INSTRUCTION MANUAL

Serial Number 1624

TU-7

plug-in test unit

Tektronix, Inc.

S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon ● Phone MI 4-0161 ● Cables: Tektronix

070-407

364

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.

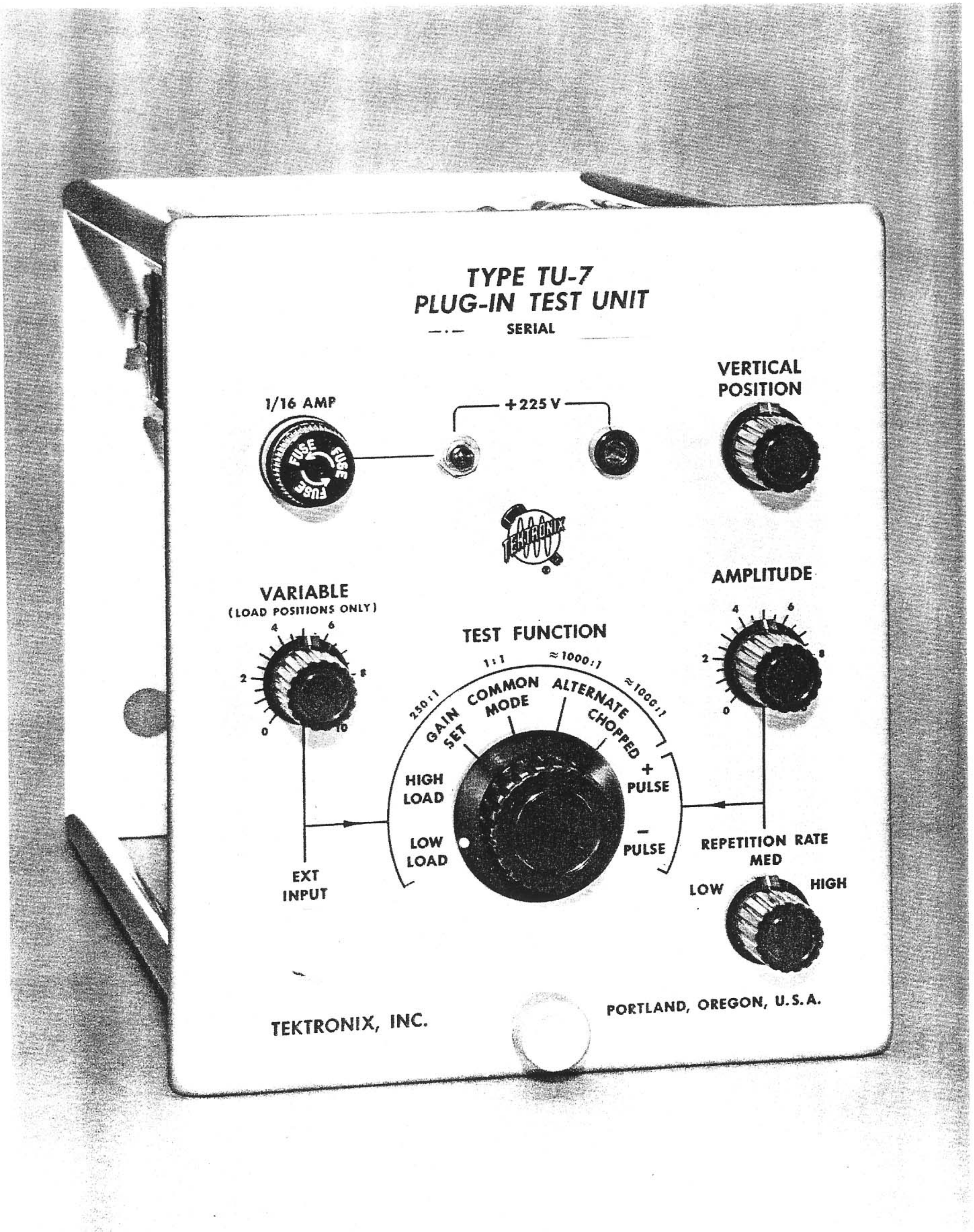
Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

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.

CONTENTS

A list of abbreviations and symbols used in this manual will be found on page 6-1. Change information, if any, is located at the rear of the manual.



Type TU-7 Plug-In Test Unit

SECTION 1
CHARACTERISTICS

General Description

The Type TU-7 Plug-In Test Unit is a versatile single-unit calibration aid for use with all Tektronix 530-, 540-, or 550-Series Oscilloscopes using 1-series or letter-series vertical plug-in units. The Type TU-7 is the only plug-in unit required for calibrating the oscilloscope.* An input connector on the front panel of the Type TU-7 permits application of various external signals for use in the calibration procedure. The self-contained unit also generates fast-rise pulses for checking risetime and adjusting transient response of the oscilloscope vertical amplifier.

The Type TU-7 permits checking the regulation limits of the power supplies. In addition, the unit provides a quick check of the oscilloscope alternate sync pulse and chopped blanking circuitry. For oscilloscopes capable of displaying two time-base signals alternately, the Type TU-7 checks the ability of the alternate-sweep switching circuitry to lock the channels of a dual-trace plug-in unit to the time bases of the oscilloscope.

ELECTRICAL

TEST FUNCTION SWITCH POSITIONS

LOW LOAD, HIGH LOAD

These two switch positions permit the oscilloscope low-voltage power supplies to be loaded from minimum to maximum. External signals applied through the EXT INPUT connector on the front panel of the unit will be ac-coupled to the oscilloscope vertical amplifier to produce a normal display. Maximum vertical sensitivity of the Type TU-7/oscilloscope combination is about 0.5 volt/cm when the VARIABLE control is set fully clockwise.

GAIN SET

Permits setting the gain of the oscilloscope vertical amplifier with a 100-volt calibrator signal applied to the EXT INPUT connector. The 250-to-1 fixed ratio of this position attenuates the 100-volt signal to 0.4 volt which produces 4 cm of vertical deflection on the crt when the oscilloscope vertical amplifier gain adjustment has been accurately set.

COMMON MODE

Checks common-mode rejection ratio and dc balance of the oscilloscope vertical amplifier.

ALTERNATE

Checks operation of the alternate-mode synchronizing circuits in the oscilloscope. Also permits checking for proper sweep slaving in oscilloscopes having two time bases that can be displayed alternately. Any external signal applied to the EXT INPUT connector is attenuated approximately 1000 times by an internal attenuation network.

CHOPPED

Checks oscilloscope for proper operation in the chopped mode. Free-running rate of the dual-trace switching multivibrator is approximately 100 kc. Any external signal applied to the EXT INPUT connector is attenuated approximately 1000 times by the internal attenuation network.

+ PULSE, − PULSE

In these two switch positions a fast-rise square wave with a risetime of 3 nsec (3×10^{-9} sec) is applied to the oscilloscope vertical deflection system. Maximum amplitude of the pulse display for either + or − polarity is approximately 6 cm with the AMPLITUDE control set fully clockwise. Minimum amplitude is approximately 2 cm.

Other Controls and Connectors

REPETITION RATE

Three-position switch to select the approximate pulse repetition rate of the Pulse Generator circuit: LOW — 5 kc, MED — 120 kc, HIGH — 600 kc.

AMPLITUDE

Adjusts amplitude of the pulse applied to the oscilloscope vertical amplifier when the TEST FUNCTION switch is set to + PULSE or − PULSE.

VARIABLE

Controls amplitude of the signal applied through the EXT INPUT connector when the TEST FUNCTION switch is set to LOW LOAD or HIGH LOAD. The minimum deflection factor is 0.5 volt/cm with the VARIABLE control set fully clockwise.

VERTICAL POSITION

Controls vertical positioning of the trace or display on the crt in all TEST FUNCTION positions except COMMON MODE.

+225V Pushbutton

Provides +225 volts at the front-panel output banana jack when the pushbutton is pressed.

+225V Banana Jack

Convenient source of +225 volts for checking dc balance of each stage of a distributed vertical amplifier. With the voltage output connected to the cathodes, the stage is effectively cut off when the +225 V pushbutton is pressed.

* A sine-wave bandpass check of the system cannot be made by applying an external high-frequency sine wave through the Type TU-7.

FUSE

Front-panel 1/16-amp fast-blow fuse protects the oscilloscope +225-volt supply if a low-resistance path occurs from the banana jack connector to ground.

EXT INPUT

Connector for applying external signals to the oscilloscope vertical system through the Type TU-7. Useful for applying the calibrator signal when setting the gain of the oscilloscope vertical amplifier and for inserting signals for calibrating the time-base generator(s), trigger circuit(s), and trace geometry.

MECHANICAL

Construction

Aluminum-alloy chassis with photo-etched anodized front panel. Etched wiring board sub-chassis.

Net Weight

Approx. 3¾ lbs.

SECTION 2
OPERATING INSTRUCTIONS

Introduction

This information should be used in conjunction with the calibration procedure section of the oscilloscope instruction manual. If desired, any of the following adjustments or checks may be performed without regard to sequence.

NOTE

If the —150 Volts control in the oscilloscope is adjusted, the oscilloscope should be completely recalibrated.

The Type TU-7 is calibrated and ready for use as shipped from the factory.

Power-Supply Output Voltages

To check the oscilloscope power-supply voltages, proceed as follows:

1. Apply design-center line voltage to the oscilloscope and turn on the oscilloscope Power switch.
2. Set the Type TU-7 TEST FUNCTION switch to LOW LOAD.
3. Measure the voltages at the power-supply test points as described in the oscilloscope instruction manual.

Power Supply Regulation and Ripple

To check the oscilloscope low-voltage power supply regulation and ripple, proceed as follows:

1. Set the oscilloscope Amplitude Calibrator switch to Off and set the oscilloscope triggering so the time-base circuit(s) does not free run.
2. With the TEST FUNCTION switch set to LOW LOAD, measure the ripple (with a test oscilloscope) of the various supplies with the line voltage at 126.5 volts (or 253 volts if the oscilloscope is wired for 230-volt operation).
3. Set the line voltage at 103.5 volts (or 207 volts) and set the TEST FUNCTION switch to HIGH LOAD. Measure the ripple of the various supplies. Refer to the oscilloscope instruction manual for ripple voltage limits.

Oscilloscope Vertical Gain

To check or set the oscilloscope vertical gain, proceed as follows:

1. Set the TEST FUNCTION switch to the GAIN SET position.
2. Apply a 100-volt peak-to-peak Calibrator signal to the Type TU-7 EXT INPUT connector.
3. Free-run the oscilloscope time base at about 1 msec/cm. Two traces should be visible on the crt. Use the Type TU-7 VERTICAL POSITION control to center the display.
4. Adjust the oscilloscope Vertical Gain control for exactly 4 cm vertical distance between the two traces. Keep the display centered vertically on the crt while making this adjustment.
5. Turn off the Calibrator and disconnect the signal lead.

Oscilloscope Vertical Amplifier Balance

The amount of vertical amplifier dc unbalance must be small for optimum common-mode rejection ratio and for linear amplifier operation. To check the amount of dc unbalance, a suggested procedure is as follows:

1. Set the TEST FUNCTION switch to COMMON MODE.
2. With a small screwdriver, short the crt vertical deflection-plate pins together.

CAUTION

Do not short the crt deflection-plate pins to ground. Excessive current will damage the power supply.

3. Note the position of the trace. This is the electrical center of the crt vertical deflection plates.
4. Remove the screwdriver from the crt pins.
5. Note the amount of vertical distance that the trace shifts between the shorted condition and the non-shorted condition. Refer to the oscilloscope instruction manual for the vertical unbalance limit.

If your oscilloscope vertical amplifier has a distributed amplifier section, the +225V front-panel connector on the Type TU-7 supplies +225 volts when the pushbutton switch is pressed. A lead connected from this connector can be used to apply +225 volts to the cathodes of the tubes in the vertical amplifier. This voltage effectively cuts the tubes off for checking the dc balance of each stage.

Oscilloscope Alternate-Trace Sync Pulse Check

Set the TEST FUNCTION switch to ALTERNATE. If two traces appear on the crt, the oscilloscope time-base generator is producing proper alternate-trace sync pulses for the plug-in unit. Check each sweep rate to be sure the sync pulse is present with sufficient amplitude. If the oscilloscope has two time bases, make the same check for the other time base.

Alternate-Sweep Slaving Check

If your oscilloscope is capable of alternating between two time bases, check this mode of operation as follows:

1. Set the oscilloscope Horizontal Display switch to Alternate.

2. Set both Time/Cm switches to .5 mSec.
3. Set both Triggering Mode switches to Auto, and both Triggering Source switches to Plug-In.
4. Set the Type TU-7 TEST FUNCTION switch to ALTERNATE.
5. Apply a 100-volt peak-to-peak Calibrator signal to the INPUT connector.
6. Adjust the Triggering Level controls of both time bases to trigger the displays. (For a Type 547 Oscilloscope, the Trace Separation control should be set to zero.)
7. Check that 0.5 cm of the Calibrator waveform is displayed when Time Base B is generating its sweep (lower trace), and that 1 trace width of the Calibrator waveform is displayed when Time Base B generates its sweep (upper trace). Fig. 2-1 shows the oscilloscope display.

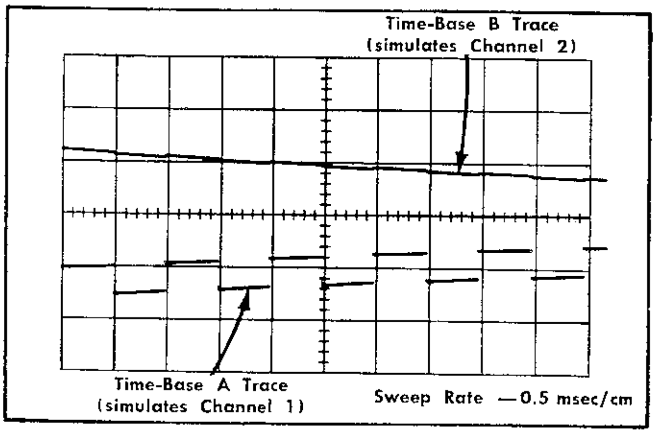


Fig. 2-1. Alternate-sweep slaving check.

8. Check that Time Base A is locked to the lower trace by turning the Time Base A Time/Cm switch. The waveform in the upper trace should not change.

In this check, the lower trace simulates the Channel 1 operation of a dual-trace plug-in preamplifier and the upper trace simulates Channel 2.

Oscilloscope Chopped-Mode Operation

To check the oscilloscope for chopped-mode operation (with no input signal applied), proceed as follows:

1. Set the TEST FUNCTION switch to CHOPPED.
2. Set the oscilloscope Time/Cm switch to 5 μSec/Cm.
3. Adjust the oscilloscope triggering controls for a stable chopped waveform display (Fig. 2-2).
4. Set the oscilloscope Crt Cathode Selector switch to the Chopped Blanking position and check that the fast rising and falling portions (switching portions) of the display are blanked so that only the "on" segments of each trace are visible (Fig. 2-3).
5. If your oscilloscope has two time bases, make the same check using the other time base.

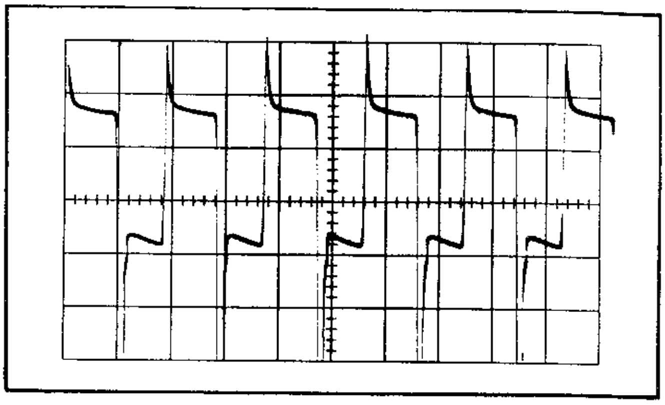


Fig. 2-2. Chopped waveform display.

6. After checking the chopped mode of operation, return the oscilloscope Crt Cathode Selector switch to the Crt Cathode position.

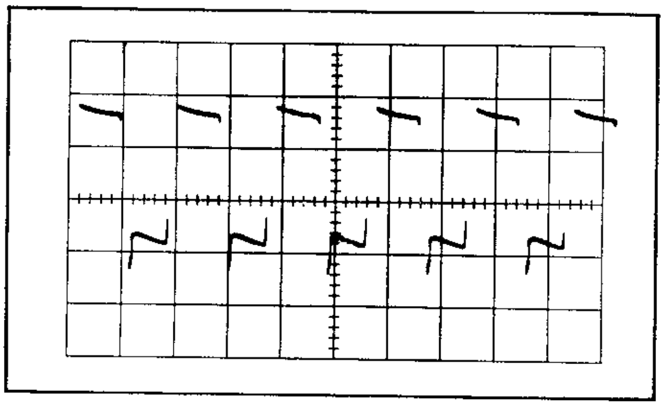


Fig. 2-3. Chopped blanking check with Crt Cathode Selector switch at Chopped. Vertical switching lines are blanked.

Oscilloscope Vertical Amplifier Transient Response

After completing the oscilloscope calibration procedure for vertical amplifier unbalance and after checking the vertical gain, check the transient response as follows:

1. Set the TEST FUNCTION switch to + PULSE.
2. Set the REPETITION RATE switch to HIGH. (For the Type 547 Oscilloscope, set switch to MED.)
3. Set the oscilloscope Time/Cm switch to .1 μSec/Cm.
4. Set the VARIABLE AMPLITUDE control to produce a display 4 cm in amplitude for 6-cm scan oscilloscopes or 3 cm in amplitude for 4-cm scan oscilloscopes.

NOTE

Do not use the Type TU-7 with a plug-in extension for the high-frequency checks. The extension may cause considerable ringing to appear on the display of fast-rising pulses such as the Pulse Generator signal.

2. Set both Time/Cm switches to .5 mSec.
3. Set both Triggering Mode switches to Auto, and both Triggering Source switches to Plug-In.
4. Set the Type TU-7 TEST FUNCTION switch to ALTERNATE.
5. Apply a 100-volt peak-to-peak Calibrator signal to the INPUT connector.
6. Adjust the Triggering Level controls of both time bases to trigger the displays. (For a Type 547 Oscilloscope, the Trace Separation control should be set to zero.)
7. Check that 0.5 cm of the Calibrator waveform is displayed when Time Base B is generating its sweep (lower trace), and that 1 trace width of the Calibrator waveform is displayed when Time Base B generates its sweep (upper trace). Fig. 2-1 shows the oscilloscope display.

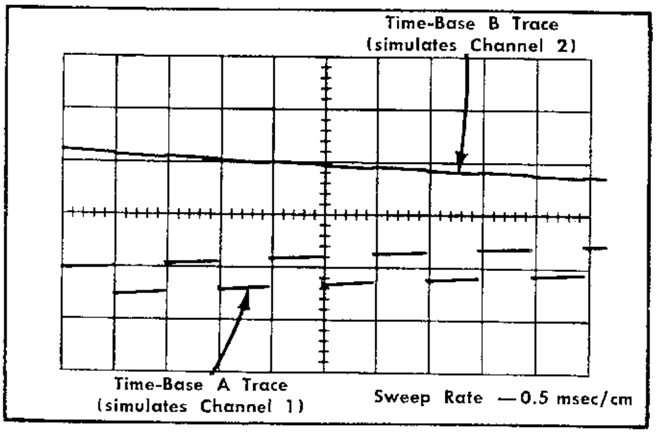


Fig. 2-1. Alternate-sweep slaving check.

8. Check that Time Base A is locked to the lower trace by turning the Time Base A Time/Cm switch. The waveform in the upper trace should not change.

In this check, the lower trace simulates the Channel 1 operation of a dual-trace plug-in preamplifier and the upper trace simulates Channel 2.

Oscilloscope Chopped-Mode Operation

To check the oscilloscope for chopped-mode operation (with no input signal applied), proceed as follows:

1. Set the TEST FUNCTION switch to CHOPPED.
2. Set the oscilloscope Time/Cm switch to 5 μSec/Cm.
3. Adjust the oscilloscope triggering controls for a stable chopped waveform display (Fig. 2-2).
4. Set the oscilloscope Crt Cathode Selector switch to the Chopped Blanking position and check that the fast rising and falling portions (switching portions) of the display are blanked so that only the "on" segments of each trace are visible (Fig. 2-3).
5. If your oscilloscope has two time bases, make the same check using the other time base.

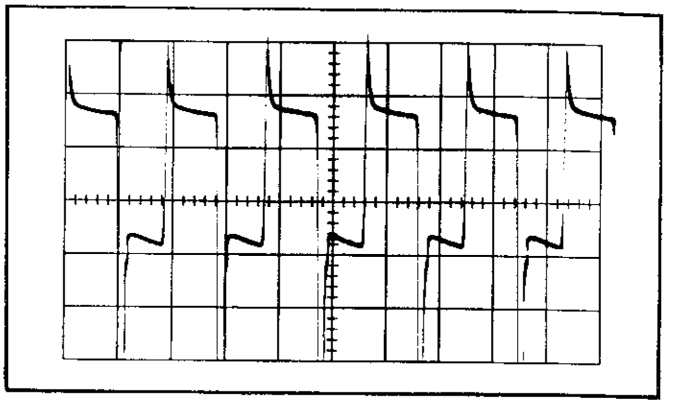


Fig. 2-2. Chopped waveform display.

6. After checking the chopped mode of operation, return the oscilloscope Crt Cathode Selector switch to the Crt Cathode position.

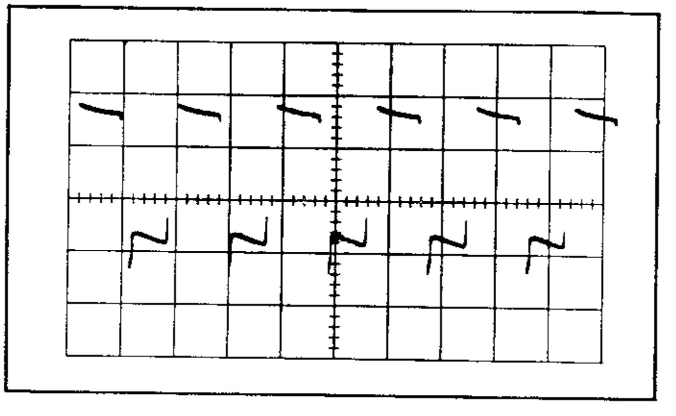


Fig. 2-3. Chopped blanking check with Crt Cathode Selector switch at Chopped. Vertical switching lines are blanked.

Oscilloscope Vertical Amplifier Transient Response

After completing the oscilloscope calibration procedure for vertical amplifier unbalance and after checking the vertical gain, check the transient response as follows:

1. Set the TEST FUNCTION switch to + PULSE.
2. Set the REPETITION RATE switch to HIGH. (For the Type 547 Oscilloscope, set switch to MED.)
3. Set the oscilloscope Time/Cm switch to .1 μSec/Cm.
4. Set the VARIABLE AMPLITUDE control to produce a display 4 cm in amplitude for 6-cm scan oscilloscopes or 3 cm in amplitude for 4-cm scan oscilloscopes.

NOTE

Do not use the Type TU-7 with a plug-in extension for the high-frequency checks. The extension may cause considerable ringing to appear on the display of fast-rising pulses such as the Pulse Generator signal.

 Ⓐ

5. Carefully focus and check the display. If the waveshape does not show good transient response because of overshoot, rolloff or bumpiness, proceed with the adjustments described in the oscilloscope instruction manual.

Other Checks

The Type TU-7 can be used as a limited bandpass plug-in unit. It is useful for inserting calibrated time marks into the vertical system when adjusting the oscilloscope geometry, trigger, and time-base circuits for proper operation. For making a sine-wave bandpass check of an oscilloscope preamplifier system, use a 1-series or letter-series plug-in unit rather than the Type TU-7.

When using the Type TU-7 to couple an input signal to the oscilloscope vertical amplifier, the deflection factor of the unit is about 0.5 volt/cm with the TEST FUNCTION switch set to LOW LOAD or HIGH LOAD and the AMPLITUDE control turned fully clockwise. LOW LOAD is the normal position of the TEST FUNCTION switch for displaying signals applied through the EXT INPUT connector.

Resistance Measurements

Blank columns are provided in Table 4-1 for recording resistance readings and the meter used. Resistance measurements recorded when the Type TU-7 operates correctly may be useful if trouble should occur.

SECTION 3
CIRCUIT DESCRIPTION

General Information

Fig. 3-1 is a block diagram of the Type TU-7 Plug-In Test Unit. The circuitry of the unit may be separated into three major divisions: the Power Supply Loading Circuit, the Dual-Trace Switching Circuit, and the Pulse Generator Circuit. All three of these circuits are controlled by TEST FUNCTION switch SW10.

POWER SUPPLY LOADING CIRCUIT

General Operation

The purpose of this circuit is to operate the regulated power supplies of the oscilloscope under extreme load conditions to determine if they regulate properly. Fixed-resistor dummy loads are used to simulate the loading effect of plug-in preamplifiers. The LOW LOAD and HIGH LOAD positions of the TEST FUNCTION switch are used to connect the correct loads to the low-voltage power supplies. The GAIN SET position provides a check of the gain of the oscilloscope vertical amplifier. The COMMON MODE position of the switch provides a check of the oscilloscope vertical amplifier rejection ratio. The last four positions of the TEST FUNCTION switch operate the dual-trace switching circuit or the pulse generator circuit and will be discussed under those headings.

Detailed Description

When TEST FUNCTION SW10 is set to the LOW LOAD position, the main load on the —150-volt supply is provided through R125, with slight additional loading through the dual-trace switching multivibrator circuit. The +100-volt supply is loaded primarily by R121, R124, R18, and R19, with additional loading through R85 and R86. Minimum loading for the +225-volt supply is provided by R122, as well as the resistors in the vertical position network, R80A,B,C,D, R81 and R82. The +350-volt supply receives no load in the LOW LOAD position. All of the minimum load resistances remain in the circuit at all times.

When the TEST FUNCTION switch is set to the HIGH LOAD position, additional dummy load resistors are connected to all four low-voltage power supplies. R116 loads the —150-volt supply; R111 and R112 in parallel load the +100-volt supply; R109 and R110 in parallel load the +225-volt supply; and R106 and R107 in parallel load the +350-volt supply.

Pins 1 and 3 of the interconnecting plug are the input signal and vertical positioning connections for the oscillo-

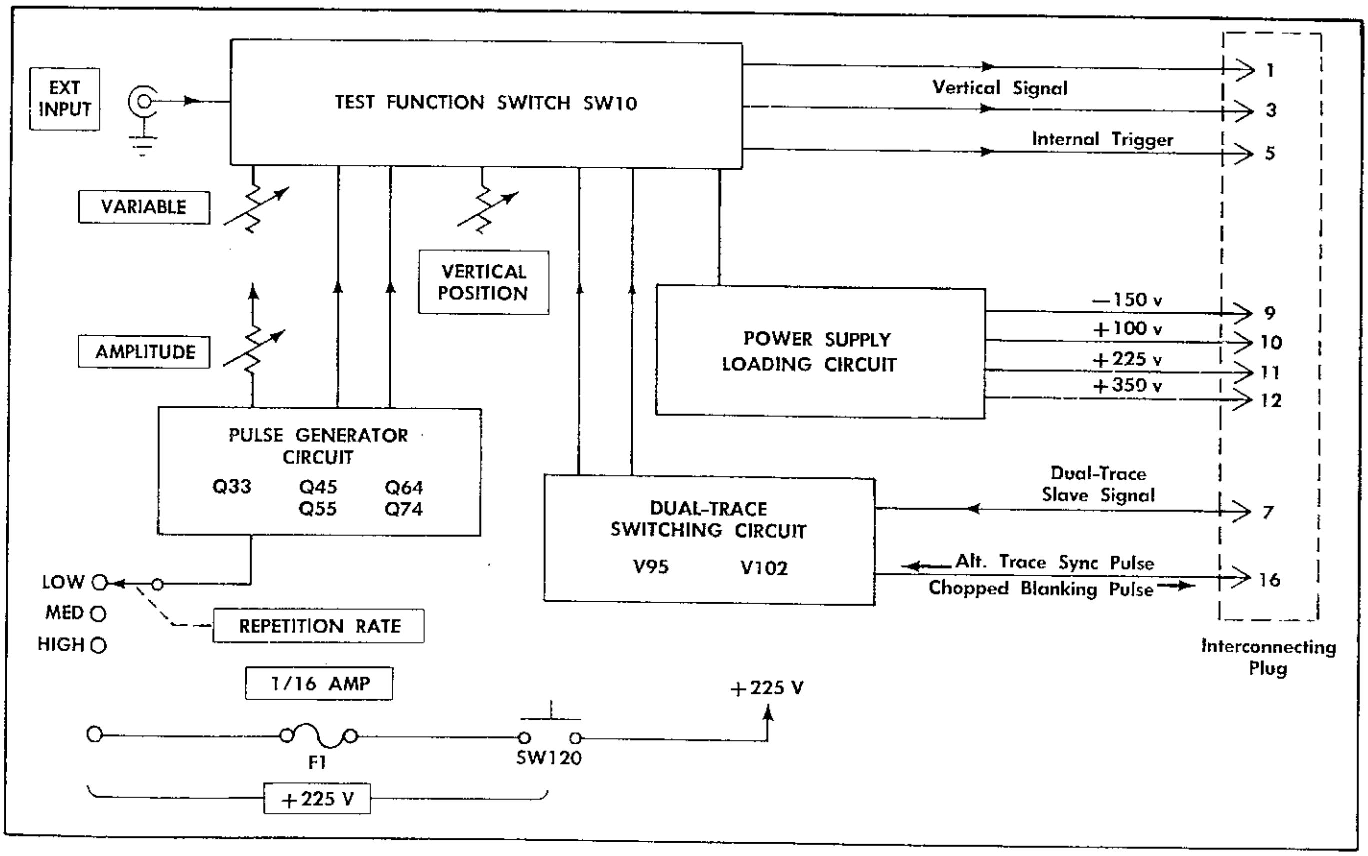


Fig. 3-1. Type TU-7 Block Diagram.

scope vertical amplifier. When using the LOW LOAD or HIGH LOAD positions, an external signal applied to the Type TU-7 INPUT connector is ac coupled through C22 to pin 1 of the interconnecting plug. Since the signal is applied to pin 1 only, it provides single-ended drive to the vertical amplifier. Front-panel VARIABLE control R11, connected between the junction of R10/C10 and ground, controls the amount of input signal applied to pin 1. R10 and C10 provide some input signal frequency compensation. Vertical positioning of the trace is provided by the voltage applied to pin 3 of the interconnecting plug through the vertical position network.

An internal trigger signal is applied from the junction of R12 and R14 to pin 5 of the interconnecting plug. For oscilloscopes that can trigger directly from the plug-in unit, this signal simulates the internal trigger signal from a dual-trace plug-in preamplifier, such as the Tektronix Type 1A1.

In all positions of the TEST FUNCTION switch except COMMON MODE, +PULSE, and —PULSE, two separate voltage dividers set the dc voltages at pins 1 and 3 of the interconnecting plug at +67.5 volts with the trace centered and no signal applied. This voltage, which simulates the nominal output voltage of a plug-in preamplifier, is essential at the input of the oscilloscope for linear operation of the vertical amplifier. The voltage at pin 1 is set by voltage divider R16, R17, R18 and R19. The voltage at pin 3 is set by voltage divider R84, R85, R86, vertical positioning network R80A, B, C, D, R81, and VERTICAL POSITION control R82. The VERTICAL POSITION control varies the divider voltage applied to pin 3 of the interconnecting plug and thus controls the vertical position of the display in all positions of the TEST FUNCTION switch except COMMON MODE.

In the GAIN SET position of the TEST FUNCTION switch, a precision 250-to-1 divider consisting of R17 in series with parallel resistors R18 and R19 sets the amount of input calibrator signal applied to the oscilloscope vertical amplifier. Thus, if a 100-volt peak-to-peak calibrator signal is used, the divider dc couples a 0.4-volt signal to pin 1 of the interconnecting plug. This signal results in a 4-cm deflection on the crt if the gain of the oscilloscope vertical amplifier is set correctly.

In the COMMON MODE position of the TEST FUNCTION switch, a signal applied to the INPUT connector is ac coupled through C22 and applied equally through R25 and R26 to pins 1 and 3 of the interconnecting plug. The TEST FUNCTION switch disconnects the AMPLITUDE and VERTICAL POSITION controls. In this position, voltage divider R16, R17, R18 and R19, sets the dc voltage at both pin 1 and pin 3. Since the same signal is applied in phase to both sides of the oscilloscope vertical amplifier, the signals will cancel if the rejection ratio of the amplifier is high. The position of the trace on the crt is the dc balance point of the oscilloscope vertical amplifier, whether or not a signal is applied to the input.

DUAL-TRACE SWITCHING CIRCUIT

General Operation

The Dual-Trace Switching Circuit consists of plate-coupled switching multivibrator V95A/V95B and steering diodes V102A/V102B. Under normal conditions, the circuit performs five general functions:

1. When the TEST FUNCTION switch is set to ALTERNATE, the switching multivibrator operates in a bistable configuration. An alternate-trace sync pulse from the oscilloscope at the end of each sweep is applied via pin 16 on the interconnecting plug, switching the multivibrator from one state to the other by turning on the steering diode that was cut off. The output of the multivibrator is a sequence of two dc levels for each complete cycle of operation. The two levels produce two alternate traces on the crt. A signal applied to the Type TU-7 EXT INPUT connector also appears at pin 1 of the interconnecting plug, and is displayed by the lower trace, simulating the Channel 1 operation of a dual-trace preamplifier plug-in unit. The upper trace, which simulates Channel 2, displays essentially no signal.

2. In the alternate mode of operation, a portion of the applied signal is picked off and used as an internal trigger signal at pin 5 of the interconnecting plug. If the oscilloscope is capable of internally triggering on the signal at pin 5, a stable display of the applied signal can be obtained.

3. In the alternate mode of operation, if the oscilloscope has two time bases that can be operated alternately, a "slave pulse" signal is applied from the oscilloscope via pin 7 of the interconnecting plug through the steering diode stage to the switching multivibrator. The slave pulse sets the state of the multivibrator so the upper trace will be displayed when Time Base B generates its sweep. At the end of the Time Base B sweep, a sync pulse applied through pin 16 and the steering diode causes the multivibrator to switch states so the lower trace will be displayed while Time Base A generates its sweep.

4. When the TEST FUNCTION switch is set to the CHOPPED position, the switching multivibrator is in an astable configuration. The free-running rate of the circuit is approximately 100 kc. The output of the circuit is a sequence of two dc levels which produces a display of two traces chopped into off-on segments at the 100 kc rate. A signal applied to the INPUT of the Type TU-7 is ac coupled to pin 1 of the interconnecting plug and is displayed by the "on" segments of the lower trace. The upper and lower traces simulate the operation of Channels 2 and 1 respectively of a dual-trace preamplifier operated in the chopped mode.

5. With the Type TU-7 set for chopped mode, the switching multivibrator produces blanking pulses that are applied through pin 16 of the interconnecting plug to the oscilloscope blanking circuit. The blanking pulses cause the crt beam to be blanked during the time the beam is being switched from one trace to the other.

Detailed Operation

When the TEST FUNCTION switch is set to the ALTERNATE position, the voltage in the grid circuit of the switching multivibrator is set at a level that causes the circuit to operate as a bistable multivibrator. Basic operation of the circuit is illustrated in Fig. 3-2. To show the operation of the circuit, assume that V95A is initially conducting and V95B is cut off. With current through V95A, V102A is forward biased and conducting due to the voltage drop across R94. D89 and D90 are forward biased by current through V95A.

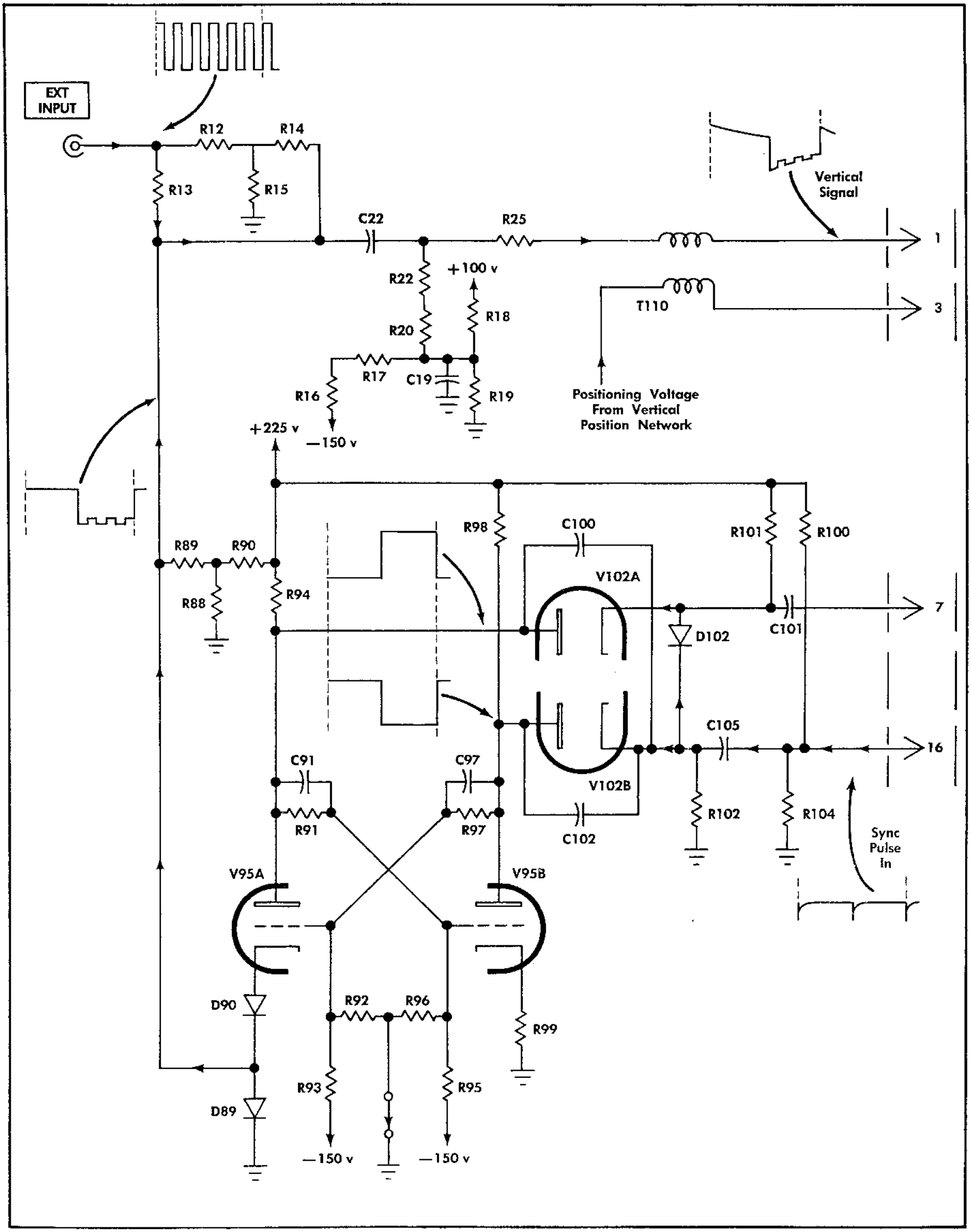


Fig. 3-2. Simplified schematic of Dual-Trace Switching circuit showing basic operation with TEST FUNCTION switch at ALTERNATE.

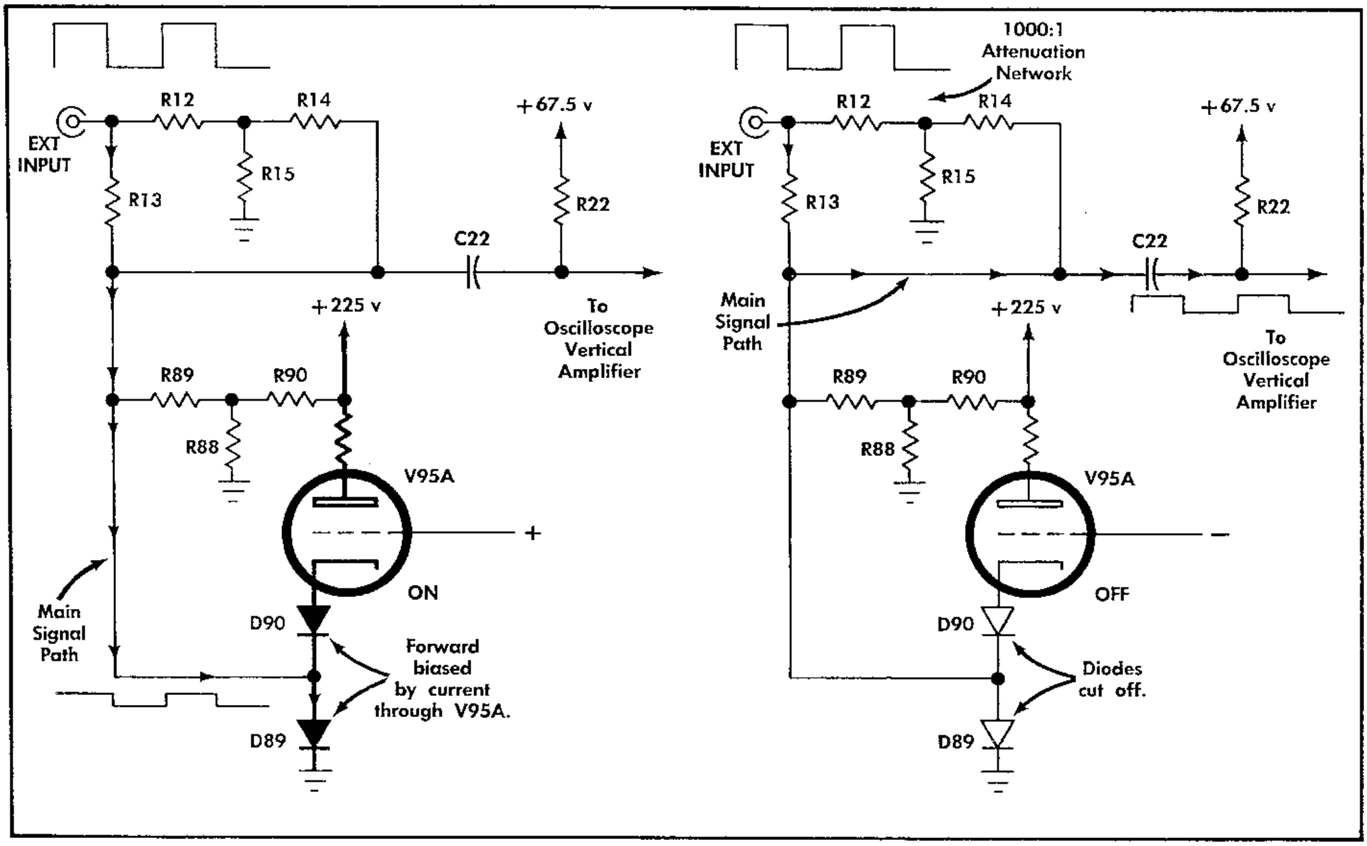


Fig. 3-3. Simplified schematic diagram showing input signal path during the two states of the dual-trace switching multivibrator, with TEST FUNCTION switch set to ALTERNATE or CHOPPED.

The voltage drop across D89 sets the dc level of the output applied to C22 at approximately 0.1 volt, causing the displayed trace to start about 2 cm above the ground reference level. The major portion of any signal applied to the EXT INPUT connector is shunted to ground through D89 (see Fig. 3-3), so essentially no waveform is displayed. After starting 2 cm above ground level, the display curves toward the dc voltage applied through R22 due to the ac-coupling through C22. At sweep rates slower than about 50 msec/cm, the trace reaches the dc voltage very near the beginning of the sweep.

A negative-going sync pulse produced by the oscilloscope at the end of a sweep is received by the Dual-Trace Switching circuit through pin 16 of the interconnecting plug and is applied through C105 to the cathode of V102B and through D102 to the cathode of V102A. With the initial conditions as given above, the negative sync pulse causes V102B to conduct momentarily, producing a negative pulse in the plate circuit of V95B. Since V102A is already conducting, the sync pulse has no effect on that diode. The negative pulse at the plate of V95B is applied to the grid of V95A through R97/C97, causing the multivibrator to switch to its other bistable state. After switching, V95A and V102A are cut off, and V95B and V102B are conducting. With no current through V95A, bias current is removed from D89 and D90, cutting them off. The dc output level applied to C22 drops from 0.1 volt to about ground, set by R88/R89. Any signal now applied to the EXT INPUT connector is attenuated by the 1000:1 attenuator at the input and applied through C22 to the vertical amplifier of the oscilloscope. The lower trace with the input waveform is then displayed on the crt.

At the end of the sweep, another sync pulse arrives through pin 16 and C105 and is directed through D102 to V102A, since V102B is already conducting. V102A is turned on momentarily by the sync pulse, applying a negative pulse through R91/C91 to the grid of V95B, reverting the multivibrator to its initial state. With V95A turned on again, current through D89 and D90 again shunts any input signal to ground and sets the dc output level at 0.1 volt, starting another cycle of operation.

When using an oscilloscope capable of alternating between time-base circuits, an alternate-trace slave pulse is applied through pin 7 of the interconnecting plug and C101 to the cathode of V102A (see Fig. 3-4). The slave pulse is a negative gate from the sweep-switching circuit of the oscilloscope, time-related to the sync pulses in such a way as to lock the upper trace of the Alternate display to the Time Base B sweep of the oscilloscope. (The Trace Separation control on a Type 547 Oscilloscope should be set to zero.) This operation simulates the locking of Channel 2 on a dual-trace plug-in preamplifier to the Time Base B sweep, and Channel 1 to the Time Base A sweep.

The negative slave pulse starts at the end of the Time Base B sweep as the voltage at pin 7 drops from about +45 volts to zero, and ends at the end of Time Base A sweep as the voltage returns to +45 volts. The pulse appears as a differentiated signal at the cathode of V102A. The positive portion of the differentiated signal forward biases D102 and

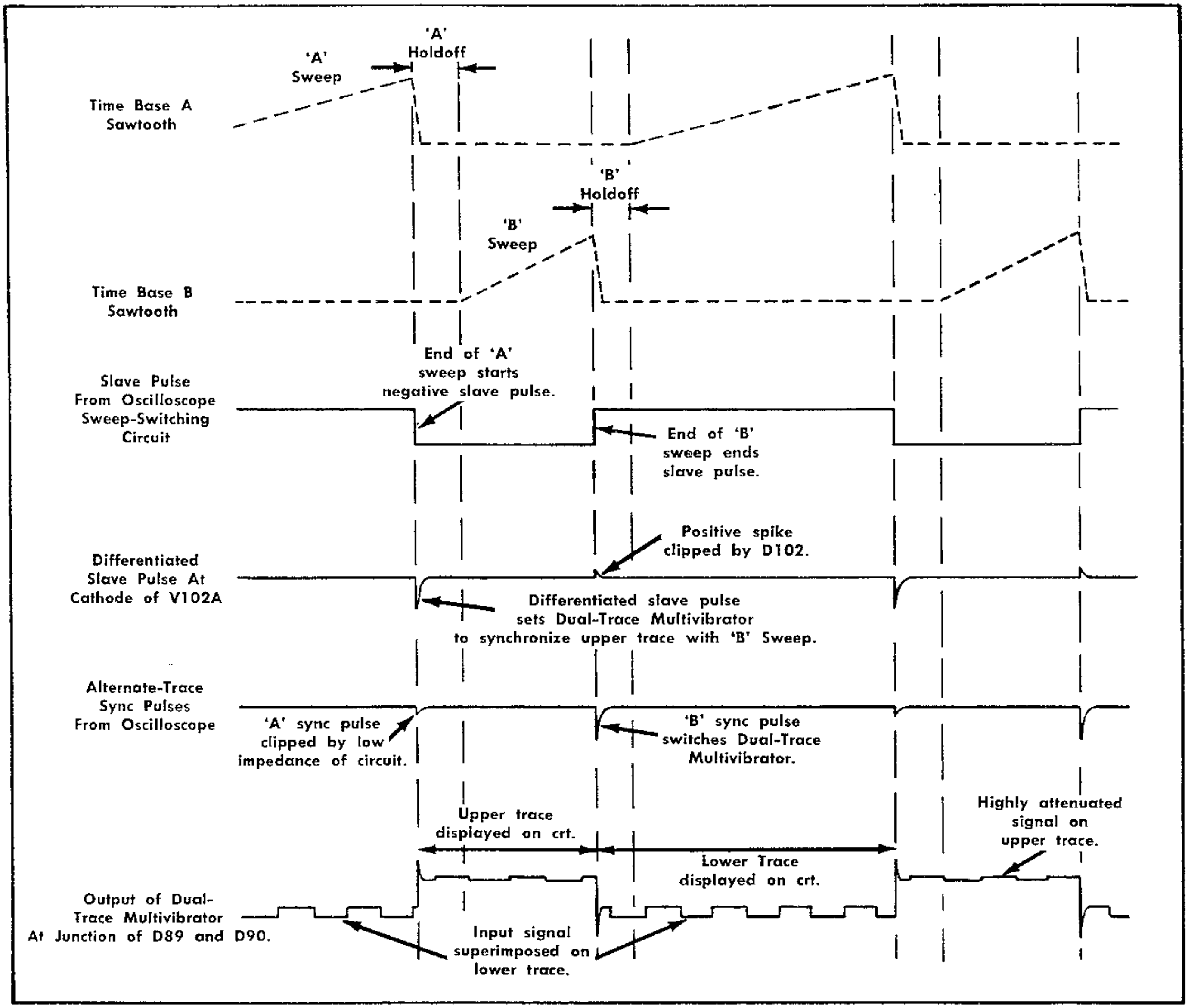


Fig. 3-4. Timing relationship of waveforms during alternate-sweep slaving operation of oscilloscopes capable of alternate-sweep switching. Sweep rate of Time Base B is set twice as fast as Time Base A and both time bases are triggered (plug-in).

is attenated by the circuit. Thus the slave pulse signal at the cathode of V102A consists primarily of negative spikes occurring at the end of each Time Base A sweep.

When V102A and V95A are conducting, the switching multivibrator is set to display the upper trace. In this state, the negative slave pulse has no effect on the multivibrator, since the pulse cannot pass through D102 and does not affect V102A while it is conducting. However, when V102A and V95A are cut off, the multivibrator is not set to display the upper trace. In this case, if a slave pulse arrives, it will turn on V102A and reset the multivibrator to be ready to display the upper trace. Thus the upper trace always occurs immediately following the negative slave pulse and is locked to the Time Base B sweep.

When the TEST FUNCTION switch is set to the CHOPPED position, the voltage in the grid circuit of the switching multivibrator sets the circuit for astable operation. See Fig. 3-5. The switching action begins as soon as supply voltages are connected, due to slight characteristic differences between the A and B sections of the tube. The repetition rate of the multivibrator in the Chopped mode is approximately 100 kc, set by the supply voltages and the resistor-capacitor combinations in the grid and plate circuits.

As the multivibrator switches from one state to the other, one output signal is generated in the same manner as the vertical switching signal in the Alternate mode as D89 turns on and off. Each time V95A conducts, D89 and D90 are forward biased and D89 shunts to ground any signal applied to the EXT INPUT connector during the time that the upper trace segment apears on the crt. Then when V95A cuts off, D89 stops conducting and the lower trace appears on the crt. If a signal is applied to the input at this time, it will be displayed by the lower trace for the duration of the trace segment. Refer to the discussion of Alternate operation for a more detailed description of this switching signal.

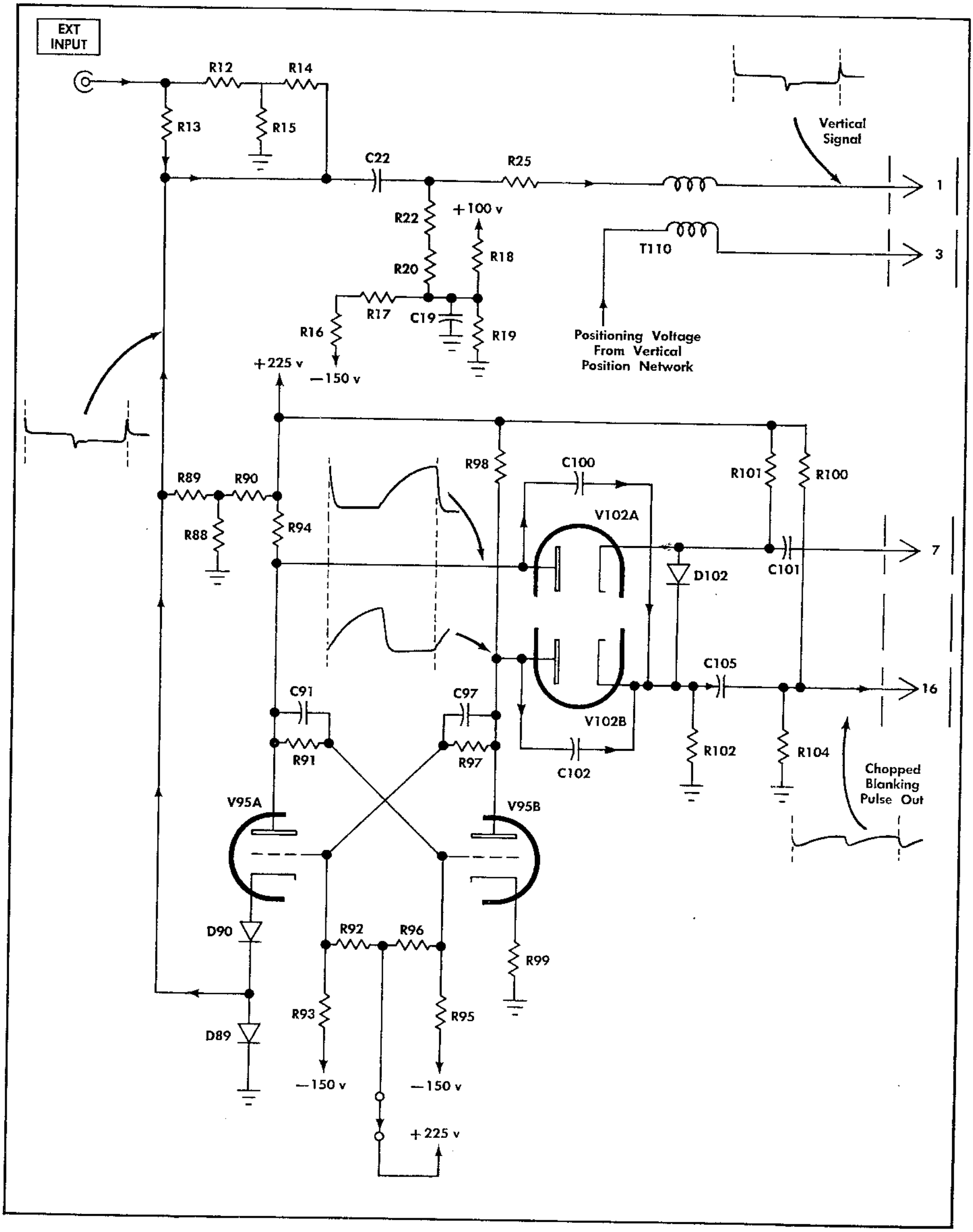


Fig. 3-5. Dual-Trace Switching circuit showing operation with TEST FUNCTION switch at CHOPPED.

Ⓐ

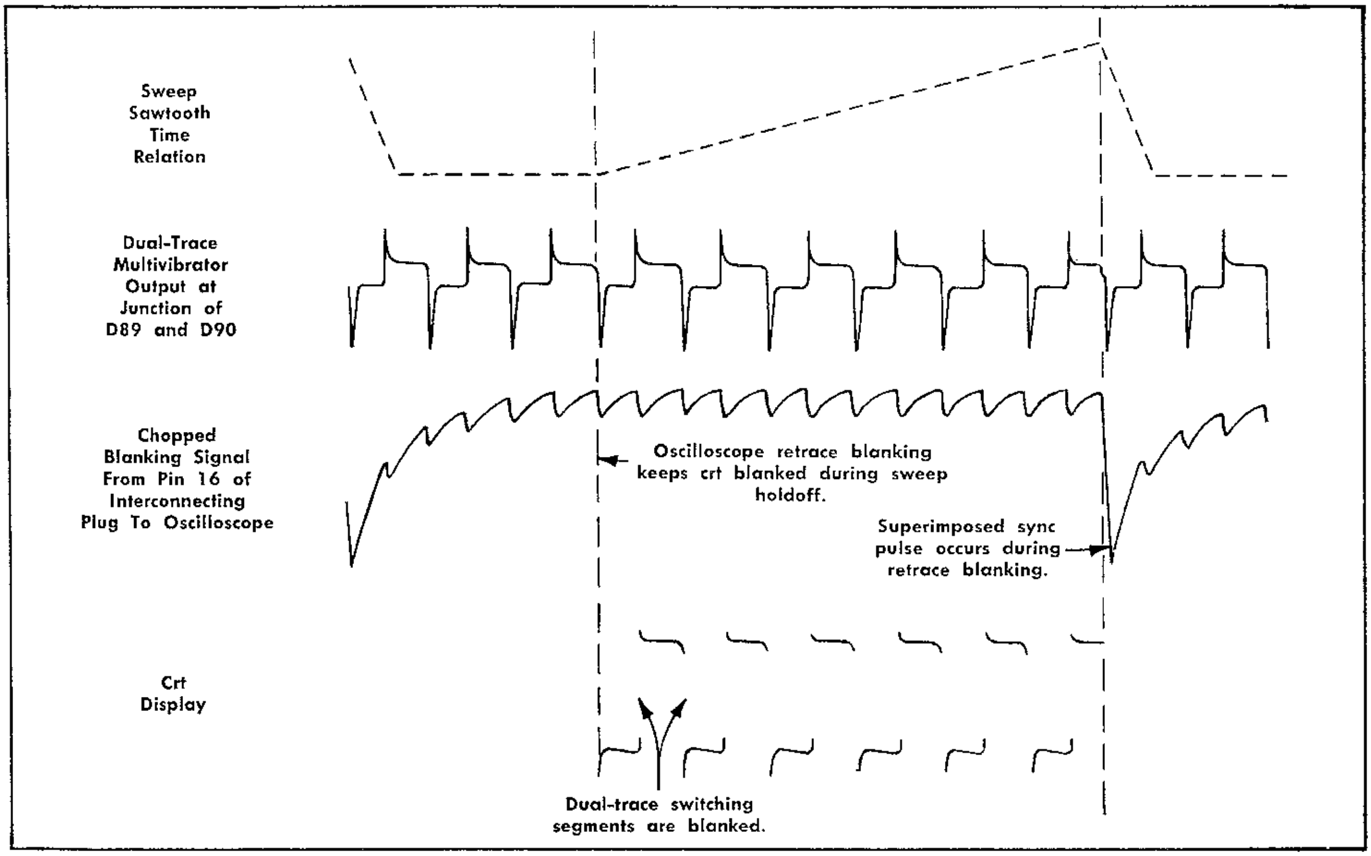


Fig. 3-6. Timing of chopped blanking pulses from Type TU-7 to oscilloscope crt cathode with TEST FUNCTION switch at CHOPPED.

A second output is produced in the plate circuits of the multivibrator and coupled out through C100 and C102. Each time the multivibrator switches states, the voltage in the plate circuit of one tube drops fast as the tube turns on, stays at the lower voltage level until the other tube turns on, then rises slowly to its maximum value as the capacitance charges through a relatively high impedance path. The waveforms produced in both plate circuits of the switching multivibrator are coupled through C100 and C102 to the cathode circuit of V102B where they are combined and applied through C105 and pin 16 of the interconnecting plug to the oscilloscope blanking circuit. The frequency of the composite output chopped blanking signal is twice the repetition rate of the switching multivibrator. See Fig. 3-6. This output signal is inverted and amplified in the oscilloscope and applied to the crt cathode to blank the crt beam during the switching portions of the signal sent to the vertical amplifier through pin 1 of the interconnecting plug.

PULSE GENERATOR CIRCUIT

General Operation

The Pulse Generator circuit consists of rate generator multivibrator Q45/Q55, constant-voltage transistor Q33, current-switching transistors, Q64/Q74, and disconnect diodes D64, D65, D74 and D75. Fig. 3-7 is a simplified schematic of the circuit. When the TEST FUNCTION switch is set to the + PULSE or — PULSE position, the rate generator operates as an astable circuit. One complete multivibrator cycle turns the current-switching transistors on and off. As these transistors are turned on, they shunt across the disconnect diodes which then cut off very fast, producing the fast-rise step-function output (see Fig. 3-8). As the current-switching transistors are turned off again, the disconnect diodes conduct again and the output pulse ends (see Fig. 3-9).

Detailed Operation

For the following discussion, assume that the TEST FUNCTION switch is set to the + PULSE position and the AMPLITUDE control is turned fully clockwise to the maximum amplitude position. The TEST FUNCTION switch connects the +100-volt supply to the collector circuit of Q33, and applies about +75 volts to the base of the transistor through D30 and R30. The transistor is thus turned on with emitter current provided through D35 and R39 from ground. When the circuit is correctly adjusted, the voltage at the emitter of Q33 is approximately +75 volts, providing all positive supply voltages for the Pulse Generator circuit. The +60 volts existing at the anode of D35 provides the supply voltage for the base circuits of the rate generator multivibrator and for one end of the amplitude control network. DRIVE BAL R40 is adjusted so the push-pull output voltages are equal.

As soon as supply voltages are applied to the circuit, the rate generator begins its astable multivibrator operation. During the multivibrator cycle, when Q45 is conducting and Q55 is cut off, the positive voltage at the collector of Q55 reverse biases the base-emitter junction of Q74, holding

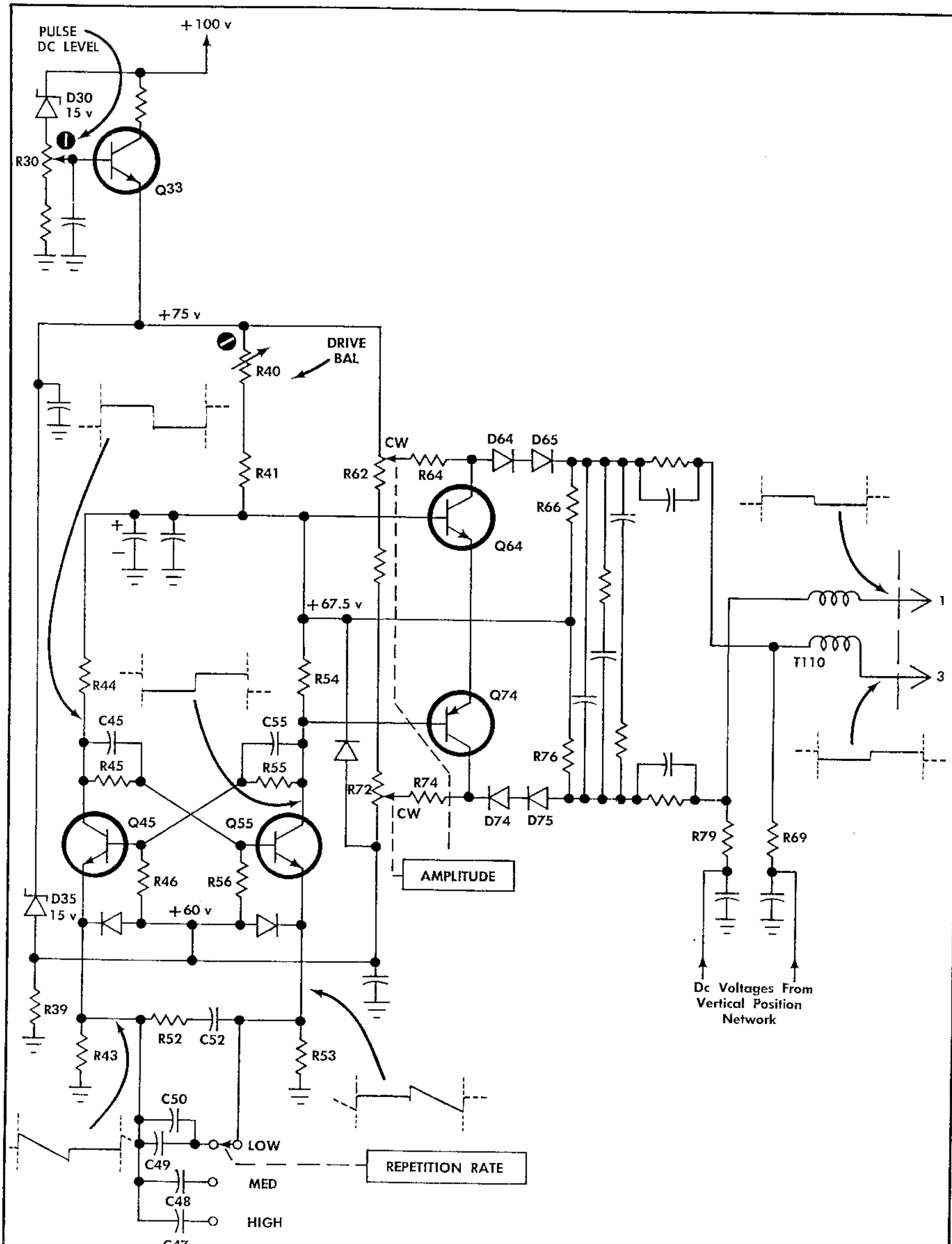


Fig. 3-7. Simplified schematic of the Pulse Generator circuit with TEST FUNCTION switch at +PULSE and AMPLITUDE control fully clockwise.

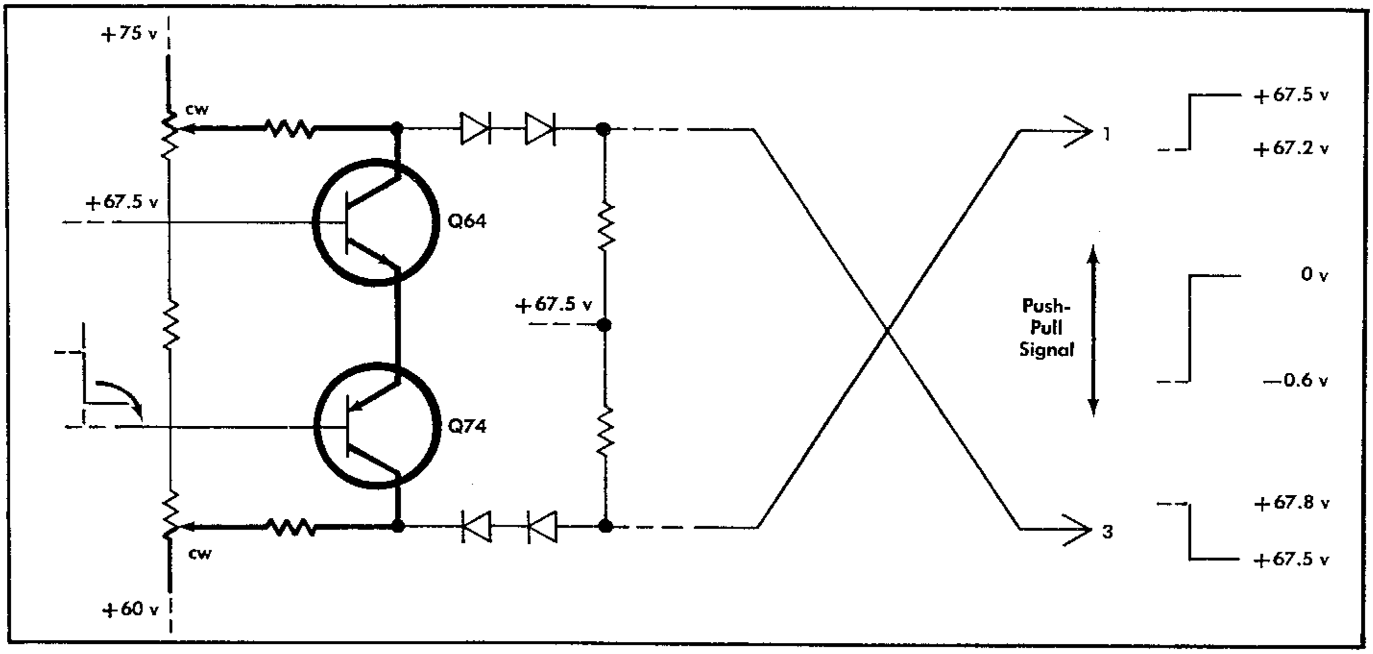


Fig. 3-8. Major current path during rise and top of pulse with TEST FUNCTION switch at +PULSE and AMPLITUDE control fully clockwise.

Q64 and Q74 in cutoff. With no current through Q64 and Q74, the disconnect diodes are forward biased and are conducting current from the supply voltages through R62/R64/R66 and R72/R74/R76. Current through the disconnect diode circuit and thus through the output resistors (R66/R76) is adjusted by ganged AMPLITUDE controls R62/R72. The output voltages are applied to pins 1 and 3 of the interconnecting plug and produce the baseline voltage on the crt display of the +pulse. With the AMPLITUDE control turned fully clockwise and the disconnect diodes conducting, this output is approximately +67.2 volts at the junction of D75 and R76, and approximately +67.8 volts at the junction of D65 and R66.

During the time that Q55 is cut off, C52 and the capacitor selected by REPETITION RATE SW50 charge to ground through R53, and the voltage in the emitter circuit becomes more negative. As the base-emitter junction of Q55 becomes forward biased, this transistor turns on and causes the multivibrator to switch states. As Q55 turns on and Q45 turns off, the base-emitter junctions of Q64 and Q74 become forward biased, turning on these transistors and shunting

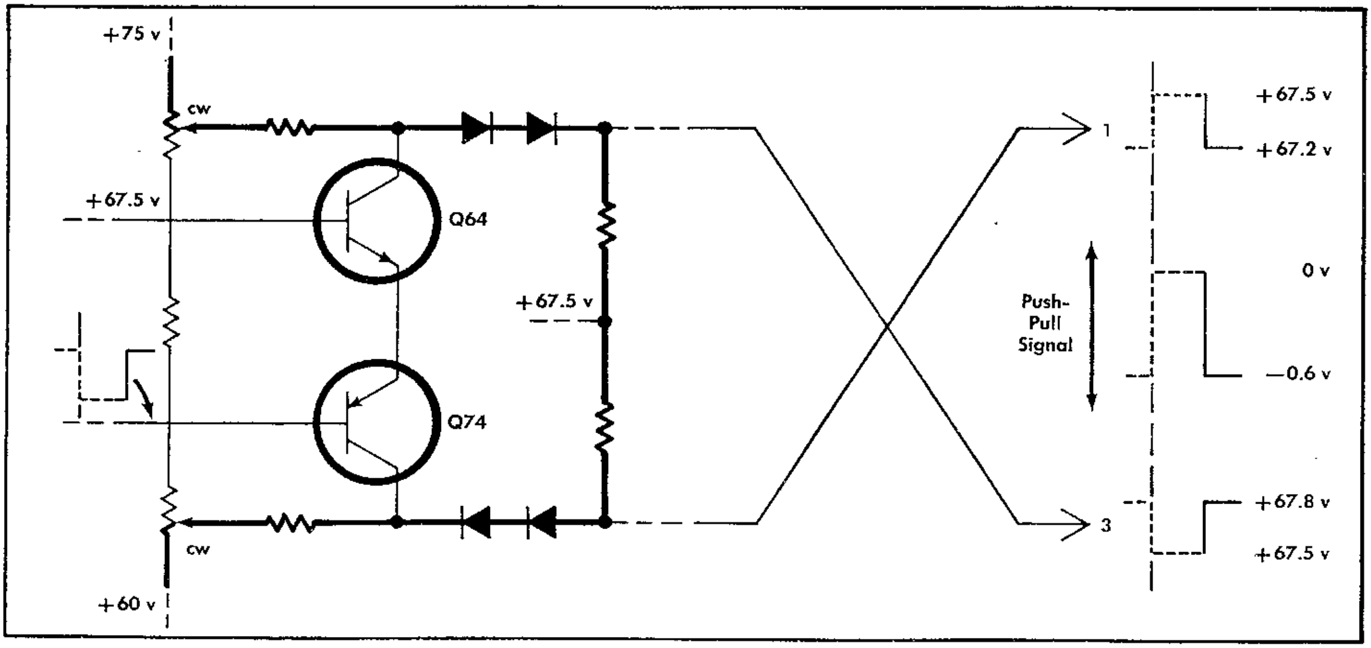


Fig. 3-9. Major current path during fall and bottom of pulse with TEST FUNCTION at +PULSE and AMPLITUDE control fully clockwise.

current away from the disconnect diodes. The fast switching characteristics of the disconnect diodes enable them to cut off very fast when the current source is removed, producing the fast-rise (3 nsec) output step as both output voltages go to +67.5 volts. As the differential voltage between pins 1 and 3 changes to zero volts, the fast rise of the pulse is displayed on the crt.

As soon as current through Q55 has reached a maximum and Q45 is cut off, the capacitors in the emitter circuit of Q45 begin to charge, allowing the emitter voltage to go negative. When the base-emitter junction of Q45 becomes forward biased, the multivibrator switches states again. The positive-going voltage at the collector of Q55 turns off the current-switching transistors, restoring the current source to the disconnect diodes. As current rises through the output resistors, the output voltages to the oscilloscope return to +67.2 and +67.8 volts, and the displayed +pulse returns to its baseline. The next pulse is started when Q55 turns on again.

The switching rate of the rate generator multivibrator is determined by the supply voltages and the resistor-capacitor combinations in the base and emitter circuits. The front-panel REPETITION RATE switch allows the capacitance in the emitter circuits to be changed, controlling the charging rate in the emitter circuits and thus the switching rate of the multivibrator. With C49 and C50 connected in the circuit (LOW), the repetition rate of the output pulse is approximately 5 kc; with C48 in the circuit (MED), the rate is 120 kc and with C47 in the circuit (HIGH), the repetition rate is 600 kc.

The output of the Pulse Generator circuit simulates a fast-rise input pulse from a 50-ohm system. The impedance presented to the oscilloscope vertical amplifier is determined primarily by the values of R66 and R76. The center voltage at the output (+67.5 volts) is adjusted by PULSE DC LEVEL control R30 during calibration. Vertical positioning of the pulse display on the crt is controlled by dc voltages added to the output through R69 and R79.

Operation of the Pulse Generator circuit is exactly the same in —PULSE as in +PULSE, but the polarity of the output is reversed by the TEST FUNCTION switch.

SECTION 4
MAINTENANCE

PREVENTIVE MAINTENANCE

Cleaning the Interior

Internal cleaning should precede calibration since the cleaning process could alter the setting of certain calibration controls.

One way to clean the interior is by vacuum and/or low-pressure compressed air (high-velocity air could damage certain components). Hardened dirt may be removed with a soft paint brush, cotton-tipped swab, or cloth dampened with a water and mild detergent solution. Pay special attention to high-voltage circuits where conductive dust can cause arcing.

The contacts on the plug-in interconnecting jacks and plugs should be lightly lubricated with an oil of the type used on rotary-switch contacts. To extend the life of the contacts clean and relubricate if the oil becomes contaminated with abrasive dust.

Visual Inspection

The instrument should be inspected occasionally for such defects as poor connections, broken or damaged ceramic terminal strips, improperly seated tubes or transistors, and heat-damaged parts. The remedy for most visible defects is obvious. However, overheating is usually a symptom of other unseen defects and unless the cause is determined before parts are replaced, the damage may be repeated.

Tube and Transistor Checks

Periodic preventive maintenance checks on the tubes and transistors used in the instrument are not recommended. The circuits within the instrument generally provide the most satisfactory means of checking tube or transistor performance. Performance of the circuits is thoroughly checked during recalibration so that substandard tubes and transistors will usually be detected at that time.

Recalibration

To insure accurate measurements, the instrument calibration should be checked after each 500 hours of operation or every six months if used intermittently. Complete calibration instructions are contained in Section 5 of this manual.

The calibration procedure can be helpful in isolating major troubles in the instrument. Moreover, minor troubles not apparent during regular operation may be revealed and corrected during calibration.

CORRECTIVE MAINTENANCE

General Information

Removal or replacement procedures for most parts in the Type TU-7 are obvious. However, some parts require special procedures. Removal and replacement of these parts are discussed in the following paragraphs.

Many components in the Type TU-7 are mounted in a particular way to reduce stray inductance and capacitance. Therefore, carefully install replacement components to duplicate lead length, lead dress, and location of the original component.

After replacing any electrical components, be sure to check the calibration of the instrument. Components of the same type usually exhibit slightly different characteristics and will often affect calibration.

Standard Parts

Many components in the instrument are standard electronic parts available locally. However, all parts can be obtained through your Tektronix Field Engineer or Field Office. Before purchasing or ordering, consult the parts list (Section 6) to determine the value, tolerance, and rating required.

Special Parts

Some parts are manufactured or selected by Tektronix to satisfy particular requirements, or are manufactured for Tektronix to our specifications. These and most mechanical parts should be ordered directly from your Tektronix Field Engineer or Field Office. See "Parts Ordering Information" and "Special Notes and Symbols" on the first page of Section 6.

Soldering

Special silver-bearing solder is used to establish a bond to the ceramic terminal strips in Tektronix instruments. This bond may be broken by repeated use of ordinary tin-lead solder or by execessive heating. Solder containing about 3% silver is recommended. Silver-bearing solder is usually available locally or may be purchased in one-pound rolls through your Tektronix Field Engineer or Field Office. Order by part number 251-514.

Soldering to Ceramic Strips:

1. Use a wedge-shaped soldering-iron tip about 1/8-inch wide. This will allow you to apply heat directly to the solder in the terminal without touching the ceramic, thereby reducing the amount of heat required.
2. Maintain a clean, properly tinned tip.

3. Use a hot iron for a short time. A 50- to 75-watt iron with good heat storage and transfer properties is adequate.
4. Avoid putting pressure on the strip with the soldering iron or other tools. Excessive pressure may cause the strip to crack or chip.

Soldering to Etched-Wiring Boards:

1. To remove a component, cut the leads near the body. This frees the leads for individual unsoldering.
2. Grip the lead with needle-nose pliers. Apply the tinned tip of a 40-watt pencil soldering iron to the lead between the pliers and the board; then pull gently.
3. When the solder first begins to melt, the lead will come out, leaving a clean hole. If the hole is not clean, use a scribe or pointed tool and the soldering iron to open the terminal hole.
4. Bend the leads on the new component to the correct shape and carefully insert the leads into the holes.
5. Apply the iron for a short time at each connection on the side of the board opposite the component to properly seat the component.
6. Apply the iron and a little solder to the connections to finish the solder joint.
7. Clip any excess lead that extends through the board.

Ceramic Terminal Strips

Fig. 4-1 shows an assembled ceramic terminal strip. Replacement strips with studs attached are supplied under a single part number and spacers under another number. The original spacers may be reused if undamaged.

Usually, a strip can be pried out of the chassis or pulled out with a pair of pliers. In some cases, you may choose to use a hammer and punch to drive out the studs from the opposite side of the chassis.

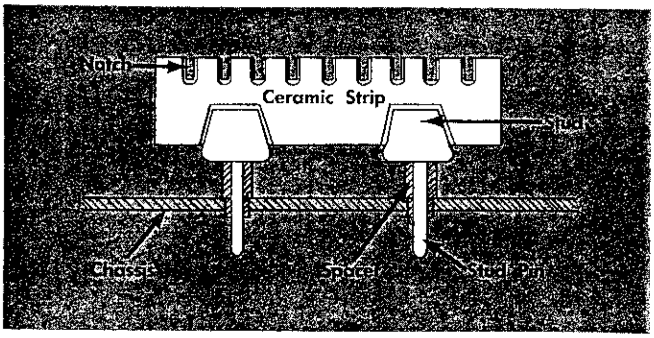


Fig. 4-1. Ceramic Terminal Strip Assembly.

When the damaged strip has been removed, place new or used (but undamaged) spacers in the chassis holes. Then carefully force the studs of the new strip into the spacers until they are completely seated. If necessary, use a soft-faced mallet and tap lightly over the stud area of the strip.

Switch Replacement

Individual wafers normally are not replaced in switch assemblies. Replacement switiches may be ordered from Tektronix either unwired or with the associated wires and components attached. See Section 6.

When soldering leads to a switch, do not let solder flow around and beyond the terminal rivet as this may destroy the contact spring tension.

Tubes and Transistors

Tubes and transistors should not be replaced unless actually defective. When a defect is suspected, it is suggested that circuit conditions be checked first to be certain that a replacement tube or transistor will not be immediately destroyed. In some cases, these checks will also show whether or not the tube or transistor is at fault.

When circuit conditions are known to be safe, install a tube or transistor that is known to be good and check for proper operation. If the original tube or transistor proves acceptable, return it to its original socket to avoid unnecessary recalibration.

TROUBLESHOOTING

Operational Checks

If trouble is encountered in the Type TU-7, first perform a visual inspection of the entire unit. If a visual inspection does not reveal the cause of trouble, change tubes or transistors, depending on the area of the trouble.

As a troubleshooting aid, Table 4-1 provides resistance values to ground at the terminals of the 16-pin interconnecting plug at the rear of the unit. The resistance measurements were taken with the unit disconnected from the oscilloscope. The measurements are not absolute since semiconductors are used in the circuitry. Therefore, for future reference, blank columns are provided in the table for recording measurements and type of meter used.

NOTE

To make the unit more accessible for servicing, use either a Tektronix 6½-inch extension (Part No. 013-055) or a 30-inch flexible extension (Part No. 012-038). Remember, however, that if the TEST FUNCTION switch is set to +PULSE or —PULSE, the oscilloscope display will contain some overshoot and ringing due to the lead lengths in the extension.

TABLE 4-1

Resistance Measurement

Pin	TEST FUNCTION Switch	Type of Meter: VOM* Approximate Resistance Readings	Type of Meter: VOM* Ohms Range	Type of Meter: Manufactured By: Model No.: Type TU-7 Serial No.: Resistance Readings	Ohms Range
1	LOW LOAD, HIGH LOAD, COMMON MODE, ALTERNATE, CHOPPED	110 k	100,000		
1	GAIN SET	9.6 k	1000		
1	+PULSE, —PULSE	18 k	1000		
2	All Positions	0	1		
3	LOW LOAD, HIGH LOAD, GAIN SET ALTERNATE, CHOPPED	45 k	1000		
3	COMMON MODE	110 k	100,000		
3	+PULSE, —PULSE	17 k	1000		
4	All Positions	0	1		
5	LOW LOAD, HIGH LOAD, ALTERNATE, CHOPPED	17 k	1000		
5	GAIN SET, COMMON MODE, +PULSE, —PULSE	20 k	1000		
6	All Positions	Infinite	100,000		
7	All Positions	Infinite	100,000		
8	All Positions	0	1		
9	LOW LOAD, GAIN SET, COMMON MODE, +PULSE, —PULSE	39 k	1000		
9	HIGH LOAD	2.4 k	1000		
9	ALTERNATE, CHOPPED	35 k	1000		
10	LOW LOAD, GAIN SET, COMMON MODE, ALTERNATE, CHOPPED	12.1 k	1000		
10	HIGH LOAD	1.5 k	1000		
10	+PULSE, —PULSE	4.4 k, 12 k**	1000	**	
11	LOW LOAD, GAIN SET, COMMON MODE, +PULSE —PULSE	15.5 k	1000		
11	HIGH LOAD	2.35 k	1000		
11	ALTERNATE, CHOPPED	10.3 k	1000		
12	All Positions except HIGH LOAD	Infinite	100,000		
12	HIGH LOAD	14 k	1000		
13	All Positions	Infinite	100,000		
14	All Positions	Infinite	100,000		
15	All Positions	500 Ω	10		
16	LOW LOAD, HIGH LOAD, COMMON MODE, GAIN SET, +PULSE, —PULSE	110 k	100,000		
16	ALTERNATE, CHOPPED	42 k	1000		

*VOM used to obtain these measurements was a 20,000 Ω/volt dc meter with a center-scale reading of 4.5 k on the 1,000 Ω scale. For the 1,000 Ω scale, center-scale deflection current is 160 μa and 320 μa at full scale.

**Ohmmeter leads are connected first in one direction, then the other, to obtain the two readings.

SECTION 5
CALIBRATION

General Information

The Type TU-7 does not require frequent recalibration, however, the calibration should be checked at regular intervals to insure that it is operating properly and accurately. In addition, calibration should be checked after tubes or transistors have been replaced or repairs have been made. A complete procedure is provided in this section for checking and adjusting the Type TU-7.

In the instructions that follow, the steps are arranged in convenient sequence to avoid unnecessary repetition. Individual steps can be performed out of sequence, but the equipment connections and control settings in previous steps will need to be noted. If the DRIVE BAL control (step 12) is adjusted, the PULSE DC LEVEL adjustment (step 13) must be checked.

Equipment Required

The following items of equipment or equivalent are required for a complete calibration of the Type TU-7.

1. Indicator oscilloscope, Tektronix 530-, 540-, or 550-Series. Must operate properly and be calibrated for vertical gain and sweep timing.
2. Test oscilloscope, laboratory-type. Dc to at least 1 mc bandpass, ac and dc input coupling, 0.02 to 20 volts/cm input deflection factor.
3. 10×probe, for test oscilloscope. High impedance input.
4. 42-inch 50-ohm coaxial cable with BNC connectors (Tektronix part no. 012-057).
5. Amplitude calibrator. 1 kc square-wave output, amplitudes from at least 0.5 volt to 100 volts peak-to-peak, accuracy within 3%. The oscilloscope Calibrator may be used.
6. Dc voltmeter. 20,000 ohms/volt impedance, 0.5% accuracy at 67.5-volt reading.
7. Ohmmeter or multimeter. Resistance scale of 1 ohm, 10 ohms, 1,000 ohms, and 100,000 ohms, 3% accuraccy.
8. Oscilloscope, sampling-type, dual-trace. 50-ohm inputs with GR connectors, at least 10 to 100 mv/cm input deflection factor, bandpass to 1 gc (gigacycle = 10^9 cps), capable of operating in differential mode. This instrument and the following two items are required only for checking the risetime of the Pulse Generator output.
9. Two 50-ohm coupling capacitors (874-K), with GR connectors, for sampling oscilloscope. (Tektronix part no. 017-028).
10. 16-pin plug-in extension, specially modified for checking Pulse Generator output. Construction of the extension is illustrated in Fig. 5-1.

PRELIMINARY INSTRUCTIONS

1. Lay the indicator oscilloscope (item 1 under "Equipment Required") on its right side. If rackmounted, leave oscilloscope upright.
2. Remove the oscilloscope bottom panel and left side panel.
3. Connect the test instruments to the power line.
4. Turn on all test instruments except the indicator oscilloscope.
5. Set the indicator oscilloscope front-panel controls as follows:

Horizontal Display	Time Base A
Time/Cm	1 mSEC
Triggering	+Internal, Ac

6. Set the sampling oscilloscope controls as follows:

Time/Cm	1 nSEC
Triggering	+Internal

7. Set the Type TU-7 controls as follows:

NOTE

Do not insert the Type TU-7 into the indicator oscilloscope until instructed later in the procedure.

TEST FUNCTION	LOW LOAD
VARIABLE	Centered
VERTICAL POSTION	Centered
AMPLITUDE	Centered
REPETITION RATE	MED

PROCEDURE

1. Check Resistances

NOTE

This step is required only if the instrument has been repaired or has been malfunctioning.

a. With the aid of Table 4-1, measure resistance from chassis ground to the interconnecting plug pins.

2. Check Protection Diode—Pulse Generator

a. Set the ohmmeter to the 1-ohm scale and check the in-circuit resistance across D54 for approximately 5 ohms in one direction; infinite in the other direction. See Fig. 5-2 for location of D54.

3. Check +225 V Output

a. Insert the Type TU-7 into the indicator oscilloscope.

1. Remove signal leads from pins 1 and 3.
2. Drill two 5/16-inch holes in side of casing
3. Place rubber grommets (348-003) around "pigtails."
4. Insert "pigtails" through holes in casing.
5. Solder both outer conductors to short piece of bus wire.
6. Solder Bus Wire to pin 2.
7. Solder center conductors to Pins 1 and 3.

*Flexible 16-pin plug-in Extension (012-038) may be substituted.

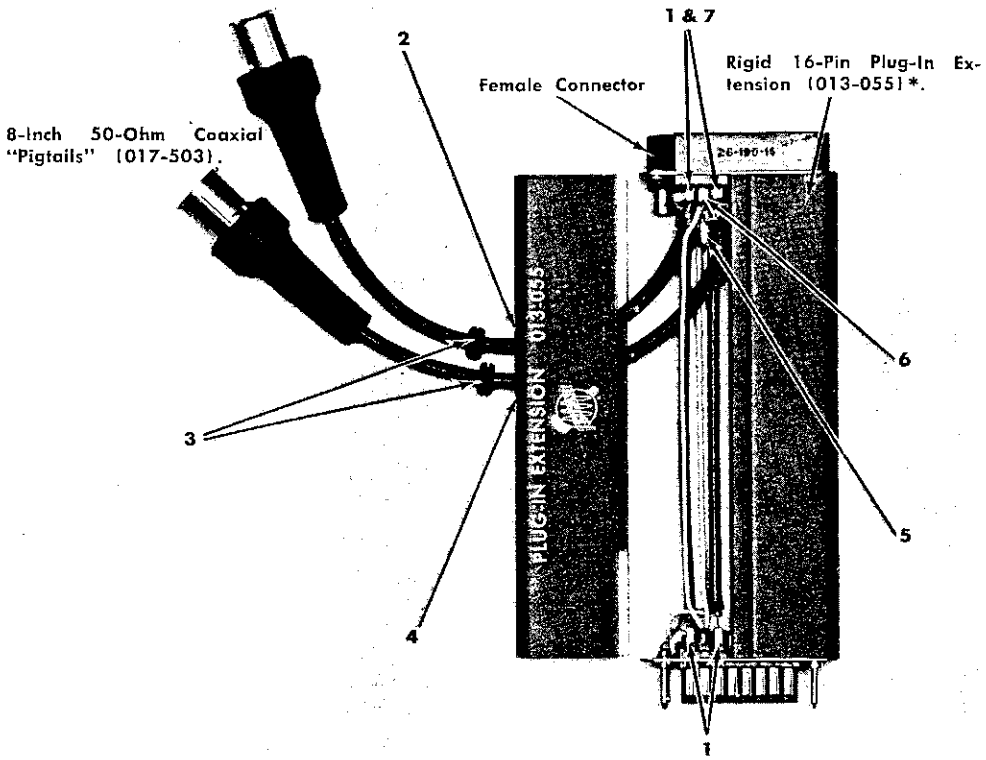


Fig. 5-1. Construction of special extender for checking pulse risetime. Tektronix part numbers are given in parentheses.

b. Turn on the instrument power and allow 10 minutes for warmup.

c. Set the TEST FUNCTION switch to LOW LOAD.

d. Connect the voltmeter between ground and the +225 V front-panel jack.

e. Press the +225 V pushbutton and check for +225 volts; then check for zero volts with the pushbutton released.

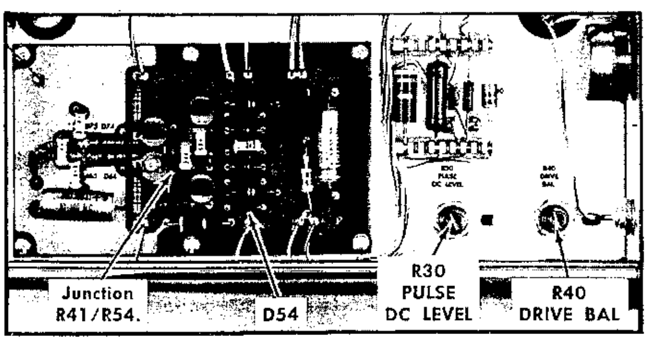


Fig. 5-2. Left side of Type TU-7 showing calibration adjustments and test points.

4. Check VARIABLE Control

a. Reset the Type TU-7 controls to the positions given under "Preliminary Instructions".

b. Set the Time Base A triggering control to free-run the sweep.

c. Adjust the Focus and Intensity controls for a proper display.

d. Connect a 50-ohm coaxial cable from the Calibrator to the Type TU-7 EXT INPUT connector.

e. Set the Calibrator for an output amplitude of 0.5 volt.

f. Turn the Type TU-7 VARIABLE control fully clockwise and check for approximately a 1-cm free-running Calibrator signal on the crt.

g. Turn the VARIABLE control fully counterclockwise and check that no signal is visible on the trace.

5. Check Internal Plug-In Trigger

a. Set the indicator oscilloscope Trigger Source switch to the External position.

b. Set the Calibrator amplitude for 5 volts.

c. Adjust the Type TU-7 VARIABLE control for 4 cm of vertical deflection on the crt.

d. Connect the test oscilloscope probe to pin 5 of the interconnecting plug and check for at least 65 mv of Calibrator signal. (This signal simulates the internal trigger from a dual-trace plug-in unit with single-channel pickoff.)

e. Remove the probe.

6. Check Gain Set Function

a. Set the TEST FUNCTION switch to GAIN SET.

b. Set the Calibrator for 100 volts and check the display for 4 cm of vertical deflection (±1%).

7. Check Common Mode Function

a. Set the TEST FUNCTION switch to COMMON MODE.

b. Set the Calibrator for 2 volts.

c. Connect the test probe to terminal 1, then terminal 3 of the interconnecting plug and check for 2 volts of Calibrator signal at each pin.

d. Remove the probe.

8. Check Alternate Operation

a. Set the TEST FUNCTION switch to ALTERNATE.

b. Set the Calibrator for 100 volts.

c. Set the indicator oscilloscope Trigger Source switch to External and adjust the triggering control for a free-running sweep.

d. Turn the indicator oscilloscope Time/Cm switch through-out its range and check for a display of two traces on all sweep rates. The lower trace should display about 0.5 cm of Calibrator signal which will identify the lower trace at slow sweep rates. Due to the ac coupling in the Type TU-7, both traces will tend to curve toward the electrical center of the vertical system.

9. Check Alternate-Sweep Slaving

NOTE

This check can be made only on an oscilloscope (such as the Type 547) that can switch alternately between two time bases.

a. Set the indicator oscilloscope Time Base A Time/Cm switch to 1 msec and the Time Base B Time/Cm switch to .5 mSec.

b. Set the Triggering Source switches to Plug-In and adjust the triggering controls of both time bases to trigger the two displays.

c. Turn the Time Base A Time/Cm switch through a few positions while watching the display.

d. Check that the lower trace is locked to Time Base A.

e. Turn the Time Base B Time/Cm switch through a few positions.

f. Check that the upper trace is locked to Time Base B.

10. Check Chopped Operation

a. Remove the Calibrator signal.

b. Set the TEST FUNCTION switch to CHOPPED.

c. Set the indicator oscilloscope Horizontal Display switch to Time Base A, Time/Cm switch to 10 μSec, and the Triggering Source switch to +Internal.

d. Trigger the display and check the chopped waveform for 1 cycle/cm (100 kc) ±20%.

11. Check Chopped Blanking

a. Set the indicator oscilloscope Crt Cathode Selector switch to Chopped Blanking and check the crt display for blanking of the vertical portions of the chopped waveform (see Fig. 2-3).

b. Return the Crt Cathode Selector switch to the Crt Cathode position.

12. Adjust DRIVE BAL R40

a. Set the TEST FUNCTION switch to +PULSE.

b. Trigger the pulse display and adjust the AMPLITUDE control for 4 cm of vertical deflection.

c. With the test oscilloscope, check the pulse amplitude at pins 1 and 3 of the interconnecting plug.

d. Adjust DRIVE BAL R40 (see Fig. 5-2) if the amplitudes are not equal.

e. Disconnect the probe.

13. Adjust PULSE DC LEVEL R30

a. Connect the dc voltmeter between chassis ground and the junction of R54 and R41 (see Fig. 5-2).

b. Check for exactly +67.50 volts (±0.03 volt).

c. Adjust PULSE DC LEVEL R30 if the voltage is incorrect.

14. Check Pulse Repetition Rate

a. Check the Pulse Generator display for the following output repetition rates, with the REPETITION RATE switch set as follows:

LOW—5 kc ±20% (1 cycle/cm at 0.2 msec/cm)

MED—120 kc ±20% (1.2 cycles/cm at 10 μsec/cm)

HIGH—600 kc ±20% (1.2 cycles/cm at 2 μsec/cm)

b. Set the TEST FUNCTION switch to —PULSE and check for an inverted display.

c. Return the switch to +PULSE.

15. Check AMPLITUDE Control

a. Turn the AMPLITUDE control fully clockwise.

b. Check for approximately 6 cm of vertical deflection (5.6 cm minimum).

c. Turn the AMPLITUDE control fully counterclockwise and check for approximately 2 cm of deflection (2.8 cm maximum).

16. Check Pulse Risetime

NOTE

The pulse risetime is not adjustable and is therefore determined by the circuit parameters and the switching characteristics of gallium arsenide diodes D64, D65, D74 and D75.

a. Set the REPETITION RATE switch to MED.

b. Adjust the AMPLITUDE control for 4 cm of vertical deflection.

c. Turn off the indicator oscilloscope power and remove the Type TU-7.

d. Insert the special plug-in extension (item 10 under "Equipment Required") in the plug-in jack.

e. Plug the Type TU-7 into the extender.

f. Turn on the indicator oscilloscope power. (If the indicator oscilloscope has a plug-in sensing switch in the plug-in compartment, pull forward on the switch plunger.)

g. Place the coupling capacitors (item 9 under "Equipment Required") on the Input connectors of the sampling oscilloscope.

h. Connect the coaxial cable from pin 1 of the interconnecting jack to the capacitor on the Channel A Input.

i. Connect the cable from pin 3 to the capacitor on the Channel B Input.

j. Display the Channel A signal on the sampling oscilloscope.

k. Set the Channel A Mv/Cm switch and Variable control for 2.5 cm of vertical deflection.

l. Switch to Channel B and adjust for 2.5 cm of vertical deflection.

m. Set the sampling oscilloscope for a differential display (A+B, B inverted).

n. Center the display and readjust the Variable Mv/Cm controls slightly to produce 5 cm of vertical deflection.

o. Check for a 10% to 90% risetime of 3 nsec or less (see Fig. 5-3).

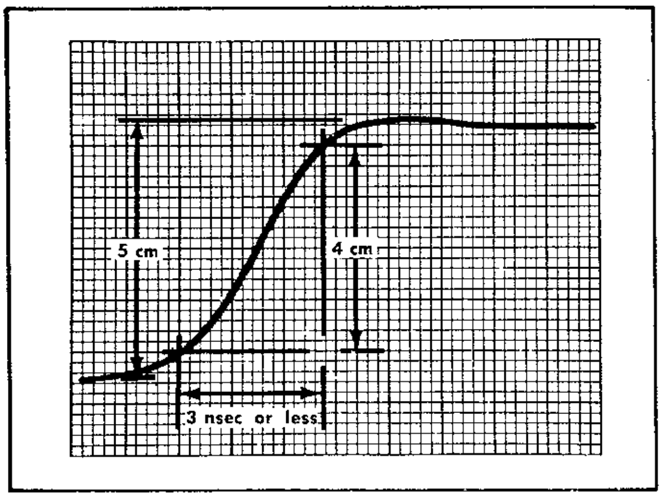


Fig. 5-3. Pulse Generator risetime check.

Ⓐ

SECTION 6
PARTS LIST AND DIAGRAMS

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.

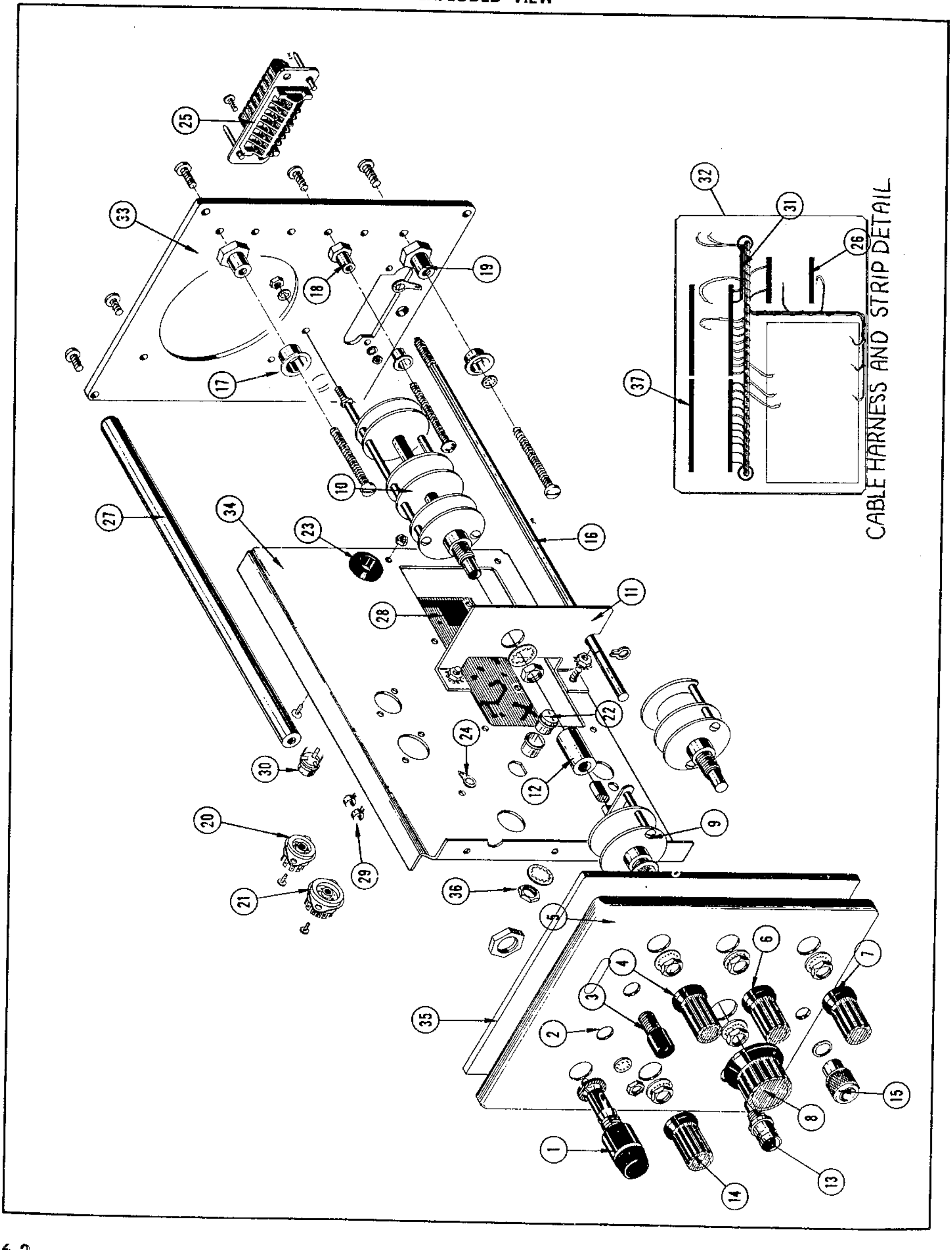
ABBREVIATIONS AND SYMBOLS

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

SPECIAL NOTES AND SYMBOLS

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

EXPLODED VIEW



Ⓐ

EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	352-002			1	HOLDER, fuse assembly
	- - - -			-	Consisting Of:
	200-015			1	CAP, fuse, 3AG
	210-873			1	WASHER, rubber
	352-010			1	HOLDER, fuse, 3AG
	NO NUMBER			1	NUT, fuse holder
2	260-274			1	SWITCH, push button, +225 V, red (not shown)
	- - - -			-	Mounting Hardware: (not included)
	210-583			2	NUT, hex, 1/4-32 x 5/16 inch double chamfer
	210-940			2	WASHER, steel, 1/4 ID x 3/8 inch OD flat
3	136-140			1	SOCKET, banana jack assembly
	- - - -			-	Consisting Of:
	136-137			1	SOCKET, banana jack sleeve, 1/4-32 x 11/16 inch, charcoal
	210-895			1	WASHER, insulating, charcoal, 3/8 inch diameter
	- - - -			-	Mounting Hardware: (not included)
	210-223			1	LUG, solder, 1/4 inch hole
	210-410			1	NUT, hex, 10-32 x 5/16 inch hole
4	366-220			1	KNOB, VERTICAL POSITION, charcoal
	- - - -			-	Includes:
	213-020			1	SCREW, set, 6-32 x 1/8 inch HSS
	- - - -			-	Pot Mounting Hardware:
	210-207			1	LUG, pot, plain
	210-590			1	NUT, hex, 3/8-32 x 7/16 inch
	210-840			1	LUG, solder, pot, plain
5	333-791			1	PANEL, front
6	366-220			1	KNOB, AMPLITUDE, charcoal
	- - - -			-	Includes:
	213-020			1	SCREW, set, 6-32 x 1/8 inch HSS
	- - - -			-	Mounting Hardware: (not included)
	210-590			1	NUT, hex, 3/8-32 x 7/16 inch
	210-840			1	WASHER, pot, flat
7	366-220			1	KNOB, REPETITION, RATE, charcoal
	- - - -			-	Includes:
	213-020			1	SCREW, set, 6-32 x 1/8 inch HSS
	262-638			1	SWITCH, REPETITION RATE, (wired)
	- - - -			-	Includes:
	260-599			1	SWITCH, REPETITION RATE, (unwired)
	- - - -			-	Mounting Hardware: (not included)
	210-590			1	NUT, hex, 3/8-32 x 7/16 inch
	210-840			1	WASHER, pot flat
8	366-117			1	KNOB, TEST FUNCTION, charcoal
	- - - -			-	Includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
9	262-644			1	SWITCH, TEST FUNCTION, (wired)
	- - - -			-	Includes:
	260-610			1	SWITCH, TEST FUNCTION, (unwired)
	- - - -			-	Mounting Hardware: (not included)
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, pot flat
10	262-639			1	SWITCH, FUNCTION, (wired)
	- - - -			-	Includes:
	260-598			1	SWITCH, FUNCTION, (unwired)
	- - - -			-	Mounting Hardware: (not included)
	210-004			1	LOCKWASHER, internal #4
	210-406			1	NUT, hex, 4-40 x 3/16 inch
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, pot flat

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
11	406-998			1	BRACKET, aluminum, switch
	- - - -			-	Mounting Hardware For Bracket:
	210-457			2	NUT, keps, 6-32 x 5/16 inch
12	376-007			1	COUPLING, aluminum, 1 inch long
	- - - -			-	Includes:
	213-005			2	SCREW, set, 8-32 x 1/8 inch HSS
13	131-106			1	CONNECTOR, chassis mount, 1 contact BNC
14	366-220			1	KNOB, VARIABLE (load positions only), charcoal
	- - - -			-	Includes:
	213-020			1	SCREW, set, 6-32 x 1/8 inch HSS
	- - - -			-	Pot Mounting Hardware:
	210-207			1	LUG, solder, pot plain
	210-590			1	NUT, hex, 3/8-32 x 7/16 inch
	210-840			1	WASHER, pot flat
15	366-125			1	KNOB, plug-in securing, aluminum, knurled
	- - - -			-	Includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
16	384-510			1	ROD, securing, 3/16 OD x 10 1/2 inch long, 10-24 thread
	- - - -			-	Includes:
	354-025			1	RING, retaining, securing #18
17	- - - -			-	Resistor Mounting Hardware:
	210-008			1	LOCKWASHER, internal #8
	210-462			1	NUT, hex, aluminum, 8-32 x 1/2 inch
	210-809			1	WASHER, brass, centering
	212-037			1	SCREW, 8-32 x 1 3/4 inch FIL HS
	212-004			1	SCREW, 8-32 x 5/16 inch BHS
18	- - - -			-	Resistor Mounting Hardware
	210-478			1	NUT, hex, aluminum, 5/16 x 21/32 inch
	210-601			1	EYELET, brass tapered barrel
	211-553			1	SCREW, 6-32 x 1 1/2 inch RHS
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
19	- - - -			-	Resistor Mounting Hardware:
	210-462			1	NUT, hex, aluminum, 8-32 x 1/2 inch
	210-808			1	WASHER, brass, centering
	212-037			1	SCREW, 8-32 x 1 3/4 inch FIL HS
	212-004			1	SCREW, 8-32 x 5/16 inch BHS
20	136-008			1	SOCKET, STM7G
	- - - -			-	Mounting Hardware: (not included)
	213-044			2	SCREW, thread forming, 5-32 x 3/16 inch PHS
21	136-015			1	SOCKET, STM9G
	- - - -			-	Mounting Hardware: (not included)
	213-044			2	SCREW, thread forming, 5-32 x 3/16 inch PHS
22	136-095			1	SOCKET, 4 pin
	- - - -			-	Mounting Hardware: (not included)
	213-113			2	SCREW, thread forming, 2-32 x 5/16 inch RHS
23	348-006			2	GROMMET, rubber, 3/4 inch
24	210-201			4	LUG, solder SE4
	- - - -			-	Mounting Hardware: (not included)
	213-044			1	SCREW, thread forming, 5-32 x 3/16 inch PHS
25	131-017			1	CONNECTOR, chassis mount, 16 contact
	- - - -			-	Mounting Hardware: (not included)
	210-004			2	LOCKWASHER, internal #4
	210-201			1	LUG, solder SE4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
	211-008			2	SCREW, 4-40 x 1/4 inch BHS
26	124-095			2	STRIP, ceramic, 9 notches x 7/16 inch
	- - - -			-	Mounting Hardware For Each: (not included)
	361-009			2	SPACERS, nylon

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
27	384-0508-00	101	319	4	ROD, frame, $^3/_8 \times 8^7/_8$ inch tapped 8-32
	384-0631-00	320		4	ROD, frame, $^3/_8 \times 8^7/_8$ inch tapped 8-32
	- - - - - -			-	Mounting Hardware For Each: (not included)
	212-0044-00			1	SCREW, 8-32 x $^1/_2$ inch RHS
28	670-0202-00			1	BOARD, printed circuit, (wired)
	- - - - - -			-	Includes:
29	344-0064-00	100	499	8	CLIP, diode
	344-0108-00	500		1	CLIP, diode
30	136-0150-00			4	SOCKET, 3 pin
	- - - - - -			-	Mounting Hardware For Board: (not included)
	210-0586-00			6	NUT, keps, 4-40 x $^1/_4$ inch
	211-0008-00			6	SCREW, 4-40 x $^1/_4$ inch
31	179-0850-00			1	CABLE, harness, chassis
32	179-0857-00			1	CABLE, harness,switch, on right side of chassis (not shown)
33	387-0901-00			1	PLATE, rear, aluminum
34	441-0542-00			1	CHASSIS, aluminum
35	387-0900-00			1	PLATE, subpanel front, aluminum
36	- - - - - -			-	Pot Mounting Hardware:
	210-0413-00			1	NUT, hex, pot, $^3/_8$-32 x $^3/_8$ inch
	210-0840-00			1	WASHER, pot flat
37	124-0145-00			4	STRIP, ceramic, 20 notches x $^7/_{16}$ inch
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0009-00			2	SPACER, nylon

ELECTRICAL PARTS

Values are fixed unless marked Variable.

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

Capacitors

Tolerance ±20% unless otherwise indicated.

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

3V — 50V = −10%, +250%
51V — 350V = −10%, +100%
351V — 450V = −10%, +50%

Ckt. No.	Tektronix Part No.	Description				S/N Range
C10	281-534	3.3 pf	Cer	500 v	±0.25 pf	
C19	281-551	390 pf	Cer	500 v	10%	
C22	285-572	0.1 μf	PTM	200 v		
C33	283-000	0.001 μf	Cer	500 v		
C35	290-194	10 μf	EMT	100 v		
C39	Use 283-057	0.1 μf	Cer	200 v		
C41	290-194	10 μf	EMT	100 v		
C42	290-226	20 μf	EMT	100 v		
C43	283-001	0.005 μf	Cer	500 v		
C45	281-518	47 pf	Cer	500 v		
C47	283-051	0.0033 μf	Cer	100 v	5%	
C48	283-004	0.02 μf	Cer	150 v		
C49	283-026	0.2 μf	Cer	25 v		
C50	283-026	0.2 μf	Cer	25 v		
C52	281-525	470 pf	Cer	500 v		
C55	281-518	47 pf	Cer	500 v		
C65	281-505	12 pf	Cer	500 v	10%	
C66	281-547	2.7 pf	Cer	500 v	10%	
C67	281-601	7.5 pf	Cer	500 v	5%	
C68	283-059	1 μf	Cer	25 v		
C69	283-001	0.005 μf	Cer	500 v		
C78	283-059	1 μf	Cer	25 v		
C79	283-001	0.005 μf	Cer	500 v		
C83	285-572	0.1 μf	PTM	200 v		
C91	281-519	47 pf	Cer	500 v	10%	
C97	281-519	47 pf	Cer	500 v	10%	
C100	281-505	12 pf	Cer	500 v	10%	
C101	281-519	47 pf	Cer	500 v	10%	
C102	281-505	12 pf	Cer	500 v	10%	
C105	283-000	0.001 μf	Cer	500 v		
C120	283-001	0.005 μf	Cer	500 v		
C121	283-001	0.005 μf	Cer	500 v		
C122	283-001	0.005 μf	Cer	500 v		
C125	283-001	0.005 μf	Cer	500 v		

Diodes

Ckt. No.	Tektronix Part No.	Description		S/N Range
D30	152-024	Zener 1N3024B	15 v	
D35	152-024	Zener 1N3024B	15 v	
D46	*152-107	Silicon Replaceable by 1N647		
D54	*152-061	Silicon Tek Spec		
D56	*152-107	Silicon Replaceable by 1N647		
D64 } D65 }	Use *152-193	Tek Spec GaAs		
D74 } D75 }	Use *152-193	Tek Spec GaAs		
D89	152-008	Germanium		
D90	152-008	Germanium		
D102	*152-061	Silicon Tek Spec		

Fuse

F120	159-024	1/16 Amp 3AG Fast Blo

Transistors

Q33	*151-103	Replaceable by 2N2219
Q45	*151-108	Replaceable by 2N2501
Q55	*151-108	Replaceable by 2N2501
Q64	151-097	2N955
Q74	*151-083	Selected from 2N964

Resistors

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

R10	302-103	10 k	½ w			
R11	311-395	2.5 k		Var	VARIABLE	
R12	316-105	1 meg	¼ w			
R13	302-564	560 k	½ w			
R14	316-104	100 k	¼ w			
R15	316-223	22 k	¼ w			
R16	301-335	3.3 meg	½ w			5%
R17	323-668	1.442 meg	½ w		Prec	¼%
R18	323-670	8.570 k	½ w		Prec	¼%
R19	323-669	18.05 k	½ w		Prec	¼%
R20	301-151	150 Ω	½ w			5%
R22	302-104	100 k	½ w			
R25	316-151	150 Ω	¼ w			
R26	316-151	150 Ω	¼ w			
R30	311-052	300 Ω		Var		PULSE DC LEVEL
R33	308-062	3 k	5 w		WW	5%
R34	301-821	820 Ω	½ w			5%
R39	305-432	4.3 k	2 w			5%
R40	311-006	1 k		Var		DRIVE BAL
R41	304-471	470 Ω	1 w			

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description					S/N Range
R43	302-153	15 k	½ w				
R44	322-097	100 Ω	¼ w		Prec	1%	
R45	316-102	1 k	¼ w				
R46	316-273	27 k	¼ w				
R52	315-220	22 Ω	¼ w			5%	
R53	302-153	15 k	½ w				
R54	321-122	182 Ω	⅛ w		Prec	1%	
R55	316-102	1 k	¼ w				
R56	316-273	27 k	¼ w				
R62†	Use 311-007	1 k		Var		AMPLITUDE	
R63	302-332	3.3 k	½ w				
R64	323-633	801 Ω	½ w		Prec	1%	
R65	321-289	10 k	⅛ w		Prec	1%	
R66	321-068	49.9 Ω	⅛ w		Prec	1%	
R67	321-189	909 Ω	⅛ w		Prec	1%	
R68	321-289	10 k	⅛ w		Prec	1%	
R69	302-225	2.2 meg	½ w				
R72†	Use 311-007	1 k		Var		AMPLITUDE	
R74	323-633	801 Ω	½ w		Prec	1%	
R76	321-068	49.9 Ω	⅛ w		Prec	1%	
R78	321-289	10 k	⅛ w		Prec	1%	
R79	302-225	2.2 meg	½ w				
R80A	316-104	100 k	¼ w				
R80B	316-104	100 k	¼ w				
R80C	316-104	100 k	¼ w				
R80D	316-104	100 k	¼ w				
R81	Use 301-433	43 k	½ w			5%	
R82	311-152	2 x 500 k		Var		VERTICAL POSITION	
R83	302-225	2.2 meg	½ w				
R84	302-105	1 meg	½ w				
R85	323-363	66.5 k	½ w		Prec	1%	
R86	323-396	130 k	½ w		Prec	1%	
R87	301-151	150 Ω	½ w			5%	
R88	302-221	220 Ω	½ w				
R89	301-202	2 k	½ w			5%	
R90	302-154	150 k	½ w				
R91	301-164	160 k	½ w			5%	
R92	301-224	220 k	½ w			5%	
R93	301-204	200 k	½ w			5%	
R94	306-333	33 k	2 w				
R95	301-204	200 k	½ w			5%	
R96	301-224	220 k	½ w			5%	
R97	301-164	160 k	½ w			5%	
R98	306-333	33 k	2 w				
R99	301-471	470 Ω	½ w			5%	

†R62 and R72 furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description					S/N Range
R100	303-333	33 k	1 w			5%	
R101	301-184	180 k	½ w			5%	
R102	302-564	560 k	½ w				
R104	301-155	1.5 meg	½ w			5%	
R106	304-224	220 k	1 w				
R107	308-024	15 k	10 w		WW	5%	
R109	308-108	15 k	5 w		WW	5%	101-199
R109	308-211	12 k	5 w		WW	5%	200-up
R110	308-044	3.8 k	25 w		WW	5%	
R111	306-822	8.2 k	2 w				
R112	308-059	2.25 k	10 w		WW	5%	
R116	308-018	2.5 k	10 w		WW	5%	
R121	324-603	27.8 k	1 w		Prec	1%	
R122	308-025	20 k	10 w		WW	5%	101-199
R122	308-027	30 k	10 w		WW	5%	200-up
R123	*312-642	500 Ω	20 w		WW	1%	
R124	301-623	62 k	½ w			5%	
R125	303-433	43 k	1 w			5%	

Switches

	Unwired	Wired		
SW10A	260-610	*262-644	Rotary	TEST FUNCTION
SW10B	260-598	*262-639	Rotary	TEST FUNCTION
SW50	260-599	*262-638	Rotary	REPETITION RATE
SW120	260-247		Push-Button	+225 V

Transformer

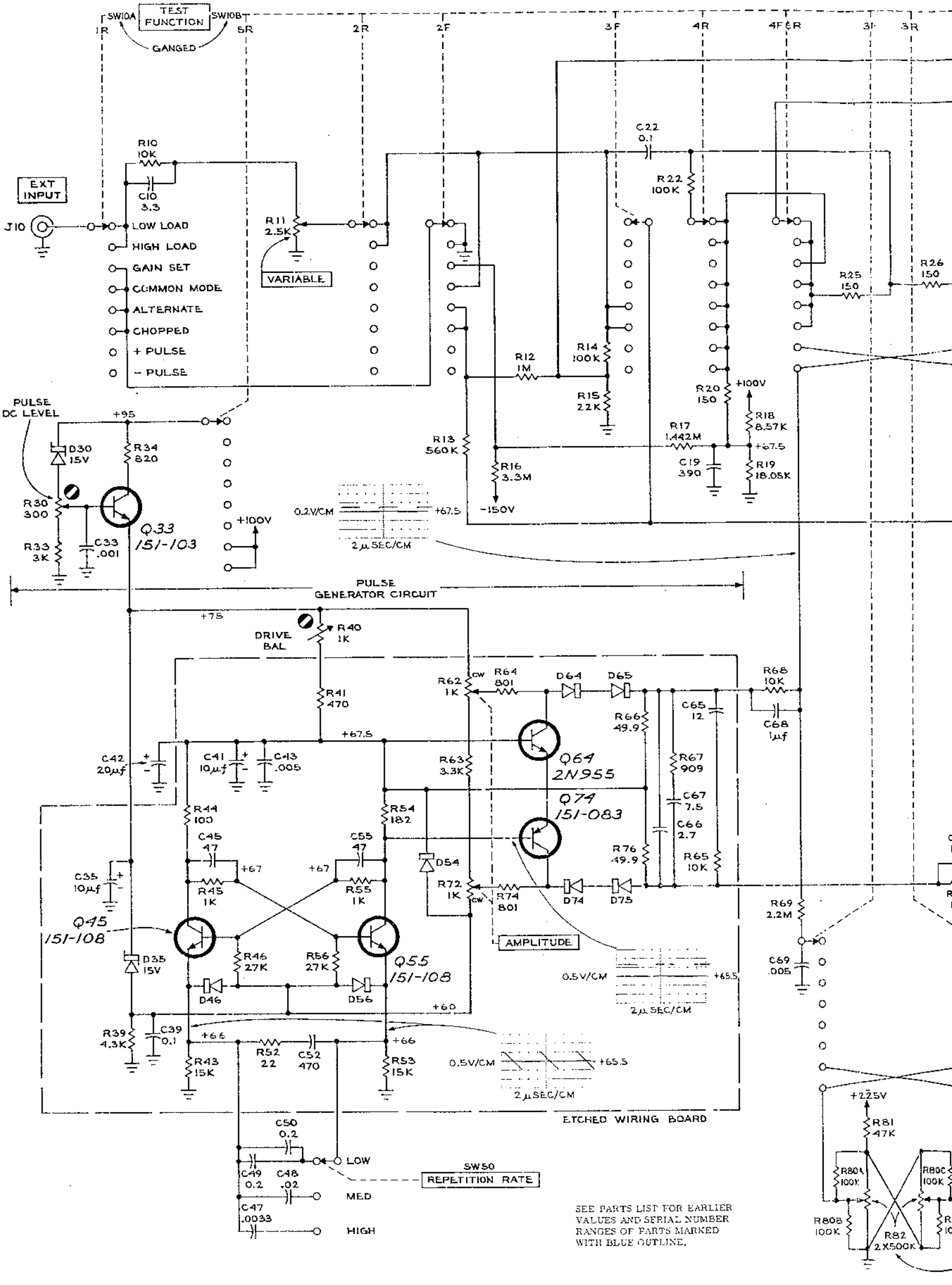
T110	*120-286	Toroid	2T Bifilar

Electron Tubes

V95	154-039	12AT7
V102	154-016	6AL5

WAVEFORMS and VOLTAGE READINGS were obtained under following conditions:

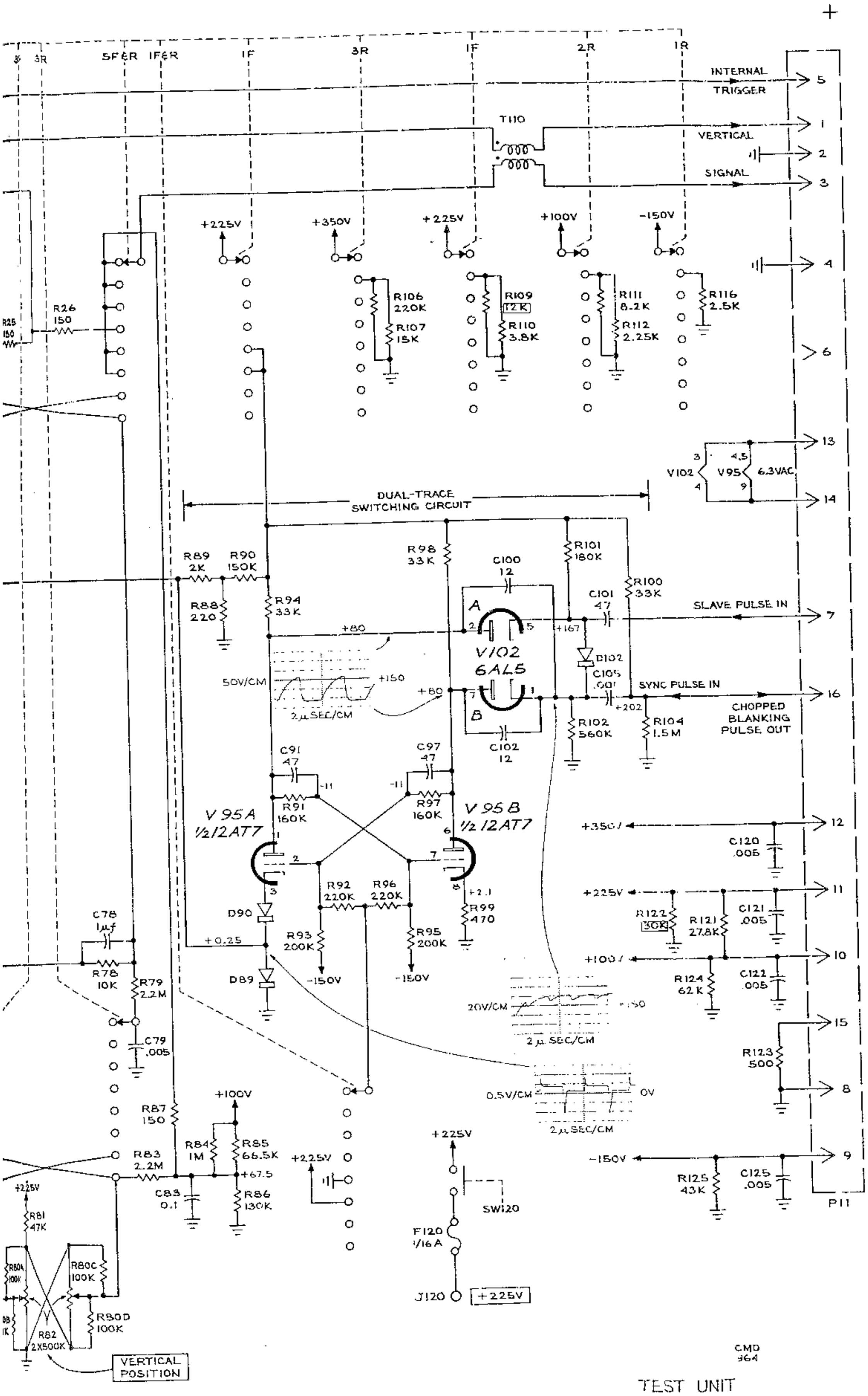
CONTROLS	SETTINGS	
VARIABLE	centered	
VERTICAL POSITION	centered	
AMPLITUDE	centered	
REPETITION RATE	MED	
Input Signal	none	
	Pulse Gen. ckt.	All other ckts.
TEST FUNCTION	+ PULSE	CHOPPED
Test Oscilloscope		
Bandpass	30 Mc	
Triggering	+ Internal	
DC Voltmeter		
Impedance	20,000Ω/volt	



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

TYPE TU-7

B1



CMD 964

TEST UNIT

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.

PARTS LIST CORRECTIONS

REMOVE:

C50	283-0026-00	.2 µF	25 V		

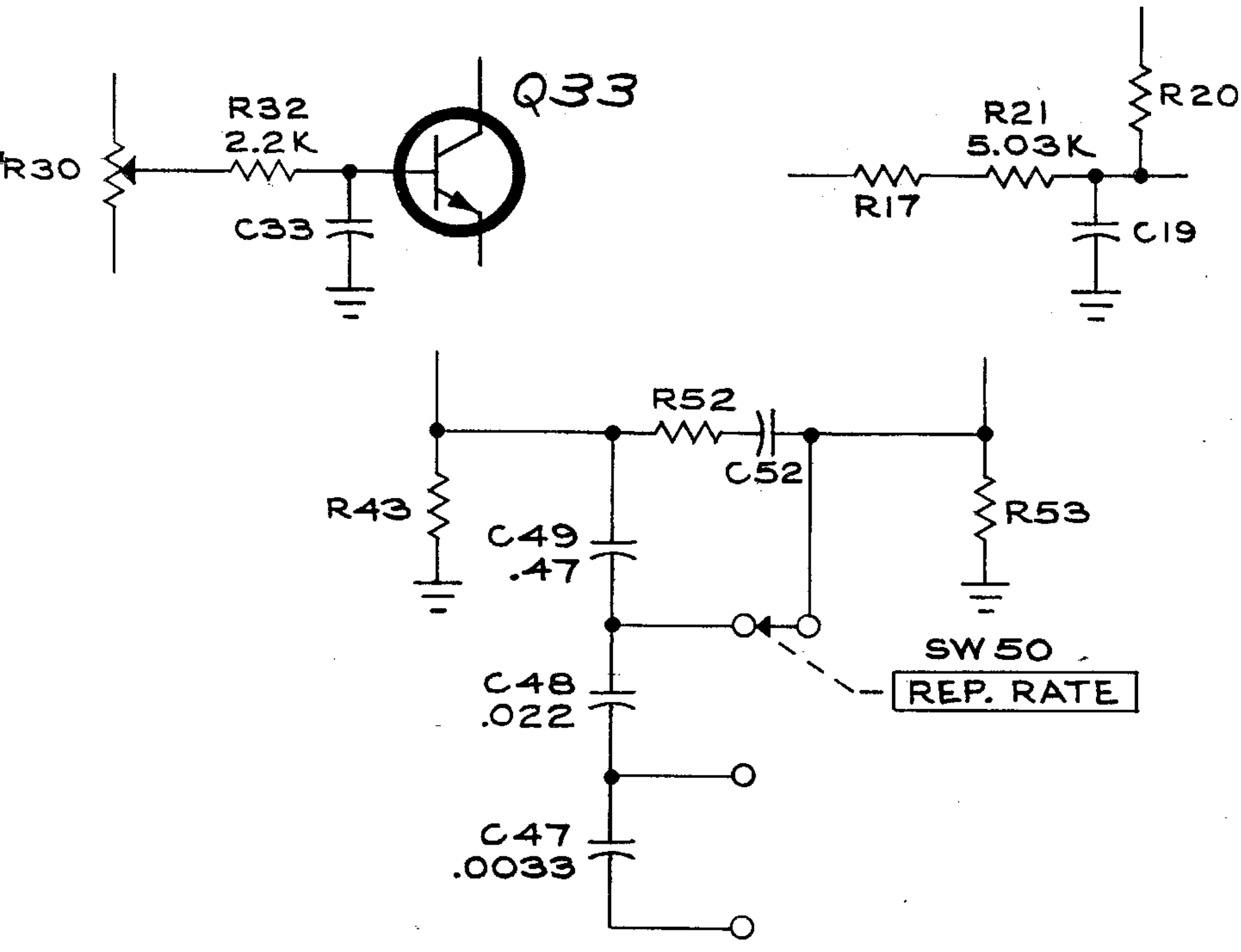
ADD:

R21	321-0613-00	5.03 k	1/8 W	Prec	1/2%
R32	302-0222-00	2.2 k	1/2 W		10%

CHANGE TO:

C47	285-0627-00	.0033 µF	PTM	100 V	
C48	285-0683-00	.022 µF	PTM	100 V	
C49	285-0623-00	.47 µF	PTM	100 V	
R43	301-0153-00	15 k	1/2 W		5%
R53	301-0153-00	15 k	1/2 W		5%
SW50	262-0638-01	Rotary	Repetition Rate		

SCHEMATIC CORRECTION



PARTIAL CIRCUIT DIAGRAM

Parts List Correction

Change to :

R109	308-0093-00	12 K	8 W	WW	5%

HIGH LOAD CURRENT

-150V	60 mA	9W
+100V	57 mA	5.7W
+225V	78 mA	17.6W
+350V	25 mA	8.75W
		41 Watts.