INSTRUCTION MANUAL

TYPE T PLUG-IN

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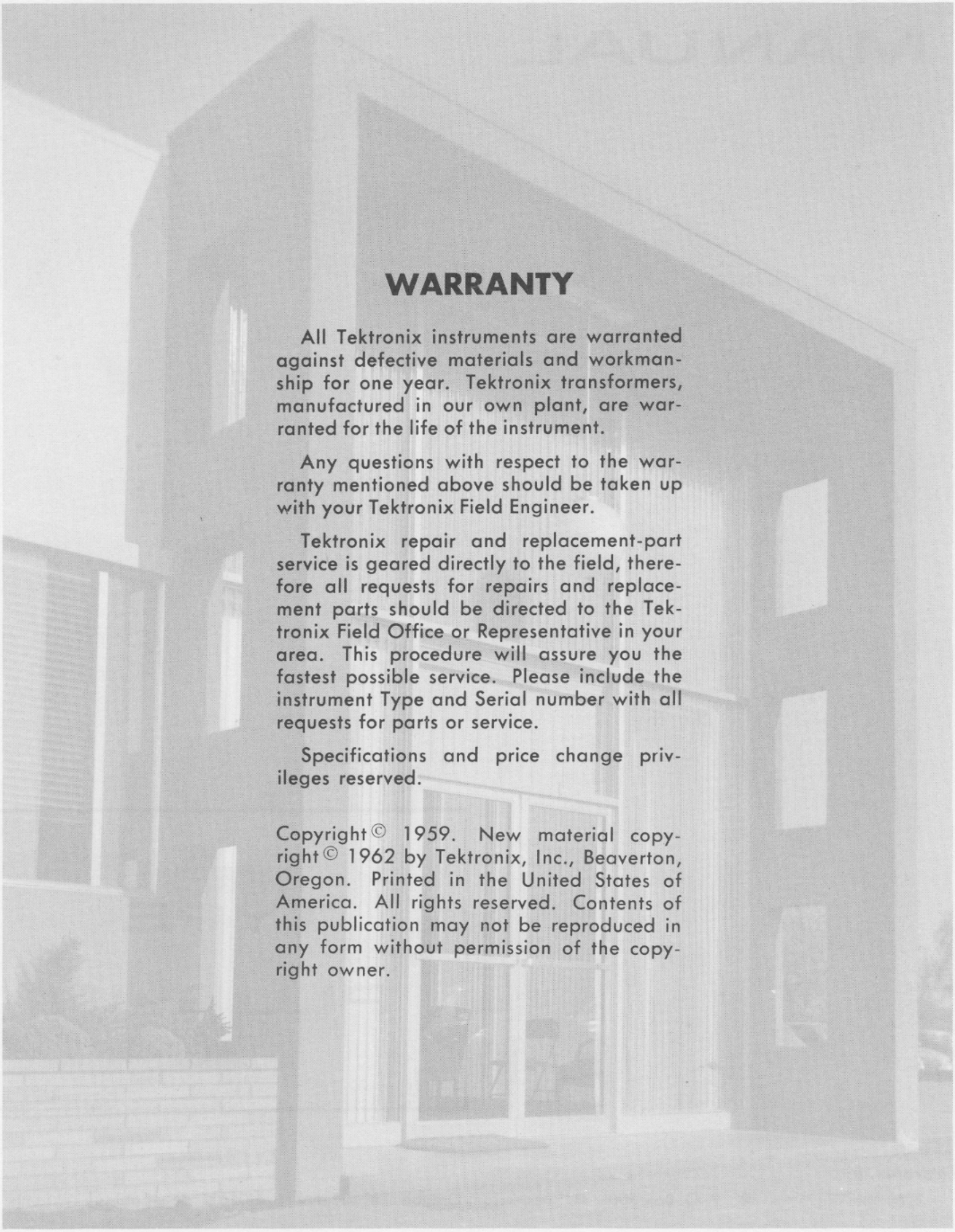

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

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

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.

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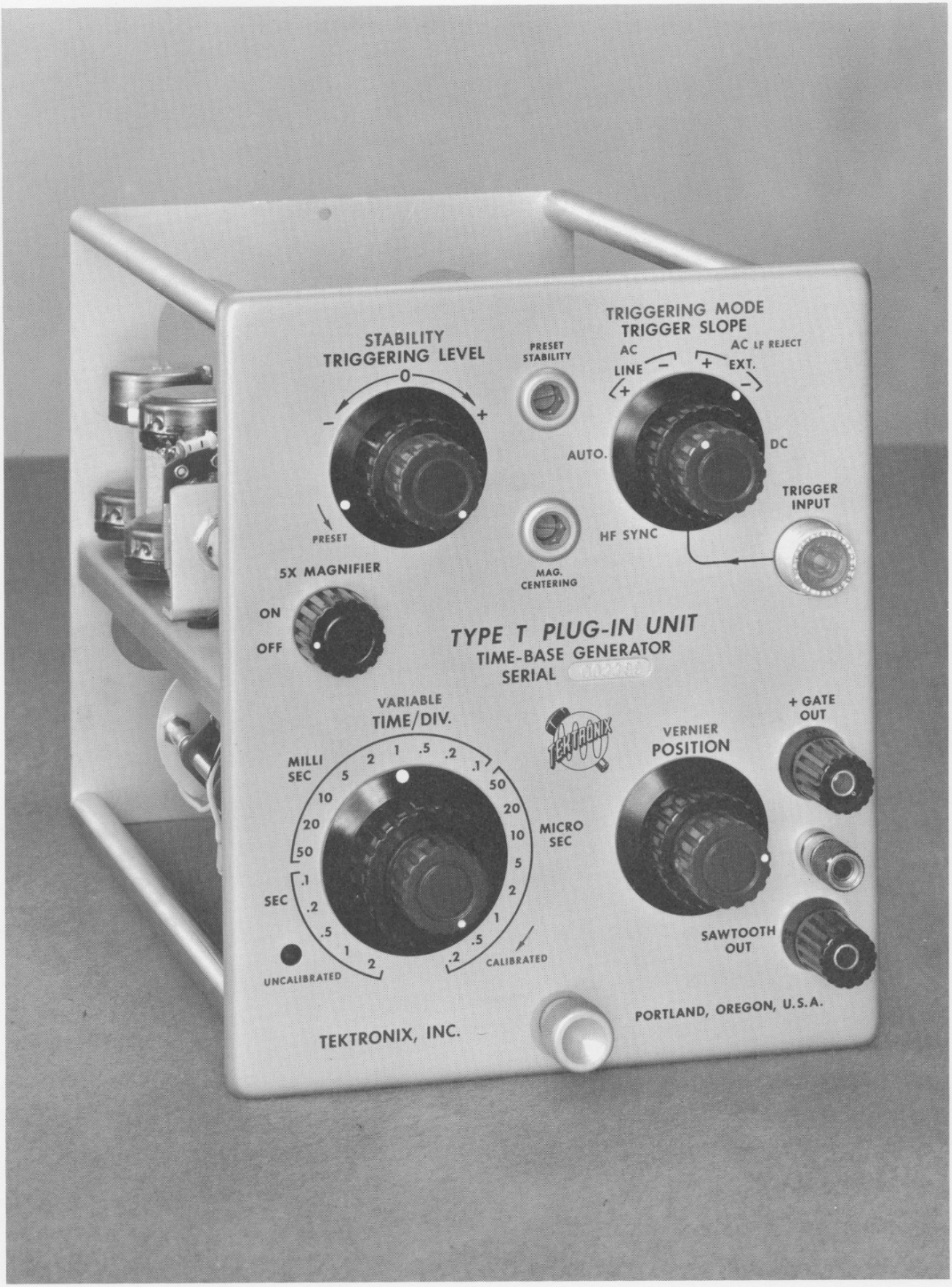
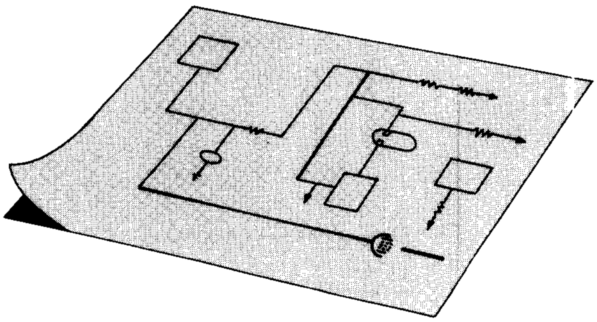

STABILITY
TRIGGERING LEVEL
0
-
+
PRESET
PRESET STABILITY
MAG. CENTERING
TRIGGERING MODE
TRIGGER SLOPE
AC
LINE
AC LF REJECT
EXT.
AUTO.
DC
HF SYNC
TRIGGER INPUT
5X MAGNIFIER
ON
OFF
TYPE T PLUG-IN UNIT
TIME-BASE GENERATOR
SERIAL
VARIABLE
TIME/DIV.
MILLI SEC
MICRO SEC
SEC
UNCALIBRATED
CALIBRATED
TEKTRONIX
VERNIER
POSITION
+ GATE OUT
SAWTOOTH OUT
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.



SECTION 1

CHARACTERISTICS

The Type T Plug-In Unit is a time-base generator developed for use with the Tektronix Type 536 Oscilloscope. The Type T provides a wide range of time-base rates for oscilloscope application. The Type T may also be used in the vertical of other Tektronix convertible oscilloscopes.

Magnifier

Provides a 5-times magnification of the center 2-division portion of the oscilloscope display. It extends the fastest sweep rate to .04 microseconds per division.

Sweep Rates

Twenty-two calibrated rates from .2 μSEC/DIV to 2 SEC/DIV.

Calibration accuracy of the fixed sweep rates will typically be within 1 per cent of full scale and in all cases within 3 per cent.

In addition, continuously variable (uncalibrated) sweep rates are available over the range from approximately 5 SEC/DIV to .2 μSEC/DIV.

Triggering-signal requirements

Responds to triggering signals in the range from dc to 5 mc. Accepts external triggering signals in this range having amplitudes from .2 v to 50 v.

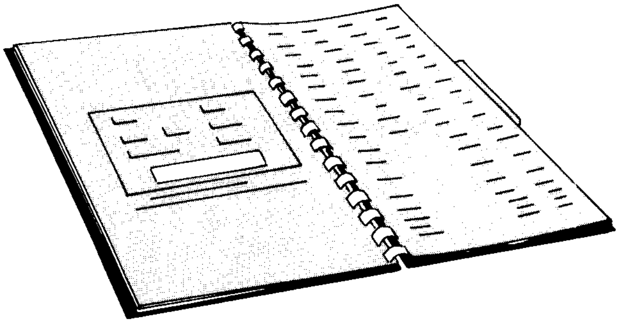
Synchronizing-signal requirements

Responds to synchronizing signals in the range from 5 mc to 15 mc. Accepts external synchronizing signals in this range having amplitude from .2 v to 50 v.

Physical Characteristics

Construction - Aluminum alloy chassis.
Finish - Photo-etched anodized panel.
Weight - 11 pounds approx.

NOTES



SECTION 2

OPERATING INSTRUCTIONS

The Type T Time-Base Generator was developed to drive the horizontal-deflection system in the Type 536 Oscilloscope. The following instructions describe its use for that purpose. However, you can also use this plug-in unit in the vertical-deflection systems of any of the Tektronix convertible Series oscilloscopes.

If you are gaining familiarity with time-base generators of this general type, we suggest that you use the 5X MAGNIFIER switch in the OFF position. Use of the 5X MAGNIFIER is described in a later paragraph.

TRIGGERED OPERATION

For many uses of your time-base generator, you will need to get a stable display of some recurrent waveform. To accomplish this, you can operate the time-base generator so that each horizontal sweep of the spot on the oscilloscope screen starts at a given point on the displayed waveform. This is called triggered operation. And for present purposes, we can refer to the starting of the horizontal sweep at the left-hand end of the graticule as triggering the sweep.

Triggered operation is also useful in looking at a waveform which occurs only once, or which occurs at random intervals.

For any of the above uses, the time-base generator can alternatively be used in such a way that each horizontal sweep of the spot is triggered by some waveform other than the one you are observing on the oscilloscope, but which has a time relationship to the observed waveform.

The waveform used to start the horizontal sweep is called a triggering signal (whether it is the waveform being observed or some other waveform). The following instructions tell you how to select the triggering signal. They also contain information on triggering according to various modes, depending upon the nature of the triggering signal.

How to select the triggering signal

1. To trigger the sweep from the power-line as in the case where you are observing a waveform which has a time relationship to the power-line wave, set the black TRIGGER SLOPE to (+ or -).

2. To trigger the sweep from some externally derived waveform, connect the source of triggering waveform to the TRIGGER INPUT connector, and set the TRIGGER SLOPE switch in the (+ or -) position. If you want to trigger the time-base generator from the signal being observed on the oscilloscope, connect the Vert. Sig. Out connector of the oscilloscope to the TRIGGER INPUT connector on the Type T.

AUTO. mode

This is an especially useful triggering mode, providing automatic triggering from periodic signals in the range from 60 cycles to 2 megacyles.

1. Select the desired triggering signal.

2. Set the TRIGGERING MODE switch to AUTO. (The TRIGGERING LEVEL and STABILITY controls are not used in this mode).

3. Set the TIME/DIV. switch for a sweep rate suited to the waveform being observed.

When you use the AUTO. mode, you get a desirable horizontal reference trace on the screen, even when no input signal is used. This will be especially handy when you are testing equipment by moving the input connection from one point to another in the equipment.

AC mode

This mode is useful for triggering either from transients, or from periodic signals in the range from 16 cps. to 5 mc. Reliable triggering is possible at frequencies lower than 16 cycles if the product of the triggering signal amplitude, in volts (external triggering) or in divisions of vertical deflection (triggering from displayed signal), and the frequency, in cycles, is greater than five. For example, a triggering signal having a frequency of 10 cycles should have an amplitude of at least 0.5 volts when triggering from an external source or 0.5 major division of vertical deflection when triggering from the displayed signal.

1. Select the desired triggering signal.
2. Set controls as follows:

5X MAGNIFIER	OFF
TRIGGERING MODE	AC
TRIGGERING LEVEL	full right or full left
STABILITY	PRESET

3. Turn the TRIGGERING LEVEL control slowly toward the center of its range until the trace begins at the desired point on the waveform being observed.
4. Set the TIME/DIV. switch for a sweep rate suited to the waveform being observed.

DC mode

In the DC mode, triggering can be effected from periodic signals in the range from dc to 5 megacycles, or from transients. This mode is expecially useful with trigger signals that change slowly; that is, signals below the lower-frequency limit of the AC mode.

For example, consider the case of a slowly-rising voltage. It is desired to start the display at a time when the voltage has risen to a particular value. In the AC mode, the signal connected to the triggering circuits would be distorted as shown in II of the figure. Obviously, in Region A, where the voltage is almost constant, the voltage discriminating TRIGGERING LEVEL control could not be set for reliable triggering at the desired point. On the other hand, in the DC mode, the triggering signal would appear as I of the figure. Here, the waveform has not been distorted and the TRIGGERING LEVEL control can be set to start the sweep when the voltage has risen to the desired value.

Another application of the DC triggering mode is to attain a stable display of a random-pulse train. The average voltage of this type of signal is dependent upon the time duration and amplitude of each pulse and the time lapse between successive pulses. Since these quantities are variable in a random-pulse train, the average voltage will also vary and this can cause unstable triggering in the AC mode. In the DC mode, however, the circuits are only sensitive to the instantaneous voltage and changes in the average voltage do not alter the operation of the circuits. As a result, the TRIGGERING LEVEL control can be set to initiate a sweep whenever a pulse reaches the desired voltage.

Operating instructions are similar to those given for the AC mode, except that you set the TRIGGERING MODE switch to DC. It is important to remember, however, that the trace always starts at a given point on the graticule for a given TRIGGERING LEVEL setting. This is true regardless of the setting of the VERTICAL POSITIONING control.

AC LF REJECT mode

For most cases, the AC mode is preferable to the AC LF REJECT mode. The AC LF REJECT mode is principally for ALTERNATE sweep operation in conjunction with the Type CA Plug-In Unit.

Apart from its use with the Type CA, the AC LF REJECT mode is sometimes useful in triggering from transients, or from periodic signals in the range from 10 kc to 5 mc. In this use, it may reduce jitter due to hum in the triggering signal.

Operating instructions are similar to those for the AC mode except that you set the TRIGGERING MODE switch to AC LF REJECT.

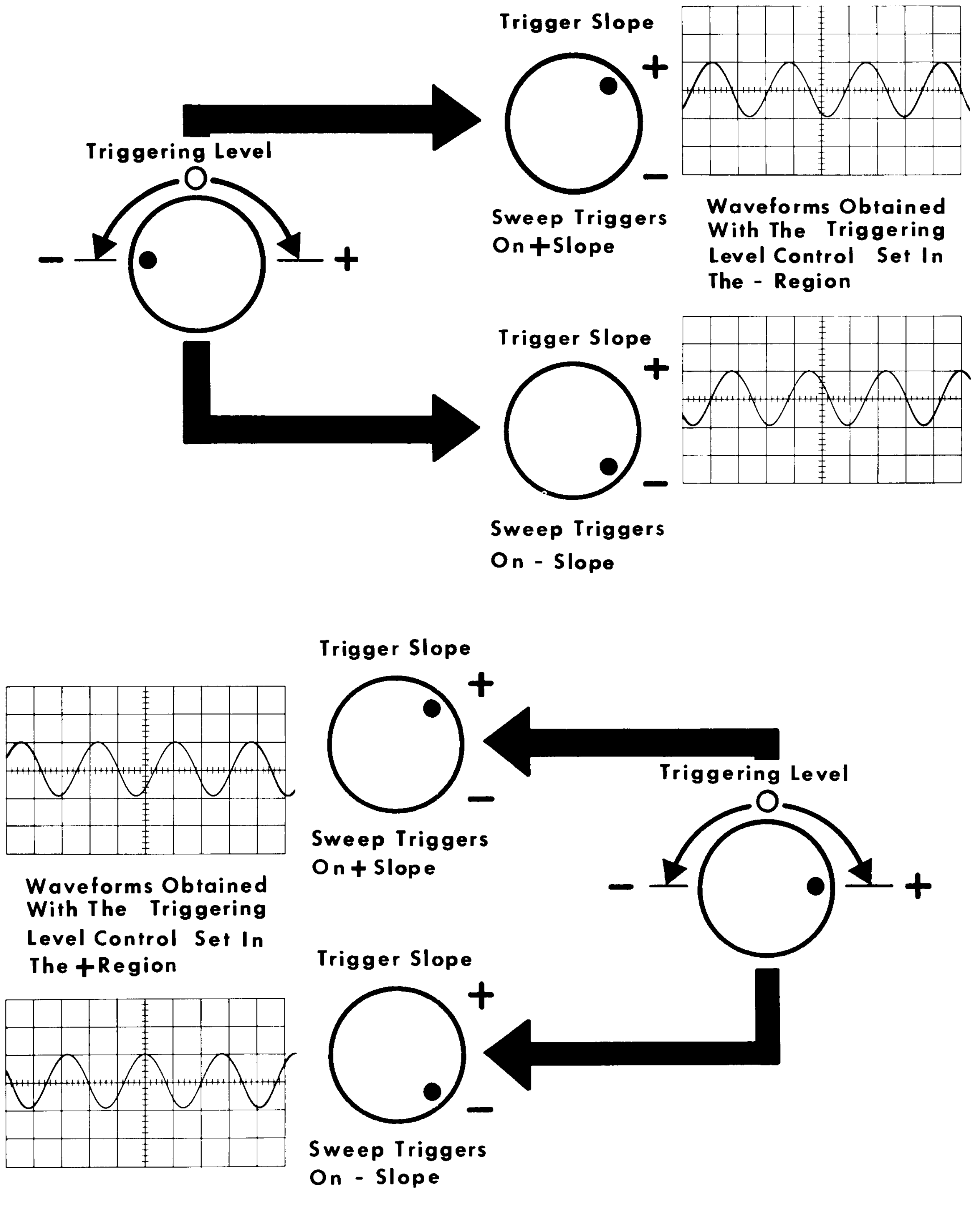


Fig. 2-1. Effects on the oscilloscope display produced by + and - settings of the TRIGGERING LEVEL control. When the TRIGGERING LEVEL control is set in the + region, the sweep is triggered on the upper portion of the input waveform; when it is set in the - region, the sweep is triggered on the lower portion of the input waveform. The TRIGGER SLOPE control determines whether the sweep is triggered on the rising portion or the falling portion of the input waveform.

Use of STABILITY Control

For a few particularly difficult triggering applications, you may wish to use a setting of the STABILITY control other than the one available in the PRESET position. You can do this if you are using triggered operation in any of these modes: DC, AC or AC LF REJECT.

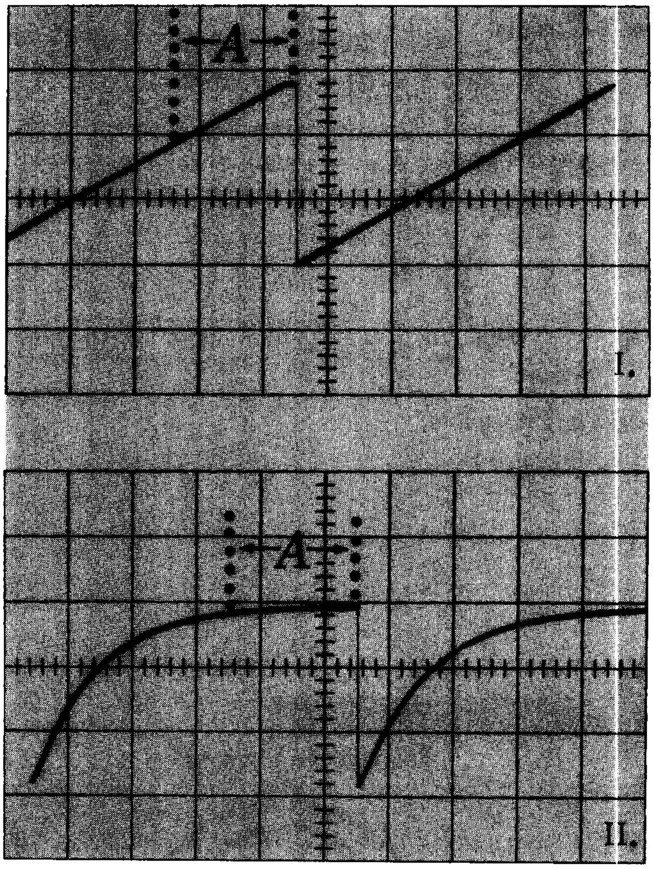


Fig. 2-2. Effect of ac coupling on a slowly-changing Voltage.

1. Start with the STABILITY control turned full right. Use other control settings as given in the above instructions for the desired triggering mode.

2. Turn the STABILITY control left until the trace just disappears, then two or three degrees further left.

3. Turn the TRIGGERING LEVEL control slowly toward the center of its range until the trace begins at the desired point on the waveform being observed.

4. Set the TIME/DIV. switch for a sweep rate suited to the waveform being observed.

Adjustment of PRESET STABILITY Control

See Calibration procedure for adjustment of this control.

SYNCHRONIZED OPERATION

HF SYNC mode

When you use the HF SYNC mode, you get a recurrent horizontal sweep which can be synchronized, by means of the STABILITY control, with external waveforms in the range from 5 megacycles to 15 megacycles.

1. Connect the source of the desired synchronizing waveform to the TRIGGER INPUT connector.

2. Set controls as follows:

5X MAGNIFIER	OFF
TRIGGER SLOPE	+ EXT. or -EXT.
TRIGGERING MODE	HF SYNC
TRIGGERING LEVEL	not used in HF SYNC mode
STABILITY	full right

3. Set the TIME/DIV. switch for a sweep rate suited to the waveform being observed.

4. Turn the STABILITY control slowly to the left until you get a stable display of the waveform being observed.

FREE-RUNNING OPERATION

You can use the Type T to generate a periodic sweep in a free-running manner, independently of any external triggering or synchronizing signal. This operation is useful where the waveform being observed is initiated by the output from either the + GATE OUT or the SAWTOOTH OUT connector.

As an application of free-running operation, you can actuate the system under investigation by means of a signal from either the + GATE OUT or the SAWTOOTH OUT connector. The signals from these connectors have a starting time and a duration corresponding to the starting time and duration of the horizontal sweep. Note that this reverses the usual situation

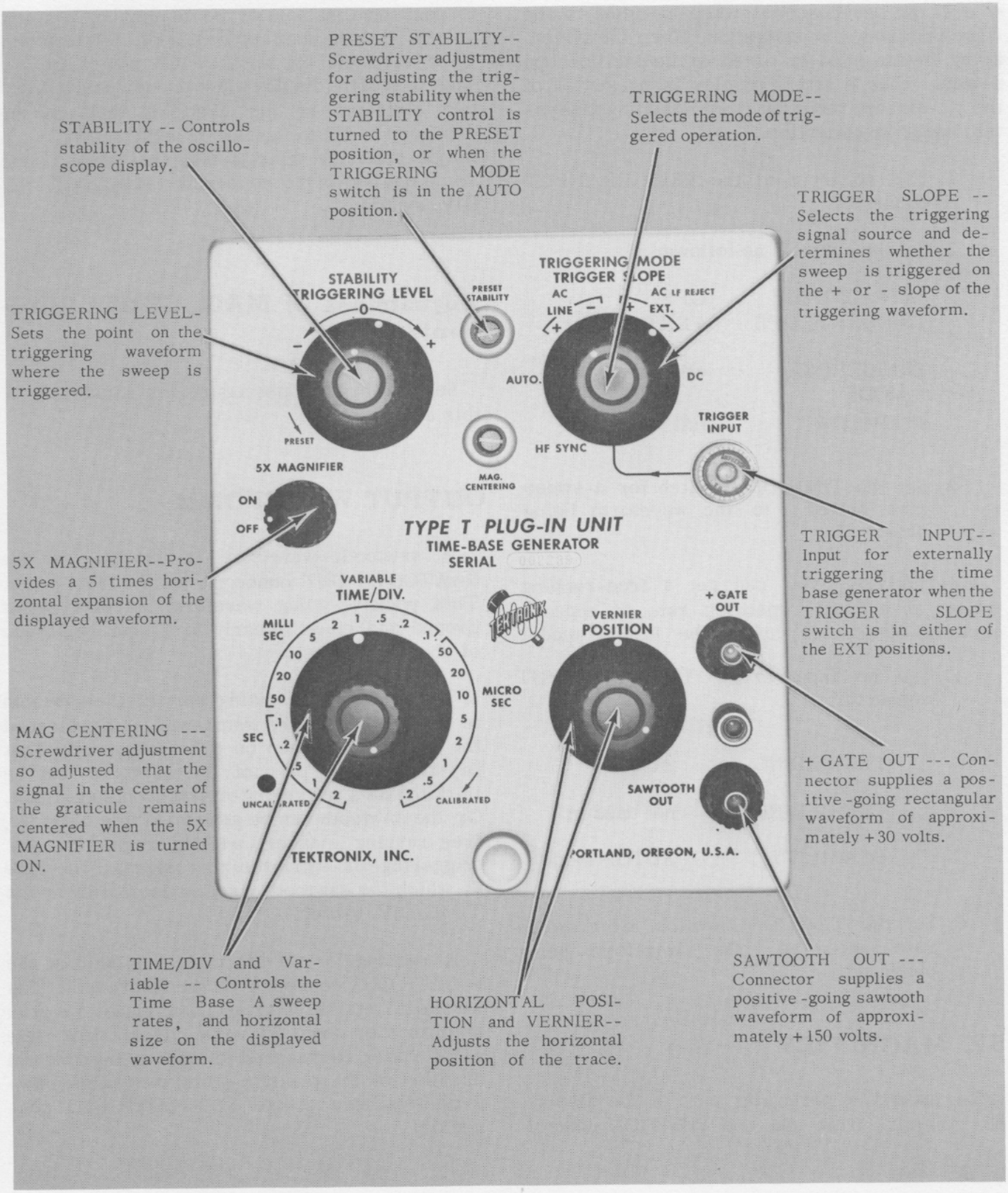


Fig. 2-3. Functions of the Type T front panel controls and connectors.

where the oscilloscope sweep is timed to the waveform under investigation. Here, the system being investigated is timed to the oscilloscope sweep. Thus a stable display is presented of the waveforms resulting from actuating the system under investigation.

1. Use no input to the TRIGGER INPUT connector.

2. Set the controls as follows:

5X MAGNIFIER	OFF
TRIGGER SLOPE	+EXT. or -EXT.
TRIGGERING MODE	other than AUTO.
STABILITY	full right

3. Set the TIME/DIV. switch for a sweep rate suited to the waveform being observed.

Alternatively, you can get a free-running sweep at a fixed repetition rate of approximately 50 cycles, using the AUTO. mode:

1. Use no input to the TRIGGER INPUT connector.

TRIGGERING MODE	AUTO.
TRIGGERING LEVEL	not used in
STABILITY	AUTO. mode

3. Set the TIME/DIV. switch for a sweep rate suited to the waveform being observed.

5X MAGNIFIER

To expand a particular part of the display horizontally, first use the POSITION control to position that part of the display horizontally so that it falls near the center of the graticule. Then turn the 5X MAGNIFIER switch to ON. That part of the display which occupied the middle two divisions of the graticule will now be expanded to fill the graticule horizontally. Each major graticule division will then have a time value one fifth of the value indicated by the TIME/DIV. switch.

Adjustment of MAG. CENTERING control

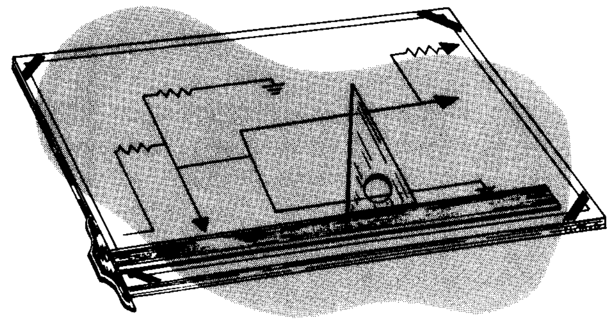
See Calibration procedure for adjustment of this control.

OUTPUT WAVEFORM

A sawtooth waveform is available at the SAWTOOTH OUT connector on the front panel. This positive-going waveform starts at about ground and rises linearly to a peak amplitude of about 150 volts.

The start of the rising part of the sawtooth is determined in the same way as the start of the horizontal sweep on the oscilloscope. That is, the rising part of the sawtooth can be initiated by a triggering or synchronizing signal. Or the sawtooth can be generated in a periodic, free-running manner, without regard to any triggering or synchronizing signal. The rate at which the sawtooth rises is controlled by the TIME/DIV. switch.

A rectangular waveform is available at the + GATE OUT connector on the front panel. This waveform starts at ground and rises to a peak amplitude of about 30 volts. Its starting time and duration correspond to the starting time and duration of the positive-going part of the sawtooth available at the SAWTOOTH OUT connector.



SECTION 3

CIRCUIT DESCRIPTION

TIME-BASE TRIGGER

Trigger Input Amplifier

The function of the Time-Base Trigger is to develop the triggering pulse which initiates a cycle of action in the Time-Base Generator. The signal from which the triggering pulse is produced may emanate from either of two sources, as determined by the setting of the TRIGGER SLOPE switch (black knob), SW7010. When the switch is in the +EXT. or -EXT. positions, an external signal is employed in the development of the triggering pulse. In the +LINE or -LINE positions of the switch, a voltage at the power line frequency is used to develop the triggering pulse. To obtain a stable display in either EXT or LINE the triggering waveform should bear a definite time relationship to the observed waveform.

In addition to selecting the source of the triggering signal, switch SW7010 (TRIGGER SLOPE) also selects the polarity of the slope on which triggering will occur.

The Trigger-Input Amplifier V7040 is a polarity-inverting, cathode-coupled amplifier. The output is taken from the plate of V7040A, but the grid of either stage may be connected to the input signal source. When the TRIGGER SLOPE knob is in the -EXT. or -LINE position the grid of V7040B is connected to the input signal source. The grid of V7040A is connected to a dc bias source, adjustable by means of the TRIGGERING LEVEL control. This bias voltage establishes the voltage present at the plate of V7040A under no-signal conditions. When the TRIGGER SLOPE knob is in the +EXT. or +LINE position the grid of V7040A is connected to the input-signal source, and the grid of V7040B is connected to the bias voltage source.

The voltage at the grid of V7040B and the voltage at the plate of V7040A are in phase with each other; that is, they both go through ac zero in the same direction at the same time. By this arrangement, V7040B acts as a cathode-follower, having a gain of approximately .5, and the signal voltage developed across the cathode resistor becomes the input signal for V7040A.

When the switch is moved to either the +EXT. or +LINE position, the grid of V7040A is connected to the input-signal source. With this configuration, the voltage at the plate of V7040A will be 180 degrees out of phase with the input-signal voltage. Thus, depending on the setting of the TRIGGER SLOPE switch (+ or -), the plate of V7040A swing may be in phase, or 180 degrees out of phase with the input-signal voltage.

Schmitt Trigger

The Schmitt Trigger consists of V7350, A and B, connected as a dc-coupled multivibrator. In the quiescent state, ready to receive a signal, V7350A is conducting and its plate is down. This holds the grid of V7350B below cut-off since the circuits are dc-coupled by the voltage divider R7440, R7460 and R7470. With V7350B cut off its plate voltage is up and no output is developed.

A negative-going signal is required at the grid of V7350A to drive the Schmitt Trigger into its other state, at which time a triggering pulse is produced. The signal coupled to the grid of V7350A may contain both positive-and negative-going components.

The negative-going portion of the signal will drive the grid of V7350A in the negative direction and the cathodes of both tubes will follow the grid down. As the grid of V7350A is driven negative the current flow through the tube is restricted, and the voltage at its plate starts to rise. Due to the coupling between the plate of V7350A and grid of V7350B, the rise in voltage at the plate of V7350A carries the grid of V7350B with it.

The cathodes of both tubes are coupled together, and follow the action of the grids. With the grid voltage of V7350B going up, and its cathode voltage going down, V7350B starts to conduct. As soon as V7350B starts to conduct the cathodes of both tubes begin to follow the action of the grid of V7350B; hence the cathode voltages start going up.

With the grid of V7350A down and its cathode up, this tube stops conducting. As V7350B conducts, its plate voltage drops, creating a negative-going step at its output. This transition occurs rapidly, regardless of how slowly the grid signal of V7350A falls.

When the signal applied to the grid of V7350A starts in the opposite direction the action described in the preceding paragraphs reverses itself. That is, V7350A will start to conduct once more, while V7350B is cut off--causing the circuit to revert to its original state.

The operation of the Schmitt Trigger is exactly the same for both + and - positions of the TRIGGER SLOPE switch. However, the polarity at the output of the Trigger Amplifier is reversed between the + and - settings of the TRIGGER SLOPE switch with respect to a certain point on the triggering signal. This causes triggering to occur at different points on the waveform being observed.

When the TRIGGER SLOPE switch is in the + positions triggering occurs on the positive-going portion of the waveform and the display starts at that point. When the TRIGGER SLOPE switch is in the - positions triggering occurs on the negative-going portion of the waveform and the display starts at a point on the negative portion.

The TRIGGERING MODE switch, SW7040, selects the type, or mode, of triggering. In the DC position, the triggering signal is dc-coupled from the TRIGGER INPUT to the Trigger Amplifier, which in turn is dc-coupled to the grid of V7350A the Schmitt Trigger. R7240 isolates the plate circuit of V7040A from the capacitance of the switch; R7250 isolates the grid circuit of V7350 from the capacitance of the switch.

In the AC position of the TRIGGERING MODE switch, capacitor C7020 is connected into the input circuit; this of course, removes any dc component of the waveform. The Trigger-Input Amplifier, however, is still dc-coupled to the Schmitt Trigger stage.

In the AUTO. position of the TRIGGERING MODE switch, the Schmitt Trigger is converted from a bistable configuration to a recurrent configuration. This is accomplished by coupling the grid circuit of V7350B to the grid circuit of V7350A via R7370. In addition, the dc coupling between the Trigger-Input Amplifier and the Schmitt Trigger is removed when the switch is in the AUTO. position.

The addition of R7370 to the circuit causes the Schmitt Trigger to free-run in the absence of a triggering signal. For example, assume the grid of V7350A is just being driven into cut-off. The voltage at the plate of V7350A starts to rise, carrying with it the grid voltage of V7350B. As the voltage at the grid of V7350B rises, V7350B starts to conduct.

The rising voltage at the grid of V7350B is coupled to the grid of V7350A through R7370. The grid of V7350A is prevented from rising immediately by the action of C7240, which must be charged sufficiently to raise the voltage at grid of V7350A above cutoff.

As V7350A starts to conduct, its plate voltage drops, which in turn lowers the voltage at the grid of V7350B. The voltage at the grid of V7350A now starts dropping exponentially toward cutoff. When V7350A reaches cutoff again, the circuit has completed one cycle of its approximately 50-cycle voltage waveform.

The range of voltage at the grid of V7350A between V7350A cutoff and V7350B cutoff, is about 3 volts when the circuit is used in the AUTO. mode. The addition of R7370 increases the voltage range from about 0.5 volts in the AC, AC LF REJECT, or DC mode. Since the grid of V7350A is never more than 3 volts from cutoff, a triggering signal with a peak-to-peak amplitude of 3 volts or more will cause the multivibrator to produce a trigger output prior to the time it would do so under no-signal conditions. Smaller signals will also produce a trigger output, but only if they occur at a time when the sum of the signal voltage and the grid voltage is sufficient to drive the grid of V7350A to cutoff.

When the Schmitt Trigger is in the recurrent configuration just described, the Time Base Generator can be triggered with repetitive signals over a wide range of frequencies, without readjustment. When not receiving triggers, the Schmitt Trigger continues to operate at approximately a 50-cycle rate. Thus, in the absence of triggers, the Time-Base Generator will continue to generate a sawtooth output.

When the TRIGGERING MODE switch is in the HF SYNC position, the Time-Base Trigger is bypassed, and the signal at the TRIGGER INPUT connector is applied directly to the Time-Base Generator. This signal acts as a synchronizing voltage, superimposed on the holdoff waveform, (to be discussed in the section that follows). This synchronizes the Time-Base Generator at a sub-multiple of the triggering-signal frequency. This mode is useful for input signals in the range from 5 megacycles to 20 megacycles.

The time-Base Trigger Produces a negative-going waveform which is coupled to the Time-Base generator. This waveform is differentiated in the grid cirucit of V7650B to produce a sharp negative-going triggering pulse to trigger the Time-Base Generator in the proper time sequence. Positive-going pulses are also produced in the differentiation process, but they are not used in the operation of the Time-Base Generator.

TIME-BASE GENERATOR

The Time-Base Generator consists of three main circuits; a Bistable Multivibrator, a Miller Runup Circuit, and a Hold-Off Circuit. The Bistable Multivibrator consists of V7650B, V7750A and the cathode-follower V7650A. The essential components in the Miller Runup Circuit are the Miller Tube V8110B, the Runup C.F. V8110A, the On-Off Diodes V8020, and the Timing Capacitor C160 and the Timing Resistor R160. The Hold-Off Circuit consists of the Hold-Off Driver V7530B, and Hold-Off Capacitor C180 and the Hold-Off Resistor R180.

In the quiescent state, V7650B of the Bistable Multivibrator is conducting and its plate voltage is down. This cuts off V7750A through the cathode-follower V7650A, the voltage divider R7680-R7690, and the cathode resistor R7710.

Miller Tube

The quiescent state of the Miller Tube is determined by the dc network between plate and grid consisting of the neon lamp B8160, the Runup C.F. V8110A, and the On-Off Diode V8200. The purpose of the dc network is to establish a voltage at the plate of the Miller Tube of such a value that the tube will operate above the knee, and thus over the linear region, of its characteristic curve.

In the absence of signal the grid of the Miller Tube rests at about -3 volts. There is about a 1 1/2 volt drop in the Runup On-Off Diodes, about 18.5-volts bias on the Runup C.F., and about a 55-volt drop across the neon lamp. This establishes a quiescent voltage of about 40 volts at the plate of the Miller Tube.

If the STABILITY control is now advanced, making the grid of V7650B more negative, a point will be reached where a negative-going triggering pulse from the Schmitt Trigger stage will cause the Bistable Multivibrator to switch rapidly to its other state. That is V7650B will be cut off and V7750A will start to conduct. (Any spiking that may occur, during this transition period, is attenuated by the R7790-C7790 network.) As V7750A conducts, its plate voltage, and the voltage at the diode plates, drops. As a result the diodes are cut off, which permits the grid of the Miller Tube and the cathode of the Runup C.F. to seek their own voltages.

As there is no connection to the diodes at this time, the grid of the Miller Tube starts negative, since it is connected to the -150-volt supply through the Timing Resistor R160. The plate of the Miller Tube then starts positive, carrying with it the grid and cathode of the Runup C.F., V8110A. This raises the voltage at the top of the Timing Capacitor C160, which in turn raises the voltage at the grid of the Miller Tube, and prevents it from going negative. The gain of the Miller Tube, as a class A amplifier, is approximately 200. This means that a 150-volt change in plate voltage will maintain the grid voltage constant within three-quarters of a volt.

The Timing Capacitor starts charging with current from the -150-volt bus. Since the voltage at the grid of the Miller Tube remains essentially constant, the voltage drop across the Timing Resistor, and hence the charging current through it, remains essentially constant. Thus, C160 charges linearly, and the voltage at the cathode of the Runup C.F. V8110A rises linearly. Any departure from a linear rise in the voltage at this point will produce a change in the voltage at the grid of the Miller Tube in such a direction as to correct for the error.

Timing Components

The linear rise in the voltage at the cathode of V8110A is used to provide the output sawtooth, or Time-Base. Timing Capacitor C160 and Timing Resistor R160 are selected by means of the TIME/DIV. switch (SW160). The Timing Resistor determines the current that charges the Timing Capacitor. By means of the TIME/DIV. switch, both the size of the capacitor being charged and the current charging the capacitor can be selected to cover a wide range of sawtooth slopes (time-bases). For high-rate time bases the bootstrap capacitor, C8140, helps supply the current to charge the stray capacitance at the plate of the Miller Tube which permits the plate voltage to rise at the required rate.

If uncalibrated time-bases are desired, the VARIABLE TIME/DIV. control may be turned away from the calibrated position. This control, R8320, varies the time-base rate from approximately 5 SEC/DIV. to .2 μSEC/DIV. Switch SW8300 is ganged with the variable control in such a way that the UNCALIBRATED light comes on when the control is turned away from the CALIBRATED position.

As explained previously, the time-base rate (the rate at which the spot moves across the face of the crt) is determined by the timing circuit components, C160 and R160. The length of the time-base (the distance the spot moves across the face of the crt), however, is determined by the setting of the Sweep Length/Sawtooth Amplitude control, R8260. As the time-base voltage rises linearly at the cathode of V8110A, there will be a linear rise in voltage at the arm of the Sweep Length/Sawtooth Amplitude control R8260. This will increase the voltage at the grid and cathode of V7530A, and at the grid and cathode of V7530B. As the voltage at the cathode of V7530B rises, the voltage at the grid of V7650B will rise. When the voltage at this point is sufficient to bring V7650B out of cutoff, the multivibrator circuit will rapidly revert to its original state with V7650B conducting and V7750A cut off.

The voltage at the plate V7750A rises, carrying with it the voltage at the diode plate, V8020B. The diode then conducts and provides a discharge path for C160 through R7780 and R7770, and through the resistance in the cathode circuit of V8110A. The plate voltage of the Miller Tube now falls linearly, under feedback conditions essentially the same as when it generated the time base portion of the waveform, 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 at 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 time-base sawtooth, during which time the crt beam returns rapidly to its starting point.

Hold-Off Circuit

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

During the trace portion of the sawtooth the Hold-Off Capacitor C180 charges through V7530A, as a result of the rise in voltage at the cathode of V7580A. At the same time, the grid of V7650B is being pulled up, through the Hold-Off C.F. V7650B, until V7650B comes out of cut-off and starts conducting. As mentioned previously, this is the action that initiates the retrace. At the start of the retrace interval C180 starts discharging through the Hold-Off Resistor. The time constant of this circuit is long enough, however, so that during the retrace interval, (and for a short period of time after the completion of the retrace) V7530B holds the grid of V7650B high enough so that it cannot be triggered. However, when C180 discharges to the point that V7530B is cutoff, it loses control over the grid of V7650B and the grid returns to the point established by the STABILITY control. The hold-off time required is determined by the size of the timing components. For this reason the TIME/DIV. switch changes the time constant of the Hold-Off Circuit simultaneously with the change of Timing Capacitors.

Stability Controls

The STABILITY control R7500 regulates the dc level at the grid of V7650B. In use, this control is adjusted so that the grid voltage is just high enough to prevent the circuit from free-running. Adjusted in this manner, a sawtooth will be produced only when a negative-going trigger from the Schmitt Trigger can drive the stage into cut-off. For convenience, a PRESET STABILITY control can be connected into the circuit via switch SW7500. In the PRESET position a fixed negative dc voltage is obtained from R7520 and applied to the grid of V7650B. This control, which is adjustable from the front panel of the Type T, can be used in most triggering applications of the instrument. Where triggering may be critical, however, the variable STABILITY control should be used.

Output Waveform

The positive pulse appearing at the cathode of V7650A is coupled through the GATE OUT C.F. V7750B to the front-panel +GATE OUT connector, and is also used to automatically supply the unblanking pulse when used with the Tektronix Type 536 Oscilloscope.

A banana plug, mounted at the rear of the Type T Plug-In, connects to a banana jack mounted within the Type 536 Oscilloscope when the Type T is used in the HORIZONTAL channel. For use in the VERTICAL channel of the Type 536, or for use in other plug-in type Tektronix oscilloscopes, the +GATE OUT connector can be connected to the oscilloscope EXT CRT CATHODE, or INTENSITY MOD INPUT connector, to provide crt unblanking. The positive pulse at the +GATE OUT connector starts at ground and rises to approximately +30 volts. The starting time and duration of the pulse is coincident with the starting time and duration of the sawtooth time-base waveform.

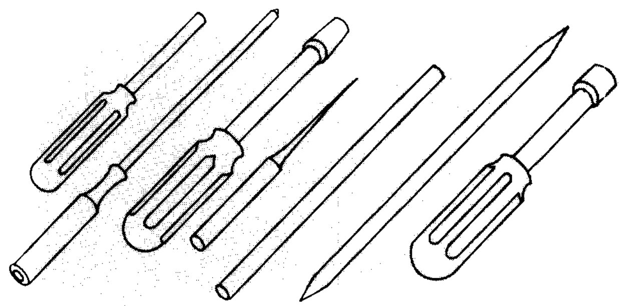
The sawtooth time-base waveform at the cathode of V8110A, in addition to driving the horizontal amplifier of the oscilloscope, is also coupled through the cathode follower V7940B and to the SAWTOOTH OUT connector on the front panel of the Type T Plug-In Unit. This provides a 150-volt linear rise in voltage, starting at zero volts with respect to ground.

5X Magnifier

The sawtooth waveform appearing at the cathode of the Runup C.F. V8110A has an amplitude of approximately 150 volts, far in excess of that needed to drive the horizontal amplifier of the Type 536 Oscilloscope. The amplitude of the sawtooth waveform is reduced to approximately one volt, peak-to-peak, by the voltage divider formed by R8400 and R8460.

The 5X MAGNIFIER switch, SW8420, changes the ratio of the voltage divider formed by R8400 and R8460 by substituting R8420 and R8430. This change in the voltage divider increases the amplitude of the output sawtooth from one volt to approximately 5 volts. The setting of R8430, Mag. Gain Adj. determines the exact output level in the magnified position. The MAG. CENTERING control, R8480, determines the position of the start of the time-base on the crt screen.

NOTES



SECTION 4

MAINTENANCE

PREVENTIVE MAINTENANCE

Recalibration

The Type T Plug-In Unit is designed for maximum stability and should not require frequent calibration. However, to insure the accuracy of measurements, we suggest that you calibrate the instrument after each 500-hour period of operation (or every six months if the unit is used intermittently). A complete step-by-step procedure for calibrating the unit and checking its operation is given in the Calibration section of this manual. The accuracy of measurements made with the Type T Unit depends not only on the accuracy of the Type T Unit calibration but on the associated oscilloscope calibration as well. Therefore, it is essential that the oscilloscope be maintained in proper calibration.

Visual Inspection

Many potential and existent troubles can be detected by a visual inspection of the unit. For this reason, you should perform a complete visual check every time the instrument is calibrated or repaired. Apparent defects may include loose or broken connections, damaged connectors, improperly seated tubes, scorched or burned parts, or broken terminal strips, as well as many other troubles. The remedy for these troubles is readily apparent except in the case of heat-damaged parts. Damage of parts due to heat is often the direct result of other, less apparent troubles in the circuit. It is essential that you determine the cause of overheating before replacing the damaged parts to prevent damage to the new components.

COMPONENT REPLACEMENT

The procedures for replacing most parts in the Type T Unit are obvious. Detailed instructions for their removal are therefore not required. Other components, however, can best be removed if a definite procedure is followed or if certain precautions are taken. Additional information for the replacement of some of these parts is contained in the following paragraphs. Because of the nature of the instrument, replacement of certain parts will require that you calibrate portions of the instrument to insure proper operation. Refer to the Calibration section of this manual.

Tubes

Care should be taken both in preventive and corrective maintenance that tubes are not replaced unless they are actually causing a definite circuit malfunctiion. Many times during routine maintenance it will be necessary for you to remove tubes from their sockets. It is important that these tubes be returned to the same sockets unless they are actually defective. Needless replacement or switching of tubes will many times result in unnecessary calibration of the instrument. If tubes do require replacement, it is recommended that they be replaced by previously checked high-quality tubes.

Switches

Methods for removal of defective switches are, for the most part, obvious and only a normal amount of care is required. Single wafers are normally not replaced on the switches used in the Type T Unit, and if one wafer is defective, the entire switch should be replaced. Switches may be ordered from Tektronix either wired or unwired as desired.

Soldering and Ceramic Strips

Many of the components in your Tektronix instrument are mounted on ceramic terminal strips. The notches in these strips are lined with a silver alloy. Repeated use of excessive heat, or use of ordinary tin-lead solder will break down the silver-to-ceramic bond. Occasional use of tin-lead solder will not break the bond if excessive heat is not applied.

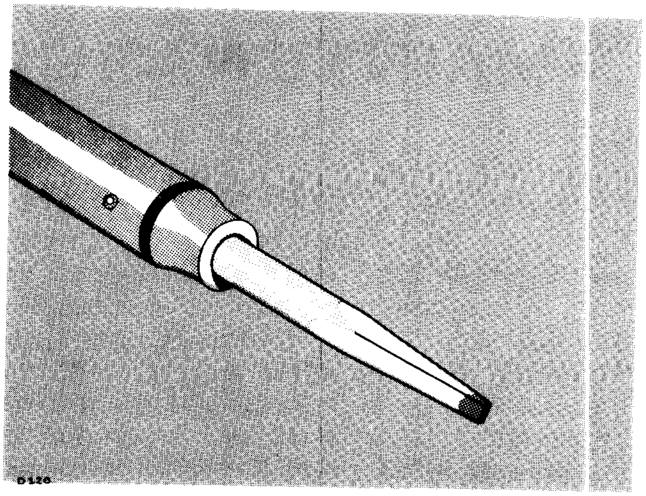


Fig. 4-1. Soldering iron tip properly shaped and tinned.

If you are responsible for the maintenance of a large number of Tektronix instruments, or if you contemplate frequent parts changes, we recommend that you keep on hand a stock of solder containing about 3% silver. This type of solder is used frequently in printed circuitry and should be readily available from radio-supply houses. If you prefer, you can order directly from Tektronix in one-pound rolls, Order by Tektronix part number 251-514.

Because of the shape of the terminals on the ceramic strips it is advisable to use a wedge-shaped tip on your soldering iron when you are installing or removing parts from the strips. Fig.4-1 will show you the correct shape for the tip of the soldering iron. Be sure and file smooth all surfaces of the iron which will be tinned. This prevents solder from building up on rough spots where it will quickly oxidize.

When removing or replacing components mounted on the ceramic strips you will find that satisfactory results are obtained if you proceed in the manner outlined below.

1. Use a soldering iron of about 75-watt rating.
2. Prepare the tip of the iron as shown in Fig. 4-1.
3. Tin only the first 1/16 to 1/8 inch of the tip. For soldering to ceramic terminal strips tin the iron with solder containing about 3% silver.

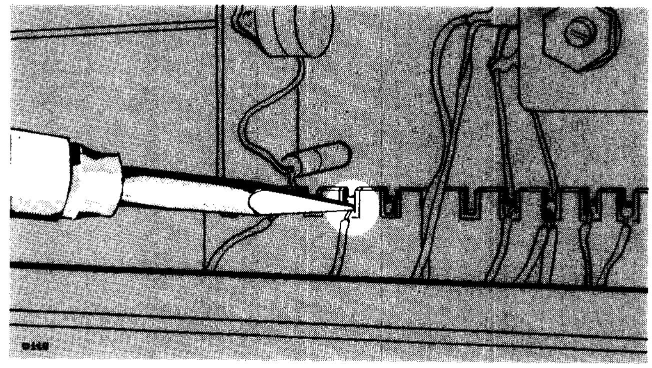


Fig. 4-2. Correct method of applying heat in soldering to a ceramic strip.

4. Apply only one corner of the tip to the notch where you wish to solder (see Fig. 4-2.
5. Apply only enough heat to make the solder flow freely.
6. Do not attempt to fill the notch on the strip with solder; instead, apply only enough solder to cover the wires adequately, and to form a slight fillet on the wire as shown in Fig.4-4.

In soldering to metal terminals (for example, pins on a tube socket) a slightly different technique should be employed. Prepare the iron as outlined above, but tin with ordinary tin-lead solder. Apply the iron to the part to be soldered as shown in Fig. 4-3. Use only enough heat to allow the solder to flow freely along the wire so that a slight fillet will be formed as shown in Fig. 4-4.

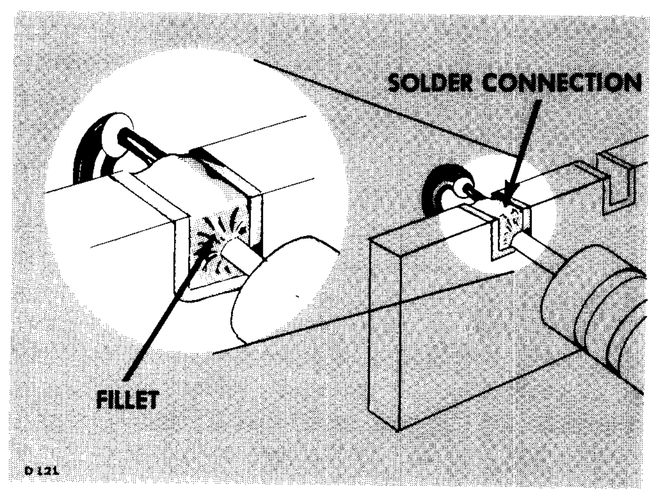


Fig. 4-3. A slight fillet of solder is formed around the wire when heat is applied correctly.

General Soldering Considerations

When replacing wires in terminal slots clip the ends neatly as close to the solder joint as possible. In clipping ends of wires take care the end removed does not fly across the room as it is clipped.

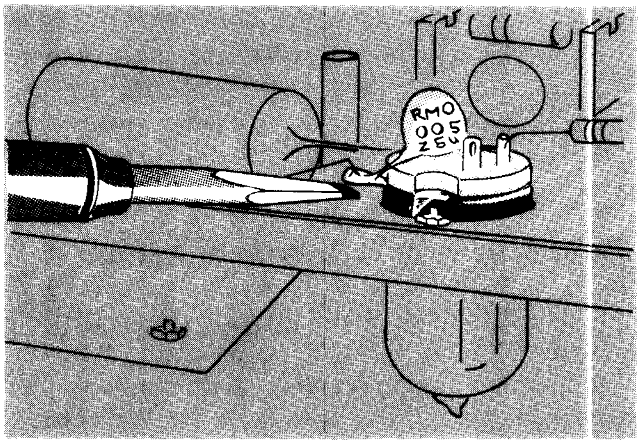


Fig. 4-4. Soldering to a terminal. Note the slight fillet of solder--exaggerated for clarity--formed around the wire.

Occasionally, you will wish to hold a bare wire in place as it is being soldered. A handy device for this purpose is a short length of wooden dowel, with one end shaped as shown in Fig. 4-5. In soldering to terminal pins mounted in plastic rods it is necessary to use some form of "heat sink" to avoid melting the plastic. A pair of long-nosed pliers (see Fig. 4-6) makes a convenient tool for this prupose.

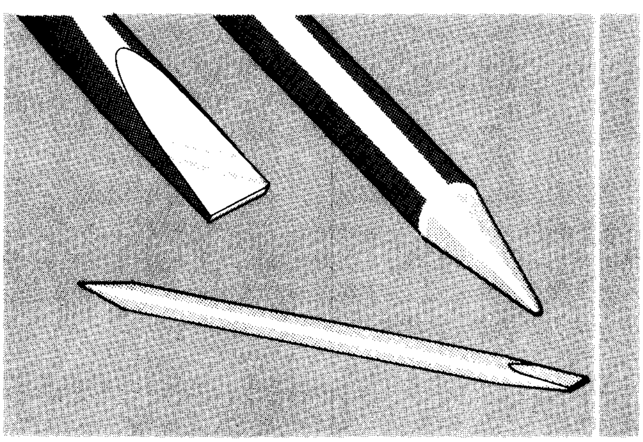


Fig. 4-5. A soldering aid constructed from a 1/4 inch wooden dowel.

Ceramic Strips

Two distinct types of ceramic strips have been used in Tektronix instruments. The earlier type mounted on the chassis by means of #2-56 bolts and nuts. The later type is mounted with snap-in plastic fittings. Both styles are shown in Fig. 4-7.

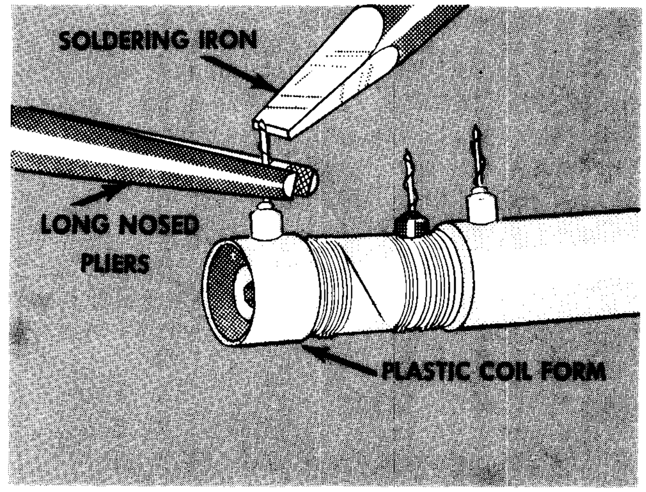


Fig. 4-6. Soldering to a terminal mounted in plastic. Note the use of the long-nosed pliers between the iron and the coil form to absorb the heat.

To replace ceramic strips which bolt to the chassis, screw a #2-56 nut onto each mounting bolt, positioning the nut so that the distance between the bottom of the nut and the bottom of the ceramic strip equals the height at which you wish to mount the strip above the chassis. Secure the nuts to the bolts with a drop of red glyptal. Insert the bolts through the holes in the chassis where the original strip was mounted, placing a #2 starwasher between each nut and the chassis. Place a second set of #2 flatwashers on the protruding ends of the bolts, and fasten them firmly with another set of #2-56 nuts. Place a drop of red glyptal over each of the second set of nuts after fastening.

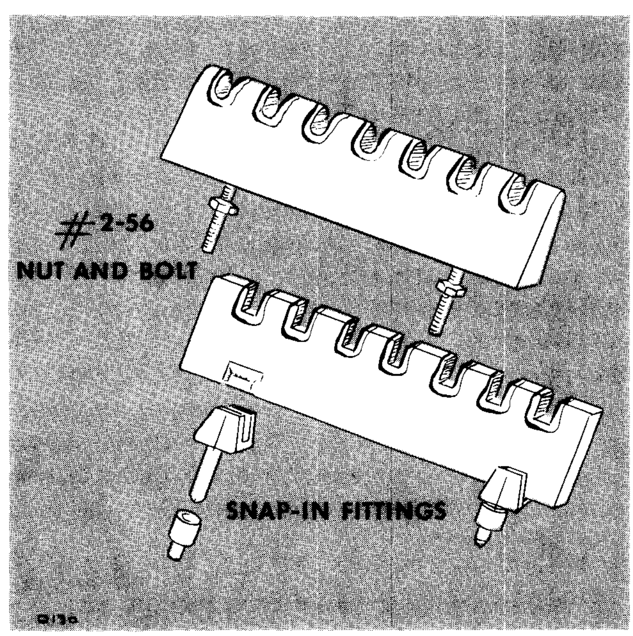


Fig. 4-7. Two types of ceramic strip mountings.

Mounting Later Ceramic Strips

To replace strips which mount with snap-in plastic fittings, first remove the orginial fittings from the chassis. Assemble the mounting post on the ceramic strip. Insert the nylon collar into the mounting holes in the chassis. Carefully force the mounting post into the nylon collars. Snip off the portion of the mounting post which protudes below the nylon collar on the reverse side of the chassis.

Note

> Considerable force may be necessary to push the mounting rods into the nylon collars. Be sure that you apply this force to that area of the ceramic strip directly above the mounting rods.

TROUBLESHOOTING

This section is included to provide you with information about the Type T Plug-In Unit that will enable you to more efficiently troubleshoot the instrument in the event of equipment failure. During troubleshooting work, you should correlate information contained in this section with information obtained from other sections of this manual. We have not attemped to give detailed step-by-step procedures for finding the cause of specific troubles. We have, instead, attempted to outline a general troubleshooting guide which can be used to locate any trouble which may occur in the instrument. This guide provides a means for determining the probable defective circuit or part from the symptoms observed rather than from detailed voltage or resistance measurements.

All wiring in the Type T Unit is color coded to facilitate circuit tracing. Specific color codes are used to distinguish the leads for the power-supply voltages obtained from the oscilloscope. These power-supply leads follow the standard RETMA code. The -150 volts bus wire is coded brown-green-brown; the +350 volts bus is coded orange-green-brown; the +225 volts bus is coded red-red-brown and the +100 volts bus is coded brown-black-brown. The widest stripe identifies the first color of the code.

Schematic diagrams of each circuit are contained in the rear portion of this manual. The reference designation of each electronic component of the instrument is shown on the circuit diagrams as well as important voltages and waveforms. These voltages and waveforms may be used during troubleshooting to isolate the cause of the trouble.

To make use of the waveform diagrams and voltage readings you may duplicate the test conditions by using the following procedure.

Procedure for Circuit Checking

To be sure that the triggering signal is getting to the TRIGGER INPUT connector, check the waveform at this point with another oscilloscope. Next, place all the switches of the Type T Unit in the positions shown in the schematic diagram. With you test oscilloscope examine the waveform at the input grid of V7040. Compare the signal at this point with that shown in the schematic diagram. If the signals appear to be similiar proceed to pin 1 of V7350, and check the waveform at this point. If the waveform at pin 1 of V7350 appears to be correct the operation of the Time-Base Trigger is satisfactory for the switch positions you have used.

To determine the condition of the Time-Base Generator examine the waveform at the grid of V7650B, pin 7. If no waveform is present you may assume the generator is inoperative. In this case you will have to proceed with the aid of a good dc voltmeter. Voltage readings are given at all significant points in the circuit.

Measure the voltage at pin 7 of V7650. For purposes of this example assume that it measures - 25 volts. This is considerable less negative than the voltage shown on the schematic for normal operation of the circuit.

Measure the voltage at pin 2 of V7530. This is also - 25 volts, considerably less negative than the normal voltage at this point. Inspection of the schematic diagram shows that the grid voltage of V8110A is likely to be important in determining the voltage at the point you have just checked. Measurement of the voltage at pin 2 of V8110 gives a reading of +200 volts, far above the normal value of +48 volts. A check of the plate voltage at the Miller Tube, V8110B shows that the plate voltage is nearly equal to the supply voltage, indicating that the Miller Tube is not conducting.

Measurement of the voltage at the grid and screen grid of the Miller Tube show that these voltages are approximately those which are present when the circuit is operating properly. Replacement of the Miller Tube will restore the circuit to normal operation.

TROUBLESHOOTING THE TIME-BASE TRIGGER CIRCUIT

Unstable Triggering

If the sweep generator is not being properly triggered, a stable display of a waveform will not be possible. If the sweep can be turned off and on with the STABILITY control (for every setting of the TRIGGERING MODE switch except AUTOMATIC) the sweep generator is capable of being triggered; this indicates the trigger circuitry is not functioning properly.

To check the quiescent state of Time-Base Trigger circuit, set the TRIGGERING MODE switch to AC, the TRIGGER SLOPE switch to -EXT., and the TRIGGERING LEVEL control to 0. Next, connect a jumper wire from the junction of R7180, R7190 and C7190 to ground. This fixes the voltage at the grid of V7040A at ground potential. Then measure the voltage at the plate of V7040A; this should be about +75 volts. If this voltage does not measure very close to +75 volts, replace the Trigger Input tube V7040. If necessary, check for off-value resistors, broken leads and poor switch contacts.

The next step is to connect the voltmeter between the plate of V7040A and the grid of V7350B (the junction of R7420, R7440, R7460 and C7420 is more convenient than the grid of V7350B). The voltage between the plate of V7040A and the grid of V7350B should not exceed about 2.75 volts. It is the function of the Triggering Level Centering control R7470 to set the voltage at the grid of V7350B approximately equal to the voltage at the gird of V7350A. With the grids of the V7350 at about the same voltage the center of the hysteresis of the Schmitt Trigger circuit will be at the proper level. It is difficult to measure the voltage directly between the two grids of V7350 due to the loading of the voltmeter; for this reason we suggest the voltage be measured between the plate of V7040A and the grid circuit of V7350B. A voltage of 2.5 to 2.75 volts between these points will indicate proper quiescent operation.

If the voltage at the grid of V7350B cannot be adjusted to within 2.5 to 2.75 volts of the voltage at the plate of V7040A, trouble in the Schmitt multivibrator is indicated. Replace the tube; then, if necessary, check for off-value resistors, broken leads and poor connections.

Conversely, if the voltages are found to be correct, the adjustment of the Trigger Sensitivity control R7330 can be checked. Refer to the Calibration Procedure for the proper method of checking the adjustment of this control.

TROUBLESHOOTING THE TIME-BASE GENERATOR

No Horizontal Sweep

If the Time-Base Generator is not producing a sawtooth sweep voltage, when the STABILITY control is adjusted for a free-running sweep, some defect in the generator is hanging up the Miller circuit. Depending on the on-off characteristics of the diodes V8020, the Miller circuit may be hung up at either the high end or the low end of the sawtooth. The manner in which it is hung up may be determined by measuring the voltage at the SAWTOOTH OUT binding post. If the Miller circuit is hung up at the high end of the sawtooth the voltage at the front-panel binding post will measure about + 200 volts; if hung up at the low end, the voltage at this point will measure anywhere between ground and -20 to -30 volts, depending on the cause.

If the Miller circuit is hung up at the high end of the sawtooth, a check of the voltage at the grid of the Miller tube will offer a clue to the cause of the trouble. The static voltage at the Miller grid is determined by conduction through the Timing Resistor R160 (from -150-volt bus), the lower diode V8020B and the divider R7770-R7780. It will be impossible to measure the exact voltage at the Miller grid because of the loading of the meter. However, if a 20,000-Ω/v meter, or a vacuum-tube voltmeter is used, the voltage reading obtained will be sufficient to indicate the source of the trouble. For example, if a voltage reading more negative than about -15 volts is obtained, there is probably no conduction through the Timing Resistor. This would indicate an open divider R7770-R7780, assuming the diode V8020 to be good.

If the Miller circuit is hung up at the low end of the sawtooth, as indicated by a voltage reading of zero or a few volts negative, a check of the voltage at the plate of the Miller tube will offer a clue to the cause. If this voltage is quite high (about +350 volts), check the neon lamp B8160 and the Runup CF tube V8110A. If the voltage at the plate of the Miller tube is zero or slightly negative, check for an open plate-load resistor R8140 or R8150.

However, if the voltage at the plate of the Miller tube is near the quiescent level (about +45 volts) the trouble will generally lie ahead of the Miller tube. The result of the trouble is that the On-Off Diodes V8020 cannot be gated off; they are conducting heavily and clamping the grid of the miller tube near ground. If all of the tubes have been checked, then check for open plate and cathode resistors in the Sweep-Gating Multivibrator circuit, the Hold-Off circuit and the Runup CF circuit. Also check that the STABILITY control can vary the voltage at the grid of V750B.

Improper Triggering

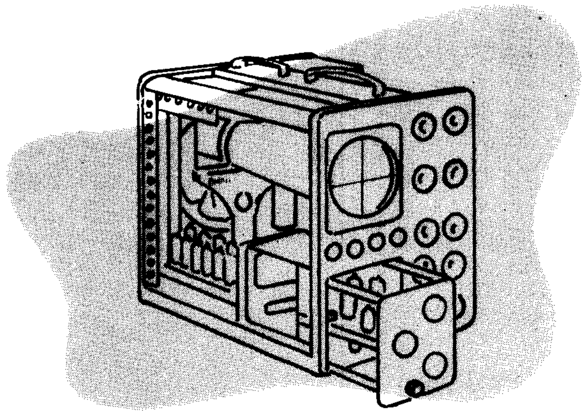
If the sweep cannot be triggered properly, the gating pulse from the Multivibrator is not turning the diodes V8020 off and on properly. The start of the gating pulse, which turns the diodes off and starts the sweep, is initiated by the triggering pulse at the grid of V7650B The end of the gating pulse, which turns the diodes on and initiates the retrace, is controlled by the hold-off waveform at the grid of V7650B. The Sweep-Gating Multivibrator can be eliminated as the cause of the trouble if the sweep can be turned off and on with the STABILTIY control. The main component to check, in addition to the the tubes, is the differentiating capacitor C7610.

Nonlinear Sweep

A nonlinear sweep voltage will be generated if the current charging the Timing Capacitor C160 does not remain constant. If the nonlinearity occurs at all sweep rates a defective Miller tube will be the probable cause. If the nonlinearity occurs only at certain sweep rates a leaky Timing Capacitor will be the probable cause but the Miller tube should not be overlooked. A defective bootstrap capacitor C8140 can cause the sweep to be nonlinear at the faster sweep rates.

Insufficient Horizontal Deflection

If the horizontal trace starts at the left side of the graticule, but does not extend to the right side, the Hold-Off circuit is causing V7650B to conduct too soon after the triggering pulse had forced it into cutoff. If the trace cannot be expanded the full length of the graticule with the Sweep Length/Sawtooth Amplitude control R8260, check the resistance values in the cathode circuit of V8110A.



SECTION 5

CALIBRATION

General

The Type T Plug-In is a stable instrument and should not require frequent calibration. However, it will be necessary to calibrate certain parts of the instrument when tubes or components are changed, and a periodic calibration is desirable. In the instructions that follow, the steps are arranged in the proper sequence for a full recalibration of the instrument. Each numbered step contains the information necessary to make one adjustment. If you are aware of the interaction between adjustments, you can refer to a particular adjustment procedure and make the adjustment without performing unnecessary steps.

Outline of Procedure

For purposes of calibration, the Type T can be divided into two distinct parts: (1) the triggering circuits, and (2) the time-base generator. Calibration adjustments made in either of these categories will frequently affect another adjustment in the same category. On the other hand, calibration adjustments made in one category will usually have little or no effect on adjustments in another category.

Interaction of Adjustments

If you find it necessary to effect a single adjustment without recalibrating the rest of the instrument, it is most important that you be fully aware of the interaction of adjustments. Generally speaking, the interaction of controls will be apparent in the schematic diagram. If you are in doubt, check the calibration of the entire section on which you are working.

EQUIPMENT REQUIRED

The following equipment or its equivalent is necessary for a full calibration of the Type T Plug-In.

1. Dc voltmeter of a least 20,000 ohms per volt sensitivity.

2. Tektronix Type EP 53/54 Plug-In Extension, Tektronix part number 013-019.

3. Tektronix Type 536 Oscilloscope and a Type CA Plug-In for the vertical channel.

The Type CA is recommended since it will be able to check the dual-trace circuitry of the Type T. If a CA Plug-In isn't available a plug-in with a bandpass of 10 mc may be substituted.

4. Time-Mark Generator, Tektronix Type 180 or Type 181. If neither of these instruments is available, it will be necessary to substitue a a time-mark generator having output markers of 100, 10 and 1 microseconds, and a sine-wave output of 10 megacycles, with an accuracy of at least 1%.

5. A constant amplitude signal generator, Tektronix Type 190B or similar Type. If another generator is used it must have a 20 mc sine-wave output of at least 100 millivolts in amplitude.

6. 52-ohm Coaxial Cable (Tektronix Type P52). Tektronix part number 012-001.

7. Type 317 Oscilloscope or a scope having a 1 mc bandpass and a vertical sensitvity of at least .05 V/DIV. A 10X probe such as a P510 or P6017 is needed with 317.

8. Patch cords 12" long. Tektronix part number 012-031.

9. Insulated alignment tools. See figure. 5-1.

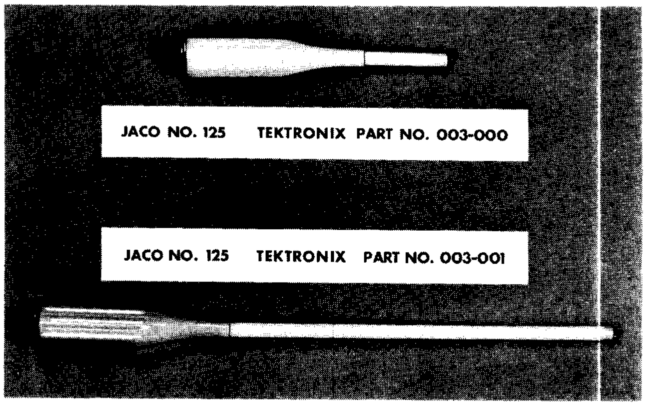


Fig. 5-1. Low capacitance, insulated alignment tools used to calibrate the Type T.

Checking the Calibration

Preliminary

Before installing the Type T Plug-In Unit in the oscilloscope, make a careful visual inspection of the wire dress. This is particularly important if any soldering has been done to the unit. Then make the following resistance-to-ground checks at the 16-pin interconnecting plug. The table below lists the nominal resistance value from each pin to ground.

NOMINAL RESISTANCES AT INTERCONNECTING PLUG

PIN NUMBER	RESISTANCE-TO-GROUND
1	2 K
1 mag on	600 Ω
2	0
3	300 Ω
4	Infinite
5	"
6	"
7	"
8	1 Meg.
9	7 K
10	50 K
11	15 K to 20 K
12	Infinite
13	"
14	"
15	400 Ω
16	2 Meg.
BANANA PLUG	5 K

It is assumed in this procedure that the Type 536 oscilloscope is in calibration.

Now install the Type T into the Horizontal plug-in box of the Type 536 Oscilloscope, connecting the EP 54 between the oscilloscope and the Type T. Turn on all of the test instruments and allow about 15 minutes for warm up.

1. Adjusting the Pos. Range

Set the oscilloscope controls:

INTENSITY MODULATION	EXT AC
PHASING	O
SQUARE WAVE CALIBRATOR	OFF

Type CA controls:

MODE	A ONLY
VOLTS/CM (VARIABLE	.05 (CALIBRATED)
POLARITY	NORMAL
AC/DC	AC
VERTICAL POSITIONING	midrange

Type T controls:

TIME/DIV (VARIABLE)	1 MILLISEC (CALIBRATED)
5X MAGNIFIER	off
STABILITY	full clockwise
TRIGGERING LEVEL	O
POSITION (VERNIER)	mid range (mid range)
TRIGGERING MODE	AC
TRIGGER SLOPE	TEXT

Connect jumpers between the + GATE OUT of the T to the INTENSITY MOD INPUT of the 536 and from the TRIGGER INPUT of the T to the VERT SIG OUT of the 536.

Adjust the Pos Range control so that the left hand end of the trace is on the center vertical graticule line. The positioning controls of the Type T must be set to midrange for this adjustment.

2. AC and AC LF REJECT Adjustments

Reset the following control:

Type 563

SQUARE WAVE CALIBRATOR	5 MILLIVOLTS

Connect a short jump from the junction of R7180, R7190 and C7190 to ground. Connect another jumper from the CAL OUT connector of the 536 to the CHANNEL A Input connector of the CA.

From the 317 (test scope) connect a 10X probe to pin one of V7350B of the T plug-in. The Volts/Div switch on the test scope should be set to .5 volts. The Time/Div switch of the text scope should be set to 1 MILLISEC.

If the controls of the 536, CA and T are properly set a free running display one half of a minor division high should be seen on the crt of the Type 536.

While observing the display on the test scope adjust the Trig. Level Cent. and Trig. Sens. controls until a clean square wave presentation is observed on the text scope. In making this adjustment keep the Trig. Sens. as low as possible to avoid oscillations in the trigger circuit.

Now switch the TRIGGER SLOPE switch of the Type T to the -EXT position. Touch up the Trig Level Cent and Trig Sens controls until a clean display is once again observed on the test scope. The test scope display should now remain steady as the TRIGGER SLOPE switch is switched from + to -.

Switch the TRIGGERING MODE switch to AC LF REJECT and once again touch up the adjustments for stable triggering. Switch back and forth from AC to AC LF REJECT until both modes trigger stably in both polarities of the TRIGGER SLOPE switch.

3. DC Mode Adjustments

Reset the TRIGGERING MODE switch to DC and the SQUARE-WAVE CALIBRATOR to 10 MILLIVOLTS. Now with the positioning control on the CA, position the free running waveform until its center is superimposed upon the horizontal graticule line.

Without disturbing any of the other controls adjust the Vert. Sig. Out DC Level Adj. in the Type 536 until the square-wave presention is once again observed on the test scope. It should be possible to get a clear waveform in both + and - EXT positions of the TRIGGER SLOPE switch of the T plug-in.

The DC mode adjustment is only good as long as this T unit stays in the particular 536 that it was calibrated in. If the T is used with another 536 this adjustment should be reaccomplished for good DC triggering.

Now remove the short jumper from between R7180, R7190 and C7190 and ground. The waveform on the test scope should still be clean in both + and - EXT positions of the TRIGGER SLOPE switch. If it isn't position the TRIGGERING LEVEL control until a spot is found where it will give clear test scope display. If the dot on the TRIGGERING LEVEL control isn't now pointing at O loosen the set screw and reposition the knob (without rotating the shaft) until the dot does point at O.

4. Adjusting PRESET STABILITY

Reset these controls:

Type T

TRIGGER SLOPE	+ LINE
TIME/DIV	.1 MILLISEC
TRIGGERING MODE	AUTO
PRESET STABILITY	full counter clockwise

The probe may be removed at this time. Now connect a voltmeter from the center arm of the PRESET STABILITY pot to ground.

Turn the PRESET STABILITY pot clockwise until the trace just appears. Take a voltage reading at this point and then continue turning the pot clockwise until the trace just brightens. At this time take another voltmeter reading. Now set the pot so that the voltmeter reading is halfway between the two readings just taken. Disconnect the meter.

At this point it would be a good idea to check out all but the HF SYNC modes of triggering using the crt of the 536 to observe the waveforms.

Remove the EP 54 and install the plug-in directly into the oscilloscope. Remove the jumper from the CHANNEL A Input connector of the Type CA.

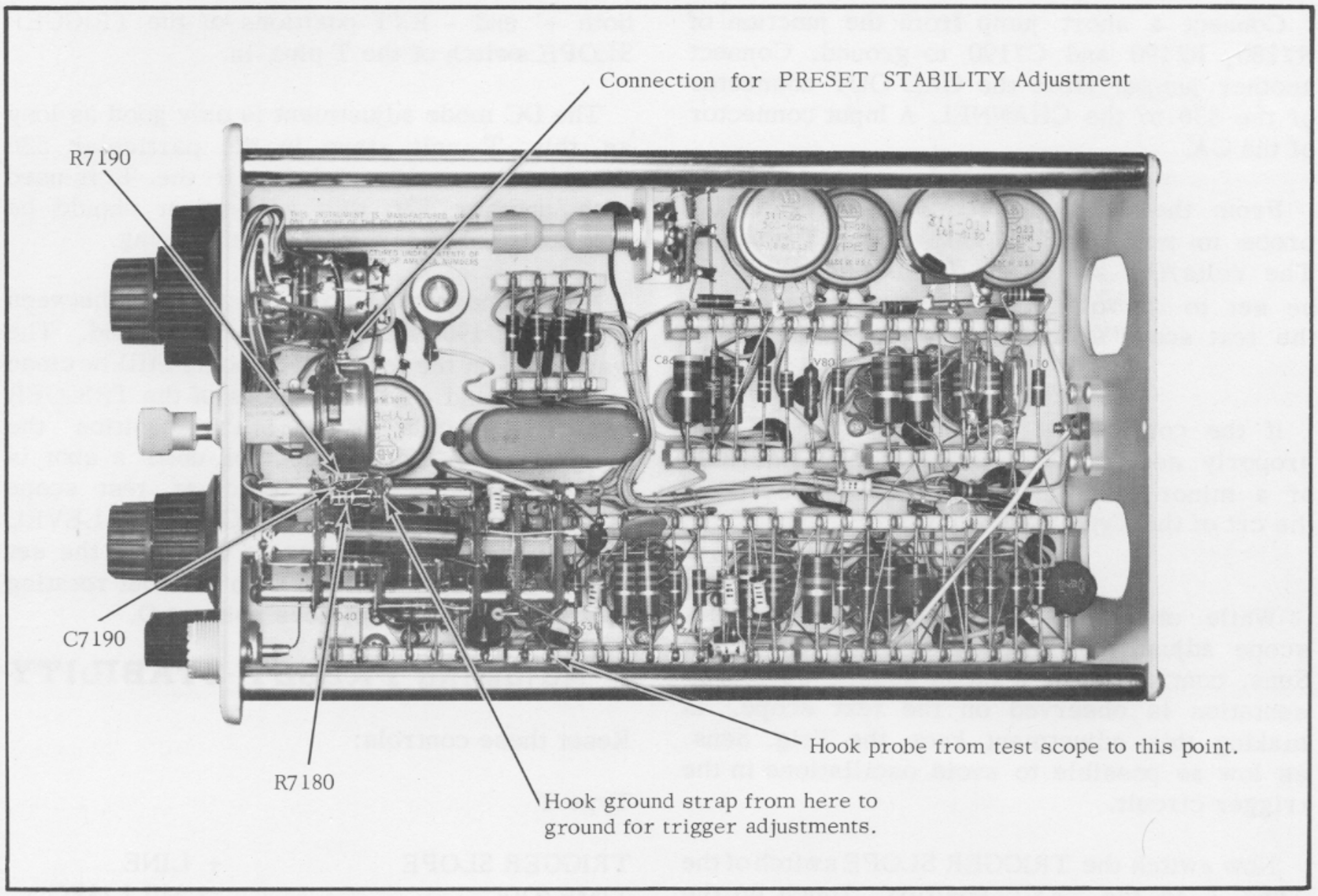


Fig. 5-2. Shows location of the various connections outlined in the Calibration procedure.

5. Adjustment of Time Base Cal

Reset the following controls:

Type CA

VOLTS/CM	2

Type T

TIME/DIV	1 MILLISEC
TRIGGER SLOPE	+ EXT
TRIGGERING MODE	AC
STABILITY	PRESET

From the Type 180 Time Mark Generator apply 100 MICROSECOND and 1 MILLSECOND time markers to the A channel vertical input of the Type CA. Adjust the TRIGGERING LEVEL of the T until stable triggering is accomplished.

The following timing adjustments should be done from the first divison line to the ninth division line.

Adjust the Time Base Cal pot until there is one 1 MILLISEC marker per major division.

6. Mag Gain Adj.

Turn the 5X MAGNIFIER ON and adjust the Mag Gain Adj. until there are two 100 MICROSEC markers per major division.

7. MAG CENTERING Adjustment

With the 5X MAGNIFIER still on, position the trace until the first 1 MILLISEC time marker is superimposed on the center vertical graticule line. Turn the 5X MAGNIFIER OFF and with the MAG CENTERING adjustment reposition the timing comb until the first 1 MILLISEC time marker is once again superimposed on the center vertical graticule line.

This adjustment may have to be repeated several times due to interaction.

Several spots in the timing comb should now be checked to see that the time markers register in both the ON and OFF positions of the 5X MAGNIFIER.

8. Sawtooth Ampl /Sweep Length Adjustment

With the 5X MAGNIFIER OFF, position the timing comb until the first time marker is superimposed on the zero graticule line.

Now adjust the Sweep Length adjustment until five 100 MICROSEC markers appear to the right of the tenth graticule line. This will make a sweep length of 10.5 divisions.

9. Checking Lower Sweep Rates

With the TIME/DIV and Time Marker Generator set as below check for the proper time marks per divisions. If the proper number of Time Markers per division doesn't appear check for an out of tolerance timing capacitor or resistor.

TIME/DIV	Time Mark Generator	Observe
2 SEC	1 SEC	2 markers/div
1 SEC	1 SEC	1 marker/div
.5 SEC	500 MILLISEC	1 marker/div
.2 SEC	100 MILLISEC	2 markers/div
.1 SEC	100MILLISEC	1 marker/div
50 MILLISEC	50 MILLISEC	1 marker/div
20 MILLISEC	10 MILLISEC	2 markers/div
10 MILLISEC	10 MILLISEC	1 marker/div
5 MILLISEC	5 MILLISEC	1 marker/div
2 MILLISEC	1 MILLISEC	2 markers/div
1 MILLISEC	1 MILLISEC	1 marker/div
.5 MILLISEC	500 MICROSEC	1 marker/div
.2 MILLISEC	100 MICROSEC	2 markers/div
.1 MILLISEC	100 MICROSEC	1 marker/div

10. High Frequency Timing Adjustments

The following adjustments may have to be repeated several times due to interaction between the adjustments.

TIME/DIV	Time Mark Generator	Adjust	Observe
10 MICROSEC	10 MICROSEC	C160E	1 marker/div
1 MICROSEC	1 MICROSEC	C160C	1 marker/div
.2 MICROSEC††	10 MC	C160A	2 cycles/div
†.2 MICROSEC††	10 MC	check linearity	4 cycles/10 div

† 5X MAGNIFIER should be on for this check.

†† The external trigger for the T should be 10 MICROSEC triggers from the Type 180 for these two steps.

11. Check remaining High Frequency Ranges

Triggers from the Type 180 can be used when checking the sweep rates above although the signal from the VERT SIG OUT of the 536 will provide stable triggering.

TIME/DIV	Time Mark Generator	Observe
50 MICROSEC	50 MICROSEC	1 marker/div
20 MICROSEC	10 MICROSEC	2 markers/div
5 MICROSEC	5 MICROSEC	1 marker/div
2 MICROSEC	1 MICROSEC	2 markers/div
.5 MICROSEC	1 MICROSEC	1 marker/2 div

12. Checking HF SYNC Mode

Reset the Type T controls as follows:

TRIGGERING MODE	HF SYNC
TRIGGER SLOPE	-EXT
TRIGGERING LEVEL	full clockwise
5X MAGNIFIER	ON
TIME/DIV	.2 MICROSEC
STABILTIY	full clockwise

Adjust the Type 190 for a 20 mc output and connect the Attenuator to the CHANNEL A Input of the Type CA. Adjust the amplitude controls of the CA and 190 until a 2 major division display has been achieved on the crt of the 536.

Adjust the STABILIYY control for a stable and rap the 536 on the top. The waveform should remain steady. Remove the Type 190 from the CHANNEL A Input of the CA plug-in.

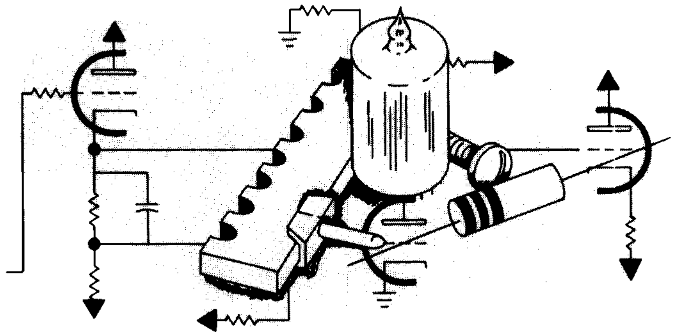
13. Check Alternate Sweep Operation

Reset the following controls:
Type T

STABILITY	full clockwise
5X MAGNIFIER	OFF
TIME/DIV	20 MILLISEC
TRIGGERING MODE	AC
Type CA	
MODE	ALTERNATE

See that the beam now sweeps on first one channel and the other channel.

NOTES



SECTION 6

PARTS LIST AND SCHEMATICS

ABBREVIATIONS

Cer.	Ceramic	n	Nano or 10^{-9}
Comp.	Composition	Ω	ohm
EMC	Electrolytic, metal cased	p	Pico or 10^{-12}
f	Farad	PTB	Paper, "Bathtub"
G	Giga, or 10^{9}	PMC	Paper, metal cased
GMV	Guaranteed minmum value	Poly.	Polystyrene
h	Henry	Prec.	Precision
K or k	Kilohms or kilo (10^{3})	PT	Paper Tubular
M/Cer.	Mica or Ceramic	T	Terra or 10^{12}
M or meg	Megohms or mega (10^{6})	v	Working volts DC
μ	Micro. or 10^{-6}	Var.	Variable
$\mu\mu$	Micromicro or 10^{-12}	w	Watt
m	milli or 10^{-3}	WW	Wire-wound

HOW TO ORDER PARTS

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, for your order to contain the following information: 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 Field Office will contact you concerning any change in part number.

PARTS LIST

Values are fixed unless named variable.

Bulbs

Ckt. No.	Tektronix Part Number	Description		S/N Range
B8160	150-002	Neon, Type NE-2		
B8200	150-002	Neon, Type NE-2		
B8330	150-002	Neon, Type NE-2	UNCALIBRATED	

Capacitors

Tolerance ±20% unless otherwise indicated.

Tolerance of all electrolytic capacitors are as follows (with exceptions):

3V - 50V = −10% - +250%

51V - 350V = −10% - +100%

351V - 450V = −10% - +50%

C160A †	281-007	3-12 μμf	Cer.	Var.		
C160B †	283-534	82 μμf	Mica		500 v	5%
C160C †	281-010	4.5-25 μμf	Cer.	Var.		
C160D †	283-534	82 μμf	Mica		500 v	5%
C160E †	281-010	4.5-25 μμf	Cer.	Var.		
C160F †	*291-008	.001 μf	Mylar			±½%
C160G †	*291-021	.01 μf	Mylar Timing Series			±½%
C160H †		.1 μf				
C160J †		1 μf				
C180A ††	283-536	220 μμf	Mica		500 v	10%
C180B ††	285-543	.0022 μf	PTM		400 v	
C180C ††	285-515	.022 μf	PTM		400 v	
C180D ††	285-526	.1 μf	PTM		400 v	
C180E ††	285-526	.1 μf	PTM		400 v	
C181 †††	281-516	39 μμf	Cer.		500 v	10%
C7010	283-001	.005 μf	Discap		500 v	
C7020	285-519	.047 μf	PTM		400 v	
C7030	281-523	100 μμf	Cer.		350 v	
C7060	283-004	.02 μf	Hi-Kap		150 v	
C7140	283-002	.01 μf	Discap		500 v	
C7190	283-000	.001 μf	Discap		500 v	
C7240	285-510	.01 μf	PTM		400 v	
C7330	283-001	.005 μf	Discap		500 v	
C7420	281-510	22 μμf	Cer.		500 v	
C7610	281-513	27 μμf	Cer.		500 v	
C7650	281-503	8 μμf	Cer.		500 v	±.5 μμf
C7680	281-508	12 μμf	Cer.		500 v	±.6 μμf
C7790	281-528	82 μμf	Cer.		500 v	10%
C7820	281-509	15 μμf	Cer.		500 v	10%
C7900	283-000	.001 μf	Discap		500 v	

† S/N 101-373 circuit numbers for C160A,B,C,D,E,F,G,H,J were C8100A,B,C,D,E,F,G,H,J.

†† S/N 101-379 circuit numbers for C180A,BC,D,E were C7580A,B,C,D,E.

††† S/N 101-379 circuit number for C181 was C7590.

Capacitors *(continued)*

Ckt. No.	Tektronix Part Number	Description					S/N Range
C7950	283-000	.001 μf	Discap		500 v		
C7970	283-002	.01 μf	Discap		500 v		
C8140	281-525	470 μμf	Cer.		500 v		
C8160	283-000	.001 μf	Discap		500 v		
C8420	281-516	39 μμf	Cer.		500 v	10%	
C8460	283-519	360 μμf	Mica		500 v	5%	
C8600	283-002	.01 μf	Discap		500 v		
C8620	283-002	.01 μf	Discap		500 v		
C8640	283-002	.01 μf	Discap		500 v		
C8650	290-000	6.25 μf	EMT		300 v		
C8660	283-002	.01 μf	Discap		500 v		
C8680	283-002	.01 μf	Discap		500 v		

Inductors

LR7740	*108-083	1500 μh	(on 5.6 k 1 w resistor)

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R160A †	309-045	100 k	½ w		Prec.	1%	
R160B †	309-051	200 k	½ w		Prec.	1%	
R160C †	309-003	500 k	½ w		Prec.	1%	
R160D †	309-014	1 meg	½ w		Prec.	1%	
R160E †	309-023	2 meg	½ w		Prec.	1%	
R160F †	309-087	5 meg	½ w		Prec.	1%	
R160G †	309-095	10 meg	½ w		Prec.	1%	
R160H †	309-095	10 meg	½ w		Prec.	1%	
R160J †	309-095	10 meg	½ w		Prec.	1%	
R180A ††	302-474	470 k	½ w				
R180B ††	302-475	4.7 meg	½ w				
R181 ††	302-475	4.7 meg	½ w				
R7040	309-045	100 k	½ w		Prec.	1%	
R7060	302-474	470 k	½ w				
R7090	302-101	100 Ω	½ w				
R7109	302-101	100 Ω	½ w				
R7110	302-822	8.2 k	½ w				
R7120	302-101	100 Ω	½ w				
R7130	306-273	27 k	2 w				
R7140	302-101	100 Ω	½ w				
R7160 †††	311-096	100 k	½ w	Var.			TRIGGERING LEVEL
R7170	302-223	22 k	½ w				
R7180	302-474	470 k	½ w				
R7190	302-474	470 k	½ w				
R7200	302-563	56 k	½ w				
R7240	302-473	47 k	½ w				

† S/N 101-373 circuit numbers for R160A,B,C,D,E,F,G,H,J were R8100A,B,C,D,E,F,G,H,J.

†† S/N 101-373 circuit numbers for R180A,B were R7580A,B; for R181 was R7590.

††† Furnished as a unit with R7500 and SW7500.

Resistors *(continued)*

Ckt. No.	Tektronix Part Number	Description				S/N Range
R7250	302-473	47 k	½ w			
R7260	302-101	100 Ω	½ w			
R7290	302-182	1.8 k	½ w			
R7300	302-332	3.3 k	½ w			
R7320	304-333	33 k	1 w			
R7330	311-066	500 Ω	.2 w	Var.	Trigger Sensitivity	
R7340	304-333	33 k	1 w			
R7370	302-275	2.7 meg	½ w			
R7400	302-222	2.2 k	½ w			
R7410	302-105	1 meg	½ w			X401-up
R7420	302-101	100 Ω	½ w			
R7440	302-104	100 k	½ w			
R7460	Use 302-124	120 k	½ w			
R7470	311-026	100 k	½ w	Var.	Trigger Level Centering	
R7500 †	311-096	100 k	½ w	Var.	STABILITY	
R7510	Use 302-683	68 k	½ w			
R7520	311-026	100 k	2 w	Var.	PRESET STABILITY	
R7540	302-273	27 k	½ w			
R7550	302-473	47 k	½ w			
R7570	302-101	100 Ω	½ w			
R7610	302-101	100 Ω	½ w			
R7640	302-562	5.6 k	½ w			
R7650	302-472	4.7 k	½ w			
R7660	302-101	100 Ω	½ w			
R7680	303-393	39 k	1 w		5%	
R7690	303-333	33 k	1 w		5%	
R7700	302-101	100 Ω	½ w			
R7710	Use 306-153	15 k	2 w			
R7770	302-222	2.2 k	½ w			
R7780	302-823	82 k	½ w			
R7790	302-681	680 Ω	½ w			
R7820	302-333	33 k	½ w			
R7830	302-823	82 k	½ w			
R7840	302-101	100 Ω	½ w			
R7870	302-472	4.7 k	½ w			
R7900	Use 301-363	36 k	½ w		5%	
R7910	302-105	1 meg	½ w			
R7920	302-103	10 k	½ w			
R7930	302-185	1.8 meg	½ w			
R7940	302-105	1 meg	½ w			
R7950	302-101	100 Ω	½ w			
R7970	302-104	100 k	½ w			
R7980	302-101	100 Ω	½ w			
R7990	304-104	100 k	1 w			
R8130	302-101	100 Ω	½ w			
R8140	304-563	56 k	1 w			
R8150	304-563	56 k	1 w			
R8160	302-334	330 k	½ w			
R8180	302-155	1.5 meg	½ w			
R8200	302-101	100 Ω	½ w			

† Furnished as a unit with R7160 and SW7500.

Resistors *(continued)*

Ckt. No.	Tektronix Part Number		Description				S/N Range
R8250	306-103	10 k	2 w				
R8260	311-011	5 k	2 w	Var.		Sweep Length	
R8270	306-682	6.8 k	2 w				
R8300	302-103	10 k	½ w				
R8320	311-083	20 k	2 w	Var.		VARIABLE	101-647
	311-108	20 k	2 w	Var.	WW		648-up
R8330	302-104	100 k	½ w				
R8340	304-223	22 k	1 w				101-647x
R8350	311-016	10 k	2 w	Var.		Time Base Cal.	101-293
	311-076	10 k	2 w	Var.			294-up
R8400	309-176	43.4 k	½ w		Prec.	1%	
R8420	301-152	1.5 k	½ w			5%	
R8430	311-005	500 Ω	2 w	Var.		Mag. Gain Adj.	
R8460	309-078	343 Ω	½ w		Prec.	1%	
R8470	302-683	68 k	½ w				
R8480	311-026	100 k	2 w	Var.		MAG. CENTERING	
R8500 †	311-030	100 k	½ w	Var.		VERNIER	
R8520	302-824	820 k	½ w				
R8540 †	311-030	100 k	½ w	Var.		POSITION	
R8550	302-473	47 k	½ w				
R8570	311-023	50 k	2 w	Var.		Position Range	
R8590	302-473	47 k	½ w				
R8600	302-101	100 Ω	½ w				
R8620	302-471	470 Ω	½ w				
R8640	302-471	470 Ω	½ w				
R8650	308-029	400 Ω	20 w		WW	5%	
R8660	306-470	47 Ω	2 w				

Switches

Ckt. No.	Unwired		Wired		Description	S/N Range
SW7010 [1]	*260-175	Use	*050-016	Rotary	TRIGGER SLOPE	101-2069
SW7040 [1]	*260-175		*262-429	Rotary	TRIGGERING MODE	2070-up
SW7500 [2]	311-096			Rotary	PRESET	
SW160 [3]	*260-174		*262-140	Rotary	TIME/DIV	101-647
SW8300 [3]	*260-226		*262-181	Rotary	TIME/DIV	648-up
SW8420	*260-122			Rotary	5X MAGNIFIER	

Electron Tubes

V7040	154-033	6U8
V7350	154-033	6U8
V7530	154-028	6BQ7A
V7650	154-028	6BQ7A
V7750	154-033	6U8
V7940	154-033	6U8
V8020	154-016	6AL5
V8110	154-132	6AU8

† R8500 and R8540 are concentric. Furnished as a unit.

[1] SW7010 and SW7040 Shafts are concentric. Furnished as a unit.

[2] Furnished as a unit with R7500 and R7160.

[3] SW160 and SW8300 are concentric. Furnished as a unit.

S/N 101-373 SW160 was SW8100.

Type T
Mechanical Parts List

	Tektronix Part Number
BRACKET, POT	406-230
BUSHING, ALUM.	358-010
BUSHING, BRASS	358-029
BUSHING, NYLON	358-036
CABLE, HARNESS, LARGE	179-145
CABLE, HARNESS, SMALL	179-146
CAP, BINDING POST	200-103
CHASSIS	441-154
CLAMP, ½", STEEL (101-809)	343-015
CONNECTOR, CHASSIS MT., 16 CONTACT, MALE	131-017
CONNECTOR, CHASSIS MT., 83—1RTY	131-038
COUPLING, INSULATING ASS'Y	376-011
COUPLING, POT	376-014
GROMMET RUBBER ¼	348-002
GROMMET RUBBER 5/16	348-003
GROMMET RUBBER ⅜	348-004
HOLDER, NYLON, NEON BULB	352-008
KNOB SMALL BLACK	366-033
KNOB SMALL RED ⅛ HOLE PART WAY	366-038
KNOB SMALL RED 3/16 HOLE PART WAY	366-039
KNOB LARGE BLACK ¼ HOLE THRU	366-040
KNOB LARGE BLACK 17/64 HOLE THRU	366-046
KNOB ALUM.	366-125
KNOB LARGE BLACK 1.625 OD W/¼ HOLE THRU	366-058
LOCKWASHER STEEL INT. #4	210-004
LOCKWASHER STEEL INT. #6	210-006
LOCKWASHER STEEL INT. #10	210-010
LOCKWASHER STEEL INT., POT, ⅜ x ½	210-012
LOCKWASHER STEEL INT., POT, ⅜ x 11/16	210-013
LOCKWASHER STEEL NO. 5 SPRING	210-017
LUG SOLDER SE4	210-201

Mechanical Parts List *(continued)*

	Tektronix Part Number
LUG SOLDER SE6 W/2 WIRE HOLES	210-202
LUG SOLDER DE6	210-204
LUG SOLDER SE10, LONG	210-206
LUG SOLDER POT, PLAIN $3/8$	210-207
LUG SOLDER SE8, LONG	210-228
NUT HEX 4-40 x $3/16$	210-406
NUT HEX 6-32 x $1/4$	210-407
NUT HEX 10-32 x $5/16$	210-410
NUT HEX $3/8$-32 x $1/2$	210-413
NUT HEX BUSHING, $3/8$-32 x $1/2$ x 1$1/16$	210-429
NUT HEX 10-32 x $3/8$ x $1/8$	210-436
NUT HEX 5-40 x $1/4$ (or) $3/16$ W/SWITCH	210-449
NUT KEPS 6-32 x $5/16$	210-457
NUT HEX $3/8$-32 x $1/2$ x $11/16$	210-494
PANEL FRONT (101-821)	333-214
PANEL FRONT (822-up)	333-519
PLATE PLEXIGLAS	386-588
PLATE SUB PANEL	386-608
PLATE FRAME BACK	387-563
PLUG BANANA	134-014
POST BINDING	129-020
POST BINDING 5 WAY STEM & CAP ASS'Y	129-036
RING RETAINING STEEL	354-025
RING SECURING POLY (810-up)	354-068
ROD EXTENSION STEEL 5$13/16$"	384-147
ROD EXTENSION ALUM. 3$5/8$"	384-149
ROD FRAME 8$7/8$"	384-508
ROD SECURING (PLUG-IN TO SCOPE)	384-510
ROD ALUM. ROUND, TAPPED 8-32 1$7/16$"	385-010
ROD NYLON	385-075
ROD ALUM. HEX (REPLACED BY 385-158)	385-148
ROD ALUM. HEX, $1/2$ x 1$5/16$ TAP $3/8$-32 (SEE 385-148)	385-158
SCREW 4-40 x $3/16$ BHS	211-007

Mechanical Parts List *(continued)*

	Tektronix Part Number
SCREW 4-40 x 1/4 BHS	211-008
SCREW 4-40 x 5/16 BHS	211-011
SCREW 4-40 x 1 FHS	211-031
SCREW 6-32 x 3/16 BHS	211-503
SCREW 6-32 x 1/4 BHS	211-504
SCREW 6-32 x 5/16 BHS	211-507
SCREW 6-32 x 5/16 FHS	211-508
SCREW 6-32 x 3/8 BHS	211-510
SCREW 8-32 x 5/16 BHS	212-004
SCREW 8-32 x 1 3/4 FIL HS	212-037
SCREW 8-32 x 1/2 FHS, 100°, PHILLIPS	212-043
SCREW 8-32 x 1/2 RHS, PHILLIPS	212-044
SCREW THREAD CUTTING 5-32 x 3/16 PAN H STEEL, PHILLIPS	213-044
SHIELD, ALUM., TIME/CM SWITCH	337-141
SOCKET STM7G	136-008
SOCKET STM9G	136-015
SPACER NYLON 5/16 (FOR CERAMIC STRIP)	361-009
STEM BINDING POST ADAPTER	355-507
STRIP CERAMIC 3/4 x 4 NOTCHES	124-088
STRIP CERAMIC 3/4 x 7 NOTCHES	124-089
STRIP CERAMIC 3/4 x 11 NOTCHES	124-091
TUBING, PLASTIC INSUL., #20 BLACK (SKEIN)	162-504
WASHER BRASS RESISTOR CENTERING	210-808
WASHER FIBER #10	210-812
WASHER STEEL .390 x 9/16 x .020	210-840

TRIGGER

IMPORTANT:
ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A 20,000Ω/V VOM. ALL READINGS ARE IN VOLTS.

VOLTAGE & WAVEFORM AMPLITUDE MEASUREMENTS ARE NOT ABSOLUTE. THEY MAY VARY BETWEEN INSTRUMENTS AS WELL AS WITHIN THE INSTRUMENT ITSELF DUE TO NORMAL MANUFACTURING TOLERANCES AND TRANSISTOR AND VACUUM TUBE CHARACTERISTICS.

ACTUAL PHOTOGRAPHS OF WAVEFORMS ARE SHOWN.

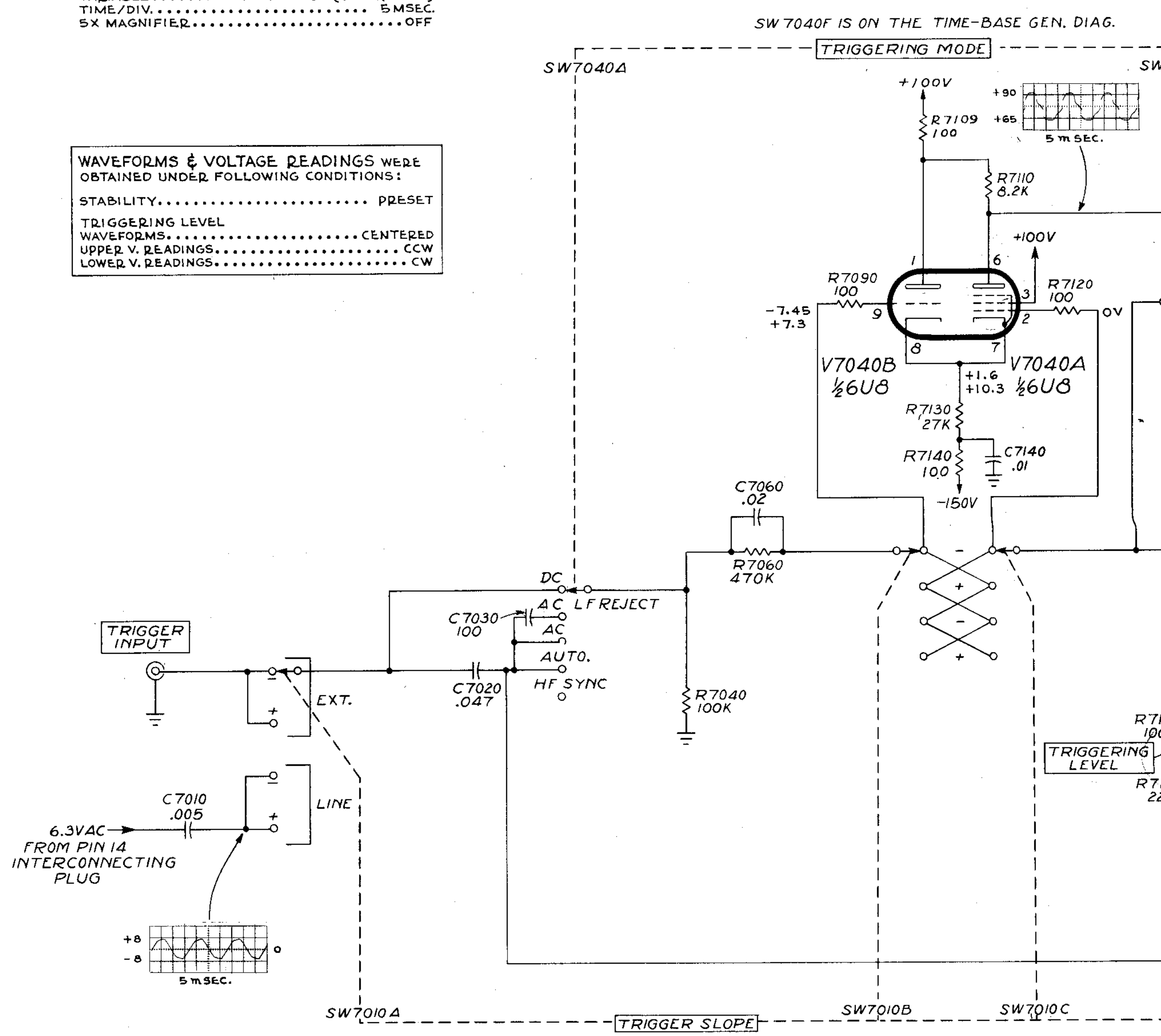
CONTROLS SET AS FOLLOWS:

TRIGGER SLOPE.................... + LINE
TRIGGERING MODE.................... AC
VARIABLE................ CW(CALIBRATED)
TIME/DIV........................ 5MSEC.
5X MAGNIFIER......................OFF

WAVEFORMS & VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:

STABILITY...................... PRESET

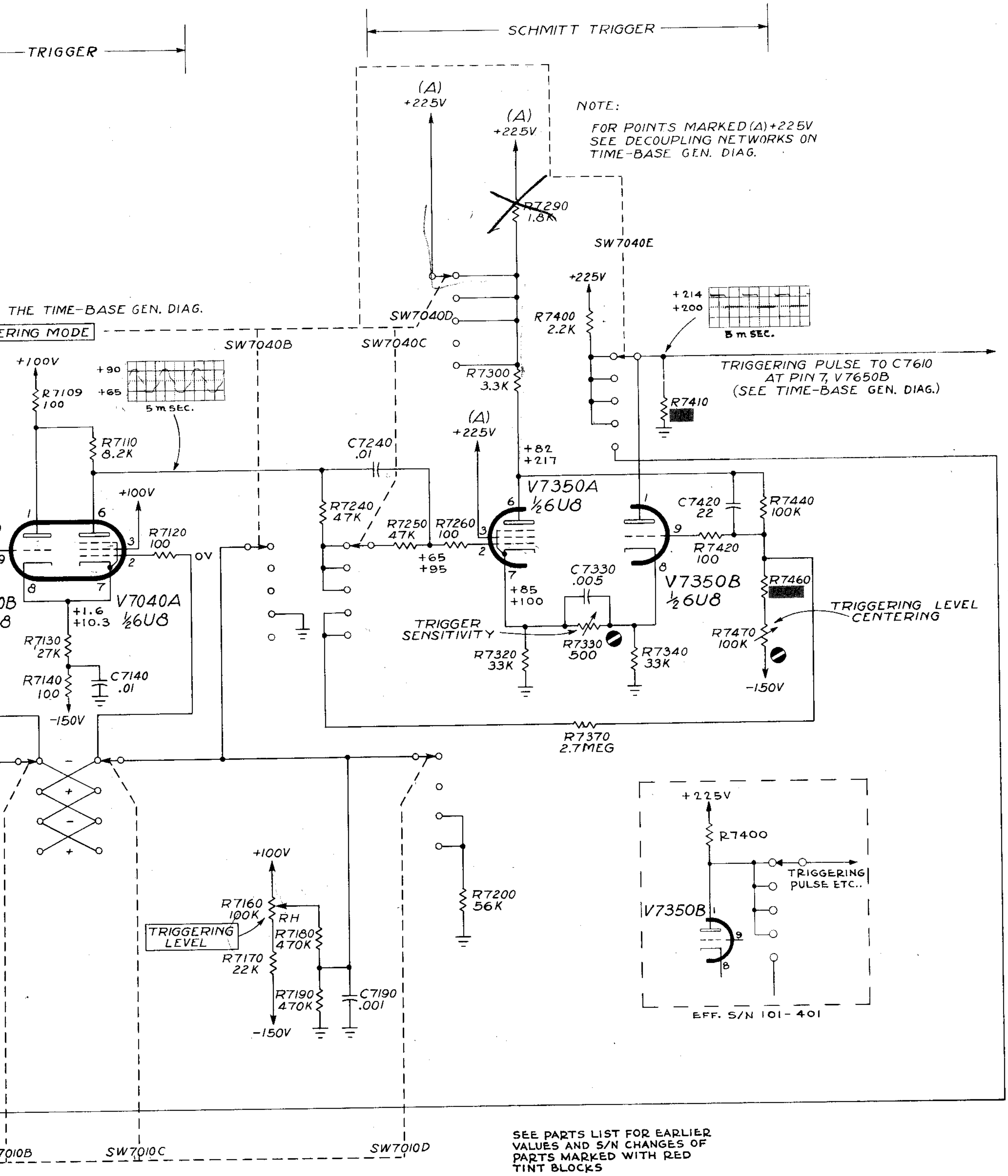
TRIGGERING LEVEL
WAVEFORMS..................... CENTERED
UPPER V. READINGS.................. CCW
LOWER V. READINGS................... CW



TYPE T PLUG-IN UNIT

AA₁

+



SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH RED TINT BLOCKS

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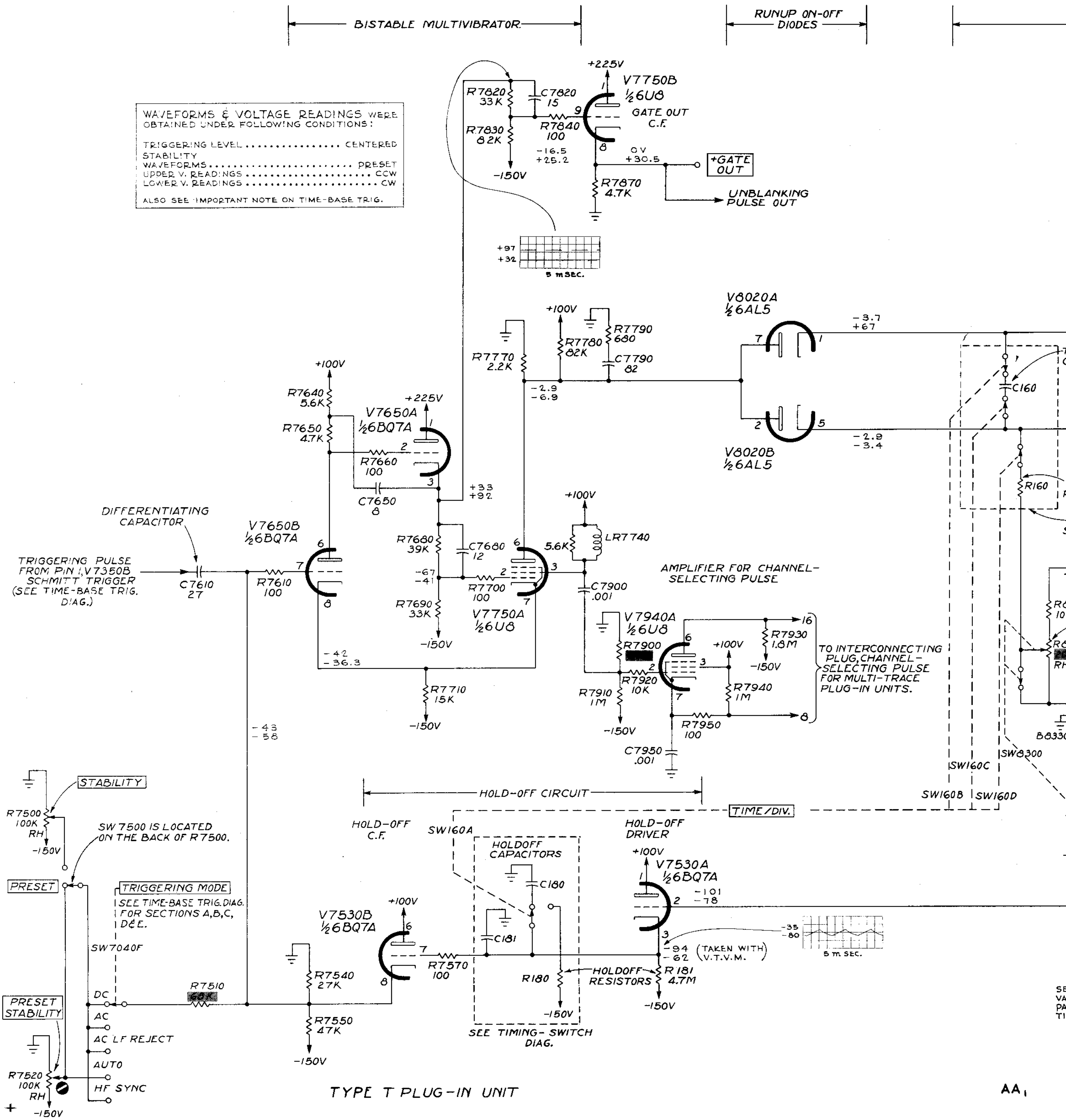
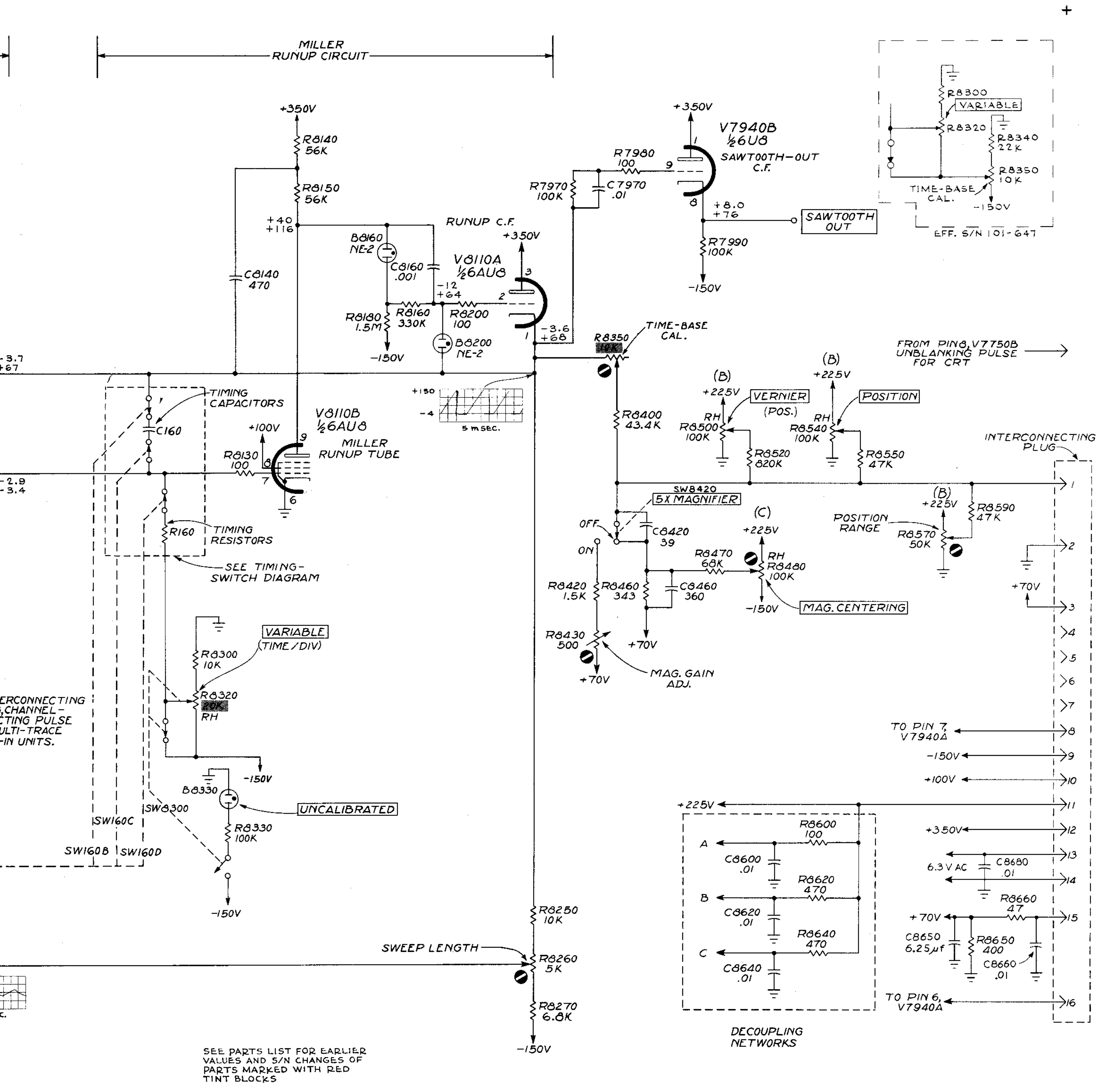
TIME-BASE TRIGGER

AA₁



BISTABLE MULTIVIBRATOR
RUNUP ON-OFF DIODES
WAVEFORMS & VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:
TRIGGERING LEVEL .... CENTERED
STABILITY
WAVEFORMS .... PRESET
UPPER V. READINGS .... CCW
LOWER V. READINGS .... CW
ALSO SEE IMPORTANT NOTE ON TIME-BASE TRIG.
R7820 33K
C7820 15
R7830 82K
R7840 100
-150V
+225V
V7750B ½6U8
GATE OUT C.F.
-16.5 +25.2
0V +30.5
+GATE OUT
R7870 4.7K
UNBLANKING PULSE OUT
+97 +32
5 mSEC.
V8020A ½6AL5
V8020B ½6AL5
-3.7 +67
-2.8 -3.4
+100V
R7790 680
R7780 82K
C7790 82
R7770 2.2K
-2.9 -6.9
C160
R160
R7640 5.6K
R7650 4.7K
V7650A ½6BQ7A
R7660 100
C7650 8
+33 +92
DIFFERENTIATING CAPACITOR
V7650B ½6BQ7A
TRIGGERING PULSE FROM PIN 1, V7350B SCHMITT TRIGGER (SEE TIME-BASE TRIG. DIAG.)
C7610 27
R7610 100
R7680 39K
C7680 12
-67 -41
R7700 100
R7690 33K
V7750A ½6U8
-42 -36.3
R7710 15K
5.6K
LR7740
C7900 .001
AMPLIFIER FOR CHANNEL-SELECTING PULSE
V7940A ½6U8
R7900
R7930 1.8M
R7920 10K
R7910 1M
R7940 1M
R7950 100
C7950 .001
TO INTERCONNECTING PLUG, CHANNEL-SELECTING PULSE FOR MULTI-TRACE PLUG-IN UNITS.
-43 -58
STABILITY
R7500 100K RH
SW 7500 IS LOCATED ON THE BACK OF R7500.
PRESET
TRIGGERING MODE
SEE TIME-BASE TRIG. DIAG. FOR SECTIONS A,B,C, D & E.
SW7040F
HOLD-OFF CIRCUIT
TIME/DIV.
SW160A SW160B SW160C SW160D SW8300
HOLD-OFF C.F.
HOLDOFF CAPACITORS
C180 C181
HOLD-OFF DRIVER
V7530A ½6BQ7A
-101 -78
-94 -62 (TAKEN WITH V.T.V.M.)
-35 -80
5 m SEC.
V7530B ½6BQ7A
R7570 100
R180
HOLDOFF RESISTORS
R181 4.7M
R7540 27K
R7550 47K
R7510 68K
DC AC AC LF REJECT AUTO HF SYNC
PRESET STABILITY
R7520 100K RH
SEE TIMING-SWITCH DIAG.
TYPE T PLUG-IN UNIT
AA₁



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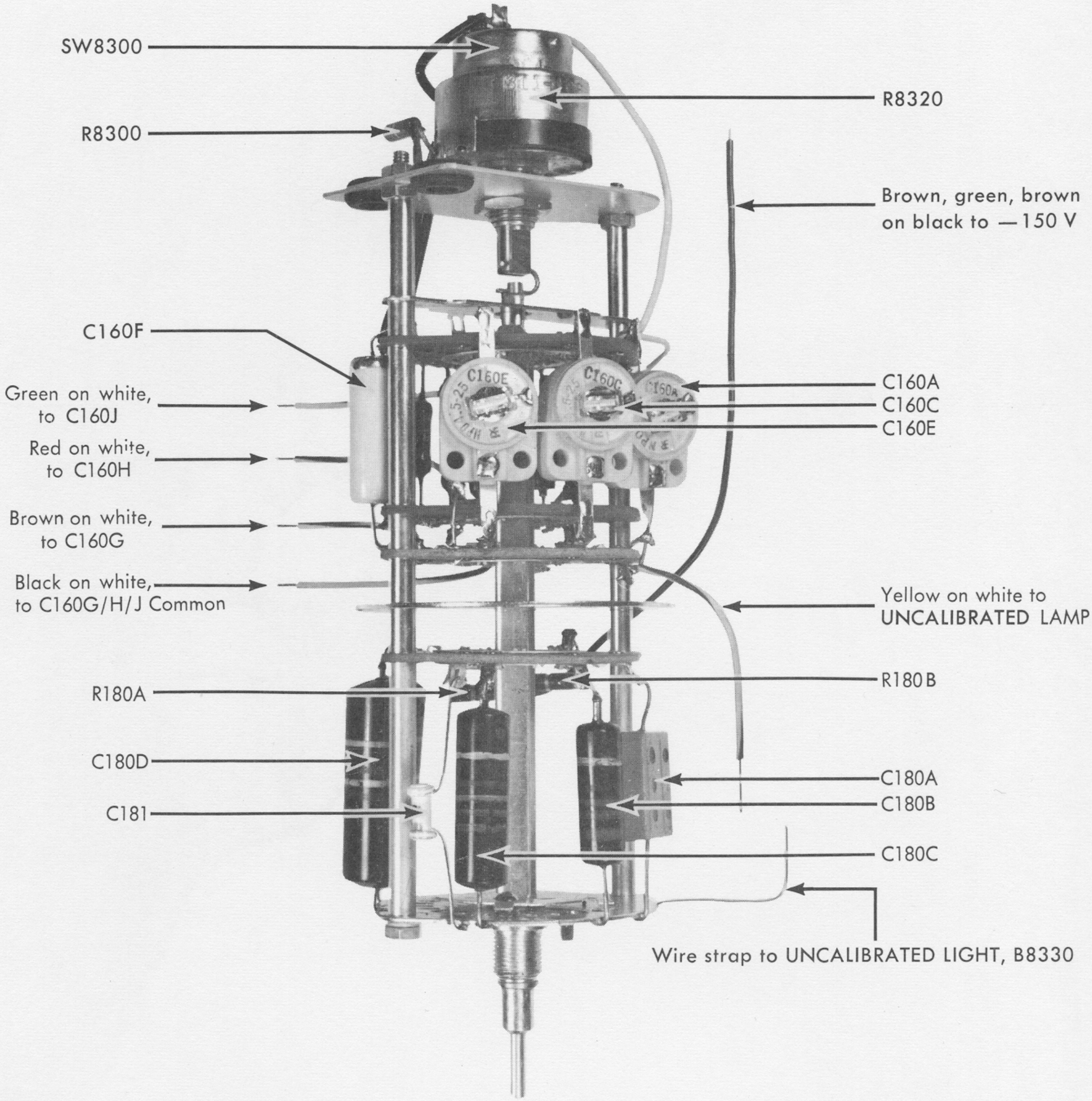
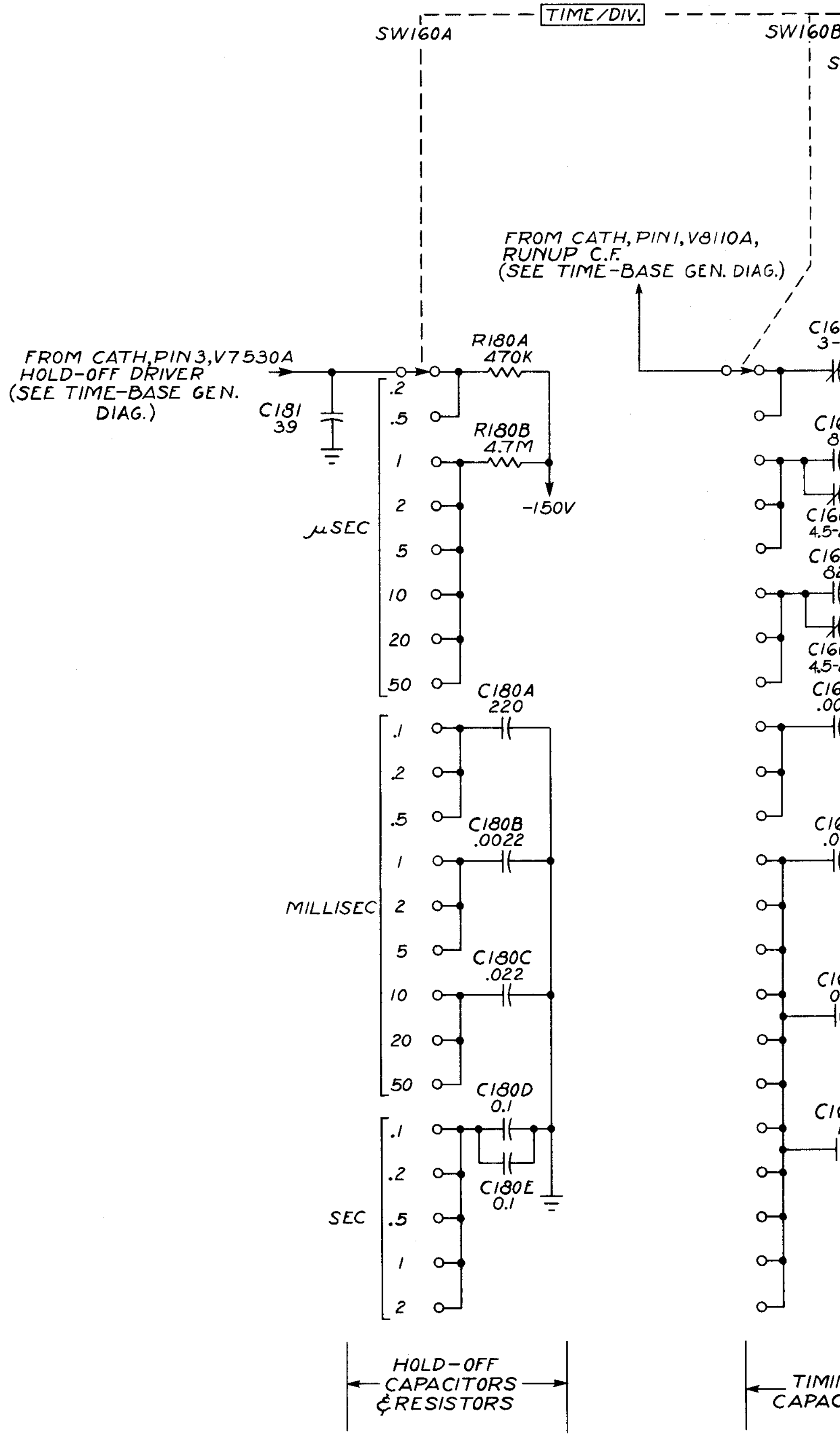
AA₁

TIME-BASE GENERATOR



TIME/DIV. SWITCH & VARIABLE CONTROL

SWITCH DETAIL



TYPE T PLUG-IN UNIT

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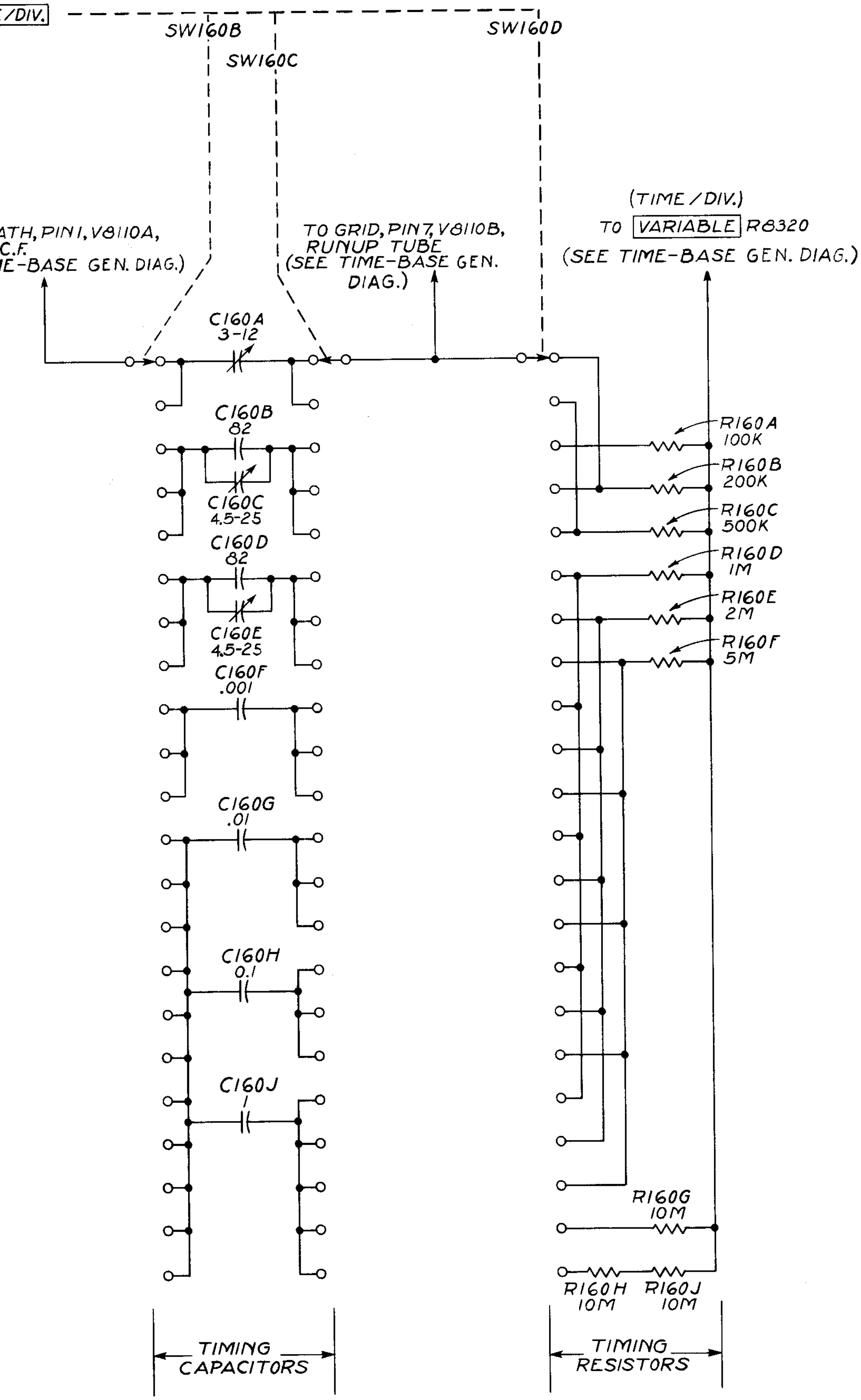

02-7-62
R.O.W.

AA

TIMING SWITCH
(TIME / DIV.)

MANUAL CHANGE INFORMATION

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

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

TYPE T

Calibration Text Correction (15)

The chart in the Preliminary section should have pin (1) and pin (1 mag on) reversed.

The last paragraph under step one should read----Adjust the Pos Range control so that the left hand end of the trace is on the far left vertical graticule line. The positioning controls of the Type T must be set to midrange for this adjustment.

Also under step one the setting for TRIGGER SLOPE should read + EXT.

Correct the last paragraph under step 12 to read-----Adjust the STABILITY control for a stable display and rap the 536 on the top. The waveform should remain steady. Remove the Type 190 from the CHANNEL A Input of the CA plug-in.