap-in, 1/4 in. dia.
7	136-0015-00	5001	13509X	9	SOCKET, STM9G
	- - - - -			-	Mounting Hardware, Each: (not included)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 in. PHS
8	348-0005-00			1	GROMMET, rubber, 1/2 in.
9	- - - - -			2	POT
	- - - - -	5001	13509X	-	Mounting Hardware For Each: (not included w/pot)
	210-0046-00			1	LOCKWASHER, internal, .400 OD x .261 inch ID
	210-0583-00			1	NUT, hex, 1/4-32 x 5/16 inch

## CHASSIS LEFT SIDE

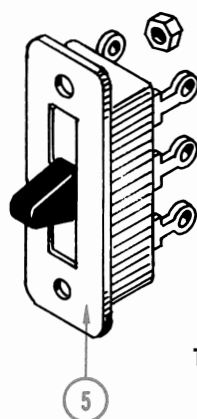
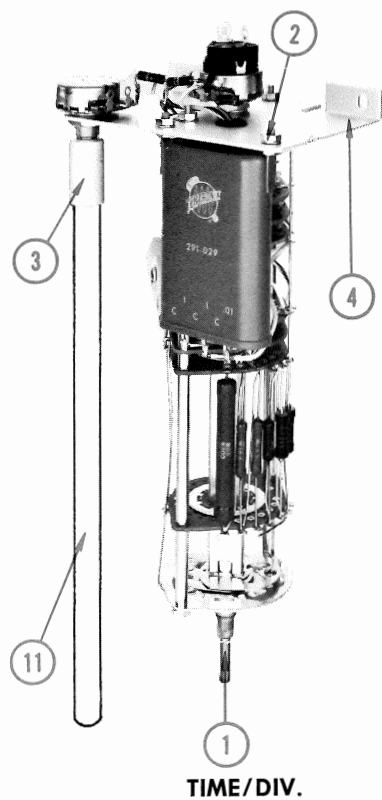
REF. NO.	PART NO.	SERIAL/MODEL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
10	124-0088-00			2	STRIP, ceramic, $\frac{3}{4}$ inch x 4 notches
	- - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - -			-	mounting hardware for each: (not included w/strip)
11	361-0007-00			2	SPACER, nylon, $\frac{1}{16}$ inch
	124-0091-00			12	STRIP, ceramic, $\frac{3}{4}$ inch x 11 notches
	- - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, nylon, $\frac{1}{16}$ inch

## REAR &amp; FRAME GROUP

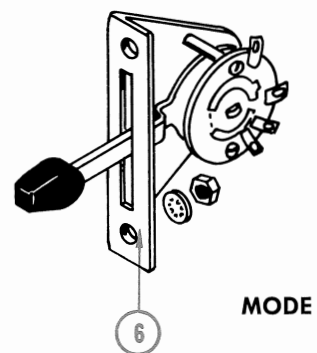


REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	384-0566-00	5001	7839	4	ROD, frame, spacing
	384-0615-00	7840		4	ROD, frame, spacing
2	212-0044-00			1	Mounting Hardware, Each: (not included)
	351-0037-00			1	SCREW, 8-32 x 1/2 in. RHS
				1	GUIDE, plug-in, delrin, 5/8 x 13/16 in. with 3/16 in. track
	211-0013-00			1	Mounting Hardware: (not included)
	210-0004-00			1	SCREW, 4-40 x 3/8 in. RHS
3	210-0406-00			1	LOCKWASHER, internal #4
	385-0134-00			1	NUT, hex, 4-40 x 3/16 in.
				1	ROD, delrin, 5/16 x 5/8 in. with one cross hole
	213-0041-00			1	Mounting Hardware: (not included)
4	131-0149-00			1	SCREW, thread forming, 6-32 x 3/8 in. THS
				1	CONNECTOR, chassis mount, 24 contact, male
					Mounting Hardware: (not included)
	211-0008-00			2	SCREW, 4-40 x 1/4 in. BHS
	210-0004-00			2	LOCKWASHER, internal #4
5	210-0406-00			2	NUT, hex, 4-40 x 3/16 in.
	387-0581-00			1	PLATE, rear

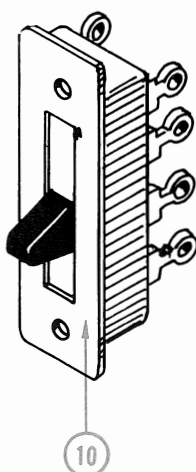
SWITCHES



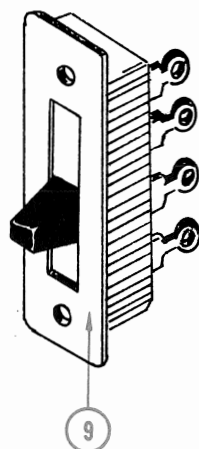
TRIGGERING SLOPE



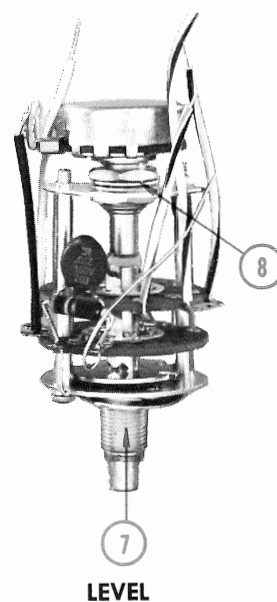
MODE



TRIGGERING SOURCE



TRIGGERING COUPLING



## SWITCHES

REF. NO.	PART NO.	SERIAL/MODEL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
1	262-0371-00	5001	15739	1	SWITCH, TIME/DIV., wired
	262-0371-01	15740		1	SWITCH, TIME/DIV., wired
	- - - - -			-	Includes:
	179-0508-00			1	CABLE, harness
	210-0006-00			3	LOCKWASHER, internal #6
	210-0012-00			2	LOCKWASHER, pot, internal, 3/8 x 1/2 in.
	210-0202-00			1	LUG, solder, SE6, with 2 wire holes
2	210-0407-00			4	NUT, hex, 6-32 x 1/4 in.
	210-0413-00			2	NUT, hex, 3/8-32 x 1/2 in.
	210-0449-00			2	NUT, hex, 5-40 x 1/4 in.
	210-0840-00			1	WASHER, pot, flat
	213-0075-00			1	SCREW, set, 4-40 x 3/32 in. HHS, allen head
	348-0003-00			1	GROMMET, rubber, 5/16 in.
	166-0354-00	5001	15739X	1	SPACER, aluminum
3	376-0007-00			1	COUPLING, 1 in. long, with 2, 8-32 in. tapped holes
	- - - - -			-	Includes:
	213-0005-00			2	SCREW, set, 8-32 x 1/8 in. HHS, allen head
	384-0226-00			1	ROD, extension, 8 1/4 in. long
4	406-0613-00			1	BRACKET, switch, rear, 3 3/16 x 2 11/16 x 1/2 in.
	260-0352-00	5001	15739	1	SWITCH, TIME/DIV., unwired
	260-0736-00	15740		1	SWITCH, TIME/DIV., unwired
	- - - - -			-	Mounting Hardware: (not included)
	210-0012-00			1	LOCKWASHER, pot, internal, 3/8 x 1/2 in.
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 in.
	210-0803-00			2	WASHER, flat, 6L x 3/8 in.
	210-0840-00			1	WASHER, pot, flat
	211-0507-00			2	SCREW, 6-32 x 5/16 in. BHS
5	260-0447-00			1	SWITCH, TRIGGERING SLOPE, unwired
	- - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 in.
6	260-0501-00			1	SWITCH, MODE, unwired
	- - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 in.
7	262-0372-00			1	SWITCH, LEVEL, wired
8	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 in.
	376-0014-00			1	COUPLING, pot, wire, steel
	260-0353-00			1	SWITCH, LEVEL, unwired
	- - - - -			-	Mounting Hardware: (not included)
	210-0012-00			1	LOCKWASHER, pot, internal, 3/8 x 1/2 in.
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 in.
	210-0840-00			1	WASHER, pot, flat
9	260-0448-00			1	SWITCH, TRIGGERING COUPLING, unwired
	- - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 in.
10	260-0450-00			1	SWITCH, TRIGGERING SOURCE, unwired
	- - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 in.
11	384-0215-00			1	ROD, extension, 1/4 in. dia. x 6 5/8 in. long
	070-0366-00			2	MANUAL, instruction (not shown)

## ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
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## BULBS

B124	150-027	Neon, NE-23	READY
B160W	150-027	Neon, NE-23	UNCAL.
B161	150-027	Neon, NE-23	
B167	150-027	Neon, NE-23	

## CAPACITORS

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

C9	281-523	100 pf	Cer.	350 v		
C10	283-002	.01 $\mu f$	Disc Type	500 v		
C15	283-000	.001 $\mu f$	Disc Type	500 v		
C20	283-003	.01 $\mu f$	Disc Type	150 v		
C24	281-546	330 pf	Cer.	500 v	10%	
C31	283-001	.005 $\mu f$	Disc Type	500 v		
C37	281-511	22 pf	Cer.	500 v	10%	
C113	283-000	.001 $\mu f$	Disc Type	500 v		
C130	281-518	47 pf	Cer.	500 v		
C134	281-504	10 pf	Cer.	500 v	10%	
C137	281-0549-00	68 pf	Cer	500 v	10%	X15380-up
C141	281-544	5.6 pf	Cer.	500 v	10%	
C147	281-525	470 pf	Cer.	500 v		
C160A	281-007	3-12 pf	Cer.	Var.		
C160B	281-574	82 pf	Cer.	500 v	10%	
C160C	281-010	4.5-25 pf	Cer.	Var.		
C160D	*291-008	.001 $\mu f$	Timing Series		$\pm 1/2\%$	
C160E		.01 $\mu f$				
C160F	*291-029	.1 $\mu f$			$\pm 1/2\%$	
C160G		1 $\mu f$				
C165	281-523	100 pf	Cer.	350 v		
C167	283-000	.001 $\mu f$	Disc Type	500 v		
C320	281-509	15 pf	Cer.	500 v	10%	
C321	281-010	4.5-25 pf	Cer.	Var.		
C334	281-510	22 pf	Cer.	500 v		
C341	281-010	4.5-25 pf	Cer.	Var.		
C348	281-534	3.3 pf	Cer.	500 v	$\pm .25$ pf	
C356	283-003	.01 $\mu f$	Disc Type	150 v		
C361	283-002	.01 $\mu f$	Disc Type	500 v		
C397	283-008	.1 $\mu f$	Disc Type	500 v		

## DIODES

D124	152-008	Germanium	5001-15919
D124	*152-0061-00	Silicon Tek Spec	15920-up
D126	*152-061	Silicon Tek Spec	
D130	152-008	Germanium	

## ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
<b>Bulbs</b>			
B124	150-027	Neon, NE-23	READY 5001-17169
B124	150-0030-00	Neon, NE-2V	17170-up
B160W	150-027	Neon, NE-23	UNCAL. 5001-17169
B160W	150-0030-00	Neon, NE-2V	17170-up
B161	150-027	Neon, NE-23	
B167	150-027	Neon, NE-23	
<b>Capacitors</b>			
Tolerance $\pm 20\%$ unless otherwise indicated.			
C9	281-523	100 pf Cer.	350 v
C10	283-002	.01 $\mu$ f Disc Type	500 v
C15	283-000	.001 $\mu$ f Disc Type	500 v
C20	283-003	.01 $\mu$ f Disc Type	150 v
C24	281-546	330 pf Cer.	500 v 10%
C31	283-001	.005 $\mu$ f Disc Type	500 v
C37	281-511	22 pf Cer.	500 v 10%
C113	283-000	.001 $\mu$ f Disc Type	500 v
C130	281-518	47 pf Cer.	500 v
C134	281-504	10 pf Cer.	500 v 10%
C137	281-0549-00	68 pf Cer.	500 v 10% X15380-up
C141	281-544	5.6 pf Cer.	500 v 10%
C147	281-525	470 pf Cer.	500 v
C160A	281-007	3-12 pf Cer.	Var. 500 v
C160B	281-574	82 pf Cer.	500 v 10%
C160C	281-010	4.5-25 pf Cer.	Var. 500 v
C160D	*291-008	.001 $\mu$ f	Timing Series $\pm 1/2\%$ 5001-22839
C160E	*291-029	.01 $\mu$ f	
C160F		.1 $\mu$ f	
C160G		1 $\mu$ f	
C160D	*295-0109-00	.001 $\mu$ f	Capacitor Assy 22840-up
C160E		.01 $\mu$ f	
C160F		.1 $\mu$ f	
C160G		1 $\mu$ f	
C165	281-523	100 pf Cer.	350 v
C167	283-000	.001 $\mu$ f Disc Type	500 v
C320	281-509	15 pf Cer.	500 v 10%
C321	281-010	4.5-25 pf Cer.	Var. 500 v
C334	281-510	22 pf Cer.	500 v
C341	281-010	4.5-25 pf Cer.	Var. 500 v
C348	281-534	3.3 pf Cer.	$\pm .25$ pf
C356	283-003	.01 $\mu$ f Disc Type	150 v
C361	283-002	.01 $\mu$ f Disc Type	500 v
C397	283-008	.1 $\mu$ f Disc Type	500 v
<b>Diodes</b>			
D124	152-008	Germanium	5001-15919
D124	*152-0061-00	Silicon Tek Spec	15920-up
D152	152-0246-00	Silicon Tek Spec	
D126	*152-061	Germanium	
D130	152-008	Silicon Low leakage 0.25 w, 40 v	X18100-up

# Parts List—Type 2B67

		Resistors					
Ckt. No.	Tektronix Part No.	Description		S/N Range			
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.							
R14	302-105	1 meg	$\frac{1}{2}$ w	Var.	5% LEVEL 5%		
R15	302-474	470 k	$\frac{1}{2}$ w				
R16	301-303	30 k	$\frac{1}{2}$ w				
R17	311-206	250 k					
R19	301-105	1 meg	$\frac{1}{2}$ w				
R20	301-304	300 k	$\frac{1}{2}$ w	Prec. Prec.	5%		
R22	302-151	150 $\Omega$	$\frac{1}{2}$ w				
R23	302-151	150 $\Omega$	$\frac{1}{2}$ w				
R24	301-512	5.1 k	$\frac{1}{2}$ w		5%		
R25	301-512	5.1 k	$\frac{1}{2}$ w		5%		
R28	303-223	22 k	1 w		5%		
R30	302-224	220 k	$\frac{1}{2}$ w				
R31	302-224	220 k	$\frac{1}{2}$ w				
R32	302-101	100 $\Omega$	$\frac{1}{2}$ w				
R34	302-122	1.2 k	$\frac{1}{2}$ w				
R35	302-272	2.7 k	$\frac{1}{2}$ w	Prec. Prec.	1%		
R37	309-139	333 k	$\frac{1}{2}$ w		1%		
R38	309-056	390 k	$\frac{1}{2}$ w				
R40	302-225	2.2 meg	$\frac{1}{2}$ w				
R41	302-101	100 $\Omega$	$\frac{1}{2}$ w				
R43	302-472	4.7 k	$\frac{1}{2}$ w	Var.	STABILITY 5% 5%		
R46	304-273	27 k	1 w				
R111	311-112	15 k					
R112	Use 301-123	12 k	$\frac{1}{2}$ w				
R113	301-183	18 k	$\frac{1}{2}$ w				
R121	302-0563-00	56 k	$\frac{1}{2}$ w			X15920-up	
R123	301-274	270 k	$\frac{1}{2}$ w		5%		
R124	302-473	47 k	$\frac{1}{2}$ w			5001-15919	
R124	301-0273-00	27 k	$\frac{1}{2}$ w		5%	15920-up	
R125	316-0334-00	330 k	$\frac{1}{4}$ w			X15920-up	
R126	Use 302-684	680 k	$\frac{1}{2}$ w			X15920-up	
R127	316-0472-00	4.7 k	$\frac{1}{4}$ w				
R130	302-472	4.7 k	$\frac{1}{2}$ w				
R131	302-101	100 $\Omega$	$\frac{1}{2}$ w				
R134	309-263	13.5 k	$\frac{1}{2}$ w		Prec. 1%		
R135	309-263	13.5 k	$\frac{1}{2}$ w	Prec.	1%	5001-15379 15380-up	
R137	302-101	100 $\Omega$	$\frac{1}{2}$ w				
R137	302-0224-00	220 k	$\frac{1}{2}$ w				
R138	302-272	2.7 k	$\frac{1}{2}$ w				
R141	310-070	33 k	1 w		Prec. 1%		
R143	309-231	16.69 k	$\frac{1}{2}$ w	Prec. Prec.	1%		
R144	Use 324-296	11.8 k	1 w		1%		
R146	302-101	100 $\Omega$	$\frac{1}{2}$ w				
R147	302-152	1.5 k	$\frac{1}{2}$ w				
R149	302-822	8.2 k	$\frac{1}{2}$ w				
R152	316-0226-00	22 meg	$\frac{1}{4}$ w	Prec. Prec. Prec. Prec. Prec.	1%	X20010-up	
R160A	309-007	666.6 k	$\frac{1}{2}$ w		1%		
R160B	309-007	666.6 k	$\frac{1}{2}$ w		1%		
R160C	309-023	2 meg	$\frac{1}{2}$ w		1%		
R160D	309-351	6.67 meg	$\frac{1}{2}$ w		1%		
R160F	309-351	6.67 meg	$\frac{1}{2}$ w		1%		

## Resistors (Cont)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R160H	310-583	20 meg	2 w	Prec.	1%	
R160W	316-104	100 k	1/4 w			
R160X	302-103	10 k	1/2 w			
R160Y†	311-166	20 k		Var.	VARIABLE	5001-15739
R160Y††	311-0567-00	20 k		Var.		15740-up
R161	302-101	100 Ω	1/2 w			
R165	302-683	68 k	1/2 w			
R166	302-683	68 k	1/2 w			
R167	302-105	1 meg	1/2 w			
R168	302-473	47 k	1/2 w			
R169	323-0418-00	221 k	1/2 w	Prec.	1%	X15180-up
R174	303-273	27 k	1 w		5%	
R176	311-117	5 k		Var.	SWP LENGTH	
R178	301-113	11 k	1/2 w		5%	
R181	302-475	4.7 meg	1/2 w			
R320	309-019	1.75 meg	1/2 w	Prec.	1%	
R321	309-016	1.23 meg	1/2 w	Prec.	1%	
R323	311-111	2 x 50 k		Var.	POSITION	
R324	Use 303-0183-00	18 k	1 w		5%	
R326	301-244	240 k	1/2 w		5%	
R330	302-101	100 Ω	1/2 w			
R332	304-183	18 k	1 w			
R333	301-103	10 k	1/2 w		5%	
R334	311-191	10 k		Var.	CALIBRATION	
R336	302-101	100 Ω	1/2 w			
R338	302-393	39 k	1/2 w			
R341	311-173	100 k		Var.	SWP GAIN	
R342	309-043	82 k	1/2 w	Prec.	1%	
R344	309-279	180 k	1/2 w	Prec.	1%	
R345	302-473	47 k	1/2 w			
R346	311-125	50 k	.2 w	Var.	SWP. MAG. REGIS.	
R348	309-126	400 k	1/2 w	Prec.	1%	
R350	302-101	100 Ω	1/2 w			
R352	302-393	39 k	1/2 w			
R355	301-155	1.5 meg	1/2 w		5%	
R356	301-124	120 k	1/2 w		5%	
R357	302-101	100 Ω	1/2 w			
R359	302-393	39 k	1/2 w			
R360	302-105	1 meg	1/2 w			
R361	302-474	470 k	1/2 w			
R370	302-101	100 Ω	1/2 w			
R371	302-101	100 Ω	1/2 w			
R373	308-105	30 k	8 w	WW	5%	
R375	305-153	15 k	2 w		5%	
R377	308-191	35 k	8 w	WW	5%	
R390	301-151	150 Ω	1/2 w		5%	
R391	301-151	150 Ω	1/2 w		5%	
R392	*308-141	1 Ω	1/2 w	WW	5%	X10810-18099X
R397	302-470	47 Ω	1/2 w			

†Concentric with SW341. Furnished as a unit.

††Furnished as a unit with SW160B and SW341.

# Parts List—Type 2B67

## Switches

Ckt. No.	Tektronix Part No.		Description	S/N Range
	Unwired	Wired		
SW5	260-450		Slide TRIGGERING SOURCE	
SW10	260-448		Slide TRIGGERING COUPLING	
SW17	260-353	*262-372	Rotary LEVEL	
SW20	260-447		Slide TRIGGERING SLOPE	
SW124	260-501		Lever MODE	
SW160A } SW160B } SW341†	260-352 311-166	{ *Use 262-0371-01	Rotary TIME/DIV. CALIBRATED 5X MAG.	5001-15739 5001-15739
SW160A } SW160B } SW341 }	260-0736-00 †311-0567-00	{ *262-0371-01	Rotary TIME/DIV.	15740-22839 15740-22839
SW160A } SW160B } SW341 }	260-0736-00 †311-0567-00	{ *262-0371-02	Rotary TIME/DIV	22840-up 22840-up

## Transistor

Q124                      151-093                      2N2043

## Electron Tubes

V24	154-187	6DJ8
V45	154-187	6DJ8
V135	154-187	6DJ8
V145	154-278	6BL8
V152	Use 154-453	6BJ7
V161	154-278	6BL8
V333	154-187	6DJ8
V353	154-187	6DJ8
V374	154-187	6DJ8

†Furnished as a unit with R160Y.





## Section 6

# Calibration

Calibration of the Type 2B67 is performed with the plug-in unit inserted in the right-hand (X-axis) opening of a 560-Series Oscilloscope. An amplifier plug-in must be inserted in the left-hand (Y-axis) opening. In order to maintain its high degree of accuracy and linearity, we recommend that the Type 2B67 be calibrated after each 500 hours of operation or about every six months, whichever comes first.

Apparent trouble in the instrument may be the result of improper calibration. If trouble appears, you should make sure it is not due to improper calibration before proceeding with more detailed troubleshooting. Also, each calibration adjustment should be checked, and adjusted if necessary, whenever a component has been changed.

Because of interaction among some adjustments, we recommend that you calibrate the instrument in the order presented. Single adjustments should not be made. Front-panel controls not mentioned in a given step are assumed to be in the same position as in the previous step. Some adjustments affect the position of the crt display; therefore, it will be necessary to reposition the display with the POSITION control to keep time markers properly aligned with the graticule lines. All measurements with time markers should be between the 2nd and 9th graticule lines.

To obtain access to the adjustments, the right-hand side panel of the oscilloscope must be removed. Fig. 6-1 shows the internal adjustments of the Type 2B67 plug-in, viewed from the right side.

### Equipment Required

The following equipment is required for a complete calibration of the Type 2B67 Time-Base.

1. Time-Mark Generator: Time markers at 1 and 10 microseconds, and at 1 and 5 milliseconds (accurate to within 1% (Tektronix Type 180 or 180A Time-Mark Generator recommended).

2. Coaxial Cable: Suitable for applying the output of the time-mark generator to the input connector of the amplifier plug-in.

3. Low-Capacity Screwdriver: (Tektronix Part No. 003-000 or 003-001 recommended).

### Initial Setup

Set the front-panel controls on the Type 2B67 as follows:

TIME/DIV.	.1 mSEC
VARIABLE*	CALIBRATED and pushed in (5X MAG. off)
LEVEL	AUTO.
SLOPE	+
COUPLING	AC SLOW
SOURCE	INT.
MODE	NORM.

\*The VARIABLE control must remain in the CALIBRATED position for all timing adjustments. The UNCAL. lamp will light if the control is not in the CALIBRATED position.

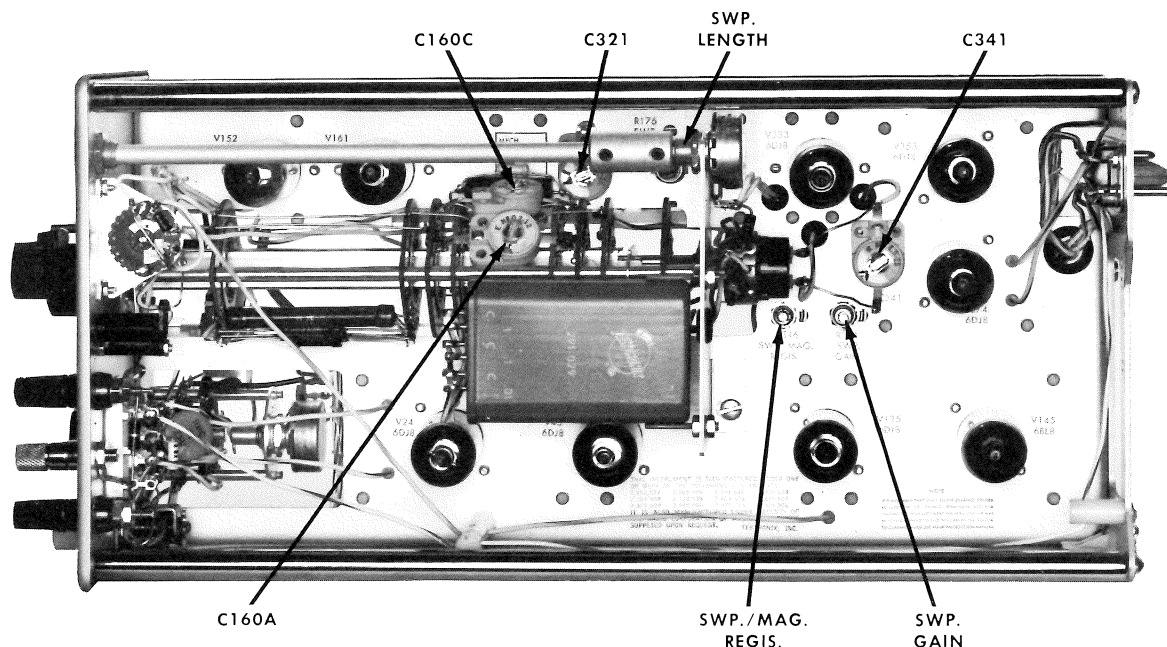


Fig. 6-1. Type 2B67 internal calibration adjustments.

## STABILITY Adjustment

Ground the input of the amplifier plug-in in the left-hand opening of the oscilloscope. Set the Type 2B67 STABILITY control (front-panel screwdriver adjustment) fully counter-clockwise, then slowly clockwise until a trace appears on the crt. Note the position of the control. Advance the adjustment farther clockwise until the trace brightens. Finally, set the control about midway between the position where the trace first appears and the position where it brightens.

## CALIBRATION Adjustment

Set the TIME/DIV. switch to 5 mSEC. Apply 1-millisecond markers to the input of the amplifier plug-in and adjust for about four divisions of vertical deflection. Center the display. Turn the 5X MAG. on (pull out the VARIABLE knob). Set the CALIBRATION control (front-panel screwdriver adjustment) for exactly one marker per major graticule division on the crt.

## SWP. GAIN Adjustment

Turn the 5X MAG. off (push in the VARIABLE knob) and apply 5-millisecond markers to the amplifier plug-in. Adjust the SWP. GAIN control for exactly one marker per major graticule division.

## SWP. LENGTH Adjustment

With the 5X MAG. off, adjust the SWP. LENGTH control for a total sweep length of about 10.5 graticule divisions.

## SWP./MAG. REGIS. Adjustment

Turn the 5X MAG. on and position the trace horizontally so the first time marker is aligned with the centerline of the graticule. Turn the 5X MAG. off. Adjust the SWP./MAG. REGIS. control so the first time marker is again aligned with the centerline of the graticule. Repeat the adjustment until alignment is maintained.

## 10-, 20-, and 50-Microsecond/Division Sweep Rates

Set the TIME/DIV. switch to 50  $\mu$ SEC and turn the 5X MAG. on. Apply 10-microsecond markers to the input of the amplifier plug-in. Position the trace so the last 11 markers at the right-hand end of the trace are displayed on the crt. (The LEVEL control may have to be moved from the AUTO. position and adjusted for a stable display.) Adjust C160C for one marker per major graticule division.

Set the TIME/DIV. switch to 10  $\mu$ SEC and apply 1-microsecond markers to the input of the amplifier plug-in. (Be sure the 5X MAG. is on.) Position the display so the first 21 markers at the left-hand end of the trace are displayed. Adjust C321 for two markers per major graticule division.

## 1-, 2-, and 5-Microsecond/Division Sweep Rates

With the 5X MAG. on, set the TIME/DIV. switch to 5  $\mu$ SEC and the POSITION control to midrange. Adjust C160A for one marker per major graticule division.

## Linearity Adjustment

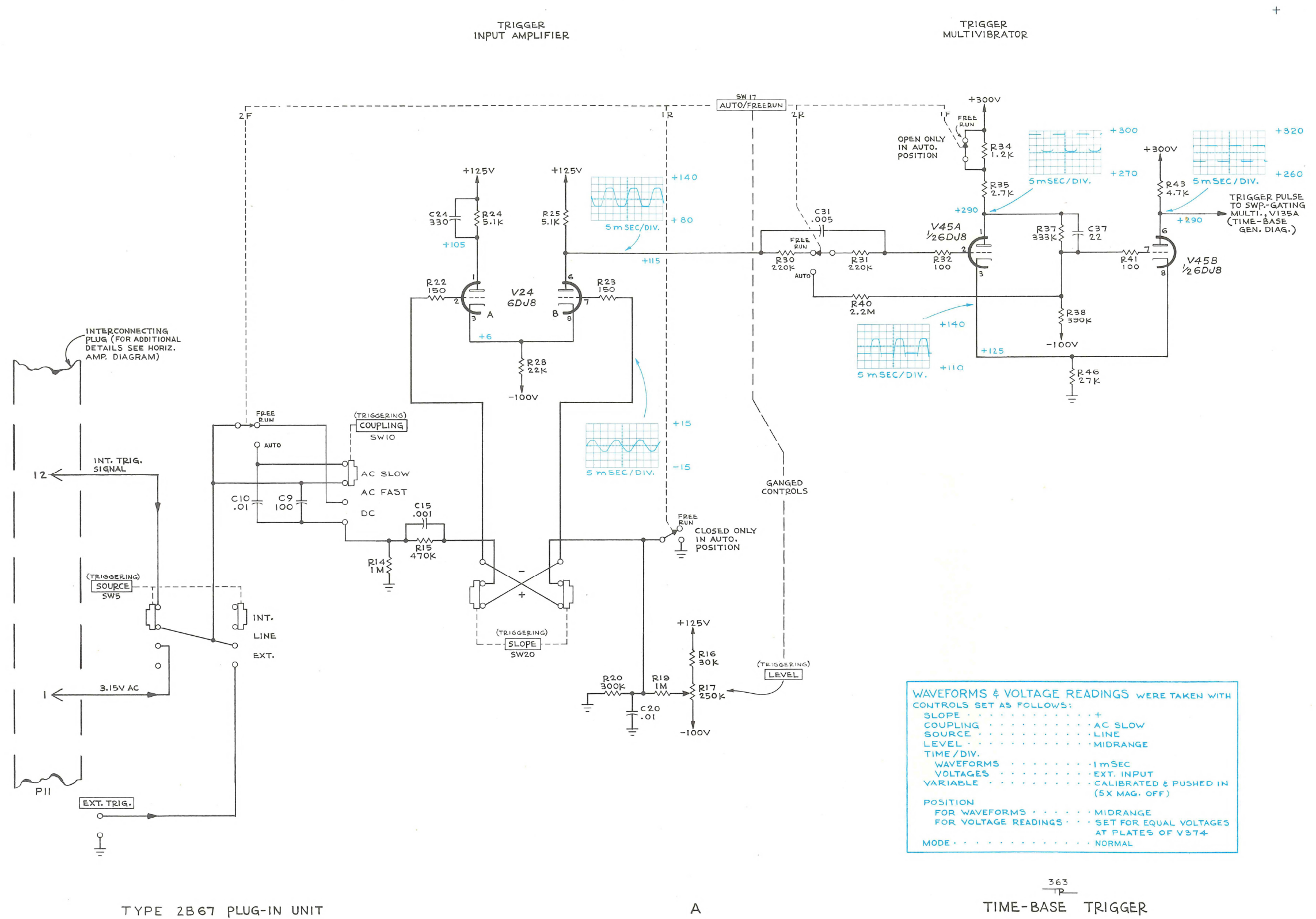
Set the TIME/DIV. switch to 1  $\mu$ SEC and turn the 5X MAG. off. Position the display horizontally so the first time marker is aligned with the centerline of the graticule. Adjust C341 for one marker per major graticule division. This adjustment affects the first 4 divisions of display.

## SINGLE SWEEP Check

Set the SOURCE switch to EXT. and the LEVEL control near, but not in, FREE RUN. Press the MODE switch to RESET and release. The READY lamp should light and remain on until the LEVEL control is moved through 0 toward AUTO. If proper operation is not obtained, recheck the setting of the STABILITY control.





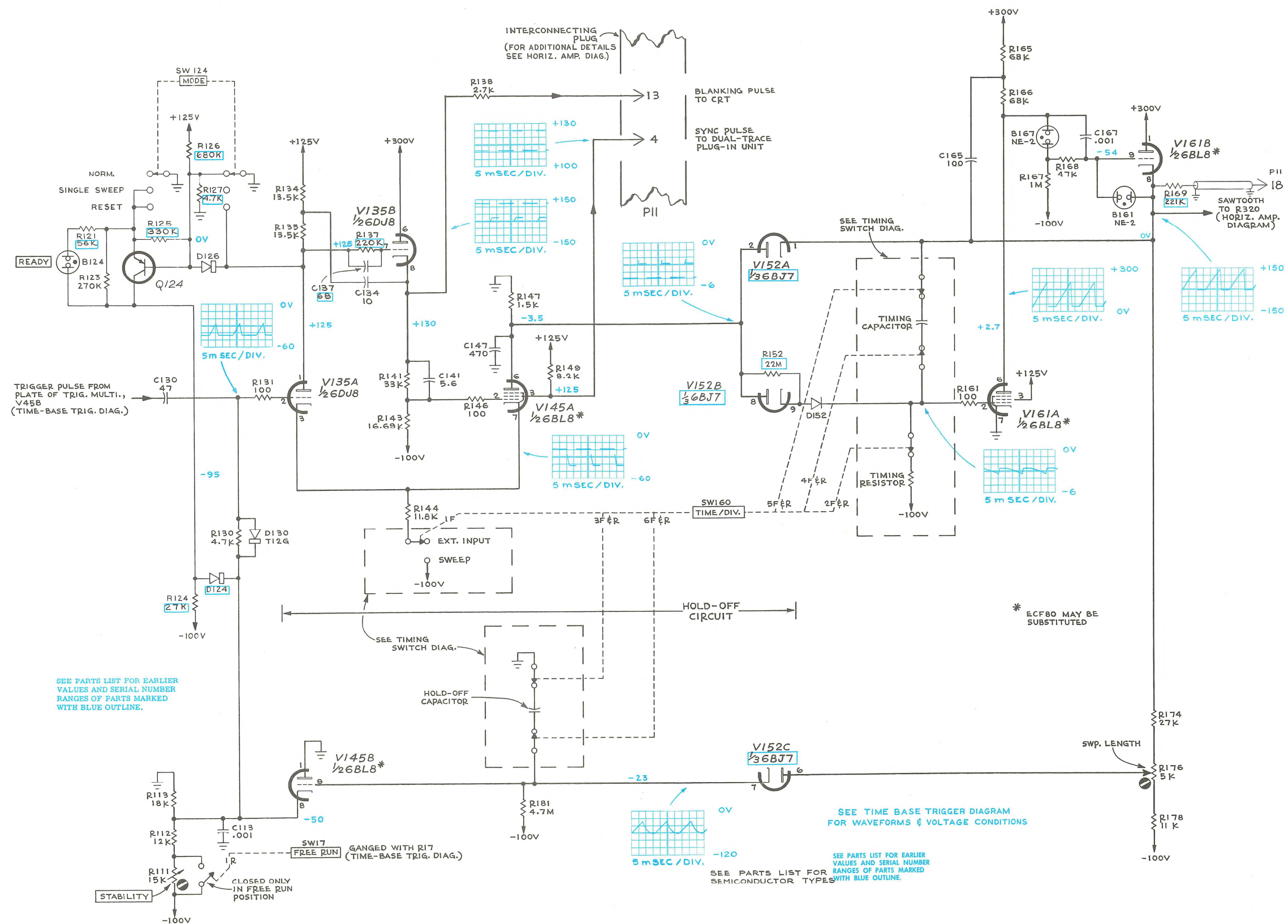


363  
P

TIME-BASE TRIGGER

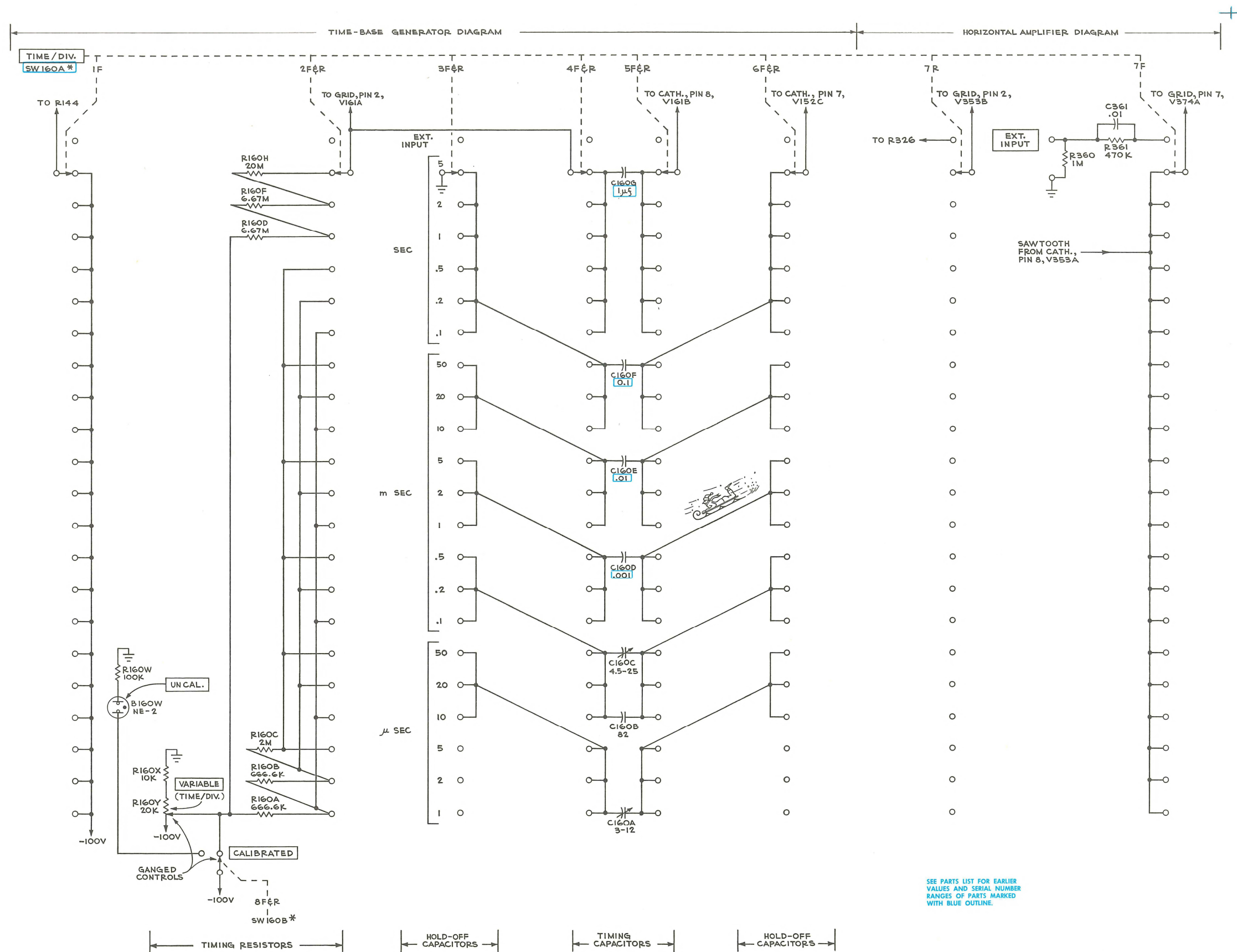
A

## MILLER RUNUP CIRCUIT



TYPE 2B67 PLUG-IN UNIT

## TIME-BASE GENERATOR



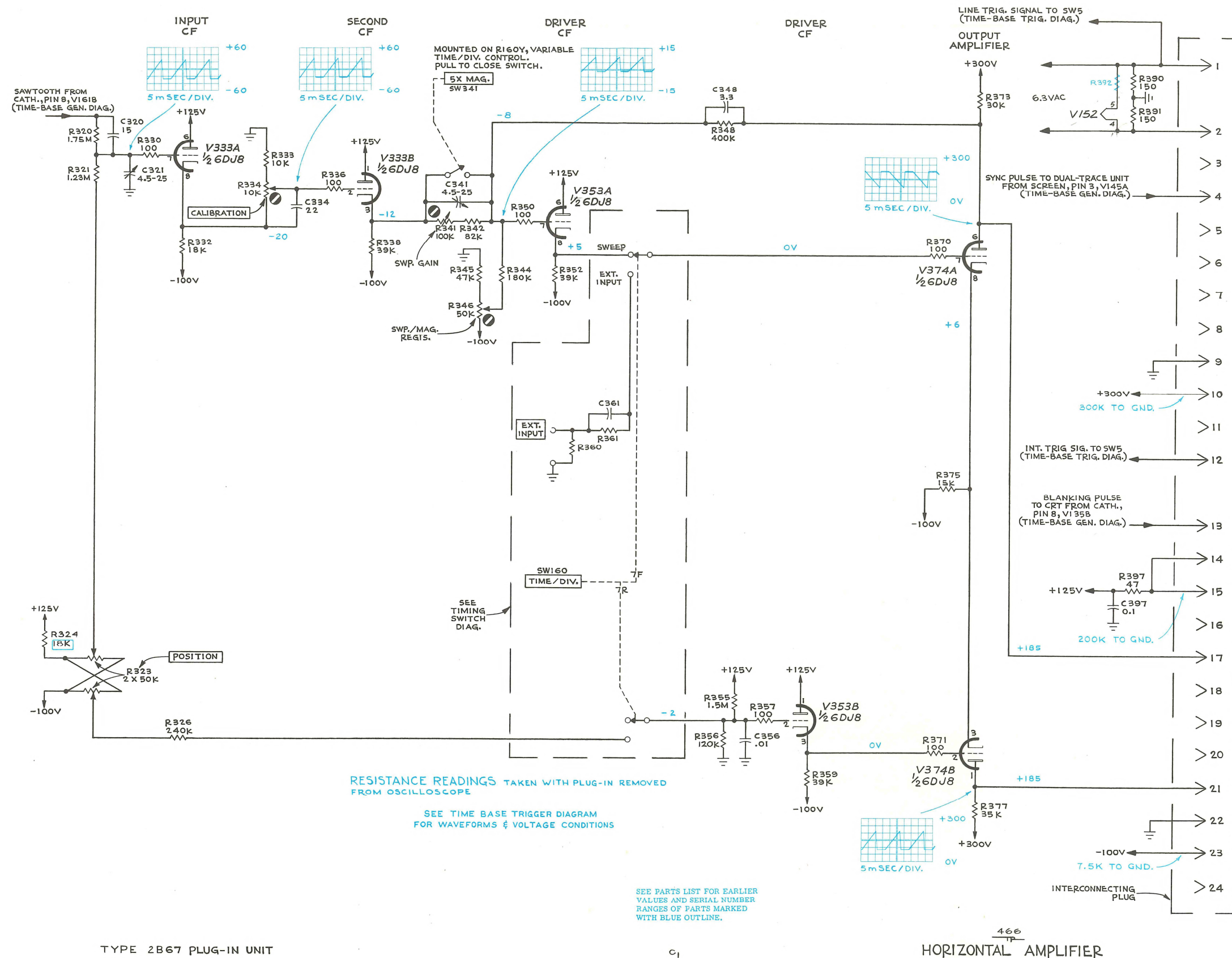
TYPE 2B67 PLUG-IN UNIT

B

TIMING SWITCH

GAB  
168

TIMING SWITCH







INSTRUMENT REFERENCE BOOK

for the Tektronix type

**67**

time-base  
plug-in unit

For all serial numbers



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# **67**

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# COMPATIBILITY

## COMPATIBILITY WITH 560 SERIES

8-15-62

The 67 is directly compatible with the following instruments (no sn exceptions):

560	RM561A	*RM567
561	565**	564
RM561	RM565**	
561A	*567	

\*The 67 doesn't provide digital readout in the 567 or RM567.

\*\*565 and RM565 have built-in time-bases, and use plug-ins for vertical deflection only.



# MODIFIED PRODUCTS

<u>Product</u>	<u>Mod</u>	<u>Description</u>
67	104A	Single sweep lockout
67/RM561A/72	119N	Vertical and horizontal connectors paralleled to rear (6).



# PERFORMANCE

## POWER DRAIN -- 560 SERIES PLUG-INS

Geoff Gass, 5-21-65

The power supply loading indicated below will vary somewhat with line-voltage and front-panel control settings. Where series-regulator shunts are indicated, the shunt consists of 2 k in the indicator unit in series with 0 to 6 k in the plug-in, the series combination connected between the unregulated supply and the regulated supply (in the -100v supply, between the unregulated +supply and ground). The shunt supplies the extra current drawn by the plug-in beyond that which can be handled by the series regulator. The actual amount of shunt current varies with line-voltage, so if a positive power-supply bus in the plug-in is opened to take a current reading, the reading will be in error unless the bus is opened on the load side of the shunt connection (with the shunt still connected). The -100v bus carries the entire load current, so a current measurement at

the plug-in connector is always correct for this supply. There is no shunting for the -12.2v supply.

CAUTION: The values below should not be used to determine if there is any "extra" power available in the compartment for other purposes or plug-in modifications. The values of the shunts, the total dissipation in the plug-in, the limitations of the indicator (transformer and series regulators) and the characteristics of the other plug-ins with which a given plug-in may be used all limit the amount of power "available" in a given plug-in compartment; in most cases, there is little or no margin allowed for extra current drain without modification of the shunts or circuitry. See 040-0245-00 instructions and power drain discussion in PRB's for indicators.

Plug-In, SN	-100v, shunt	-12.2v	+125v, shunt	+300v, shunt	6.3v AC	117v
(2B)67	50-70 FS	0	25-40 --	22-25 --	3.5 A	0



# TYPE 67 TIME-BASE

The Tektronix Type 67 Time-Base, Fig. 1, is designed for use with Tektronix Type 560-Series Oscilloscopes. It provides a triggered or free-running sweep at 21 calibrated sweep rates from 1 microsecond per division to 5 seconds per division. When the module is properly calibrated, the accuracy of the sweep rates is within 3% of the indicated

value. In addition, a variable control provides continuous sweep rate adjustment (uncalibrated) from 1 microsecond per division to 12 seconds per division. Sweep magnification of 5 is available at all sweep rates. The external input sensitivity is approximately 1 volt per division.

## Operating Instructions

Throughout the instructions that follow it is assumed, unless otherwise noted, that the Type 67 is inserted in the right-hand (X-axis) opening of the oscilloscope, thereby providing horizontal deflection of the trace. If it is inserted in the left-hand (Y-axis) opening of the oscilloscope it will provide vertical deflection of the trace and the instructions must be interpreted accordingly. It is further assumed throughout the discussion that there is an amplifier module in the left-hand opening of the oscilloscope.

### Front Panel Controls and Connectors

Functions of all front panel controls and connectors are described in Table 1.

TABLE 1

POSITION	Controls horizontal position (when the Type 67 is in the right-hand opening of the oscilloscope) of the display on the crt screen.
CALIBRATION	Adjusts gain to compensate for differences in crt deflection sensitivities.
TIME/DIV.	Selects the desired sweep rate from a choice of 21 calibrated steps. In addition, an EXT. INPUT position is provided for connecting external signals.
VARIABLE (red knob)	Provides a continuous range of sweep rates between the fixed steps of the TIME/DIV. switch. (The sweep rates are calibrated only when the VARIABLE control is set fully clockwise to the CALIBRATED position.) By pulling the VARIABLE control out, 5X magnification of the sweep is obtained.
UNCAL. lamp	Lights when VARIABLE control is off CALIBRATED position to warn operator he is using an uncalibrated sweep rate.
EXT. INPUT	Input connector for application of external signals (TIME/DIV. switch must be in the EXT. INPUT position).
EXT. TRIG.	Input connector for external triggering signal.
STABILITY	Sets voltage level at input to Time-Base Generator to permit proper triggering by Time-Base Trigger.

LEVEL	Selects the voltage level on the triggering signal at which the sweep is triggered. This control also selects automatic triggering (AUTO position) or allows the sweep to free run (FREE RUN position).
SLOPE	Selects whether the sweep starts on the positive-going portion (+ slope) or on the negative-going portion (—slope) of the triggering signal.
COUPLING	Selects coupling of trigger input.
SOURCE	Selects the source of the triggering signal.

### Sweep Triggering

In order to obtain a stable display, it is necessary to start the sweep consistently at the same time relative to recurring cycles of the input waveform. The sweep therefore must be triggered by the input signal, or by some signal which bears a fixed time relationship to the input signal. The following instructions tell you how to select and use the proper triggering signal for various applications.

### Selecting the Triggering Source

For most applications the sweep can be triggered by the input signal. The only requirement is that the signal be large enough to provide at least one minor graticule division of deflection on the screen at the sensitivity for which the amplifier module in the left-hand opening of the oscilloscope is set. To obtain triggering of the sweep from the input signal, set the SOURCE switch to the INT. position.

Sometimes it is advantageous to trigger the sweep with an external signal. External triggering is especially useful where signals are going to be sampled from several different places within a device. By using external triggering, it is not necessary to reset the triggering controls each time a new waveform is shown. External triggering should also be used with a dual-trace amplifier module in the alternate mode to show the proper time relationship between the two displayed signals. In order to obtain a stable display, it is necessary that the external triggering signal have an amplitude of at least one volt, peak-to-peak, and bear a fixed time relationship to the displayed signal. To use an external signal for triggering the sweep, connect the signal to the EXT. TRIG. connector and set the SOURCE switch to EXT.

## Type 67

When you are observing a signal which bears a fixed time relationship to the line frequency, you may wish to trigger the sweep from the line-frequency signal. To do this, place the SOURCE switch in the LINE position.

### Selecting the Trigger Coupling

For most recurrent waveforms, satisfactory triggering will be obtained with the COUPLING switch in the AC SLOW position. However, when triggering from very low frequencies (below about 16 cps), greater triggering sensitivity will be obtained with the COUPLING switch in the DC position. The AC FAST position of the COUPLING switch is used when it is desired to trigger only on the high-frequency component of a signal containing both high- and low-frequency components. It should also be used any time you are using a dual-trace module in the alternate mode with internal triggering.

When using ac coupling, the sweep is triggered when the signal reaches a given amplitude with respect to its dc average. When using dc coupling the sweep is triggered when the signal reaches a given amplitude with respect to zero.

### Selecting the Trigger Slope

In most cases, selection of the triggering slope is not critical since triggering on either slope will provide a suitable display. When the SLOPE switch is in the + position, the sweep is triggered on the positive slope of the triggering signal. When the SLOPE switch is in the — position, the sweep is triggered on the negative slope of the triggering signal.

### Selecting the Trigger Level

The LEVEL control determines the instantaneous voltage level (ac or dc, depending upon the setting of the COUPLING switch) on the triggering signal at which the sweep is triggered. With the SLOPE switch in the + position, adjustment of the LEVEL control makes it possible to trigger the sweep consistently at virtually any point on the positive slope of the triggering signal. Likewise, with the SLOPE switch in the — position, adjustment of the LEVEL control makes it possible to trigger the sweep consistently at virtually any point on the negative slope of the triggering signal.

At the extreme clockwise and counterclockwise ends of its range, the LEVEL switch activates, respectively, the FREE RUN and AUTO switches. The effects of these switches are discussed in the following paragraphs.

### Automatic Mode of Operation

Setting the LEVEL control to the AUTO position sets the Type 67 up for an automatic mode of triggering which is suitable for most applications. In this mode the triggering signal is ac-coupled, and the triggering level is automatically set such that any external triggering signal of one volt or more, or internal triggering signal which produces one minor graticule division or more of deflection on the crt screen, will trigger the sweep. In the absence of such a

triggering signal, the sweep will continue to be triggered automatically at about a 50-cps rate.

### Free-Running Mode of Operation

Setting the LEVEL control to the FREE RUN position produces a free-running sweep, independent of any synchronizing signal. The frequency of the free-running sweep is dependent upon the setting of the TIME/DIV. switch. This free-running trace is useful as a base line from which dc measurements may be made.

### Magnification of the Sweep

Any portion of the trace can be expanded horizontally by a factor of 5 by pulling the VARIABLE control knob out. To expand a given portion of the trace, set that portion to the center of the graticule by means of the POSITION control, and pull the VARIABLE control knob out.

To determine the true sweep rate in magnified sweep operation, divide the setting of the TIME/DIV. switch by 5. (The VARIABLE control must be turned fully clockwise.)

### Setting the CALIBRATION Adjustment

Any time you move the Type 67 from one oscilloscope opening to another, you must adjust the CALIBRATION adjustment to compensate for differences in crt deflection-plate sensitivities. Making this adjustment is also sometimes necessary when the amplifier module used in the same oscilloscope with the Type 67 module is changed. This is because the difference in average deflection plate voltages of the amplifier modules can affect the overall deflection sensitivity of the crt.

To properly set the CALIBRATION adjustment on the Type 67 in an oscilloscope with a line-frequency Calibrator, proceed as follows:

1. Set the TIME/DIV. switch to 5 mSEC and display a Calibrator signal on the screen.
2. Set the CALIBRATION adjustment so that the number of cycles of Calibrator signal occupying 10 graticule divisions is equal to the line frequency times 50 milliseconds. (If the line frequency is 60 cps, there will be 3 cycles displayed in 10 divisions.)

If your oscilloscope does not have a line-frequency Calibrator, you can accomplish the same purpose by displaying the line-frequency waveform and setting the CALIBRATION adjustment for the proper number of cycles.

In the Calibration instructions in this manual, there is another method of setting the CALIBRATION adjustment which is slightly more accurate, but requires the use of a time-mark generator.

### Time and Frequency Measurements

To measure the time interval between two points on a waveform, proceed as follows:

1. Apply the signal to the input of the amplifier module and set the triggering controls for a stable display. Make sure the VARIABLE control on the Type 67 is in the CALIBRATED position (UNCAL. light out).

2. Measure the horizontal distance, in graticule divisions, between the two points whose interval you wish to find.

3. Multiply the distance obtained in step 2 by the setting of the TIME/DIV. switch. (If the 5X MAG. is on—VARIABLE knob pulled out—divide the result by 5.) This is the time interval between the two points measured.

To determine the frequency of a recurrent waveform, simply take the reciprocal of the time interval between corresponding points on two consecutive cycles of the waveform.

### Phase-Shift Measurements

To measure the phase difference between two sine waves, proceed as follows:

1. Adjust the Type 67 for externally triggered operation, and apply one of the sine waves to the input of the ampli-

fier module. (The signal should be ac-coupled to the amplifier module.)

2. Set the TIME/DIV. switch so that at least one cycle of the sine wave is displayed.

3. Vertically center the display, and horizontally position it so that one of the positive slopes crosses the horizontal centerline at the left side of the graticule.

4. Measure the horizontal distance between corresponding points on two consecutive cycles of the waveform.

5. Without making any adjustments to the oscilloscope, disconnect the first sine wave and apply the second to the input of the amplifier module. (Normally, this can be done simply by moving the probe from one signal source to the other.) If there is a phase difference between the two sine waves, you will find that the display has shifted horizontally.

6. Measure the amount of horizontal shift of the display. (You may increase or decrease the deflection sensitivity of the amplifier module, if desired, to make the measurement easier.)

7. Divide the distance measured in step 6 by the distance measured in step 4 and multiply the result by  $360^\circ$ . This is the phase difference between the two sine waves.

## Circuit Description

### Block Diagram

A block diagram of the Type 67 Time-Base module is shown in Fig. 2. In general, the overall operation of the module is as follows:

A triggering signal (internal, external, or line) is applied to the Time-Base Trigger circuit. The Time-Base Trigger generates a negative trigger pulse coincident with a selected

point on each cycle of the triggering signal. This negative pulse triggers the Time-Base Generator which generates a positive-going sawtooth waveform. This sawtooth is amplified by the Horizontal Amplifier and applied push-pull to the deflection plates of the crt to sweep the electron beam across the screen. After the beam has traveled across the screen, the Time-Base Generator resets itself and awaits the next trigger pulse. If desired, the Time-Base Trigger and Time-Base Generator also can be disconnected (by placing

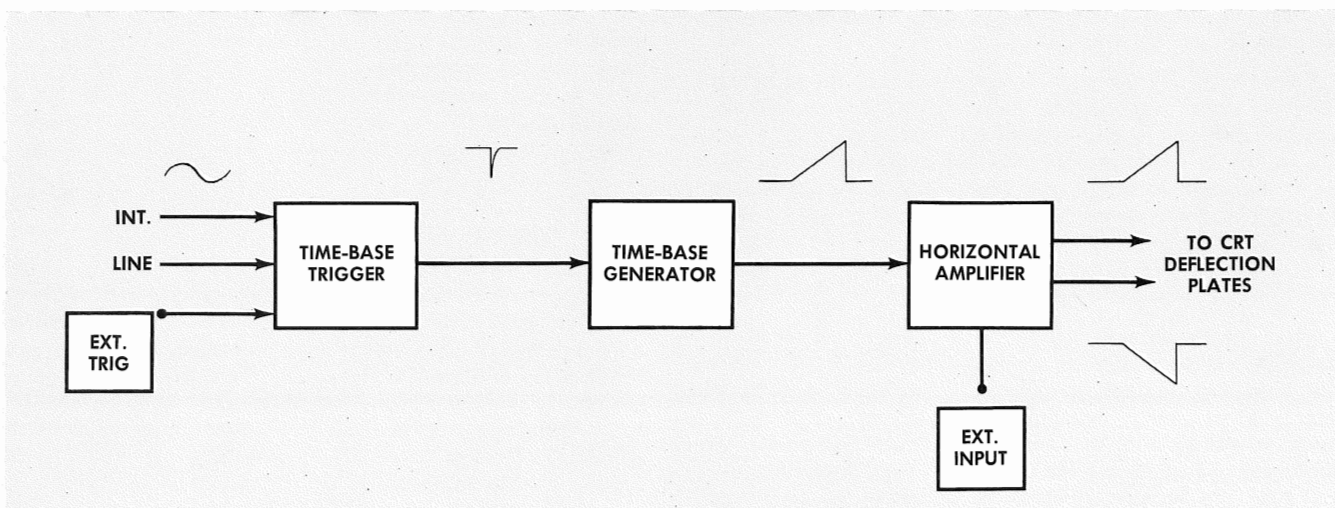


Fig. 2. Type 67 module block diagram.

the TIME/CM switch in the EXT. INPUT position) and an external signal applied directly through the Horizontal Amplifier to the deflection plates of the crt.

The following paragraphs describe the operation of each of the circuits of the Type 67 in detail. During these discussions, you should refer to the schematic diagrams at the rear of this manual.

## TIME-BASE TRIGGER

The Time-Base Trigger consists basically of the Trigger Input Amplifier, V24, and the Trigger Multivibrator, V45. The Trigger Input Amplifier amplifies (and when desired, inverts) the incoming triggering signal and applies it to the input grid of the Trigger Multivibrator. The Trigger Multivibrator is a Schmitt circuit which is switched from one state to the other by the signal at its input. Its square-wave output is differentiated to form negative and positive spikes which are applied to the Time-Base Generator. The negative spikes trigger the Time-Base Generator to start the sweep; the positive spikes are clipped by diode action and not used.

### Trigger Input Amplifier

The input to the Trigger Input Amplifier, V24, may be selected from one of three sources by means of the SOURCE switch, SW5. When the SOURCE switch is in the INT. position, the signal is obtained from the module in the left-hand opening of the oscilloscope. When the SOURCE switch is in the EXT. position, the signal may be obtained from an external source through the EXT. TRIG. connector on the front panel. When the SOURCE switch is in the LINE position, the signal is obtained from one side of the 6.3-volt circuit supplying heater current to the tubes of the module.

As will be seen later, the negative spike at the output of the Time-Base Trigger occurs only when there is a negative-going signal at the input of the Trigger Multivibrator (output of the Trigger Input Amplifier). However, it is desired to start the sweep during either a positive-going or negative-going portion of the incoming triggering signal. To accomplish this, the SLOPE switch, SW20, provides the means for inverting or not inverting, as desired, the triggering signal in the Trigger Input Amplifier.

When the SLOPE switch is in the — position, the incoming triggering signal is applied to the grid of V24A, and V24 becomes a cathode-coupled amplifier. Its output is in phase with its input. Thus, the negative-going portion of the signal at the input to the Trigger Multivibrator corresponds to the negative-going portion of the incoming triggering signal. The negative spike at the output of the Time-Base Trigger will therefore occur during a time when the triggering signal is moving in a negative direction.

When the SLOPE switch is in the + position, the incoming triggering signal is applied to the grid of V24B, and V24B acts as a plate-loaded amplifier. Its output is opposite in polarity to its input. Thus, the negative-going portion of the signal at the input of the Trigger Multivibrator corresponds to the positive-going portion of the incoming triggering signal. And, the negative spike at the output of the Time-Base Trigger will occur during a time when the triggering signal is moving in a positive direction.

The LEVEL control, R17, varies the average dc level of the plate of V24B from about +100 volts to +125 volts. This is true whether the SLOPE switch is in the — position or the + position. As will be seen later, the voltage at the plate of V24B must pass through the approximate center of this range (about +112.5 volts) in order to cause the Trigger Multivibrator to change states.

For small triggering signals, R17 is set such that the average dc level of the plate of V24B is close to the center of its range. Then a small triggering signal, as amplified by V24, is sufficient to carry the plate voltage through the 112.5-volt point. When a large triggering signal is applied and it is desired to trigger on an extreme positive or negative point of it, R17 is set so that V24B is well into saturation, or cutoff, depending on whether triggering is desired on a negative or positive point on the signal and on a negative or positive slope. In this case, the triggering signal must be large enough to overcome the saturation or cutoff of V24B and produce an additional 12.5 volts of swing at the plate of V24B in order to cause the trigger multivibrator to change states.

It should be noted that the voltages given in the foregoing discussion are typical nominals only and will vary somewhat from instrument to instrument and with time.

### Trigger Multivibrator

The Trigger Multivibrator, V45, is a typical two-state Schmitt circuit. When the voltage at the grid of V45A is above a certain critical level (neglecting hysteresis) the Trigger Multivibrator is in one state, with V45A conducting and V45B cut off. When the Trigger Multivibrator is in this state, the voltage at its output (plate of V45B) is +300 volts. When the voltage at the grid of V45A is below the critical level (neglecting hysteresis), the Trigger Multivibrator is in the other state, with V45A cut off and V45B conducting. When the Trigger Multivibrator is in this state, the voltage at its output is about +280 volts. The transition from one state to the other occurs very rapidly, regardless of how slowly the voltage at the input passes the critical level. Thus the output of the Trigger Multivibrator is a 20-volt square wave. The negative-going portion of the square wave occurs when the voltage at the grid of V45A passes the critical level while moving in a negative direction; the positive-going portion of the square wave occurs when the voltage at the grid of V45A passes the critical level while moving in a positive direction. As mentioned before, only the negative-going portion of the square wave is of significance timewise. By means of the SLOPE switch and the LEVEL control, this point can be made to coincide with virtually any point on the incoming triggering signal.

Actually, the voltage level at the grid of V45A at which the Trigger Multivibrator changes states on a negative-going signal is slightly lower than that at which it changes states on a positive-going signal. The difference between the two levels is the hysteresis of the circuit. To maintain stable triggering, the incoming triggering signal must be large enough that, when it is amplified by the Trigger Input Amplifier, it will have sufficient amplitude to overcome the hysteresis of the Trigger Multivibrator.

It will be seen in the discussion of the Time-Base Generator that not every negative trigger pulse from the Time-Base

Trigger initiates a sweep. During the sweep time, the negative trigger pulses have no effect on the Time-Base Generator. It is only after a sweep has been completed and all circuits have returned to their quiescent states that the Time-Base Generator can be retriggered.

## Automatic Triggering Mode

When the LEVEL control is turned fully counterclockwise, the AUTO switch, SW17, is activated and converts the Trigger Multivibrator from a bistable configuration to an astable (free running) configuration. This is accomplished by coupling the grid circuit of V45A to the grid circuit of V45B via R40. The time constant thus formed is such that, in the absence of a triggering signal, the Trigger Multivibrator free-runs at about 50 cps. However, since the triggering signals from the Trigger Input Amplifier are still coupled to the Trigger Multivibrator through C31, any triggering signal over 50 cps in frequency and of sufficient amplitude will produce synchronized operation of the Trigger Multivibrator at the triggering signal frequency. In the absence of any such triggering signal, the sweep continues to be triggered at a 50-cps rate.

## TIME-BASE GENERATOR

The Time-Base Generator, upon receipt of a negative trigger pulse, or spike, from the Time-Base Trigger, produces a linearly rising sawtooth voltage which is applied through the Horizontal Amplifier to the crt deflection plates. This causes the electron beam to be deflected across the crt screen and form the sweep. The amplitude of the sawtooth is about 150 volts. Its rate of rise is controlled by the values of the Timing Capacitor and Timing Resistor switched into the circuit by the TIME/DIV. Switch.

## Sweep Generation

In the quiescent state—that is, when no sweep is being generated—V135A is conducting and V145A is cut off. The plate of V145A is about  $-3$  volts with respect to ground. The Disconnect Diodes are conducting and clamp both sides of the Timing Capacitor at about  $-3$  volts. With its cathode grounded and its grid at about  $-3$  volts, V161A is conducting heavily and its plate is at about  $+28$  volts.

A negative trigger pulse, arriving at the grid of V135A from the Time-Base Trigger, causes the Sweep-Gating Multivibrator to switch rapidly to its other state. That is, V135A cuts off and V145A conducts. As V145A conducts, the increased current through the common cathode resistor, R144, raises the cathode voltage of the two tubes. This holds V135A in cutoff after the negative trigger pulse has passed. Since V135A is now in cutoff, further trigger pulses arriving at its grid will have no effect on the circuit until after the sweep has been completed and the grid has been returned to its quiescent level by the Hold-Off Circuit. (The positive spikes from the Time-Base Trigger are clipped by D130.)

As V145A conducts, its plate voltage goes down, cutting off the Disconnect Diodes. When the Disconnect Diodes cut off, the plates of the Timing Capacitor are no longer held at  $-3$  volts, and the Timing Capacitor starts to charge

toward the instantaneous potential difference between the  $-100$ -volt supply and the potential on the cathode of V161B. However, as the lower side of the Timing Capacitor starts to move in a negative direction, it takes the grid of V161A with it. This produces a positive swing at the plate of V161A which is coupled through B167 and V161B to the upper side of the Timing Capacitor. This positive swing on the upper side tends to prevent the lower side from swinging negatively. It also increases the voltage to which the Timing Capacitor is trying to charge. The effect is to "straighten out" the charging curve by increasing the charging voltage with each increment of charge on the capacitor. Since the gain of V161A is about 150, the potential on the upper side moves about 150 volts with respect to ground while the potential on the lower side moves about one volt. The result is an extremely linear sawtooth at the cathode of V161B, which is applied through the Horizontal Amplifier to the deflection plates of the cathode-ray tube.

The values of the Timing Capacitor C160 and the Timing Resistor R160 are selected by the TIME/DIV. switch to provide the 21 different charging rates and, therefore, 21 calibrated sweep rates. The VARIABLE control, R160Y, permits vernier changes in the value of the Timing Resistor to produce sweep rates between the calibrated steps selected by the TIME/DIV. switch. The UNCAL. lamp, B160W, is lighted whenever the VARIABLE control is moved away from the CALIBRATED position to warn the operator that he is using an uncalibrated sweep rate.

## Sweep Length

The sweep length—that is, the total time duration of the sweep for any given sweep rate—is determined by the setting of the SWP. LENGTH adjustment, R176. As the sweep voltage rises at the cathode of V161B, there is a proportionate rise in voltage at the arm of the SWP. LENGTH adjustment. This increases the voltage at the plate, and therefore the cathode, of V152C and at the grid and cathode of V145B. As the voltage at the cathode of V145B rises, the voltage at the grid of V135A also rises. When the voltage at the grid of V135A rises to the point where V135A comes out of cutoff, the Sweep-Gating Multivibrator reverts rapidly to its original state, with V135A conducting and V145A cut off. The voltage at the plate of V145A rises, carrying with it the voltage at the plates of the Disconnect Diodes.

V152B starts conducting and forms a discharge path for the Timing Capacitor, which brings the grid of V161A quickly back up to its quiescent level. The rise in voltage at the grid of V161A causes the tube to conduct more, so that the plate voltage drops, carrying with it the grid and cathode of V161B. When the voltage at the cathode of V161B returns to about  $-3$  volts, V152A conducts, clamping the voltage at this point. The circuit has now returned to its quiescent level and is ready for the next trigger.

## Hold-Off

The Hold-Off Circuit prevents the Time-Base Generator from being triggered until after the Miller Runup Circuit has stabilized in the quiescent condition following the previous sweep. It does this by holding the grid of V135A positive enough to keep the tube in conduction for a given period after the completion of a sweep.

## Type 67

During sweep time, the rising voltage at the cathode of V152C charges the Hold-Off Capacitor, C160. Then, at the end of the sweep, the voltage at the plate of V152C drops suddenly, cutting off the tube. The cathode of V152C, however, is held up by the charge on the Hold-Off Capacitor which must discharge through the Hold-Off Resistor, R181. This holds the grid and cathode of V145B and the grid of V135A high enough to hold V135A in conduction for a length of time determined by the time constant of the Hold-Off Capacitor and the Hold-Off Resistor. The amount of hold-off time required is determined, in general, by the sweep rate. For this reason, the TIME/DIV. switch changes the amount of capacitance in the Hold-Off Circuit simultaneously with that of the Timing Circuit.

## Sweep Stability

The STABILITY adjustment, R111, regulates the quiescent dc level at the grid of V135A. This potentiometer (a front-panel screwdriver adjustment) is adjusted so that the quiescent voltage at the grid of V135A is just high enough (with the FREE RUN switch open) to hold V135A in conduction. In this case, a sweep can be produced only when a negative trigger pulse from the Time-Base Trigger drives V135A into cutoff. Turning the LEVEL control fully clockwise closes the FREE RUN switch and shorts out R111. This places a more negative voltage on the grid of V135A such that V135A cuts off upon decay of the hold-off voltage and the next sweep is initiated immediately (no trigger pulse is necessary). The result is a free-running sweep whose period is the total of the sweep time plus the hold-off time at any given setting of the TIME/DIV. control. (This is compared to a fixed repetition rate of about 50 cps when the LEVEL control is turned fully counterclockwise to the AUTO position to make the Trigger Multivibrator in the Time-Base Trigger free run.)

## Unblanking

The positive rectangular pulse appearing at the cathode of V135B during sweep time is applied as an unblanking pulse to the cathode-ray tube of the oscilloscope. Action of this pulse on the crt circuit is discussed in detail in the oscilloscope instruction manuals. It should be noted that, when the TIME/DIV. switch is in the EXT. INPUT position, the Sweep-Gating Multivibrator is disabled, and there is no current through V135A or V145A. Therefore, the cathode of V135B is held at about +125 volts and the crt is continuously unblanked.

Blanking and unblanking is controlled only by the module in the right-hand oscilloscope opening. Thus, if the Type 67

module is inserted in the left-hand opening (producing a vertical trace), the trace will not be blanked between sweeps.

## HORIZONTAL AMPLIFIER

The Horizontal Amplifier consists of the Input Cathode Follower (V333A), the Second Cathode Follower (V333B), two Driver Cathode Followers (V353A and V353B), and the Output Amplifier (V374).

The sweep sawtooth from the Time-Base Generator is coupled to the grid of V333A via the frequency-compensated voltage divider, R320-R321. The POSITION control, R323, supplies a manually adjustable dc voltage to the grid of V333A for positioning the trace on the screen of the cathode-ray tube.

The CALIBRATION adjustment, R334, varies the sawtooth amplitude at the grid of V333B. This provides a means of calibrating the displayed sweep rate.

The output of V333B is coupled through R341 and R342 (in parallel with C341) to the grid of V353A. The cathode of V353A, in turn, drives the grid of V374A. V374 is a cathode-coupled paraphase amplifier which converts the single-ended input to a push-pull output. The push-pull output is coupled through pins 17 and 21 of the plug-in connector to the crt deflection plates.

Negative feedback from the plate of V374A to the grid circuit of V353A develops a voltage across R341 and R342 which attenuates the signal from the cathode of V333B by a factor of five. When SW341 is closed (5X MAG. on), R341 and R342 are shorted out and the sweep rate, as seen at the crt deflection plates, is effectively magnified five times.

The SWP/MAG. REGIS. adjustment, R346, is adjusted to cancel the average dc level of the negative feedback voltage from V374A. This, in effect, insures that the voltage at the grid of V353A equals the voltage at the cathode of V333B when the electron beam is in the center of the screen and SW341 is open. This, in turn, assures that the center of the trace will not move as SW341 is opened and closed (5X MAG. turned off and on).

The EXT. INPUT position of the TIME/DIV. switch allows the application of external signals through the EXT. INPUT connector on the front panel. The external signal is applied directly to the Output Amplifier and is converted to push-pull for application to the cathode-ray tube deflection plates. When the TIME/DIV. switch is in the EXT. INPUT position, the POSITION control varies the dc voltage at the grid of V353B. This, in turn, sets the grid level of V374B.

## Troubleshooting

General maintenance and troubleshooting information is contained in the oscilloscope manuals. In the following discussion, it is assumed that you have already read that information and have definitely isolated a trouble to the Type 67 by the procedures described there.

First, remove the right-hand side panel of the oscilloscope and check to see if there is heater glow in all of the tubes.

Replace any in which there is no heater glow. If there is still no heater glow in any tube, trace out its heater circuit to find the trouble.

If there is heater glow in all tubes, remove the Type 67 and inspect it closely for damaged or burned components, loose wires, broken switches, etc., which could cause trouble. If visual inspection does not reveal the source of trouble, in-

sert the module in the left-hand opening of the oscilloscope and remove the left-hand side panel. This will allow access to the wiring and components of the module.

The Type 67 will produce a vertical sweep when it is inserted in the left-hand opening of the oscilloscope. For troubleshooting purposes you do not need a module in the right-hand opening (except to check triggering and blanking circuits). If, for some reason, you do not wish to exchange positions of modules for troubleshooting work, you may use a plug-in extension, Tektronix part no. 013-034, which allows the module to be operated while extended partially out of the front of the oscilloscope.

The following troubleshooting information is divided into two major sections, Circuit Isolation and Circuit Troubleshooting. It is intended that you will refer first to Circuit Isolation to determine which major circuit (Time-Base Trigger, Time-Base Generator, or Horizontal Amplifier) the trouble is in. Then you should refer to Circuit Troubleshooting for instructions on troubleshooting that particular circuit. In each case, the information is further divided according to the symptoms the trouble presents to the operator.

## CIRCUIT ISOLATION

This portion of the troubleshooting information tells you how to isolate trouble to one of the major circuits of the Type 67. After you have so isolated the trouble, refer to Circuit Troubleshooting for instructions on troubleshooting that particular circuit.

### NOTE

In the case of insufficient horizontal deflection, nonlinear sweep, or improper sweep timing, check the supply voltages in the Indicator Unit first, especially the high voltage.

### No Sweep

If you cannot obtain a properly triggered sweep on the screen, set the LEVEL control to FREE RUN. If you obtain a free-running sweep which can be turned off and on with the LEVEL control, the trouble is in the Time-Base Trigger. If you do not obtain a free-running sweep, set the TIME/DIV. switch to EXT. INPUT and adjust the POSITION controls. If a spot appears, set the TIME/DIV. switch to 10 mSEC and observe the neon bulb, B167, in the plate circuit of V161A. If there is a pulsating glow in B167, the Time-Base Generator is functioning properly and the trouble is in the Horizontal Amplifier. If there is no glow in B167, the trouble is in one of the components connected to it. If there is a steady glow (not pulsating) in B167, the trouble is elsewhere in the Time-Base Generator. If no spot appears when the TIME/DIV. switch is placed in the EXT. INPUT position, the trouble is in the Horizontal Amplifier.

If you have a free-running trace at all positions of the LEVEL control (TIME/DIV. switch not in the EXT. INPUT position), the trouble is in the Time-Base Generator.

### Insufficient Horizontal Deflection

This condition can be the fault of either the Time-Base Generator or the Horizontal Amplifier. To determine the faulty circuit, proceed as follows:

Set the TIME/DIV. switch to .5 SEC and the LEVEL control to FREE RUN. Connect a voltmeter between pin 8 of V161B and ground (negative voltmeter lead to ground). The voltage at this point should rise linearly from zero to +150 volts  $\pm 15\%$  in about 5 seconds and then drop quickly to zero. If it does, the Time-Base Generator is functioning properly and the trouble is in the Horizontal Amplifier. No voltage variations at pin 8 of V161B, or a significantly smaller variation, indicates that the trouble is in the Time-Base Generator.

### Nonlinear Sweep

This condition can be caused by nonlinear amplification in the Horizontal Amplifier or by the generation of a nonlinear sawtooth in the Time-Base Generator.

Set the TIME/DIV. switch to .5 mSEC and the LEVEL control to FREE RUN. Connect a 10X probe between pin 8 of V161B and the INPUT connector of an amplifier module in the other opening of the oscilloscope. Set the VOLTS/DIV. switch on the amplifier module to 5 VOLTS. A diagonal trace should now be displayed on the screen. If the slope of the trace is constant, the nonlinearity is being produced by the Time-Base Generator. If the slope of the trace is not constant, the nonlinearity is being produced by one of the cathode follower stages in the Horizontal Amplifier.

### Improper Sweep Timing

If the sweep timing is off in some, but not all, positions of the TIME/DIV. switch, one of the timing resistors or capacitors has changed in value. By comparing the switch positions with the Timing Switch schematic diagram, you will be able to tell which components are common to these positions.

If the timing is off in all positions of the TIME/DIV. switch, the Horizontal Amplifier or the Miller Runup Tube, V161A, is probably faulty. Replace V161 before troubleshooting the Horizontal Amplifier.

## CIRCUIT TROUBLESHOOTING

This portion of the troubleshooting information tells you how to locate a defective stage within a given circuit. Once the faulty stage is known, you should first replace the tube or tubes. If this does not eliminate the trouble, replace the original tubes and check the rest of the circuit by voltage measurements, waveform tracing, and resistance checks. Typical voltage and waveforms to be encountered at various points throughout the module are shown on the schematic diagrams at the rear of this manual. Resistance checks will normally be point-to-point measurements whose value can be approximated from the schematic diagram.

All voltages should be measured with a 20,000-ohms-per-volt or better voltmeter.

## Troubleshooting the Time-Base Trigger

If a trouble has been isolated to the Time-Base Trigger, set the LEVEL control to AUTO (and the TIME/DIV. switch to some position other than EXT. INPUT). If a trace appears, the trouble is in the Trigger Input Amplifier or in the trigger input circuitry. First, change V24. If this does not eliminate the trouble, check the rest of the stage by voltage and resistance measurements.

If a trace does not appear when the LEVEL control is set to AUTO (but it does when the LEVEL control is set to FREE RUN), the trouble is in the Trigger Multivibrator. First change V45. If this does not eliminate the trouble, check the rest of the stage by voltage and resistance measurements.

## Troubleshooting the Time-Base Generator

**No Horizontal Sweep.** If the Time-Base Generator is not producing a sawtooth waveform when the LEVEL control is set to FREE RUN, some defect in the circuit is causing the output to remain at some fixed voltage. A clue to the cause of this trouble can be obtained by measuring the voltage at the plate (pin 6) of the Miller Runup tube, V161A.

The voltage reading obtained at the plate of V161A will probably be approximately +250 volts, or approximately +30 volts. A reading of +250 volts indicates that the Miller Runup Circuit has run up and has not been reset, while a reading of +30 volts indicates that the Miller Runup Circuit is not being allowed to run up. The condition that exists will depend on the type of trouble. The two conditions of plate voltage are handled separately in the following paragraphs.

**High voltage at the plate of V161A** indicates the tube is cut off. If this is the case, instantaneously ground the grid (pin 2) of the tube while monitoring the plate voltage. If the tube is functioning, the plate voltage will drop to about +6 volts. (Do not hold the grid grounded for more than an instant.) If V161A is found to be good, measure the voltage at its grid. If this voltage is more than about 5 or 6 volts negative with respect to ground, V152B is probably not conducting. In this case, check V152 and R147.

If the voltage at the grid of V161A is not more negative than about -5 or -6 volts (it should be about -4 volts), measure the voltage at the cathode (pin 8) of V161B. If this voltage is greater than +200 volts, the Runup Cathode Follower stage may be assumed to be operating correctly. If this voltage is lower than about +200 volts, the stage is defective and its grid and cathode circuits should be checked.

If the Runup Cathode Follower is found to be operating properly, measure the voltage at the cathode (pin 8) of V145B. If this voltage is more positive than about -45 volts, the trouble is in the Sweep-Gating Multivibrator. The voltage divider in the cathode circuit of V135B is particularly critical.

If the voltage at the cathode of V145B is more negative than about -55 volts, the trouble is in the Hold-Off Circuit.

**Low voltage at the plate of V161A** indicates that the tube is conducting heavily and is not being allowed to perform its normal run-up operation. If this trouble exists at

only a few positions of the TIME/DIV. switch, the trouble is probably in the Sweep-Gating Multivibrator.

Check the voltage at the grid (pin 2) of V135A. If the voltage at this point is in the vicinity of -65 volts or lower (more negative), the Sweep-Gating Multivibrator is faulty.

If the voltage at the grid of V135A is more positive than -65 volts, measure the voltage at the grid (pin 9) of V145B. If the voltage at this point is -70 volts or lower (more negative), the Hold-Off Circuit is faulty. If the voltage at the grid of V145B is more positive than about -70 volts, the Runup Cathode Follower circuit is faulty.

**Nonlinear Sweep.** A nonlinear sweep will be generated if the current charging the Timing Capacitor does not remain constant. If the nonlinearity occurs at all sweep rates, a defective Miller Runup tube is probably the cause. If the nonlinearity occurs only at certain sweep rates, the cause is probably a defective timing resistor or capacitor. A defective C165 can also cause the sweep to be nonlinear at the faster sweep rates.

**Constant Free-Running Trace.** If the free-running trace cannot be turned off with the LEVEL control, the Sweep-Gating Multivibrator is at fault. The most probable cause is a change in resistance in either of the grid circuits or in the cathode circuit.

**Insufficient Horizontal Deflection.** If the horizontal trace starts at the left-hand side of the oscilloscope screen, but does not extend to the right-hand side, the Hold-Off Circuit is resetting the Sweep-Gating Multivibrator before the sweep is completed. If the sweep cannot be adjusted to normal length with the SWP. LENGTH adjustment, R176, the resistances in the cathode circuit of V161B should be checked.

## Troubleshooting the Horizontal Amplifier

**No Spot or Trace.** If you are unable to obtain a trace on the screen but it has been determined that the Time-Base Generator is working properly, place the TIME/DIV. switch in the EXT. INPUT position and adjust the POSITION control. If a spot appears, the trouble lies between the input to the Horizontal Amplifier (top of R320) and the cathode of V353A. To further isolate the trouble, set the TIME/DIV. switch to 5 SEC and ground the following points in the order listed: grid (pin 7) of V353A; cathode (pin 3) of V333B; grid (pin 2) of V333B; cathode (pin 8) of V333A; grid (pin 7) of V333A; and cathode (pin 8) of V161B. Each time you ground one of these points, a spot should appear on the screen. When you ground a point and no spot appears, the trouble lies between that point and the previous point tested. If the spot does not appear when you ground the grid of V353A (the first point tested), the trouble lies in V353A.

If a spot does not appear when the TIME/DIV. switch is set to EXT. INPUT, short the two grids (pins 2 and 7 of V374) together. If a spot now appears, the trouble is in V353B or associated circuitry; if a spot does not appear, the trouble is in the Output Amplifier.

**Insufficient Deflection.** If the gain of the Horizontal Amplifier decreases, the timing will no longer correspond to the calibrated values indicated by the TIME/DIV. switch.

If the change in gain is only slight, as indicated by improper timing and a slightly decreased sweep length, the

amplifier can usually be recalibrated. However, since the gain of the Horizontal Amplifier regulates the timing of the sweep, care must be taken to insure that the gain adjustments are accurately made. Refer to the Calibration Section of this manual if it is necessary to adjust the gain of the Horizontal Amplifier. (Also check the Indicator Unit power-supply voltages, including the high voltage.)

If the decrease in gain is more pronounced, or if there is no deflection at all, check for defective components that can affect the gain but not the balance of the circuit. Such components, in addition to tubes, are R334, R342, and R375.

**Nonlinear Sweep.** You can isolate a stage producing nonlinear amplification within the Horizontal Amplifier by

much the same method as used for isolating nonlinear amplification to the Horizontal Amplifier. First, set the TIME/DIV. switch to .5 mSEC and the LEVEL control to FREE RUN. Set the VOLTS/DIV. switch on the amplifier module in the other oscilloscope opening to 5 VOLTS and the AC-DC-GND switch to AC. Connect a 10X probe between the INPUT connector of the amplifier module and pin 8 of V353A, then pin 3 of V333, and then pin 8 of V333. When each connection is made you should obtain a straight line extending from lower left to upper right on the screen. (The slope of the line will vary from one connection to the next.) When you reach the point where the line is not straight when you make the connection, the stage following is the one producing the nonlinear amplification.

## Calibration

Calibration of the Type 67 is performed with the module inserted in the right-hand (X-axis) opening of a Type 560 or Type 561 Oscilloscope. An amplifier module must be inserted in the left-hand (Y-axis) opening. In order to maintain its high degree of accuracy and linearity, it is recommended that the Type 67 be calibrated after each 500 hours of operation or about every six months, whichever comes sooner.

Apparent trouble in the instrument can be caused by improper calibration of one or more circuits. Therefore, if trouble appears in the instrument, you should first make sure it is not due to improper calibration before proceeding with more detailed troubleshooting. Also, each of the calibration adjustments should be checked, and adjusted as necessary,

whenever a component has been changed.

Because of interaction among some of the adjustments, it is recommended that you perform the calibration in the order presented. Single adjustments should not be made. Front-panel controls not mentioned in a given step are assumed to be in the position they were in at the end of the previous step. Some of the adjustments affect the position of the crt display; therefore, it will be necessary to reposition the display with the POSITION control to keep the time markers properly aligned with the graticule lines.

To obtain access to all of the adjustments referred to in this procedure, the right-hand side panel of the oscilloscope must be removed. Fig. 3 shows the internal adjustments of the Type 67 module as viewed from the right side.

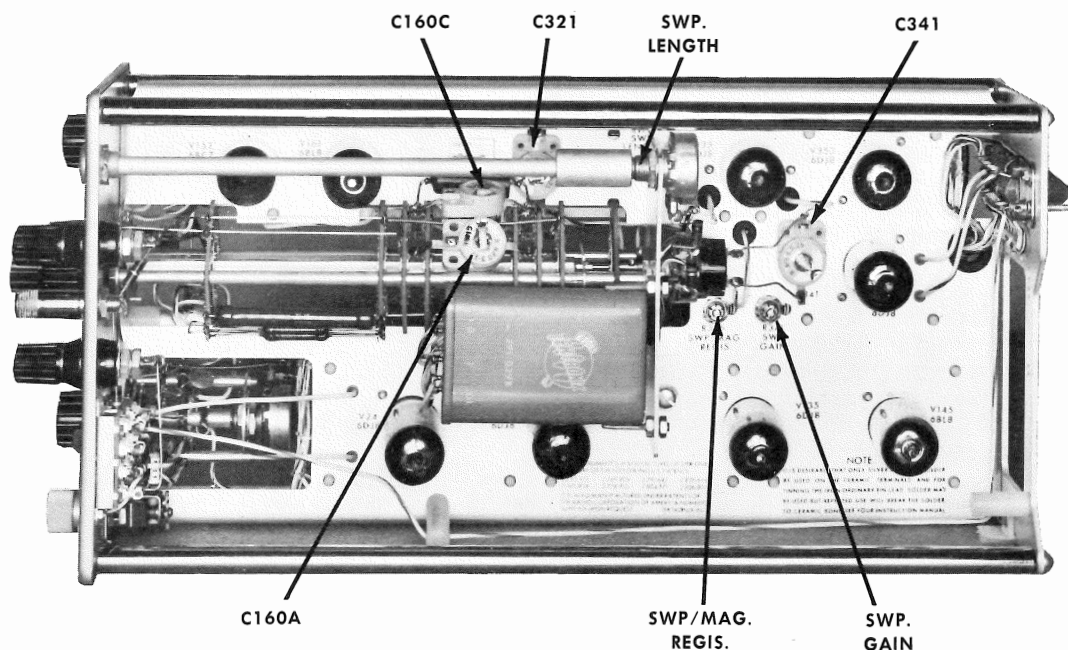


Fig. 3. Type 67 module internal calibration adjustments.

## Type 67

### Equipment Required

The following equipment is required for a complete calibration of the Type 67 Time-Base module:

1. Time mark generator, with time markers at 1 and 10 microseconds, and at 1 and 5 milliseconds, accuracy at least 1% (Tektronix Type 180 or 180A Time-Mark Generator recommended).
2. Coaxial cable suitable for applying the output of the time-mark generator to the INPUT connector of the amplifier module.
3. Low-capacity calibration tool (Tektronix Part No. 003-000 or 003-001 recommended).

### Initial Setup

Set the front-panel controls on the Type 67 module as follows:

TIME/DIV.	.1 mSEC
VARIABLE*	CALIBRATED and pushed in (5X MAG. OFF)
LEVEL	AUTO
SLOPE	+
COUPLING	AC SLOW
SOURCE	INT.

### STABILITY Adjustment

Ground the input of the amplifier module in the left-hand opening of the oscilloscope. Set the STABILITY adjustment (front-panel screwdriver adjustment) fully counterclockwise. Next, turn the STABILITY adjustment clockwise until a trace appears on the screen. Note the position of the adjustment. Advance the adjustment farther clockwise until the trace brightens. Finally, set the adjustment approximately midway between the position where the trace first appears and the position where it brightens.

### CALIBRATION Adjustment

Set the TIME/DIV. switch to 5 mSEC and turn the 5X MAG. on (pull out the VARIABLE knob). Apply 1-millisecond markers to the input of the amplifier module and adjust for approximately four divisions of vertical deflection. Position the display so that the approximate center of the trace is observed. Set the CALIBRATION adjustment (front-panel screwdriver adjustment) for exactly one marker per major graticule division on the screen.

\* The VARIABLE control must remain in the CALIBRATED position for all timing adjustments. The UNCAL. light will be lighted if the control is not in the CALIBRATED position.

### SWP. GAIN Adjustment

Turn the 5X MAG. off (push in the VARIABLE knob) and apply 5-millisecond markers to the amplifier module. Adjust the SWP. GAIN adjustment for exactly one marker per major graticule division.

### SWP. LENGTH Adjustment

Adjust the SWP. LENGTH adjustment for a total sweep length of about 10.5 divisions.

### SWP/MAG. REGIS. Adjustment

Turn the 5X MAG. on and position the trace so that the first time marker is aligned with the vertical centerline of the graticule. Turn the 5X MAG. off. Adjust the SWP/MAG. REGIS. adjustment so that the first time marker is again aligned with the vertical centerline of the graticule.

### 10-, 20-, and 50-Microsecond/Division Sweep Rates

Set the TIME/DIV. switch to 50  $\mu$ SEC and turn the 5X MAG. on. Apply 10-microsecond markers to the input of the amplifier module. Position the trace so that the last 11 markers at the right-hand end of the trace are displayed on the screen. (The LEVEL control may have to be moved from the AUTO position and adjusted for a stable display.) Adjust C160C for one marker per major graticule division.

Set the TIME/DIV. switch to 10  $\mu$ SEC and apply 1-microsecond markers to the input of the amplifier module. Position the display so that the first 21 markers at the left-hand end of the trace are displayed. Adjust C321 for two markers per major graticule division.

### 1-, 2-, and 5-Microsecond/Division Sweep Rates

Set the TIME/DIV. switch to 5  $\mu$ SEC and the POSITION control to midrange. Adjust C160A for one marker per major graticule division.

### Linearity Adjustment

Set the TIME/DIV. switch to 1  $\mu$ SEC and turn the 5X MAG. off. Position the display so that the first time marker is aligned with the vertical centerline of the graticule. Adjust C341 for one marker per major graticule division.





# MODIFICATION SUMMARY

67

## INTRODUCTION

The Modification Summary has been prepared for field personnel with two objectives in mind. To provide a by-instrument historical documentation of production "Modification Notices,"\* and to convey recommendations and procedures for installation of production modifications in field instruments.

The modifications are listed by effective serial number, starting with the lowest. The "Parts Removed" and "Parts Added" lists include all electrical components and all major, or unusual, mechanical parts affected.

The modifications are evaluated for adaptability to field use and are designated with one of three categories: "Recommended," "Optional," or "Information Only".

Publication:  
062-0497-00  
April 1965

Supersedes:  
February 1965

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The "Recommended" category indicates that the modification meets the criteria below, and should be installed in the majority of field instruments, whenever possible, to insure proper operation. Installation instructions are provided.

Criteria for "Recommended" category:

- \*\* 1. The time required for installation is less than one hour.
- \*\* 2. Parts are readily available and relatively inexpensive.
- 3. The modification prevents catastrophic or consistently recurring circuit failure, allows instrument to meet advertised specs, or solves a general instrument problem.

The "Optional" category indicates that the modification meets the criteria below and should be installed in instruments used for specific applications, or when the modification involves components that you would not normally need to replace until they become defective. Installation instructions are provided.

Criteria for "Optional" category:

- \*\* 1. The time required for installation is less than one hour.
- \*\* 2. Parts are readily available and relatively inexpensive.
- 3. The modification prevents minor or occasional circuit failures; or it corrects a problem that only occasionally occurs, or only occurs in a few instruments.

The "Information Only" category includes all other modifications and indicates that the mod is either too complicated for field installation, or is not considered important enough.

- \* "Modification Notices" are all production modifications that have been designated with an effective serial number. Production modifications not requiring serial numbers are called "Change Notices" and are not included in this summary.
- \*\* This criterion doesn't necessarily apply if mod has been incorporated into a Field Modification Kit.





## 67 MODIFICATION SUMMARY

### MYLAR TIMING CAPACITOR PART NUMBERS CHANGED

INFORMATION ONLY

M3337

Effective Prod s/n not given

#### DESCRIPTION:

To reduce rejects by customers who purchase timing capacitors as spare parts, the tolerance specification is changed from  $\pm 1/4\%$  or  $-1/4\%$  to a straight  $\pm 1/2\%$ . The printed tolerance is removed on capacitors and the "A" or "B" suffix deleted on part numbers. (This change will not cause difficulty in the timing of instruments.)

#### Parts Removed:

C160E,F,G	1 x 0.1 x 0.01 $\mu f$ $\pm 1/4\%$	291-0029-01
	1 x 0.1 x 0.01 $\mu f$ $-1/4\%$	291-0029-02
C160D	0.001 $\mu f$ $\pm 1/4\%$ (wh end)	291-0008-01
	0.001 $\mu f$ $-1/4\%$ (bl end)	291-0008-02

#### Parts Added:

C160E,F,G	1 x 0.1 x 0.01 $\mu f$ $\pm 1/2\%$	291-0029-00
C160D	0.001 $\mu f$ $\pm 1/2\%$	291-0008-00

### SWEEP TIMING ERROR REDUCED

OPTIONAL

M3404

Effective Prod s/n 301

Usable in field instruments s/n 101-300  
w/exceptions: 238,259,261,263, and 280

#### DESCRIPTION:

Changes in sweep timing error caused by capacity variation of timing capacitor C160B with changes in temperature when operated in the 10  $\mu$ SEC, 20  $\mu$ SEC, and 50  $\mu$ SEC TIME/DIV positions is reduced by changing C160B to an NPO type.

#### Parts Removed:

C160B	82pf $\pm 10\%$ GP1A	281-0528-00
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#### Parts Added:

C160B	82pf $\pm 10\%$ NPO	281-0574-00
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Parts Required for Field Installation:

See 'Parts Added'.

#### INSTALLATION INSTRUCTIONS:

Replace C160B with an 82pf  $\pm 10\%$  NPO capacitor, located on Timing Switch in parallel with C160C (4.5pf - 25pf).

67 MODIFICATION SUMMARY (con'd)

TIME - BASE GENERATOR FAILURE  
BECAUSE OF SWEEP LENGTH  
CONTROL SETTING PREVENTED

OPTIONAL

M3637

Effective Prod s/n 580

Usable in field instruments s/n 101-579

DESCRIPTION:

Prevents the TIME - BASE GENERATOR from becoming inoperative when the Sweep Length potentiometer center arm is adjusted toward the -100 volt supply by increasing the value of divider resistor R178.

Parts Removed:

R178            10k 1/2w 10%    302-0103-00

Parts Added:

R178            11k 1/2w 5%            301-0113-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R178 with an 11k 1/2w 5% resistor, located between ceramic strips above R176 Sweep Length potentiometer.

TIME/DIV SWITCH CHANGED

INFORMATION ONLY

M3868

Effective Prod s/n not available  
Starting date 1/1/62

DESCRIPTION:

TIME/DIV switch rotors changed to 'break-before-make' type on wafers 3, 4, 5, and 6 to eliminate grounding control grid of V161.

Parts Removed:

SW160A        TIME/DIV            260-0352-00

Parts Added:

SW160A        TIME/DIV            260-0352-00

JB:ceb

# MODIFICATION KIT

## SWEEP LOCKOUT

For Tektronix Type 67 Time Base Units  
All Serial Numbers

### DESCRIPTION

This modification adds a sweep lockout feature which allows the electron beam to sweep once after receiving a triggering pulse. The lockout circuitry then prevents any subsequent triggering pulses from producing another sweep. The sweep circuit may be reset by depressing the lever arm of the MODE switch. This feature will allow the study of 'one-shot' phenomena.

The modification is accomplished by adding a sweep lockout transistor circuit, a new front panel, and a MODE switch.



# 040-318

Publication:  
Instructions for 040-318  
October 1964

Supersedes:  
March 1964

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# PARTS LIST

Quantity	Description	Part Number
1 ea.	Assembly, Subpanel, consisting of:	
2 ea.	Bulb, NE-23	150-027
1 ea.	Diode, silicon, 6061	152-061
1 ea.	Lockwasher, int.#4	210-004
1 ea.	Lug, solder, SE4	210-201
6 ea.	Nut, hex, 4-40 x 3/16	210-406
2 ea.	Screw, 4-40 x 1 FHS	211-031
1 ea.	Switch, lever, 3-position	260-501
2 ea.	Holder, neon bulb, single, black molded	352-008
1 ea.	Knob, lever, (push-on)	366-215
1 ea.	Plate, front subpanel	387-731
1 ea.	Wire, #22 solid, 4 in. white-red	(175-522)
1 ea.	Wire, #22 solid, 12 in. white-yellow	(175-522)
1 ea.	Wire, #22 solid, 4 in. white-green	(175-522)
1 ea.	Wire, #22 solid, 5 in. white-blue	(175-522)
1 ea.	Assembly, Transistor, consisting of:	
1 ea.	Transistor, 2N2043	151-093
1 ea.	Cover, transistor, Thermo-Fit, Teflon T0-5	200-385
1 ea.	Post, binding	129-020
2 ea.	Post, binding, miniature, 5-way, charcoal gray	129-064
1 ea.	Diode, T12G	152-008
2 ea.	Lug, solder, SE6	210-202
1 ea.	Lug, solder, SE10, long	210-206
8 ea.	Nut, hex, 4-40 x 3/16	210-406
1 ea.	Nut, hex, 10-32 x 5/16	210-410
2 ea.	Nut, Keps, 6-32 x 5/16	210-457
4 ea.	Screw, 8-32 x 1/2 RHS, Phillips slot	212-044
1 ea.	Spool, solder, w/3 ft. silver solder	214-210
1 ea.	Resistor, comp, 270 k 1/2 w 5%	301-274
2 ea.	Resistor, comp, 1 meg 1/2 w 10%	302-105
1 ea.	Resistor, comp, 680 k 1/2 w 10%	302-684
1 ea.	Resistor, comp, 47 k 1/2 w 10%	302-473
1 ea.	Resistor, prec, 11.8 k 1 w 1%	324-296
1 ea.	Panel, front (for Type 67 Mod 040-318)	333-835
1 ea.	Tag, front panel insert ("040-318")	334-679
2 ea.	Bushing, nylon, charcoal	358-181
1 ea.	Spacer, nylon molded	361-007
1 ea.	Rod, delrin, 5/16 x 2-1/4 w/3 cross holes	385-137
1 ea.	Wire, #22 solid, 3 in. white-green	(175-522)
1 ea.	Wire, #22 solid, 9 in. white-orange	(175-522)
1 ea.	Wire, #22 solid, 6 in. bare	(176-005)
1 ea.	Tag, MODIFIED INSTRUMENT, gummed back	(001-910)

## INSTRUCTIONS

**IMPORTANT:** When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

Do not discard any parts until the modification is completed, since some parts may be re-used.

### A. TO REMOVE THE FRONT PANEL:

- ( ) 1. Remove the bushings securing the STABILITY and CALIBRATION controls.
- ( ) 2. Remove all knobs.
- ( ) 3. Unsolder and remove the following wires and resistors:
  - ( ) Bare wire between EXT INPUT binding post and first wafer of TIME/DIV switch (mark location of switch contact).
  - ( ) 1 meg resistor between EXT INPUT post and ground post.
  - ( ) 1 meg resistor between ground post and TRIGGERING COUPLING switch.
  - ( ) Bare wire between EXT TRIG binding post and TRIGGERING SOURCE switch.
- ( ) 4. Remove the three binding posts.
- ( ) 5. Remove the POSITION and TRIGGERING LEVEL potentiometer mounting nuts; remove the front panel.
- ( ) 6. Remove the serial insert tag from the old panel.
- ( ) 7. Install and tape the serial insert tag in the new front panel from the kit.

### B. TO REMOVE THE FRONT SUBPANEL:

- ( ) 1. Remove the four Phillips screws on the rear of the plug-in.
- ( ) 2. Unscrew and remove the four frame rods.
- ( ) 3. Unsolder the white-red wire and 47k resistor from the UNCAL neon holder.

- ( ) 4. Remove the 1/2 in. nut securing the TIME/DIV switch.
- ( ) 5. Remove the 4-40 nuts securing the following TRIGGERING switches:
  - ( ) SOURCE
  - ( ) COUPLING
  - ( ) SLOPE
- ( ) 6. Remove the 4-40 nuts securing the plug-in fastener; remove the front subpanel.

### C. TO INSTALL SPACER ON PLUG-IN CHASSIS:

- ( ) 1. Drill a 5/32 in. hole in the plug-in chassis near V135 (see Fig. 1).
- ( ) 2. Insert a nylon spacer (from kit) in the hole drilled above.

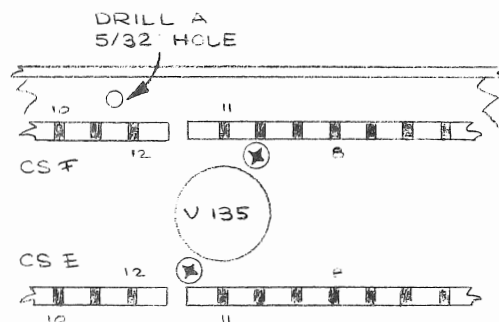


Fig. 1

### D. TO INSTALL THE DELRIN ROD: DO NOT PERFORM THIS SECTION IF THE DELRIN ROD NEAR V24 ALREADY HAS THREE PARALLEL CROSS HOLES.

- ( ) 1. Temporarily unsolder the white-orange wire connected to the top terminal of the TRIGGERING SOURCE switch.
- ( ) 2. Replace the one-hole delrin rod near V24 with the 3-hole rod from the kit.
- ( ) 3. Place the white-orange wire through the top hole in the delrin rod. Resolder the white-orange wire to the TRIGGERING SOURCE switch.

## INSTRUCTIONS (con'd)

### E. TO MOUNT THE NEW FRONT SUBPANEL:

- ( ) 1. Place the new subpanel assembly (from kit) against the front of the plug-in.
- ( ) 2. Replace the four frame rods removed in step B-2. Refasten the rods to the rear plate with the four Phillips screws from the kit.
- 3. Remount the following TRIGGERING switches with 4-40 nuts from the kit. The switches will be in the same relative positions as before, but closer together; therefore, it may be necessary to shorten or bend some of the leads:
  - ( ) SLOPE
  - ( ) COUPLING
  - ( ) SOURCE
- ( ) 4. Remount the plug-in fastener, with the 4-40 nuts from the kit.
- ( ) 5. Re-install the 1/2 in. nut to secure the TIME/DIV switch.
- ( ) 6. Resolder the white-red wire (see step B-3) to the 'inside' terminal of the UNCAL neon holder.
- ( ) Resolder the 47k resistor to the 'outside' terminal of the UNCAL neon holder.

### F. TO INSTALL THE NEW FRONT PANEL:

- ( ) 1. Place the new front panel over the new subpanel (remove the lever switch knob first).
- ( ) 2. Re-install the STABILITY and CALIBRATION control bushings removed in step A-1.

- ( ) 3. Install the EXT INPUT and EXT TRIG binding posts from the kit. Use a nylon bushing, SE6 solder lug and 6-32 Keps nut from the kit.
- ( ) 4. Install the ground binding post (from kit), using a SE10 solder lug (from kit) under the nut.
- ( ) 5. Replace the POSITION and TRIGGERING LEVEL mounting nuts.
- ( ) 6. Install the push-on knob on the MODE switch from the kit.
- ( ) 7. Re-install the knobs removed in step A-2.

### G. TO INSTALL THE SINGLE SWEEP CIRCUITRY:

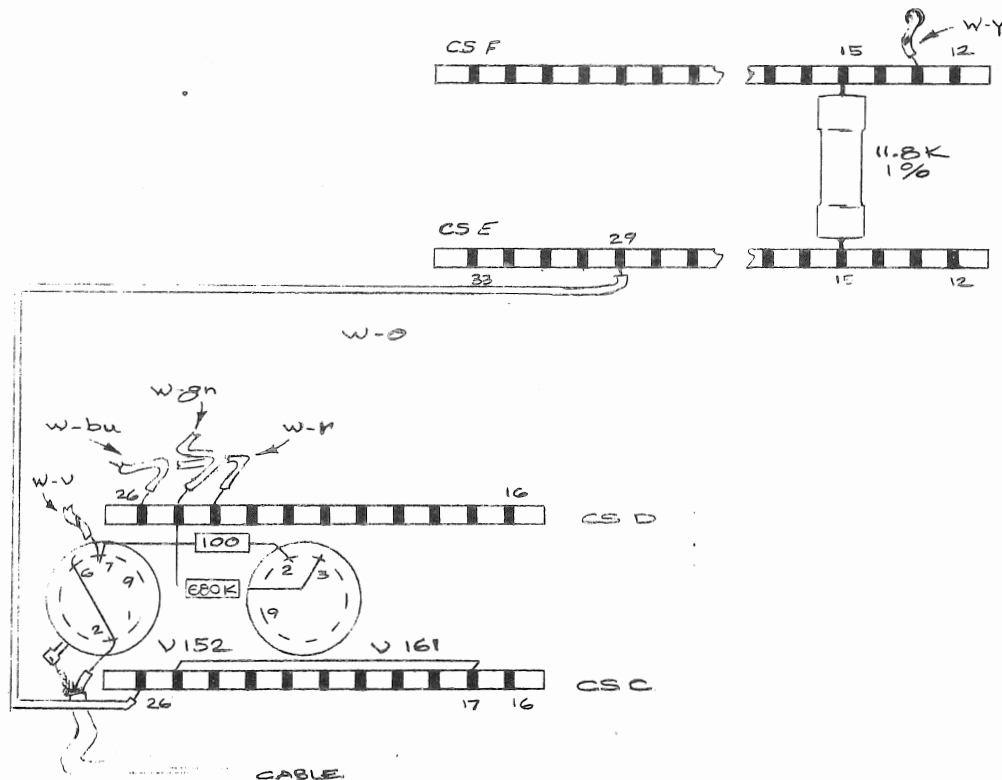
- ( ) 1. Solder a 1 meg resistor (from kit) between the EXT INPUT binding post lug and the ground post lug. Reposition these lugs as necessary.
- ( ) 2. Solder a 1 meg resistor (from kit) between the bottom terminal of the TRIGGERING COUPLING switch and ground post lug.
- ( ) 3. Solder a 3 in. length of white-green wire (from kit) between the EXT INPUT lug and the TIME/DIV switch contact noted in step A-3.
- ( ) 4. Solder a length of bare wire (from kit) between the lower right terminal (looking at the rear of the subpanel) of the TRIGGERING SOURCE switch and the EXT TRIG binding post lug.

## INSTRUCTIONS (con'd)

### Section G continued

REFER TO FIG. 2 FOR STEPS G-5 THROUGH G-15

- ( ) 5. Remove the bare wire between CSD-26 and V152, pin 7.
- ( ) 6. Move the white-violet wire and the end of the  $100\Omega$  resistor from CSD-26 to V152, pin 7.
- ( ) 7. Remove the bare wire between CSC-26 and V152, pin 2.
- ( ) 8. Move the center conductor of the coax cable from CSC-26 to V152, pin 2.
- ( ) 9. Solder the white-green wire from the MODE switch to CSD-25.
- ( ) 10. Solder the white-red wire from the MODE switch to CSD-24.
- ( ) 11. Solder the white-blue wire from the READY light to CSD-26.
- ( ) 12. Solder a length of #22 bare wire (from kit) between CSC-17 and CSC-25.
- ( ) 13. Solder the white-orange wire (from kit) from CSC-26 to CSE-29.
- ( ) 14. Replace R144 (15k, 1w precision) between CSE-15 and CSF-15, with the 11.8k 1w precision resistor from kit.
- ( ) 15. Solder the 680k resistor (R126, from kit) from pin 3 of V161 to CSD-25. Dress the lead down so that other components may be added to the strip above R126.



← Front of Instrument  
Fig. 2

## INSTRUCTIONS (con'd)

Step G continued

REFER TO FIG. 3 FOR STEPS G-16 THROUGH G-19

- ( ) 16. Solder the 270k resistor (R123, from kit) between CSD-24 and CSD-26. Mount the resistor on the inward side of CSD and bend down out of the way.

CAUTION: When soldering diodes or transistors, use a pair of pliers between the soldering iron and the components, as a heat sink.

- ( ) 17. Solder the diode (D124, from kit) between CSC-26 (cathode or banded end) and CSD-26 (anode end).
- ( ) 18. Solder the 47k resistor (R124, from kit) between CSC-25 and CSD-26.

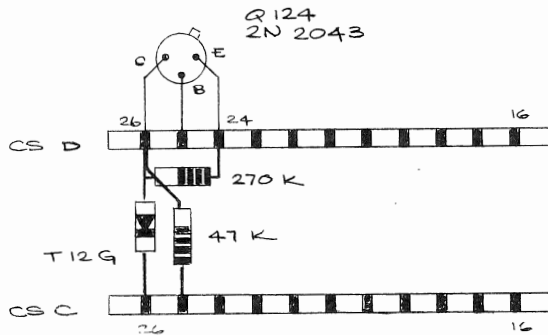


Fig. 3

19. Solder the 2N2043 transistor (Q124, from kit) as follows:

( )	EMITTER	to	CSD-24
( )	BASE	to	CSD-25
( )	COLLECTOR	to	CSD-26

20. Route the white-yellow wire from the MODE switch as follows:

- ( ) through the middle hole in the delrin rod installed in step D-2.
- ( ) through the nylon spacer, installed in step C-2.
- ( ) 21. Solder the free end of the white-yellow wire to CSF-13 (see Fig. 2).

THIS COMPLETES THE INSTALLATION.

- ( ) Check wiring for accuracy.
- ( ) Check the calibration of the plug-in as indicated in your Instruction Manual.
- ( ) Moisten the back of the MODIFIED INSTRUMENT tag (from kit) and place it on the Manual schematic page affected by this modification.
- ( ) Fasten the Insert pages in your Instruction Manual.

JB:ls

# **SWEEP LOCKOUT**

Type 67 -- All Serial Numbers  
Installed in Type 67 s/n \_\_\_\_\_

## **GENERAL INFORMATION**

This modification adds a sweep lockout feature which allows the electron beam to sweep once after receiving a triggering pulse. The lockout circuitry then prevents any subsequent triggering pulses from producing another sweep. The sweep circuit may be reset by depressing the lever arm of the MODE switch. This feature will allow the study of 'one-shot' phenomena.

The modification is accomplished by adding a sweep lockout transistor circuit, new front panel, and a MODE switch.

The information on these pages supplements, or supersedes the information in your Manual.

## **OPERATING INSTRUCTIONS**

To display a single-shot phenomenon:

1. Set the TRIGGERING COUPLING switch to AC SLOW or DC.
2. Set the MODE lever switch, SW124, to NORMAL.
3. Adjust the STABILITY and TRIGGERING LEVEL controls for triggering operation. To do this, display successive trial single traces of the desired waveform or of a waveform having similar characteristics. Alternatively, you can use the CALIBRATOR waveform for a trial display.
4. Set the rest of the front panel controls for settings suited to the waveform to be observed.
5. Remove the signal source from the INPUT or CHANNEL connector. Set the lever switch to SINGLE SWEEP.
6. If the READY lamp is not lighted, push the lever switch to RESET. The lamp should now be lighted.
7. Connect the source of the expected signal to the INPUT or CHANNEL connector.

When a signal is received to trigger the sweep, a single sweep will occur. Following this, the READY lamp will be extinguished and subsequent signals will not trigger the sweep. The sweep circuits can be prepared for another sweep by pushing the lever switch to RESET.

## **CIRCUIT DESCRIPTION**

The Sweep Lockout circuit consists of transistor Q124 and associated components.

With the MODE switch at NORM, the base of Q124 and the anode of D126 are grounded. The emitter of Q124 has no ground return, and both emitter and collector are negative with respect to the base. Some current (about 0.4 ma) flows through the base-collector junction of Q124, setting the collector at about -80 volts. This reverse biases D124, since the grid of V135A runs between about -25 and -58 volts. When V135A conducts (grid at about -25 v) the plate voltage is about +14 volts.

Placing the MODE switch to SINGLE SWEEP changes Q124 from a grounded-base to a grounded-emitter configuration. READY lamp B124 conducts and holds the collector of Q124 at about -55 to -60 volts. Conduction through R126 forward biases D126 and connects the base of Q124 to the plate of V135A. This reverse biases Q124 and 'arms' the sweep . . . that is, V135A is ready to be triggered.

The next trigger to arrive at the grid of V135A will force the Sweep-Gating Multivibrator to switch states (V135A cut off; V145A conducting) and start a sweep. At the completion of the sweep, V135A again conducts and its plate voltage drops below ground. This forward biases Q124 (through D126) and drives it into saturation. Collector current then pulls up the collector of Q124 and the grid of V135A (through D124) to near ground. This extinguishes READY lamp B124 and drives V135A hard into saturation. With V135A in saturation, it is insensitive to incoming triggers and the sweep is 'locked out'.

Depressing the MODE switch to RESET transfers V135A plate current from the base of Q124 to ground. Current through R126 and D126 raises the base of Q124 slightly positive, which reverse biases Q124. The reduction in collector current then lets the grid of V135A fall to its 'ready-to-be-triggered' level. The READY lamp then fires to indicate the sweep is again 'armed', waiting for a trigger.

## ELECTRICAL PARTS LIST

Values fixed unless marked Variable.

### BULBS

Ckt.No.	Part Number	Description
B124	150-027	Neon, NE-23
B160W	150-027	Neon, NE-23

### DIODES

D124	152-008	Germanium	T12G
D126	152-061	Silicon	6061

### RESISTORS

Resistors are 10% composition 1/2 watt unless otherwise noted.

R123	301-274	270k	5%
R124	302-473	47k	
R126	302-684	680k	
R144	324-296	11.8k	1 w 1%

### SWITCHES

SW124	260-501	Lever	MODE
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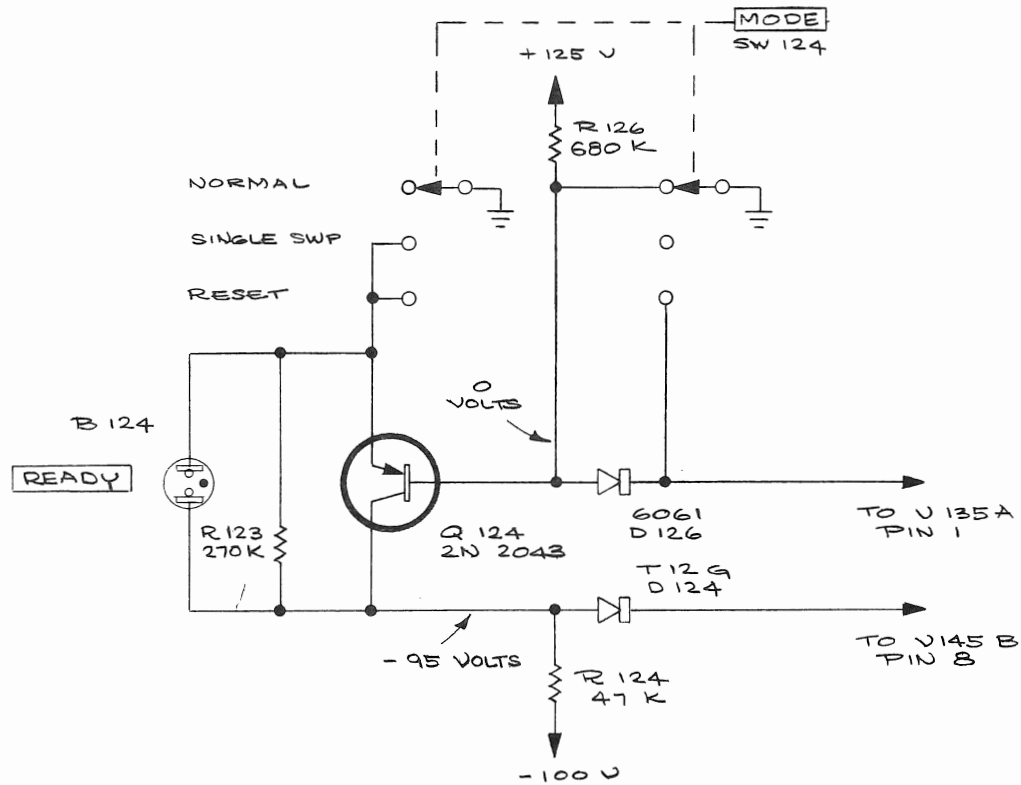
### TRANSISTORS

Q124	151-093	2N2043
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## MECHANICAL PARTS LIST

	Part Number
Bushing, nylon, charcoal	358-181
Cover, transistor, Thermo-Fit	2
Holder, neon bulb, single, black molded	352-008
Knob, lever	366-215
Lockwasher, int.#4, cad plated	210-004
Lug, solder, SE4, w/2 wire holes	210-201
Lug, solder, SE6, w/2 wire holes	210-202
Lug, solder, SE10, long	210-206
Nut, hex, brass, 4-40 x 3/16, cad plated	210-406
Nut, Keps, steel, 6-32 x 5/16	210-457
Nut, hex, brass, 10-32 x 5/16	210-410
Panel, front	333-835
Plate, front subpanel	387-731
Post, binding	129-020
Post, binding, miniature, 5-way fluted cap, charcoal gray	129-064
Rod, delrin, 5/16 x 2-1/4 in., w/3 cross holes	385-137
Screw, 4-40 x 1 FHS, cad plated	211-031
Screw, 8-32 x 1/2 RHS, Phillips slot	212-044
Spacer, nylon molded	361-007
Tag, front panel insert ("040-318")	334-679

SCHEMATIC:



PARTIAL DIAGRAM, TIME-BASE GENERATOR

Also make the following changes in your Manual Schematics:

Change R144 to 11.8 k (TIME-BASE GENERATOR)

Change B160 w to NE-23 (TIMING SWITCH)



# PARTS LIST

## Type 67

Values are fixed unless marked Variable.

Ckt. No.	S/N Range	Description	Tektronix Part Number
<b>Bulbs</b>			
B160W		NE-2	150-002
B161		NE-2	150-002
B167		NE-2	150-002

### Capacitors

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

C9	100 pf	Cer.	350 v		281-523
C10	.01 $\mu f$	Discap	500 v		283-002
C15	.001 $\mu f$	Discap	500 v		283-000
C20	.01 $\mu f$	Discap	150 v		283-003
C24	330 pf	Cer.	500 v	$\pm 10\%$	281-546
C31	.005 $\mu f$	Discap	500 v		283-001
C37	22 pf	Cer.	500 v	$\pm 10\%$	281-511
C113	.001 $\mu f$	Discap	500 v		283-000
C130	47 pf	Cer.	500 v		281-518
C134	10 pf	Cer.	500 v	$\pm 10\%$	281-504
C141	5.6 pf	Cer.	500 v	$\pm 10\%$	281-544
C147	470 pf	Cer.	500 v		281-525
C160A	3-12 pf	Cer.	Var.		281-007
C160B	82 pf	Cer.	500 v	$\pm 10\%$	Use 281-574
C160C	4.5-25 pf	Cer.	Var.		281-010
C160D	.001 $\mu f$		Mylar	$\pm 1/2\%$	*291-008
C160E	.01 $\mu f$				
C160F	.1 $\mu f$				
C160G	1 $\mu f$				
C165	100 pf	Cer.	350 v		281-523
C167	.001 $\mu f$	Discap	500 v		283-000
C320	15 pf	Cer.	500 v	$\pm 10\%$	281-509
C321	4.5-25 pf	Cer.	Var.		281-010
C334	22 pf	Cer.	500 v		281-510
C341	4.5-25 pf	Cer.	Var.		281-010
C348	3.3 pf	Cer.		$\pm 0.25$ pf	281-534
C361	.01 $\mu f$	Discap	500 v		283-002
C356	.01 $\mu f$	Discap	150 v		283-003
C397	.1 $\mu f$	Discap	500 v		283-008

### Diodes

D130	T12G				152-008
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# Resistors

Tektronix  
Part Number

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

R14	1 meg	$\frac{1}{2}$ w				302-105
R15	470 k	$\frac{1}{2}$ w				302-474
R16	30 k	$\frac{1}{2}$ w			$\pm 5\%$	301-303
R17	250 k		Var.	LEVEL		311-206
R19	1 meg	$\frac{1}{2}$ w			$\pm 5\%$	301-105
R20	300 k	$\frac{1}{2}$ w			$\pm 5\%$	301-304
R22	150 $\Omega$	$\frac{1}{2}$ w				302-151
R23	150 $\Omega$	$\frac{1}{2}$ w				302-151
R24	5.1 k	$\frac{1}{2}$ w			$\pm 5\%$	301-512
R25	5.1 k	$\frac{1}{2}$ w			$\pm 5\%$	301-512
R28	22 k	1 w			$\pm 5\%$	303-223
R30	220 k	$\frac{1}{2}$ w				302-224
R31	220 k	$\frac{1}{2}$ w				302-224
R32	100 $\Omega$	$\frac{1}{2}$ w				302-101
R34	1.2 k	$\frac{1}{2}$ w				302-122
R35	2.7 k	$\frac{1}{2}$ w				302-272
R37	333 k	$\frac{1}{2}$ w		Prec.	1%	309-139
R38	390 k	$\frac{1}{2}$ w		Prec.	1%	309-056
R40	2.2 meg	$\frac{1}{2}$ w				302-225
R41	100 $\Omega$	$\frac{1}{2}$ w				302-101
R43	4.7 k	$\frac{1}{2}$ w				302-472
R46	27 k	1 w				304-273
R111	15 k		Var.	STABILITY		311-112
R112	15 k	$\frac{1}{2}$ w			$\pm 5\%$	301-153
R113	18 k	$\frac{1}{2}$ w			$\pm 5\%$	301-183
R130	4.7 k	$\frac{1}{2}$ w			$\pm 5\%$	301-472
R131	100 $\Omega$	$\frac{1}{2}$ w				302-101
R134	13.5 k	$\frac{1}{2}$ w		Prec.	1%	309-263
R135	13.5 k	$\frac{1}{2}$ w		Prec.	1%	309-263
R137	100 $\Omega$	$\frac{1}{2}$ w				302-101
R138	8.2 k	$\frac{1}{2}$ w				302-822
R141	33 k	1 w		Prec.	1%	310-070
R143	16.69 k	$\frac{1}{2}$ w		Prec.	1%	309-231
R144	15 k	1 w		Prec.	1%	310-115
R146	100 $\Omega$	$\frac{1}{2}$ w				302-101
R147	1.5 k	$\frac{1}{2}$ w				302-152
R149	8.2 k	$\frac{1}{2}$ w				302-822
R160A	666.6 k	$\frac{1}{2}$ w		Prec.	1%	309-007
R160B	666.6 k	$\frac{1}{2}$ w		Prec.	1%	309-007
R160C	2 meg	$\frac{1}{2}$ w		Prec.	1%	309-023
R160D	6.67	$\frac{1}{2}$ w		Prec.	1%	309-351
R160F	6.67	$\frac{1}{2}$ w		Prec.	1%	309-351
R160H	20 meg	2 w		Prec.	1%	310-583
R160W	47 k	$\frac{1}{2}$ w				302-473
R160X	10 k	$\frac{1}{2}$ w				302-103
R160Y†	20 k		Var.	VARIABLE		311-166
R161	100 $\Omega$	$\frac{1}{2}$ w				302-101
R165	68 k	$\frac{1}{2}$ w				302-683
R166	68 k	$\frac{1}{2}$ w				302-683
R167	1 meg	$\frac{1}{2}$ w				302-105

† Concentric with SW341. Furnished as a unit.

# Resistors (continued)

							Tektronix Part Number
R168	47 k	1/2 w					302-473
R174	27 k	1 w					303-273
R176	5 k		Var.		SWP. LENGTH	5%	311-195
R178	11 k	1/2 w				5%	Use 301-113
R181	4.7 meg	1/2 w					302-475
R320	1.8 meg	1/2 w			Prec.	1%	309-020
R321	1.11 meg	1/2 w			Prec.	1%	309-015
R323	2 x 50 k		Var.			POSITION	311-111
R326	240 k	1/2 w				±5%	301-244
R330	100 Ω	1/2 w					302-101
R332	18 k	1 w					304-183
R333	10 k	1/2 w				±5%	301-103
R334	10 k		Var.			CALIBRATION	311-191
R336	100 Ω	1/2 w					302-101
R338	39 k	1/2 w					302-393
R341	50 k	.2 w	Var.			SWP. GAIN	311-125
R342	82 k	1/2 w			Prec.	1%	309-043
R344	180 k	1/2 w			Prec.	1%	309-279
R345	47 k	1/2 w					302-473
R346	50 k	.2 w	Var.			SWP/MAG REGIS.	311-125
R348	400 k	1/2 w			Prec.	1%	309-126
R350	100 Ω	1/2 w					302-101
R352	39 k	1/2 w					302-393
R355	1.5 meg	1/2 w				±5%	301-155
R356	43 k	1/2 w				±5%	301-433
R357	100 Ω	1/2 w					302-101
R359	39 k	1/2 w					302-393
R360	1 meg	1/2 w					302-105
R361	470 k	1/2 w					302-474
R370	100 Ω	1/2 w					302-100
R371	100 Ω	1/2 w					302-100
R373	30 k	8 w			WW	±5%	308-105
R375	12 k	2 w				±5%	305-123
R377	35 k	8 w			WW	±5%	308-191
R390	150 Ω	1/2 w				±5%	301-151
R391	150 Ω	1/2 w				±5%	302-151
R397	47 Ω	1/2 w					302-470

## Switches

SW5	Slide/DPTT	SOURCE		260-251
SW10	Slide/SPTT	COUPLING		260-316
SW17	Rotary	AUTO	*262-372	260-353
SW20	Slide/DPDT	SLOPE		260-212
SW160	Rotary	TIME/DIV.	*262-371	260-352
SW341†		5X MAG		311-166

## Vacuum Tubes

V24	6DJ8		154-187
V45	6DJ8		154-187
V135	6DJ8		154-187
V145	*6BL8		154-278
V152	6BC7		154-232

†Concentric with R160Y. Furnished as a unit.

# **Vacuum Tubes** *(continued)*

Tektronix  
Part Number

V161	6BL8 *	154-278
V333	6DJ8	154-187
V353	6DJ8	154-187
V374	6DJ8	154-187

\* ECF80 may be substituted.

## Type 67 Mechanical Parts List

	Tektronix Part Number
BRACKET, SWITCH	406-613
BUSHING, $\frac{3}{8}$ -32 x $\frac{9}{16}$ x .412	358-010
BUSHING, FOR 5-WAY BINDING POST	358-036
CABLE, HARNESS	179-460
CABLE, HARNESS ATTENUATOR SWITCH	179-508
CAP, POT 1" DIA. x .390 HI	200-247
CHASSIS	441-332
CLAMP, #20 WIRE FOR NEON BULBS	343-043
CONNECTOR, CHAS. MT. 24 CONT. MALE	131-149
COUPLING, 1 DG. W/2 TAPPED HOLES $\frac{1}{2}$ DIA.	376-007
COUPLING, POT. WIRE STEEL	376-014
FASTENER, PAWL RIGHT W/STOP	214-052
FASTENER, SNAP DOUBLE PRONGED	214-153
GROMMET, RUBBER $\frac{1}{4}$	348-002
GROMMET, RUBBER $\frac{5}{16}$	348-003
GROMMET, RUBBER $\frac{1}{2}$	348-005
GROMMET, POLYPROPYLENE SNAP-IN	348-031
GUIDE, DELRIN $\frac{5}{8}$ x $\frac{13}{16}$ W/ $\frac{3}{16}$ TRACK	351-037
HOLDER, NEON BULB SINGLE	352-008
LOCKWASHER, INT. #4	210-004
LOCKWASHER, INT. #6	210-006
LOCKWASHER, INT. #10	210-010
LOCKWASHER, POT INT. $\frac{3}{8}$ x $\frac{1}{2}$	210-012
LOCKWASHER, POT INT. $\frac{3}{8}$ x $\frac{11}{16}$	210-013
LUG, SOLDER SE6 W/2 WIRE HOLES	210-202
LUG, SOLDER SE10 LONG	210-206
LUG, SOLDER $\frac{1}{4}$ HOLE LOCK ROUND PERIMETER	210-223
KNOB, SMALL RED, $\frac{1}{8}$ HOLE PART WAY	366-038
KNOB, SMALL BLACK, $\frac{1}{4}$ HOLE PART WAY	366-044
KNOB, LARGE BLACK, $\frac{17}{64}$ HOLE THRU	366-058
KNOB, PLUG-IN SECURING $\frac{9}{16}$ x $\frac{5}{8}$	366-109
NUT, HEX 4-40 x $\frac{3}{16}$	210-406
NUT, HEX 6-32 x $\frac{1}{4}$	210-407
NUT, HEX $\frac{3}{8}$ -32 x $\frac{1}{2}$	210-413

# **Mechanical Parts List (continued)**

	Tektronix Part Number
NUT, HEX 10-32 x $\frac{3}{8}$ x $\frac{1}{8}$	210-445
NUT, HEX 5-40 x $\frac{1}{4}$	210-449
NUT, HEX $\frac{1}{4}$ -28 x $\frac{3}{8}$ x $\frac{3}{32}$	210-455
NUT, HEX $\frac{3}{8}$ -32 x $\frac{1}{2}$ x $\frac{1}{16}$	210-494
PANEL, FRONT	333-623
PLATE, FRONT	387-580
PLATE, REAR	387-581
POST, BINDING 5-WAY STEM AND CAP ASS'Y (FLUTED)	129-036
POST, BINDING ASS'Y OF 355-507 & 200-182	129-051
ROD, $\frac{1}{4}$ x $6\frac{5}{8}$	384-215
ROD, EXT. .125 OD x $\frac{3}{4}$ x .081 x $8\frac{1}{4}$ LG.	384-226
ROD, FRAME $\frac{3}{8}$ x $12\frac{1}{4}$ TAPPED 8-32 BOTH ENDS	384-566
ROD, DELRIN $\frac{5}{16}$ x $\frac{5}{8}$ MTG. HOLE $\frac{3}{8}$ ONE END W/ #44 CROSS HOLE	385-134
ROD, DELRIN $\frac{5}{16}$ x $2\frac{1}{4}$ MTG. HOLE $\frac{3}{8}$ ONE END W/3 #44 CROSS HOLES	385-137
SCREW, 4-40 x $\frac{1}{4}$ BHS	211-008
SCREW, 4-40 x $\frac{3}{8}$ RHS	211-013
SCREW, 4-40 x 1 FHS	211-031
SCREW, 6-32 x $\frac{1}{4}$ BHS	211-504
SCREW, 6-32 x $\frac{5}{16}$ BHS	211-507
SCREW, 8-32 x $\frac{1}{2}$ FHS 100°, PHILLIPS	212-043
SCREW, 8-32 x $\frac{1}{2}$ RHS	212-044
SCREW, THREAD CUTTING 6-32 x $\frac{3}{8}$ TRUSS HS PHILLIPS	213-041
SCREW, THREAD CUTTING 5-32 x $\frac{3}{16}$ PHS PHILLIPS	213-044
SCREW, SET 4-40 x $\frac{1}{8}$ HSS ALLEN HEAD	213-048
SOCKET, STM9G	136-015
SPACER, NYLON MLD. $\frac{5}{32}$ FOR CERAMIC STRIP	361-007
STRIP, CERAMIC $\frac{3}{4}$ x 4 NOTCHES, CLIP MTD.	124-088
STRIP, CERAMIC $\frac{3}{4}$ x 11 NOTCHES, CLIP MTD.	124-091
WASHER, STEEL, 6L x $\frac{3}{8}$	210-803
WASHER, STEEL, .390 x $\frac{9}{16}$	210-840

# MECHANICAL PARTS LIST

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### PUBLICATION NO.

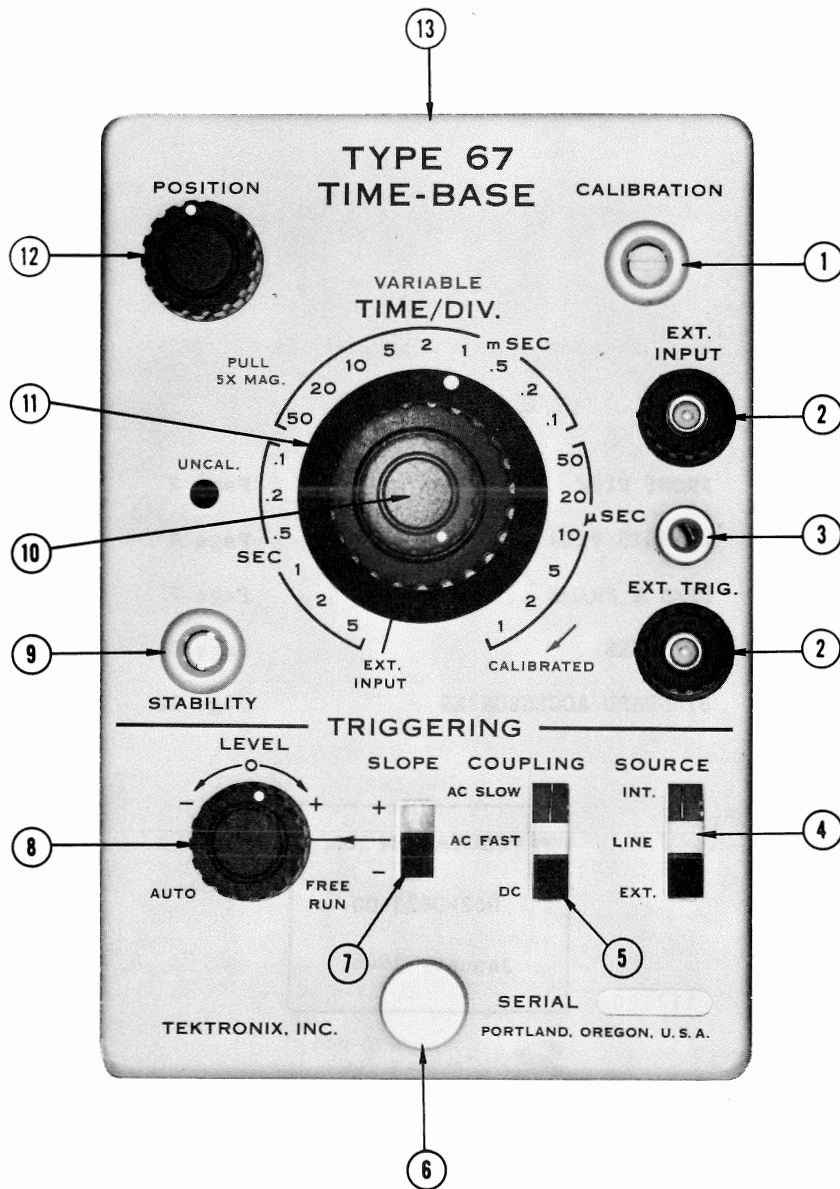
062-0623-00

January 1966



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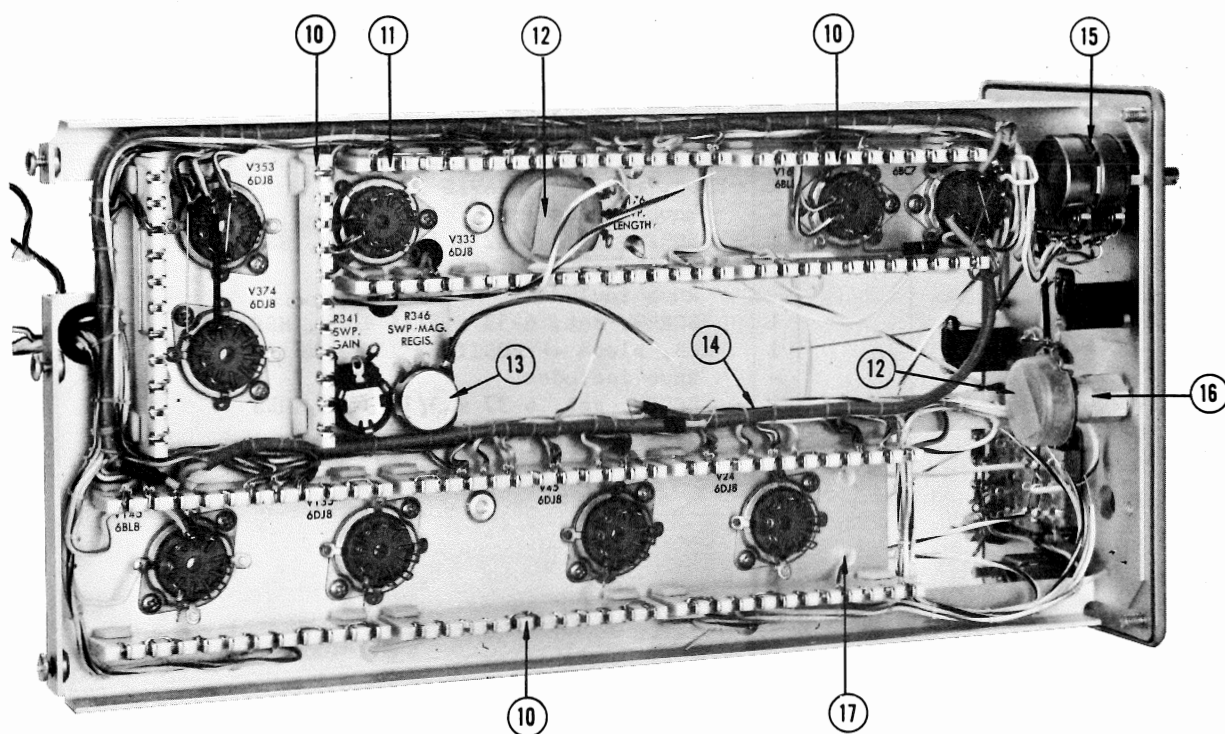
FRONT



## FRONT

REF. NO.	PART NO.	SERIAL/MODEL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
1	358-0010-00 - - - - - 210-0413-00			1 - 1	BUSHING, 3/8-32 x 9/16 x 0.412 inch long mounting hardware: (not included w/bushing) NUT, hex., 3/8-32 x 1/2 inch
2	129-0036-00 - - - - - 358-0036-00 210-0010-00 210-0206-00 210-0445-00			2 - 1 1 1 2	POST, binding mounting hardware for each: (not included w/post) BUSHING, binding post LOCKWASHER, internal, #10 LUG, solder, SE # 10, long NUT, hex., 10-32 x 3/8 inch
3	129-0051-00 - - - - - 355-0507-00 200-0182-00 - - - - - 210-0223-00 210-0455-00			1 - 1 1 - 1 1	POST, binding post includes: STEM, binding post adapter CAP, binding post mounting hardware: (not included w/post) LUG, solder, 1/4 ID x 7/16 inch OD, SE NUT, hex., 1/4-28 x 3/8 inch
4	260-0251-00 - - - - - 210-0406-00			1 - 2	SWITCH, slide -- TRIGGERING SOURCE mounting hardware: (not included w/switch) NUT, hex., 4-40 x 3/16 inch
5	260-0316-00 - - - - - 210-0406-00			1 - 2	SWITCH, slide -- TRIGGERING COUPLING mounting hardware: (not included w/switch) NUT, hex., 4-40 x 3/16 inch
6	366-0109-00 - - - - - 213-0005-00			1 - 1	KNOB, plug-in securing knob includes: SCREW, set, 8-32 x 1/8 inch, HSS
7	260-0212-00 - - - - - 210-0406-00			1 - 2	SWITCH, slide -- TRIGGERING SLOPE mounting hardware: (not included w/switch) NUT, hex., 4-40 x 3/16 inch
8	366-0044-00 - - - - - 213-0004-00			1 - 1	KNOB, black -- TRIGGERING LEVEL knob includes: SCREW, set, 6-32 x 3/16 inch, HSS
9	358-0010-00			1	BUSHING, 3/8-32 x 9/16 x 0.412 inch long
10	366-0038-00 - - - - - 213-0004-00			1 - 1	KNOB, red -- VARIABLE knob includes: SCREW, set, 6-32 x 3/16 inch, HSS
11	366-0058-00 - - - - - 213-0004-00			1 - 1	KNOB, black -- TIME/DIV knob includes: SCREW, set, 6-32 x 3/16 inch, HSS
12	366-0044-00 - - - - - 213-0004-00			1 - 1	KNOB, black -- POSITION knob includes: SCREW, set, 6-32 x 3/16 inch, HSS
13	333-0623-00			1	PANEL, front

## RIGHT SIDE



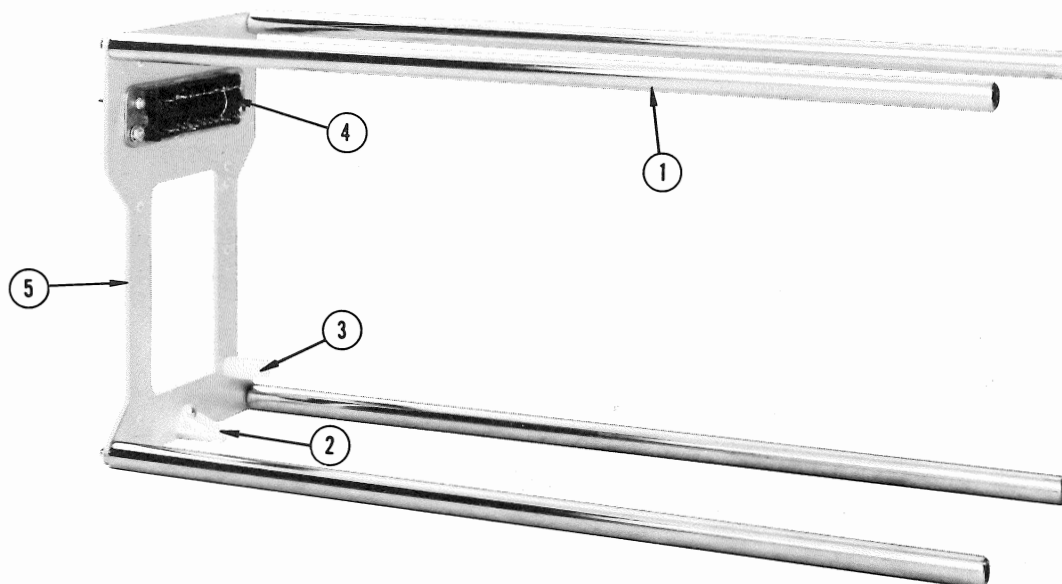
## CHASSIS

REF. NO.	PART NO.	SERIAL/MODEL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
1	387-0580-00			1	PLATE, front sub-panel
2	136-0015-00			9	SOCKET, tube, 9 pin, w/ground lugs
	- - - - -			-	mounting hardware for each: (not included w/socket)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS, phillips
3	441-0332-00			1	CHASSIS
	- - - - -			-	mounting hardware: (not included w/chassis)
	211-0504-00			3	SCREW, 6-32 x 1/4 inch, BHS
4	- - - - -			2	CAPACITOR
	- - - - -			-	mounting hardware for each: (not included w/capacitor)
	214-0153-00			1	FASTENER, plastic
5	348-0002-00			3	GROMMET, rubber, 1/4 inch diameter
6	348-0005-00			1	GROMMET, rubber, 1/2 inch diameter
7	385-0082-00	101	290	1	ROD, plastic, 2 1/4 inches long
	385-0137-00	291		1	ROD, plastic, 2 1/4 inches long
	- - - - -			-	mounting hardware: (not included w/rod)
	211-0507-00	101	290	1	SCREW, 6-32 x 5/16 inch, BHS
	213-0041-00	291		1	SCREW, thread cutting, 6-32 x 3/8 inch, THS, phillips
8	214-0052-00			1	FASTENER, pawl right, w/stop
	- - - - -			-	mounting hardware: (not included w/fastener)
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
9	352-0008-00			1	HOLDER, neon bulb, single
	- - - - -			-	mounting hardware: (not included w/holder)
	211-0031-00			1	SCREW, 4-40 x 1 inch, FHS
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
10	124-0091-00			12	STRIP, ceramic, 3/4 inch h, w/11 notches
	- - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, plastic, 0.188 inch long
11	124-0088-00			2	STRIP, ceramic, 3/4 inch h, w/4 notches
	- - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, plastic, 0.188 inch long
12	200-0247-00			2	CAP, variable capacitor
13	- - - - -			2	RESISTOR, variable
	- - - - -			-	mounting hardware for each: (not included w/resistor)
	210-0046-00			1	LOCKWASHER, internal, 1/4 ID x 0.400 inch OD
	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
14	179-0460-00			1	CABLE HARNESS, chassis

## CHASSIS

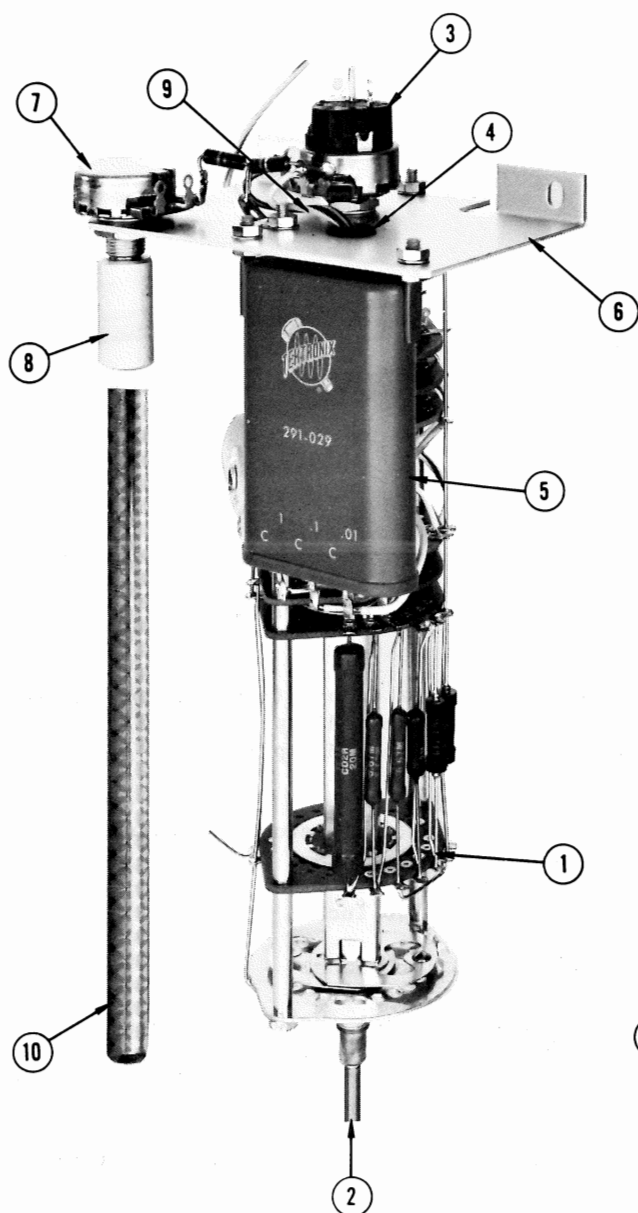
REF. NO.	PART NO.	SERIAL/MODEL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
15	- - - - - 210-0840-00 210-0413-00			1 - 1 1	RESISTOR, variable mounting hardware: (not included w/resistor) WASHER, flat, 0.390 ID x 9/16 inch OD NUT, hex., 3/8-32 x 1/2 inch
16	- - - - - 210-0012-00 210-0494-00			1 - 1 1	RESISTOR, variable mounting hardware: (not included w/resistor) LOCKWASHER, internal, 3/8 ID x 1/2 inch OD NUT, hex., 3/8-32 x 1/2 x 11/15 inch long
17	348-0031-00			4	GROMMET, plastic, 3/32 inch diameter

# REAR & FRAME

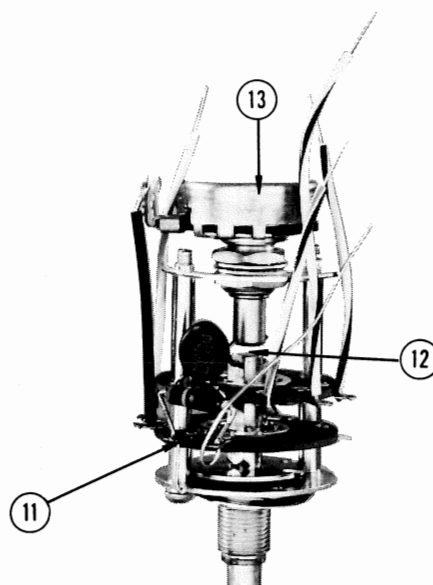


REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	384-0566-00			4	ROD, frame
	- - - - -			-	mounting hardware for each: (not included w/rod)
	212-0043-00	101	1758X	1	SCREW, 8-32 x 1/2 inch, FHS, phillips
	212-0044-00			1	SCREW, 8-32 x 1/2 inch, RHS, phillips
2	351-0037-00			1	GUIDE, plug-in, plastic
	- - - - -			-	mounting hardware: (not included w/guide)
	211-0013-00			1	SCREW, 4-40 x 3/8 inch, RHS
	210-0004-00			1	LOCKWASHER, internal, #4
	210-0406-00			1	NUT, hex., 4-40 x 3/16 inch
3	385-0073-00	101	290	1	ROD, plastic, 3/4 inch long
	385-0134-00	291		1	ROD, plastic, 5/8 inch long
	- - - - -			-	mounting hardware: (not included w/rod)
	211-0507-00	101	290	1	SCREW, 6-32 x 5/16 inch, BHS
	213-0041-00	291		1	SCREW, thread cutting, 6-32 x 3/8 inch, THS, phillips
4	131-0149-00			1	CONNECTOR, 24 contact
	- - - - -			-	mounting hardware: (not included w/connector)
	211-0008-00			2	SCREW, 4-40 x 1/4 inch, BHS
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
5	387-0581-00			1	PLATE, rear frame

# SWITCHES



TIME/DIV.



LEVEL

SWITCHES

REF. NO.	PART NO.	SERIAL/MODEL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
1	262-0371-00			1	SWITCH, wired -- TIME/DIV
	- - - - -			-	switch includes:
	260-0352-00			1	SWITCH, unwired -- TIME/DIV
2	384-0226-00			1	ROD, extension
3	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
	213-0048-00			1	SCREW, set, 4-40 x 1/2 inch, HSS
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
4	348-0003-00			1	GROMMET, rubber, 5/16 inch diameter
5	- - - - -			1	CAPACITOR
	- - - - -			-	mounting hardware: (not included w/capacitor)
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
6	406-0613-00			1	BRACKET, switch
	- - - - -			-	mounting hardware: (not included w/bracket)
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0202-00			1	LUG, solder, SE #6
	210-0449-00			2	NUT, hex., 5-40 x 1/4 inch
7	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0840-00			1	WASHER, flat, 0.390 ID x 9/16 inch OD
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
8	376-0007-00			1	COUPLING, variable resistor
	- - - - -			-	coupling includes:
	213-0005-00			2	SCREW, set, 8-32 x 1/8 inch, HHS
9	179-0508-00			1	CABLE HARNESS, attenuator switch
	- - - - -			-	mounting hardware: (not included w/switch)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, BHS
	210-0803-00			2	WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
10	384-0215-00			1	ROD, extension
11	262-0372-00			1	SWITCH, wired -- TRIGGERING LEVEL
	- - - - -			-	switch includes:
	260-0353-00			1	SWITCH, unwired -- TRIGGERING LEVEL
12	376-0014-00			1	COUPLING, variable resistor, wire
13	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	- - - - -			-	mounting hardware: (not included w/switch)
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0840-00			1	WASHER, flat, 0.390 ID x 9/16 inch OD
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch

# ACCESSORIES

REF. NO.	PART NO.	SERIAL/MODEL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
	070-0267-00			2	MANUAL, instruction (not shown)

# TYPE 67 PLUG-IN

## TEST SPECIFICATIONS

### TRIGGERING REQUIREMENTS:

<u>INTERNAL:</u>	<u>AC SLOW:</u>	± on a 1.0 major division signal with the junction of R-19 and R-20 grounded.
	and	
	<u>AC FAST:</u>	± on a 1 minor division signal by adjusting the <u>TRIGGERING LEVEL CONTROL</u> .
	<u>DC:</u>	Same as <u>AC</u> when INT. TRIG. DC LEVEL is at zero (0) volts.
	<u>AUTO:</u>	± on a 1 minor division signal with no jitter.
<u>LINE:</u>		must trigger on proper phase ±.
<u>EXTERNAL:</u>	<u>ALL</u>	must trigger on a .5 volt signal.
	<u>MODES:</u>	must trigger on a 1 volt, 2 mc signal.

The TRIGGERING LEVEL control must be within ± 10° of zero when triggered on a 1 major division signal (INT AC both + and -)

EXTERNAL INPUT amplifier sensitivity should be at least .9 V/Div (1.1 major divisions of deflection with a 1 volt signal applied to EXT. INPUT) with a CRT OF 19.6 V/Div. horizontal sensitivity.

The sweep timing error must not exceed: ± 2% on the 0.5 sec/Div. through 1 μs/Div. ranges. ± 2.5% on the 5 sec/Div. through 1 sec/Div. ranges. ± 3% on any sweep speed with the magnifier on.

The sweep linearity must be within 1% with magnifier on.

The VARIABLE TIME/DIV control must have at least a range of 2.5 to 1.

With the TIME/DIV switch set to EXT INPUT, it must be possible to position the dot off the right and left side of the graticule, and with the POSITION control centered the dot must be within 2 major divisions of graticule center.

With the TIME/DIV switch set to 1 milli sec and TRIGGERING LEVEL to FREE RUN it must be possible to position the trace, 0.2 major divisions to the right and left of CRT Electrical Center., with magnifier on.

The range of control with the CALIBRATION adjustment must meet the following specifications with various CRT horizontal deflection plate sensitivities:

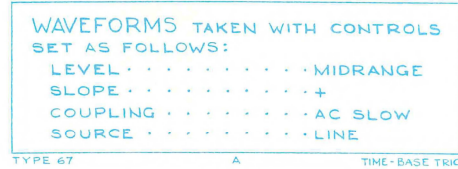
<u>Horiz. Sens.</u>	<u>% of Deflection more than Proper Setting</u>	<u>% of Deflection less than Proper Setting</u>
17.8 V/DIV	20%	10%
18.7 V/DIV	15%	15%
19.6 V/DIV	10%	20%

Sweep Hold-off Specifications:

SWEEP RATE	APPROXIMATE HOLD-OFF
1, 2, and 5 $\mu$ sec/div	60 $\mu$ s
10, 20, and 50 $\mu$ sec/div	70 $\mu$ s
.1, .2, and .5 msec/div	250 $\mu$ s
1, 2, and 5 msec/div	2 ms
10, 20, and 50 msec/div	20 ms
.1, .2, and .5 sec/div	200 ms
1, 2, and 5 sec/div	200 ms






$$A_1$$

12-08-60  
TP  
TIME-BASE TRIGGER

### MILLER RUNUP CIRCUIT



7-19-61  
TP  
TIME-BASE GENERATOR

# Parts List Correction

## Parts Added:

R121	302-0563-00	56 K	1/2 W	10%
R125	316-0334-00	330 K	1/4 W	10%
R127	316-0472-00	4.7 K	1/4 W	10%

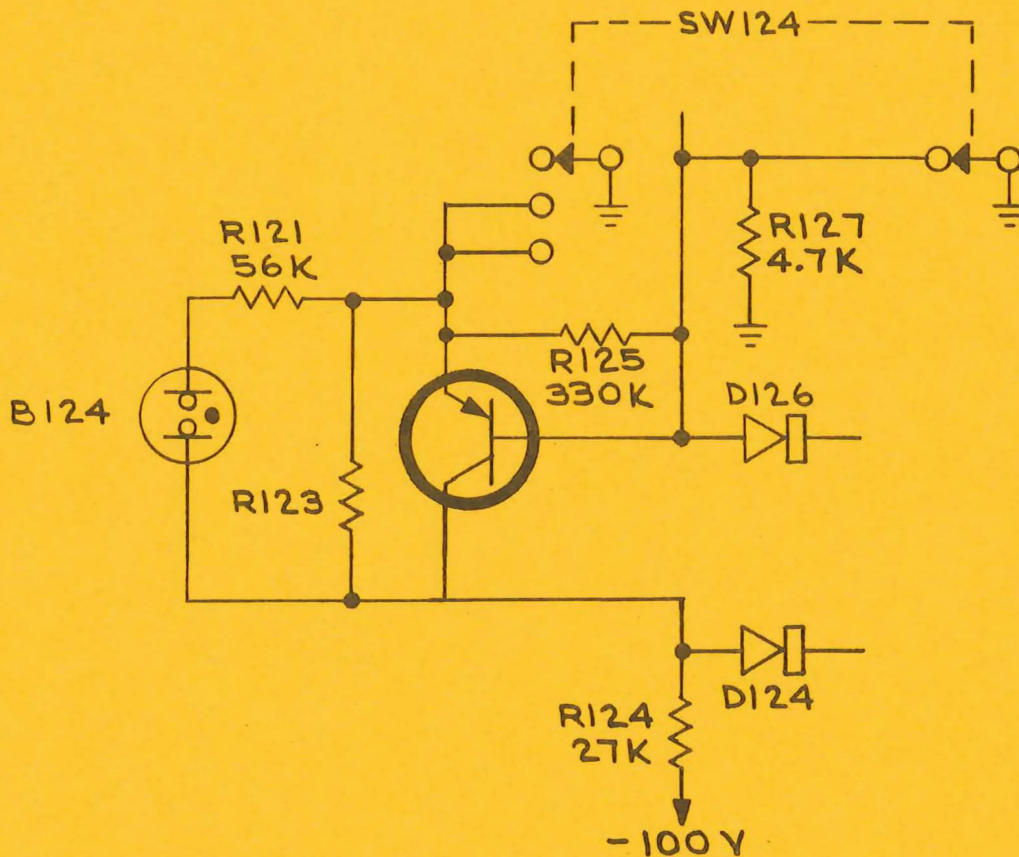
## Change To:

D124	152-0061-00	Silicon	6061	
R124	301-0273-00	27 K	1/2 W	5%

## TIME-BASE GENERATOR

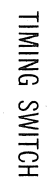
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tent s/n 15920

## Schematic Correction



Mod 9976





GAB  
4 - 7 - 61

