INSTRUMENT REFERENCE BOOK

for the Tektronix type

315D

oscilloscope

For all serial numbers

MPI EXTRACT

MPI January 1964

<u>315D</u> (also see 315 IRB)		
*Calibration procedure		061-039
*Conversion from 6BQ7A to 6DJ8	FMR-157	4-6-61
*History parts list		061-418
Instruction Manual, composite, SN 101 up		070-084
Maintenance spares list		061-284
*Non-linearity problem solved	FQD	5-59
*Selenium rectifiers, interchangeability of SR756 and SR440	FQD	3-58
*T31P not a practical replacement for 3WP	FQD	9-57

*Included within IRB.

SALES

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

CONTENTS-SALES


TYPE 315 D CATHODE-RAY OSCILLOSCOPE
MULTIPLIER
INPUT
1 MEG. 35 MMFD.
600 V. MAX.
VERTICAL
AMPLIFIER
AMPLITUDE
VOLTS/DIVISION
AC
DC
FOCUS
INTENSITY
SCALE ILLUM.
POSITION
HORIZ.
VERT.
TIME BASE
MULTIPLIER
5X MAGNIFIER
RANGE
TIME/DIVISION
MILLISEC.
MICROSEC.
1 SEC.
CALIBRATOR
VOLTS. PEAK TO PEAK
OFF
STABILITY
TRIGGER SELECTOR
SLOW
RISE
FAST
RISE
TRIGGER AMPLITUDE
DISCRIMINATOR
POWER
ON
CAL. OUT
EXT. TRIGGER
AC
SERIAL
+GATE
SAWTOOTH
GND.

TYPE 315D OSCILLOSCOPE

DC-Coupled Portable Cathode-Ray Oscilloscope

Passband

DC-Coupled—dc to 5 mc.
AC-Coupled—5 cycles to 5 mc.

Transient Response

Risetime—0.07 μsec

Calibrated Sensitivity

DC-Coupled—0.1 v/div to 50 v/div.
AC-Coupled—0.01 v/div to 50 v/div.

Calibrated Sweep Range

0.1 μsec/div to 5 sec/div.

GENERAL DESCRIPTION

The Tektronix Type 315D combines small size with laboratory-oscilloscope capabilities. Wide sweep range adapts it to a great many applications, including those requiring very slow sweeps. Pulse observation is facilitated by the less than 0.07-μsec risetime of the vertical amplifier, the 0.25-μsec signal delay, and high-speed sweeps. Sensitivity and sweeps are calibrated for accurate amplitude and time readings directly from the screen. A 3" flat-faced cathode-ray tube displays a sharp image of sufficient size for easy interpretation. The Type 315D is an excellent general-purpose laboratory oscilloscope that is easily transported to temporary setups and remote installations.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—A seven-position vertical-input switch covers the calibrated ranges of 0.01, 0.1, 1, 10 v/div ac-coupled and 0.1, 1, 10 v/div dc-coupled. AC-coupled passband is 5 cycles to 5 mc, dc-coupled passband is dc to 5 mc. Multipliers of 1, 2, and 5 provide 9 calibrated dc-coupled and 12 calibrated ac-coupled ranges. Continuously variable sensitivity from 0.01 v/div to 100 v/div is provided by a 10-to-1 variable control. The vertical amplifier is factory adjusted for optimum transient response. Risetime is less than 0.07 μsec and input impedance is 1 megohm paralleled by approximately 35 $\mu\mu$f.

Calibration Accuracy—A front-panel screwdriver adjustment sets the vertical amplitude calibration. When accurately set on any one range, all other steps will fall within 3% of the panel reading.

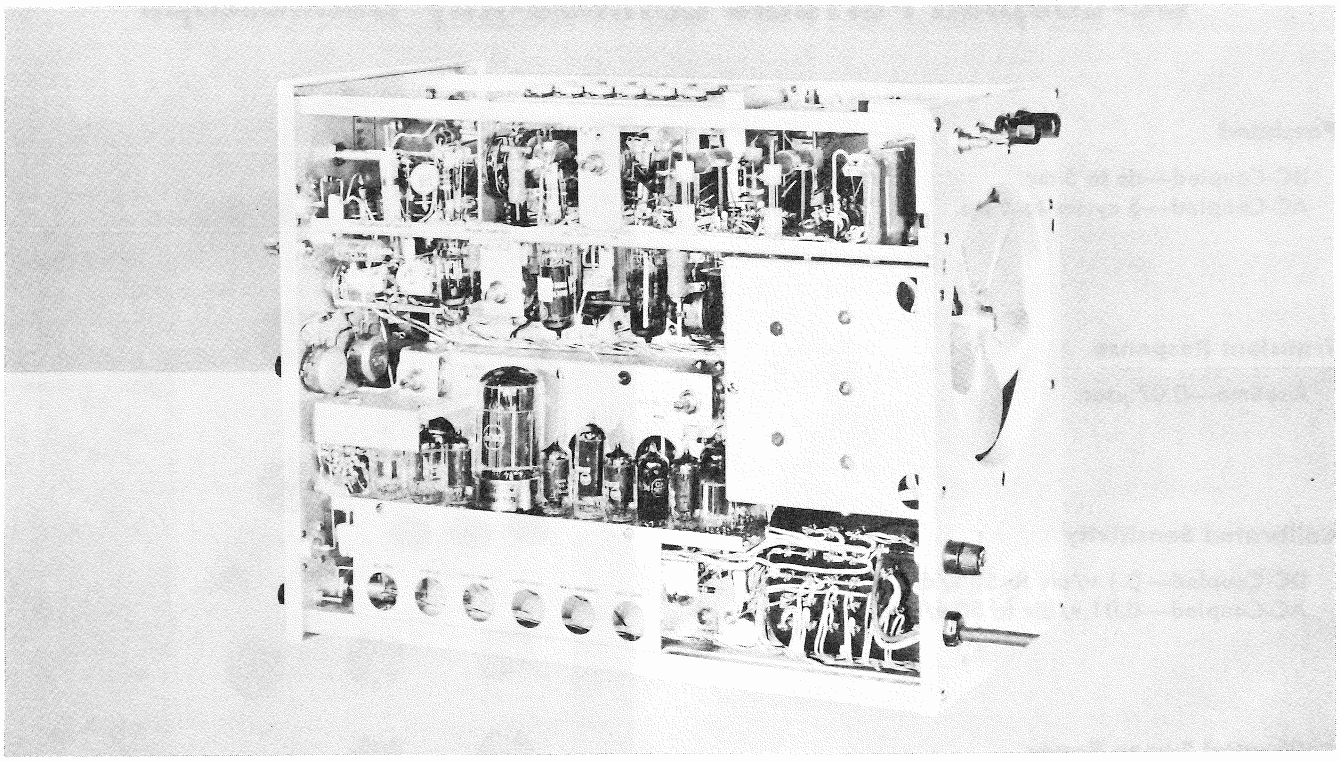
Probe—The vertical sensitivity is reduced by a factor of ten by use of the small, insulated 10x attenuator probe furnished with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 13 $\mu\mu$f.

Signal-Delay Network — Delays vertical signal 0.25 μsec. Permits observation of the waveform that triggers the sweep.

HORIZONTAL DEFLECTION SYSTEM

Wide Sweep Range—An 8-position range switch and a 1, 2, 5, multiplier switch provide 24 calibrated time bases, 3 per decade, from 0.1 μsec/div to 5 sec/div. A 10-to-1 variable control fills in between steps, providing a continuous uncalibrated sweep range from 0.1 μsec/div to 10 sec/div. Calibration accuracy is within 3% on all ranges except 0.1, 0.2, 0.5 μsec/div, 1, 2, 5 sec/div ranges where the accuracy is within 5%.

TYPE 315D OSCILLOSCOPE



Sweep Magnifier—Sweep magnification is obtained by increasing the gain of the output amplifier by a factor of 5. The center 2-division portion of the trace is expanded to the left and right of center to 10 divisions. The HORIZONTAL POSITION control has sufficient range to display any one-fifth of the magnified sweep. Sweep magnification of 5x is accurate for all settings of the sweep-speed controls slower than 0.5 μsec/div.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the control grid of the cathode-ray tube, assuring uniform bias for all sweep speeds and repetition rates.

DC-Coupled Trigger Amplitude Discriminator—The amplitude level on a waveform where triggering occurs is selected by the TRIGGER AMPLITUDE DISCRIMINATOR control. The sweep can be triggered at various levels on simple or complex waveforms. The flexibility of this system permits the sweep to be initiated at any point on the positive or negative portion of the negative-going slope of a sine wave, as well as any point on the positive-going slope.

Trigger Selector—A ten-position switch permits selection of the positive or negative-going waveform portion to trigger the sweep, either from the signal under observation or from an external source; and use of either a fast or slow-rise waveform for a trigger. Selection of either the positive or negative-going portion of the line-voltage waveform is also available.

Trigger Requirements—Internal triggering—a signal large enough to produce a one-half division deflection. External—a signal of 0.2 v to ±20 v.

OTHER CHARACTERISTICS

Voltage Calibrator—A square-wave voltage is available through a front-panel uhf connector. Four fixed voltages—0.1, 1, 10 and 100 volts peak-to-peak—are provided. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Output Waveforms—The sweep sawtooth waveform and +GATE voltage of the same time duration as the sweep are available at the front panel via cathode followers.

Accelerating Potential—1.85-kv accelerating potential, electronically regulated, is applied to the flat-faced 3WP2 cathode-ray tube.

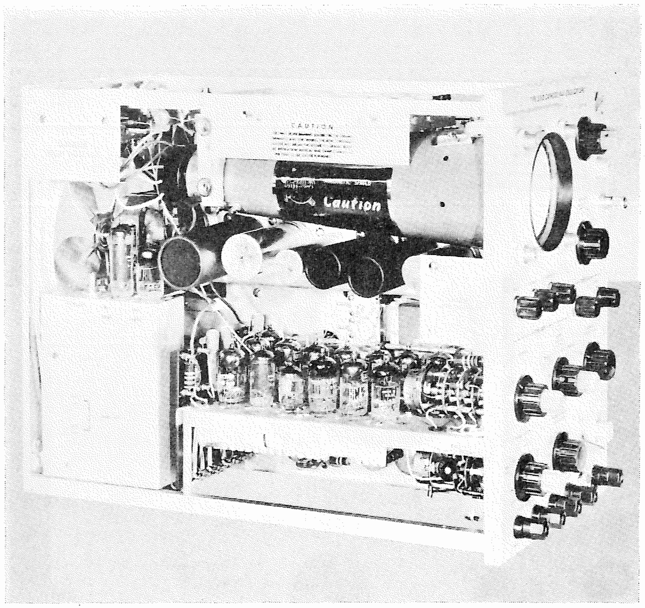
Regulated Power Supply—All dc voltages are electronically regulated to insure stable operation over line variations from 105 to 125 v.

Illuminated Graticule—The edge-lighted graticule has 8 vertical and 10 horizontal quarter-inch divisions. Illumination is controlled by a front-panel knob. An appropriate filter is provided to increase contrast when viewing in a brightly-lighted room.

VACUUM TUBE COMPLEMENT

Vertical input preamplifier		6BQ7A
Preamplifier and cathode follower		6BQ7A
Vertical amplifier input		6CL6
Amplifier, delay line driver		6CL6
Cathode followers		6BQ7A
Vertical output amplifiers	4	12BY7
Trigger phase inverter		12AT7

TYPE 315D OSCILLOSCOPE



Trigger shaper multivibrator		6U8
Trigger amplifier		6BQ7A
Trigger CF and holdoff CF		6BQ7A
Clamp diode and trigger holdoff		12AT7
Unblanking CF and buffer CF		6BQ7A
Cascode multivibrators	2	6BQ7A
Multi reverting CF and constant current tube		12AT7
Gate out CF and sweep clamping CF		6U8
Disconnect diodes		6AL5
Sweep generator		6AK6
Sweep out CF and sweep position CF		6BQ7A
Driver CF and sawtooth out CF		6BQ7A
Sweep amplifier and sweep out CF	2	6BQ7A
Cal multivibrator		12AU7
Cal clipper and output CF		12AT7
Voltage reference		5651
Regulator amplifiers	4	6AU6
Series regulators	2	12B4
Series regulator		6AS5
Series regulator		6080
High-voltage oscillator		6AQ5
High-voltage regulator		12AT7
High-voltage rectifiers	2	5642
Cathode-ray tube		3WP2

MECHANICAL SPECIFICATIONS

Construction—Self-contained, chassis and cabinet made of aluminum alloy.

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Finish—Photo-etched anodized front panel, gray wrinkle cabinet.

Dimensions—12⅜" high, 8⅝" wide, 15⅞" deep. Maximum depth including knobs and air filter, 18¼".

Weight—36 pounds.

Power Requirements—105-125 or 210-250 volts, 50-60 cycles, 375 watts. The ability of the Type 315D to operate on power-line frequencies up to 800 cycles is limited only by the type of ventilating fan used. The Type 315D is furnished with a shaded-pole ac ventilating fan motor to be used on 50 to 60 cycle ac only. This fan motor has the advantage of being quieter and requiring very little maintenance. For operation on power-line frequencies of 50 to 800 cycles, a dc ventilating fan motor and selenium rectifier are used in place of the shaded-pole ac motor. The Type 315D then carries the additional designation of S1. When the Type 315D is ordered for use on power-line frequencies from 50 to 800 cycles (designated Type 315D-S1), it must be stated on the order.

Type 315D Cathode-Ray Oscilloscope—For use on 105-125 or 210-250 v, 50-60 cycles only.... **$770**

Includes: 1—P510A attenuator probe
2—A510 binding-post adapters
1—F310-5 green filter (378505)
1—Instruction manual

Type 315D-S1 Cathode-Ray Oscilloscope—For use on 105-125 or 210-250 v, 50-800 cycles..... **$785**

Type 315D-S2 Cathode-Ray Oscilloscope—For use in PTM systems. Includes a front-panel controlled trigger circuit permitting direct, stable triggering from the sync pulse group with these general characteristics:
Rep rate..........9 to 17 kc (12 or 24 channels)
Sync group..4 pulses, 0.5 μsec wide, spaced 0.8 μsec
Channel pulses.....0.5 μsec wide, spaced 3.85 μsec

Type 315D-S2 .... **$790**

Your inquiries are invited about the availability of this instrument for use with PTM systems having general characteristics differing from the above.

Currently Available Extras

P2 crt phosphor normally furnished.
P1, P7, P11 crt phosphor optional....No extra charge

Recommended Additional Accessories

MU15 Fan Motor Kit—For converting Type 315D for use on 50-800 cycle line frequency (Type 315D-S1). Contains brackets, selenium rectifier, dc fan motor, and fan blade. Price....................$22.50

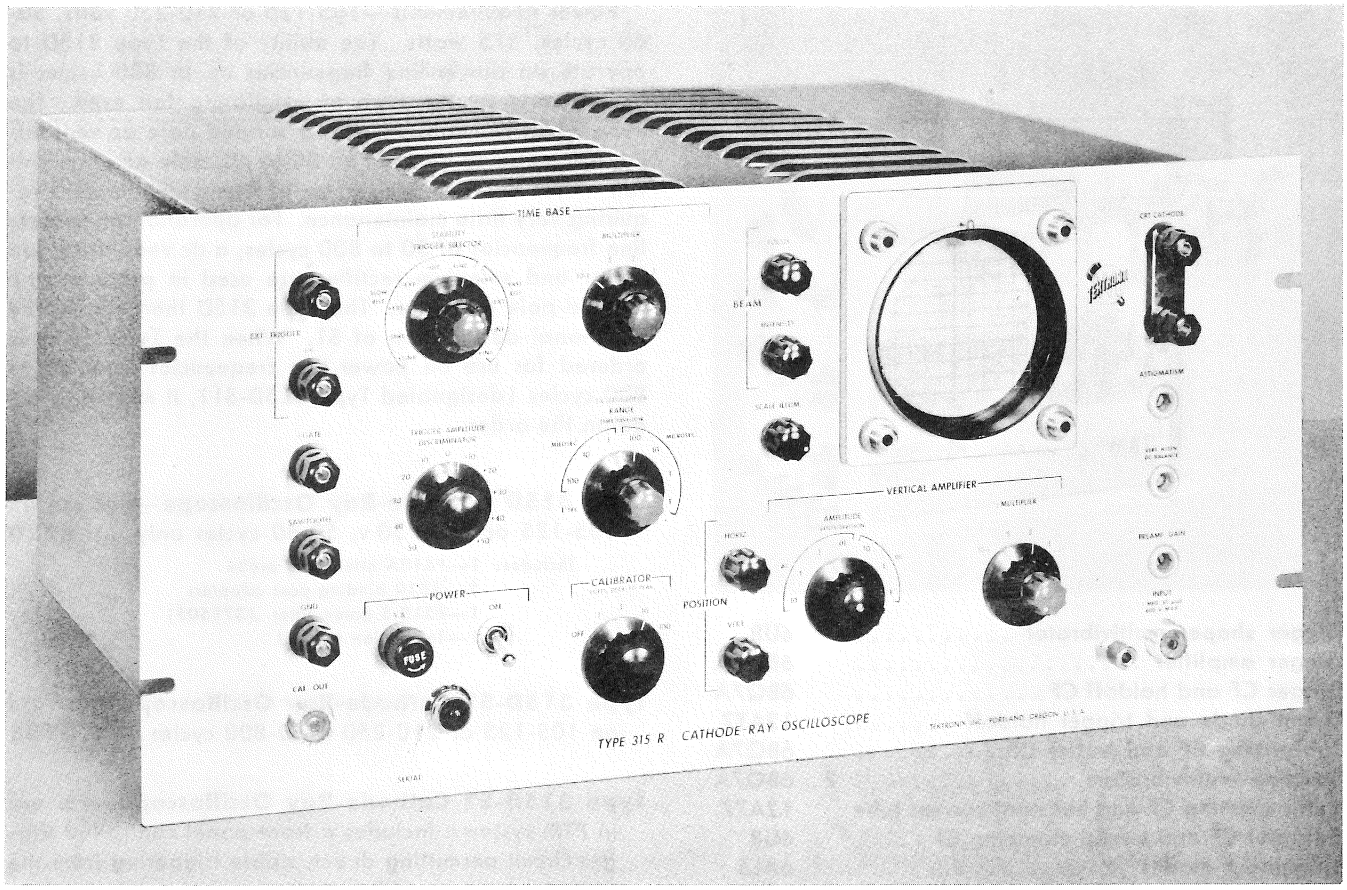
MS15 Fan Motor Kit—For converting Type 315D-S1 for use on 50-60 cycle line frequency (Type 315D). Contains brackets, ac fan motor and fan blade.

Price $7.50

Prices f.o.b. Portland (Beaverton), Oregon.

TYPE 315R OSCILLOSCOPE

Rack-Mounting 3-Inch Oscilloscope



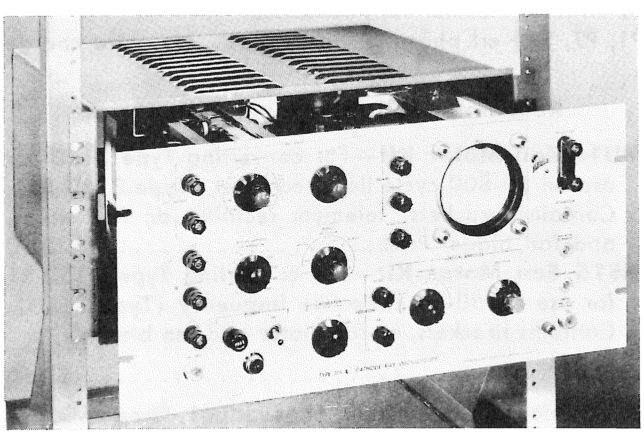
The Type 315R is a mechanically rearranged form of the Type 315D, for mounting in five vertical units of a standard 19-inch rack. Dimensions are: 18-31/32" wide, 8-23/32" high, 15-3/4" rack depth, 17" overall depth.

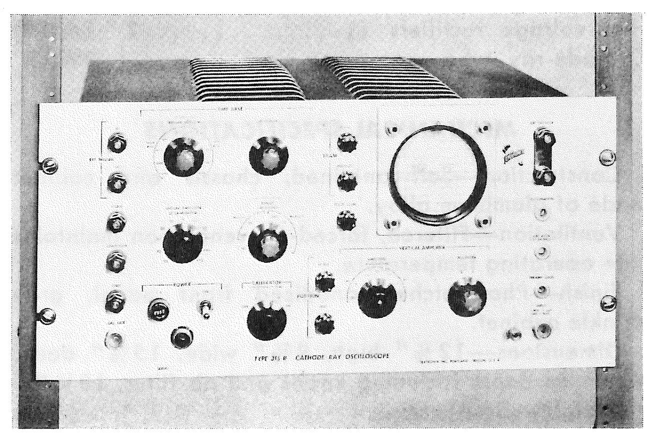
The cabinet of the Type 315R fastens to the rack with four mounting screws on each side. The chassis slides into the cabinet on two horizontal rails, providing firm support over its full length, and permitting easy access for servicing by sliding the chassis partly out of the cabinet. The chassis can be secured in place by four screws at the front, or by two fasteners at the rear of the instrument.

Rear mounted controls and terminals have been relocated on the front panel. Electrical specifications remain unchanged. All special models of the Type 315D are available in rack-mount form.

Type 315R $795
Type 315R-S1 . . . . $810
Type 315R-S2 . . . . $815

Prices f.o.b. Portland (Beaverton), Oregon.





SECTION 1
DESCRIPTION

The Tektronix Type 315D cathode-ray oscilloscope is a small compact and portable high-performance laboratory instrument particularly designed to occupy minimum space. The vertical bandwidth extends to five megacycles from dc. Time-base ranges extending from one microsecond per sweep to fifty seconds per sweep are provided. An amplitude calibrator and a time-base magnifier are also included.

SPECIFICATIONS

Sensitivity

Twelve calibrated fixed sensitivities: ac only, 0.01, 0.02 and 0.05 volts per division, 5 cycles to 5 megacycles: dc and ac 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 volts per division. These sensitivities fit graticule divisions for direct reading of voltages. Continuously variable 10 to 1 sensitivity multiplier control also available.

Calibrator

Square wave at approximately one kilocycle available at front-panel UHF connector at four fixed peak-to-peak voltages of 0.1, 1, 10, and 100 volts with accuracy within 3 per cent.

Signal Delay

Quarter-microsecond signal delay line permits all of the triggering waveform to be viewed.

Trigger Amplitude Discriminator

Permits time base to be triggered at any desired amplitude point on the triggering waveform.

Time Base

Twenty-four fixed times per division between 0.1 microsecond and 5 seconds per division fit graticule divisions for direct reading of time. Continuously variable 10 to 1 sweep-time control also available.

Time Base Magnifier

Magnifies time base to right and left of center by factor of five times. Portion of trace appearing at center is made five times as wide.

Direct-Coupled Unblanking

Accommodates slowest sweeps.

Cathode-Ray Tube

Flat-faced high definition three-inch tube.

Graticule

Quarter-inch divisions, 8 lines vertically, 10 lines horizontally. Variable intensity edge lighting.

Power Supply

Four electronically regulated plate-voltage supplies. Power transformer will operate on either 117 or 234 volts, 50 to 800 cycles. (Special ventilating fan required for other than 50-to 60-cycle operation).

CRT Accelerating Voltage

1850 volts (for serial numbers below 350) or 1500 volts (for serial numbers above 350) from electronically regulated rf oscillator high-voltage supply.

Ventilating Fan

The Type 315D is normally supplied with a 50- to 60-cycle induction-motor fan. For frequencies much above 60 cycles a dc commutator motor and selenium rectifier are available at extra cost to extend the range to 800 cycles.

Dimensions

12 3/8" high, 8 5/8" wide and 18 1/4" long.

Weight

36 pounds.

Construction

Welded aluminum alloy.

Finish

Anodized photo-etched aluminum panel, blue wrinkle enamel case.

FUNCTIONS OF CONTROLS AND CONNECTORS

MULTIPLIER	Four-position switch to multiply VOLTS/DIVISION by factors of 1, 2, or 5. Fourth position marked 10-1 in red permits red coaxial knob to adjust multiplier continuously over 10 to 1 range.
INPUT	Coaxial UHF connector for connecting signal to vertical-deflection system.
AMPLITUDE	Seven-position control provides four fixed ac sensitivities and three fixed dc sensitivities.
FOCUS	Adjusts voltage of focusing anode to provide focusing.
INTENSITY	Adjusts control-grid voltage to control brightness of trace.
SCALE ILLUM	Adjustable series resistor in graticule lighting circuit to control amount of scale illumination.
POSITION HORIZ.	Adjusts voltages between horizontal deflection plates to position trace horizontally.
VERT.	Adjusts voltages between vertical deflection plates to position trace vertically.
TIME BASE MULTIPLIER	Four-position switch to multiply time-base TIME/DIVISION by factors of 1, 2, or 5. Fourth position marked 10-1 in red permits red coaxial knob to adjust multiplier continuously over 10 to 1 range.
RANGE	Eight-position switch provides eight fixed time base times per division in decade ratio between 0.1 microsecond per division to 1 second per division.
5X MAGNIFIER (Red label, red knob)	Two-position switch turns time-base magnifier on in clockwise position, returns time base to normal in counterclockwise position.
CALIBRATOR	Five-position switch selects four fixed peak-to-peak squarewave voltages of 0.1, 1, 10, or 100 volts. Turns calibrator oscillator off in fifth position.
TRIGGER SELECTOR	Ten-position switch selects trigger source and accommodates trigger circuits to rising or falling trigger waveforms. Accommodates trigger circuits to fast-rising or slow-rising triggering waveforms.

STABILITY (Red label, red knob)	Adjusts voltages of gating multivibrator so that it can be set for recurrent operation or at the threshold of recurrent operation for triggered sweeps.
TRIGGER AMPLITUDE DISCRIMINATOR	Continuously variable voltage control determines point of operation of trigger inverter stage to select point on triggering waveform at which time-base circuit is tripped.
POWER ON	AC supply off-on toggle switch.
CAL OUT	Coaxial UHF connector for output of calibrator oscillator.
EXT TRIGGER AC Binding Post	Connects to EXT. positions of TRIGGER SELECTOR switch through capacitor.
DC Binding Post	Connects directly to EXT. positions of TRIGGER SELECTOR switch.
+ GATE	Binding post provides 25-volt positive gating pulse coincident with time base.
SAWTOOTH	Binding post provides positive-going sawtooth voltage coincident with time base.
GND.	Binding post connected to frame of instrument.

ENGINEERING

CONTENTS-ENGINEERING

SECTION 2 OPERATING INSTRUCTIONS

PRELIMINARY INSTRUCTIONS

The Tektronix Type 315D Oscilloscope may be operated in any indoor location or in the open if it is protected from moisture.

Ventilation

Forced-air cooling is required so that care must be taken to avoid obstructing the air intake to the circulating fan.

> WARNING: The Type 315D Oscilloscope should not be operated unless the fan is running. The interior will reach dangerous temperatures within five to ten minutes of such operation.

Introduction

The operation of the calibrator and the trigger circuits of the Type 315D oscilloscope is different enough that it is especially important for users familiar with previous Tektronix oscilloscopes to understand the difference.

The vertical amplifier is sufficiently stable that once the gain has been standardized, voltages can be read directly from the graticule just as you would read a voltmeter. For this reason, the calibrator in the Type 315D is not continuously variable in amplitude as are the calibrators in previous Tektronix oscilloscopes. The calibrator is intended to be used as a source of squarewave voltage, operating in the vicinity of one kilocycle, available at four accurate fixed voltage levels, 0.1, 1, 10, and 100 volts, peak-to-peak. It is useful to supply a signal for aligning the vertical amplifier, and the attenuator and probe, as well as for standardizing the gain of the vertical amplifier to the graticule calibrations.

To check the calibration of the vertical amplifier, make a connection between the CAL OUT terminal and the INPUT terminal. Then, for example, set the VERTICAL AMPLIFIER MULTIPLIER selector to 2, the AMPLITUDE selector to DC, 0.1, and the CALIBRATOR to 1 volt, peak-to-peak. With these settings, there should be exactly five graticule divisions deflection of the trace. The amplifier gain can be corrected for any difference by means of a screwdriver adjustment in the center of the AMPLITUDE selector switch.

Amplitude Measurements

To use the Type 315D for making an amplitude measurement, place the AMPLITUDE selector in the approximate range of sensitivity desired, and the MULTIPLIER selector on any one of the three steps, 1, 2, or 5. Each division of the graticule then corresponds to a voltage which can be determined directly by multiplying the AMPLITUDE and the MULTIPLIER scale readings.

In the most counterclockwise position of the MULTIPLIER selector, a continuously-variable gain is provided over a range of 10 to 1, marked in red. In this selector position, varying the red knob mounted coaxially with the AMPLITUDE selector knob varies the gain over the 10 to 1 range.

In addition to the coaxial red knob on the AMPLITUDE selector switch, there are three other red knobs mounted in a like manner on the TIME BASE and TRIGGER controls. In each case, a red scale on the panel pertains to the position or to the function of the red knob.

Trigger Amplitude Discriminator

In the operation of the time base of the Type 315D oscilloscope, the TRIGGER AMPLITUDE DISCRIMINATOR control is likely to be somewhat confusing to users familiar with previous Tektronix instruments. This control is not in any sense a trigger amplitude adjustment. The triggering circuit is direct coupled to the vertical amplifier in the INT positions of the TRIGGER SELECTOR switch, both for the AC and DC connections of the vertical amplifier and is direct coupled to one of the EXT TRIGGER panel connectors. The TRIGGER AMPLITUDE DISCRIMINATOR control determines by amplitude the portion of the triggering waveform at which triggering occurs. At settings of the DISCRIMINATOR control near zero, triggering will occur at a point on the trace above the center of the screen. Regardless of the amplitude of the waveform, triggering will occur at a point on the trace the same distance above the center of the screen, provided that the wave reaches that amplitude. The negative trigger positions of the TRIGGER SELECTOR control refer to the direction of slope of the triggering waveform at which triggering occurs. For example, to trigger the sweep from a sine wave at a point beyond the peak but above zero, the TRIGGER SELECTOR should be placed in one of the negative trigger positions and the TRIGGER AMPLITUDE DISCRIMINATOR should be turned to a positive position.

For slow rise signals whose rise time is longer than one microsecond, the TRIGGER SELECTOR should be placed in one of the SLOW RISE positions of the scale. In these positions of the control, a regenerative trigger generator produces sharp triggers suitable for initiating the sweep regardless of the rise time of the input wave. For the FAST RISE positions, the trigger generator is not regenerative and is capable of producing faster triggers so that for high frequency or fast rise time signals, the TRIGGER SELECTOR switch should be in one of these positions. The best way to determine which position is proper for a marginal type of signal is to try both positions. There is appreciable overlap.

Generally speaking, there is no difference in trigger sensitivity in the different control positions. A change in voltage which will produce a quarter of a division deflection, will easily initiate a trigger at any speed or in any part of the wave. For a small amplitude wave, the TRIGGER DISCRIMINATOR control will need to be set near zero. With settings near maximum either clockwise or counterclockwise, a large trace will be required to initiate a sweep and the point of initiation will be near the top or bottom of the waveform.

Calibrations on the DISCRIMINATOR dial are approximately in volts for externally connected trigger voltages. For internally derived triggers, approximately seven divisions on the DISCRIMINATOR scale correspond to about ten graticule divisions of deflection.

The magnifier circuit expands to right and left the portion of the trace that is centered on the screen. Horizontal positioning precedes the magnifier circuits so that this control is used for both the normal and magnified trace.

First Time Operation

The following procedure is suggested when you put the instrument into service for the first time:

1. Set the panel controls as follows:

   POWER OFF

   VERTICAL AMPLIFIER MULTIPLIER. . 2

   VERTICAL AMPLIFIER AMPLITUDE....... DC, 0.1 VOLTS/DIVISION

   FOCUS. . . . . .CENTER

   INTENSITY . . . . COUNTERCLOCKWISE

   SCALE ILLUM . . . . .CENTER

   HORIZ. POSITION. . . . . CENTER

   VERT. POSITION . . . . CENTER

   TIME BASE MULTIPLIER 1

   TIME BASE RANGE . . . . . 1 MILLISEC.

   CALIBRATOR . . . . 1 VOLT

   TRIGGER SELECTOR . . . . SLOW RISE, + INT.

STABILITY . . . . COUNTERCLOCKWISE

TRIGGER AMPLITUDE DISCRIMINATOR . . . . --50

2. Connect the power cord to a source of ac power capable of supplying 4 amperes at 117 volts at 60 cps. (240 volts if power transformer is so connected, and 50 to 800 cps for the universal-frequency model.)

3. Make a connection between the CAL OUT terminal and the INPUT terminal. Turn the POWER switch to ON, and permit the instrument to warm up for about a minute.

4. Advance the INTENSITY control clockwise a little past center.

5. Advance the STABILITY control until a trace appears on the screen.

6. Adjust the FOCUS and INTENSITY controls for a sharp trace and satisfactory brightness.

7. Adjust the two POSITION controls until the trace is centered on the screen as desired.

8. Return the STABILITY control clockwise until the trace just disappears and return the TRIGGER AMPLITUDE DISCRIMINATOR control clockwise toward 0 until the calibrator waveform appears on the screen.

The stability control determines whether the multivibrator retriggers itself or whether it returns to a stable condition after executing a single sweep for each trigger received.

In the SLOW RISE positions of the TRIGGER SELECTOR switch the regenerative trigger generator produces triggers of the same amplitude when tripped regardless of the amplitude or speed of the triggering waveform. The STABILITY control should therefore be set at such a level that a trigger output of this amplitude will trigger the sweep and thereafter no change in the STABILITY control setting will be needed. The trigger sensitivity is the voltage difference needed to trip the regenerative trigger generator, which is determined by the gain between halves of this generator. There is no front-panel control of this gain, but there is an internal screwdriver adjustment which should not be changed, however, except possibly after replacing the generator tube.

In the FAST RISE positions of the TRIGGER SELECTOR switch regeneration between the halves of the trigger-generator tube is effectively removed by shorting out the plate-load resistor of the input pentode section. Since the circuit thus becomes a cathode-coupled amplifier, the amplitude of the output triggers is dependent on the differentiated rise of the triggering waveform. For slow-rising waveforms, therefore, the output trigger will be too small to trip the time-base generator. The point of transition at which better triggering will result from one or the other of the switch positions is not critical. For risetimes near one microsecond it will be well to try both types of operation. Triggering from the calibrator waveform will be more satisfactory with the TRIGGER SELECTOR switch in the SLOW RISE positions.

TRIGGERING INSTRUCTIONS

Trigger Amplitude Discriminator

1. The proper setting of this control is rather critical on trigger signals with fast rise or fall, such as square waves. Turn the control slowly and carefully. You will find the triggering unusually stable once this adjustment is made properly.

2. Set the control near zero for small signals.

3. This control is not an adjustment of trigger sensitivity. It selects the level on the triggering signal at which triggering will take place. A control setting to the right or left of zero center will require a larger trigger signal than a setting near zero.

4. The + signs to the right and - signs to the left indicate relative voltage levels, above or below zero for dc positions of the TRIGGER SELECTOR, above and below the average for ac settings of the TRIGGER SELECTOR.

Trigger Selector

1. The + and - signs on this switch indicate the direction of slope of the triggering voltage at which triggering will occur, + for triggering during the rising part, or positive slope of the signal, and - for the falling part, or negative slope of the signal.

2. SLOW RISE positions of the selector provide a sharp trigger signal to trigger the time base when the trigger voltage passes the level set by the discriminator in the direction selected by the selector, no matter how slowly it passes this level.

3. FAST RISE positions of the selector require a fast rise (or fall) of the triggering signal to trigger the time base.

Stability

This control sets the time-base circuit so that it will run either recurrently or triggered. For triggered operation this control should be set just left of the point of recurrent operation. Once it is set for a given time-base speed, it does not need to be reset for a wide range of trigger signals. It is not a trigger sensitivity control. Trigger sensitivity is determined by the gain of the trigger amplifier tube, which is essentially constant. The trigger amplifier gain is adjustable only by an internal screwdriver control, and will rarely need readjustment.

How to Trigger the Time Base

For a triggered sweep, first select the speed of time-base and set the TRIGGER AMPLITUDE DISCRIMINATOR clockwise.

Then adjust the STABILITY control just left of setting that gives recurrent sweeps.

Then set the TRIGGER SELECTOR for the desired source and slope of trigger voltage.

Finally, adjust the DISCRIMINATOR carefully near the expected voltage of triggering (very frequently near zero) until a triggered sweep occurs.

SECTION 3
CIRCUIT
DESCRIPTION

SWEEP CIRCUIT

The time base of the TYPE 315 CATHODE-RAY OSCILLOSCOPE is generated by means of a Miller runup generator. New circuitry eliminates the usual distortion of the early part of the sawtooth. A constant current charging source to the timing capacitor improves the sawtooth linearity.

The triggering signal is selected by means of the TRIGGER SELECTOR switch connected to the B section of the cathode-coupled phase inverter, V201, with a gain of about six at each plate. The A section grid is connected to the arm of a potentiometer so that its bias can be varied over a wide range. By adjusting the bias properly you can select the portion of the triggering waveform that triggers the sweep.

A second section of the trigger selector switch connects the output of B-section plate to the trigger generator, V202, for negative-going triggering waveforms and the A section plate for positive-going triggering waveforms.

The trigger generator consists of V202, as a bistable multivibrator for slow-risetime trigger signals, and as a cathode-coupled amplifier for fast-risetime trigger signals. For signals with a risetime slower than one microsecond, the multivibrator circuit will provide the best trigger signal. In the SLOW RISE positions of the TRIGGER SELECTOR switch, SW201, C227 connected between the triode-section grid and pentode-section plate of V202 provide the regeneration. For faster rising trigger signals, the FAST RISE positions of the switch effectively removes the regeneration by shorting out plate-load resistor R220 in the pentode section of V202. V202 thus becomes a cathode-coupled amplifier.

Trigger output voltage is taken from the plate of the triode section of V202. The plate load is inductor-resistor differentiating circuit, L221, R221, so that a reasonably fast transition is required to develop large enough triggers to operate the sweep circuit. The multivibrator performs this fast transition for triggering waves otherwise too flat. It will perform a regenerative transition in either direction for slowest risetime signals.

The sharp trigger signal is capacitance coupled into V203, a cathode-coupled stage whose output is direct coupled through cathode follower V204A to the junction of the plate of V211A and the cathode of V211B of the cascode Eccles-Jordan multivibrator. A positive signal on the B section grid of V203 is required to trigger the multivibrator. The B section of V203 is also connected to a bias-control potentiometer called STABILITY which sets the dc level.

V204B, and V205A and B surrounding V204A comprise a hold-off circuit. The function of the hold-off circuit is to reduce the voltage on the grid of the triggering cathode follower, V204A, during the sweep and for a short period after the multivibrator has recovered. V205B performs this function. During the sweep, V205B conducts so that its plate drops. At the termination of the sweep, V205B is cut off and its plate rises toward 225 volts positive. A switched capacitor between plate and ground delays this rise toward + 225 volts during the charge period, depending on the size of the capacitor. When the plate of V205B reaches 100 volts positive it is clamped to this voltage by diode-connected V205A. The trigger amplifier is so designed that it will trigger the multivibrator only when its plate is in the vicinity of 100 volts, so that triggering is held off during the rise period of the plate of V205B.

V211 and V212 comprise the cascode Eccles-Jordan multivibrator. The left-hand side of this multivibrator, V211A and B are normally conducting. Triggering is accomplished when a positive trigger through V203 to cathode follower V204A causes it to divert current from the upper half of V211, so that the plate rises. The positive step at V211B plate is coupled through cathode follower V210B to the grid of the opposite lower side of the multivibrator, V212B, and the multivibrator flops over with conduction on the right-hand side. Cathode follower V210B acts as a buffer between the plate of V211B and all other external loads so that the only additional capacitance is that added by the input capacitance of the cathode follower. This permits the plate to execute a much more rapid rise. The cathode follower drives the opposite side of the multivibrator, the unblanking cathode follower, the hold-off tube, V205B, and the gate output cathode follower, V214A.

The sweep is gated by the negative-going portion of the multivibrator, V212A and B. The plate of V212A is connected to the grid of the cathode-follower-connected pentode section of V214 through a speed-up capacitor. The cathode of this cathode follower holds the grid of V220 at about -3 volts through diode V215 during the quiescent state of the multivibrator. The negative step from the multivibrator cuts off the cathode follower and the cathode falls, disconnecting the grid of V220 through diode V215. V220 is the Miller tube time base generator. When the grid is freed from V214B cathode, it immediately begins to drop and the plate begins to rise. The plate of V220 is coupled back to the grid through a cathode follower (V221A before S/N 351, V212A after S/N 351) and the timing capacitor, and a Miller runup commences. When the plate has risen to the vicinity of 200 volts, the grid of cathode follower V213B has risen to about 100 volts so that current begins to flow in this tube which diverts current from the upper right section of the multivibrator, V212A, and the multivibrator reverts to the initial state with the left-hand side conducting. When V212A plate rises, it carries the grid of V214B with it causing diode V215B to conduct and the Miller grid to rise to -3 volts so that the plate drops again to the starting position.

The additional circuitry around the Miller tube and direct-coupled Eccles-Jordan multivibrator is provided to raise the maximum sweep speed and to eliminate the usual distortion of the sawtooth at the beginning of the Miller runup action.

Since the multivibrator has no timing-circuit components its recovery time of about 1 microsecond is dependent largely on tube and wiring capacitance, and is therefore more or less constant over the entire range of time bases. For the longer time bases, as much as a millisecond is required to discharge the timing capacitor, so that circuitry is needed to prevent the multivibrator from being triggered before the Miller tube has returned to its quiescent state. The required hold-off function is produced by lowering the plate return voltage of the trigger amplifier V203A for an adequate period after the time base termination. Furthermore, a sharp differentiated pulse must be derived from a triggering waveform to trigger the multivibrator so as to prevent the multivibrator from retriggering after the hold-off circuit has reached quiescence, in the presence of a sustained triggering waveform.

The circuit complication around the Miller tube removes the step from the start of the Miller runup. This is accomplished by means of a dc feedback to its grid, which causes an equilibrium point to be established where the plate of the Miller tube is resting at about 50 volts positive whenever the grid of the gating cathode follower, V214B, is held in a positive direction by the right-hand multivibrator, and the grid is at -3 volts. This is well within the class A region of the Miller tube, V220, where the plate voltage is directly proportional to the grid voltage. The relationship of 50 volts plate to -3 volts grid voltage is therefore determined by the grid to plate relationship of the Miller tube itself in the class A region of its operation. The actual grid voltage set by the voltage-divider cathode follower arrangement with V214B through disconnecting diode V215B and constant-current tube V213A, determines the starting voltage of the sawtooth. When diode V215B disconnects the Miller tube grid from the divider, constant-current tube V213A attempts to sustain the current, which it does by reducing its plate resistance, thereby pulling the Miller tube grid downward. During the period of the runup, the timing-capacitor charging current is kept essentially constant by action of the constant-current tube. The charging current remains constant within about a tenth of a per cent, but the time base is not this linear because of the variation of capacitance with voltage of the timing capacitors.

The sawtooth voltage is fed to the output amplifier through cathode follower V221A by means of a voltage divider so that horizontal positioning can be accomplished. Cathode follower V221B prevents grid current from flowing in the positioning circuit, and cathode follower V222A prevents grid current from flowing in the MAG-NORM feedback network. This network reduces the net gain of the horizontal amplifier by a factor of five in the NORM position, and permits the full gain to be realized when it is in the MAG position.

The horizontal-output amplifier stage is a cathode-coupled phase inverter with a cathode-follower coupler to each deflection plate. Use of the cathode followers to drive the deflection plates increases the horizontal bandwidth by a factor of about three times.

Magnifier

A degenerative network between the plate of V224B of the output amplifier to the grid of cathode follower V222A reduces the loop gain by a factor of five in the NORM position of the MAG-NORM switch. In the MAG position, the network is opened to permit the amplifier to operate at full gain. The MAG POSITION screwdriver control permits the dc level of the cathode follower to be set at the same value for both positions. Another screwdriver adjustment labeled MAG GAIN ADJ on the chassis permits the magnified time base to be made exactly five times the normal time base. The HORIZ POSITION control precedes the magnifier circuits and therefore positions for both the magnified and the normal time bases.

Vertical Amplifier

V1 is a twin-triode with the two sections operated in parallel. The signal is taken from the common cathode connection of V1 and applied to the cathode of V2A. V2A is operated as a grounded-grid amplifier. V2B is a cathode-follower output coupler between V2A plate and V3 grid. The preamplifier is used only on the AC, .01 VOLTS/DIVISION position of the AMPLITUDE selector switch. In this switch position, switch section SW1B connects the input terminal through C1 to the grid of V1A and B, and SW1C connects the cathode of cathode-follower V2B to the grid of V3 through a protective network. R15 is a screwdriver adjustable resistor to permit the preamplifier gain to be adjusted accurately to ten times. L1 and L2 are peaking coils to improve high-frequency response.

V3 and V4 form a cathode-coupled gain-control stage. The signal is applied to the grid of V3 and coupled through the common unbypassed cathode connection to V4 which operates as a grounded-grid amplifier. The MULTIPLIER switch, SW2, connects any one of three resistor networks or a short circuit between the two cathodes to control the stage gain. In the X1 position, the cathodes are connected together and the gain is at a maximum. In the 10-1 position, an adjustable resistor is connected between cathodes to permit continuous adjustment of gain. R51 and R53 connected into the circuit in the other two positions of the switch are screwdriver adjustable to permit the gain to be adjusted to one-half or to one-fifth accurately so as to accommodate the gain to the calibrations of the graticule. R34 is a protective resistor which limits the positive excursion of V3 grid in case a high dc voltage is connected to the input connector in the dc position of SW1. C14 bypasses R34 at higher frequencies.

Plate output from V4 feeds through the delay network to the grid of V8B, a cathode-follower output-coupling tube. R521 terminates the delay network through C21 to ground. (C21 is physically located on a bracket underneath the delay-network assembly.) The delay network delays the vertical-deflection signal long enough to permit the portion of the waveform that has triggered the sweep to be displayed on the crt screen.

The output amplifier consists of V10 and V11 in parallel, in a cathode-coupled grounded-grid phase-inversion circuit with V12 and V13 in parallel. The dc grid voltage of V12 and V13 is used for vertical positioning. This voltage is controlled by V8A, a cathode-follower voltage regulator whose grid voltage is obtained from potentiometer R70, labeled VERT POSITION, connected between ground and +100 volts. R65 and R66 limit the positioning range.

R90, a part of the coupling between cathodes of V10, V11 and V12, V13, is a screwdriver adjustable resistor whose shaft is mounted coaxially with the AMPLITUDE control knob. This adjustment permits the gain of the amplifier to be accommodated to the calibrations of the graticule.

L3 in the grid circuit and L4, L5, L6, and L7 in the plate circuit provide frequency compensation.

An internal triggering signal connection from the plate of V3 to the trigger-selector circuits permits the sweep circuit to be triggered by the observed signal.

In all other positions of the AMPLITUDE control SW1, than the previously-described AC, .01 VOLTS/DIVISION position, the preamplifier is removed from the circuit, and the INPUT connector is connected to the grid of V3, either through attenuators, or unattenuated. In the AC portion of the control, C1 is connected in series with the INPUT connector. The grid of V4 is grounded, and V3 and V4 comprise a cathode-coupled grounded-grid amplifier.

The compensated input attenuators to the grid of V3 are voltage dividers in which parallel capacitor and resistor voltage dividers have the same division ratio. C3 in the 10-to-1 divider and C6 in the 100-to-1 divider permit adjustment to be made of the capacitive voltage division so that the high-frequency division ratio is the same as the low-frequency division ratio.

C2, C5, and C10 are adjustable so that the same input capacitance will exist at all AMPLITUDE switch positions. This is necessary when the probe is used because the probe is compensated for the input capacitance, and would otherwise need to be readjusted for each switch setting. C15 connected between grid of V3 and screen of V4 is a neutralizing capacitor that reduces the change in input capacitance that occurs when the MULTIPLIER switch inserts the various coupling resistors between cathodes of V3 and V4.

The MULTIPLIER switch, SW2, selects the amount of coupling between cathodes of V3 and V4 to determine the gain of the amplifier when the preamplifier is switched out. The VERT AMP DC BAL is a chassis-mounted screwdriver adjustable potentiometer connecting the cathodes of V3 and V4 to -150 volts. This control operates differentially. When it increases the resistance to the cathode of V3 it simultaneously decreases the resistance to the cathode of V4. When it is properly adjusted, the dc voltage at the two cathodes is the same and no change in vertical positioning occurs when the multiplier switch connects larger or smaller resistors between them.

CALIBRATOR

The calibrator provides four squarewave voltages of 100 volts, 10 volts, 1 volt and .01 volt, available at a UHF coaxial fitting on the front panel but not connected internally to the vertical amplifier. The source of squarewave voltage is a self-excited symmetrical ac-coupled multivibrator operating at a repetition frequency of about one kilocycle. The cathode and grids of this multivibrator are returned to -150 volts.

During the conducting period of V601B, the grid of V601A is below -150 volts and the A-section plate is cut off. V602B grid is directly connected to V601A grid and V602B plate is therefore also cut off during this period.

During the conducting period of the A section of V601, grids of V601A and V602B are both high and the plate of V602B is down below ground potential. The grid of cathode-follower V602A is directly connected to V602B plate, and it therefore varies between cutoff in the negative direction and a point near 100 volts in the positive direction, determined by voltage divider R610, R611, R612.

The cathode resistor of cathode-follower V602A is made up of a voltage-divider string, R620, R621, R622, R623, which are of such values that voltages of 10 volts, 1 volt and 0.1 volt, peak-to-peak, are produced at the taps when the cathode voltage is set at 100 volts, peak-to-peak.

R612, a screwdriver adjustment labeled CAL ADJ on the chassis, permits the grid of V602A to be set at such a level that the cathode will be at 100 volts when V602B is cut off. Since this portion of the circuit remains connected to the + 225-volt supply when the CALIBRATOR switch is turned to the OFF position, the voltage calibration of the calibrator circuit can be checked with a dc voltmeter.

C603 in the grid circuit and C604 in the cathode circuit of the cathode follower reduce a small transient waveform distortion.

POWER SUPPLY

The power-supply transformer, T401, is capable of operating satisfactorily over the range of frequencies between 50 cps and 800 cps. The primary of this transformer is wound in two 117-volt sections, normally paralleled for 117-volt operation, but they are arranged to be easily reconnected in series for 234-volt operation.

Four selenium full-wave bridge rectifiers, each supplied with ac from a separate section of the transformer secondary, provide dc to four electronic voltage regulators from which are obtained the regulated voltages of -150 volts, +100 volts, +225 volts and +350 volts. In addition to these four regulated voltages, two unregulated voltage sources are provided, one at a nominal +330 volts from a tap taken ahead of the +225-volt regulator, the other at a nominal +420 volts taken from a tap ahead of the +350-volt regulator.

The regulator will regulate satisfactorily over a primary input-voltage range between 105 and 125 volts, or between 210 volts and 250 volts.

Five 6.3-volt secondary windings furnish heater power for the various parts of the instrument, and for the pilot light and graticule illumination.

Forced-air cooling is provided by a blower fan. Two fan types are available. If the Type 315D oscilloscope is to be used only on 50- to 60-cycle supply voltage, a 60-cycle fan is recommended, and is ordinarily supplied with the instrument. If higher frequencies of input voltage are to be used, however, a dc fan and rectifier are available at extra cost which will operate over the same range of frequencies that the transformer will.

Negative 150-Volt Regulator

The basic source of reference voltage is a type 5651 voltage-regulator gas diode, V401, in the cathode circuit of V402, a voltage-comparator tube. Voltage-divider string, R409, R410, R411, connected between regulated -150 volts and ground, is tapped at a voltage above -150 volts approximately equal to the voltage across the reference tube, V401, and connected to the grid of V402. This sets the cathode and grid of V402 at approximately the same voltage, and any change in voltage at the -150-volt bus becomes a change in grid-to-cathode voltage at V402. This change is amplified in V402 and applied directly to the grids of V403 and V404, two series-regulator tubes connected together in parallel in the ground lead of the power supply. If the -150-volt bus tends to go negative below this voltage, for example, the cathode of V402 will drop thereby increasing V402 plate current. Increased plate current will lower V402 plate, which will pull down the grids of V403 and V404, thereby increasing their plate resistance, so that they insert a higher drop in the ground lead, and the -150-volt bus will rise in the direction to correct the original negative tendency. C404, bypassing R407, R409, and part of R410, improves the ac gain of the comparator circuit and reduces ripple. R410 is adjustable by a screwdriver adjustment labeled 150 V ADJ on the chassis, so that this voltage can be set accurately.

+ 100-Volt Regulator

The +100-volt supply is regulated by comparing to ground in comparator-tube V421, a voltage near ground on voltage-divider R424, R425, connected between -150 volts and the regulated +100-volt bus. The difference voltage is amplified in V421 and applied to the grid of series-regulator tube, V422, connected in series with the positive lead. C421 improves the ac gain and reduces ripple. C420 filters the unregulated dc input to the regulator, and C422A, one of three capacitors in one can, filters the regulated portion.

+ 225-Volt Regulator

The +225-volt supply is regulated by comparing to ground potential in comparator tube V441, the voltage near ground potential on voltage divider R444, R445, connected between -150 volts and the regulated +225-volt bus. The difference voltage is amplified in V441 and applied to the grid of series-regulator tube V442A, connected in series with the +225-volt bus. Dc input to this regulator is supplied from a second rectified and filtered but unregulated source connected in series with the previous source. C440 filters the unregulated input to the regulator. A tap ahead of the regulator provides a nominal +330 volts, unregulated. C442B, the second of three capacitors in one can, filters the regulated supply at +225 volts. R443, bypassing the series-regulator tube, increases the available current at the regulated bus. C441 increases the regulator ac gain to reduce ripple.

+ 350-Volt Regulator

The +350-volt supply is regulated by comparing to ground potential the voltage near ground potential on voltage-divider R467, R468, connected between -150 volts and the regulated +350-volt bus, in comparator tube V461. The difference voltage is amplified in V461 and applied to series-regulator tube V442B in series with the +350-volt bus. Dc input to this regulator is supplied from a third rectified and filtered, but unregulated source connected in series with the previous two sources. C460, in series with C440 of the previous supply, filters the unregulated input to the regulator. A tap is taken off ahead of the regulator at a nominal +420 volts, unregulated. C422C, the third of three capacitors in one can, filters the regulated +350-volt bus. R465, bypassing the series-regulator tube increases the current available at the regulated bus. C461 increases the regulator ac gain to reduce ripple.

R412, a front-panel control labeled SCALE ILLUM, is a variable resistor in series with the graticule illuminating lights which permits the brightness of the graticule illumination to be varied.

HIGH VOLTAGE AND CATHODE-RAY TUBE CIRCUITS

Accelerating voltage is applied to the cathode of the cathode-ray tube. The high voltage is obtained by rectifying a 50- to 60-kilocycle high-voltage alternating current supplied by an oxide-core transformer whose primary forms the inductor of an inductance-capacitance oscillator. The primary inductance is center-tapped so that it can be used in a Hartley oscillator. C804 is the tank capacitor and V803 is the oscillator tube. Plate power is fed by way of the center tap on the inductor at a nominal +350 volts from the unregulated side of the regulated +225-volt supply. V804 in the negative lead of the high-voltage winding is the rectifier supplying dc to the crt cathode. The rectifier filaments are supplied from additional windings on the same transformer. The positive end of the transformer winding is connected to regulated +225 volts. Filtering is provided by C815 connected to ground from V804 plate, and by C816 and C817 in series, also between V804 and ground.

A voltage-divider string of resistors, R902, R903, R904, R817, and R816 connected between the rectifier plate and regulated +350 volts provides voltage taps for the focusing grid and for a sample of the high voltage for use in the high-voltage regulator system. R903 of the resistor string is a front-panel control potentiometer labeled FOCUS which permits the voltage of the focusing grid to be adjusted for best focus.

R817 in the resistor string is a screwdriver-adjustable potentiometer, the arm of which is at about -150 volts. The voltage from the arm is compared to -150 volts in comparator tube V801A. The plate of V801A is connected to +350 volts through a very high resistance load, R802, and sits near ground potential. The grid of V801B is connected directly to the plate of V801A, and the plate of V801B is connected directly to the screen of oscillator-tube V803 and through plate-load resistor R803, to regulated +350 volts. Any departure of the voltage tap on R817 of the high-voltage resistor string is therefore first amplified in comparator tube V801A and again in V801B so as to change the screen voltage of V803. For example, if the oscillator voltage becomes too high, the grid voltage of V801A will drop, its plate will rise carrying V801B grid up with it. Plate current in V801B will increase, its plate will drop carrying the screen of oscillator V803 down with it, thereby reducing the gain of this tube so that the oscillation amplitude will drop.

Unblanking

A second high-voltage winding and rectifier supply high voltage to the control grid of the cathode-ray tube at about -1750 volts. V805 is the rectifier and C818 is the filter capacitor. R910, in a voltage-divider resistor string across the high voltage is adjustable by means of a front-panel control labeled INTENSITY to permit adjustment of the spot intensity.

The positive end of this supply is connected to the unblanking-output tube, V210A, through R914. Thus the whole control-grid voltage supply including the transformer winding is raised and lowered in voltage by the unblanking pulse. This arrangement provides dc coupling of the unblanking waveform to the control grid, thereby making it possible to use as slow a sweep as desired. R914 and C902 improve the risetime of the pulse appearing at the control grid.

The ASTIGMATISM control is a potentiometer, R920, connected between regulated +225 volts and regulated +100 volts.

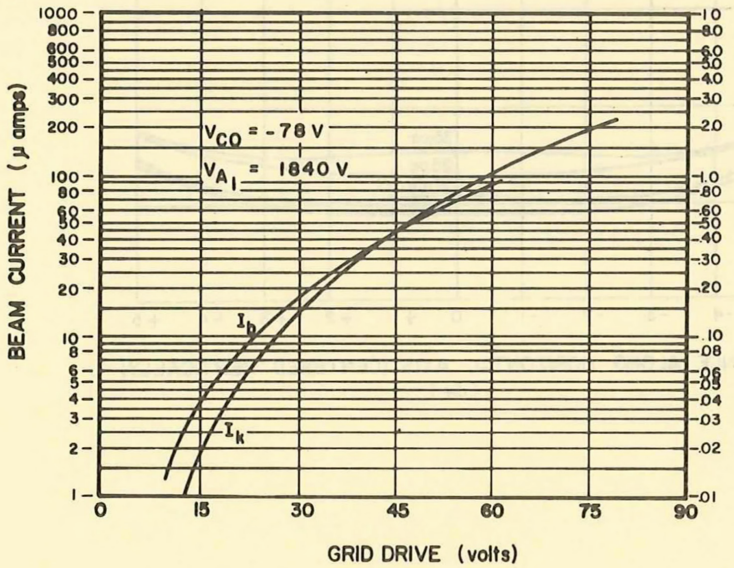
An external cathode connection is provided via C901 for introducing external z-axis signals to provide beam-intensity modulation if desired. R905 prevents dc, which might leak through the dielectric of C901, from developing high voltage at the connector.

Components shown on the right of the broken line in the diagram are located on a horizontal bakelite mounting board above the end of the cathode-ray tube. The transformer, rectifier tubes, and filter capacitors shown on the diagram to the left of the broken line, are mounted inside a shield at the left lower rear corner to the left of the power transformer.

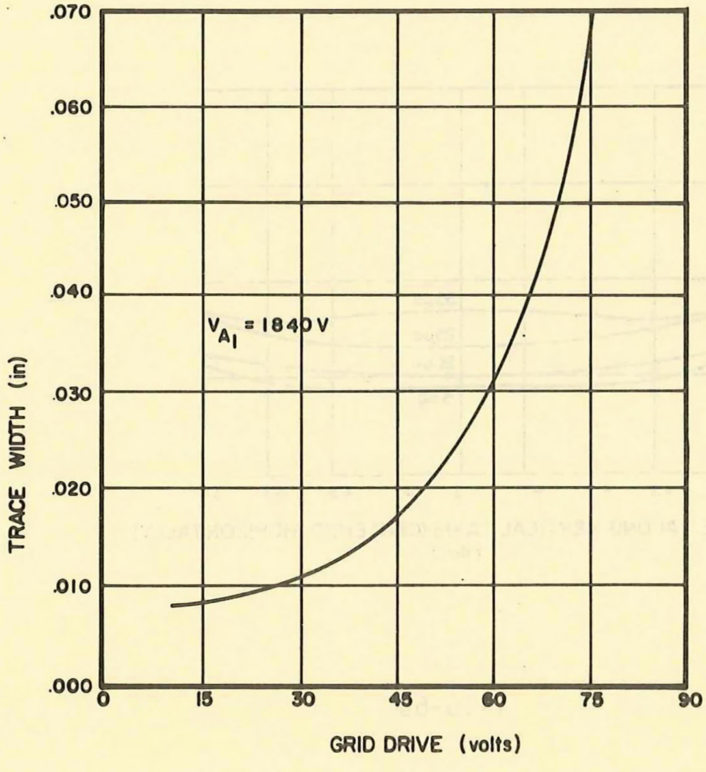
All measurements taken with voltages specified under Typical Operating Conditions on the T3100 CRT Data Sheet. This data is representative of the CRT alone dissociated from any operating circuitry.

AVERAGE GRID-DRIVE CHARACTERISTICS:

Grid drive measured as volts above cutoff.

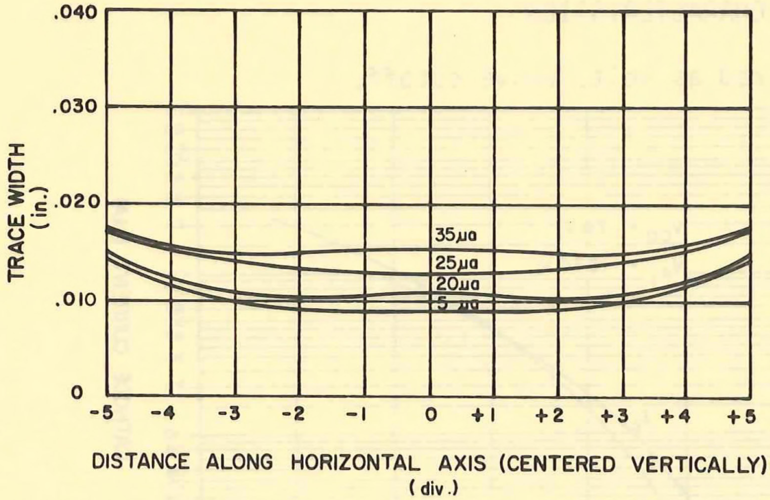


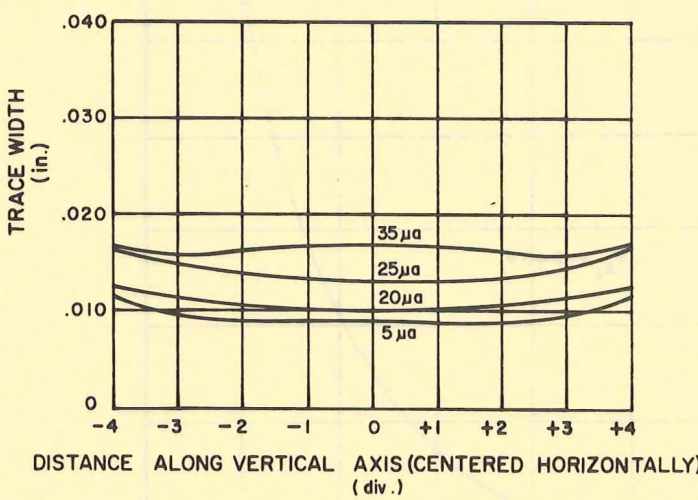
AVERAGE CENTER-SPOT-SIZE CHARACTERISTICS:



TRACE WIDTH VERSUS LOCATION ALONG AXIS:

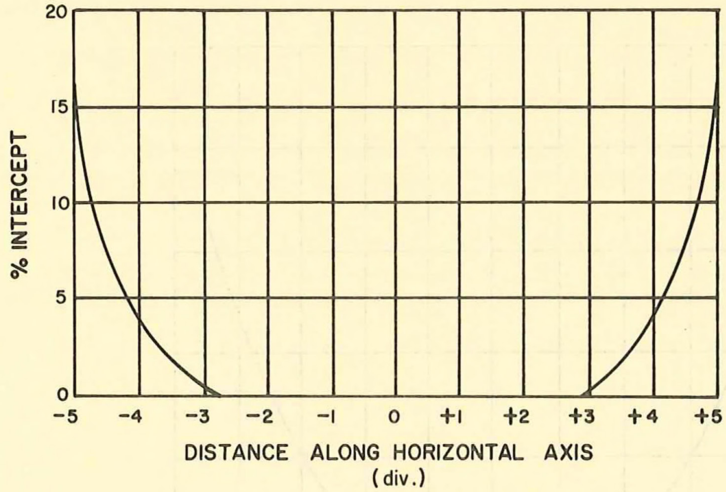
All trace width measurements taken using shrinking-raster method with 11-line raster at 2 kc rep-rate.



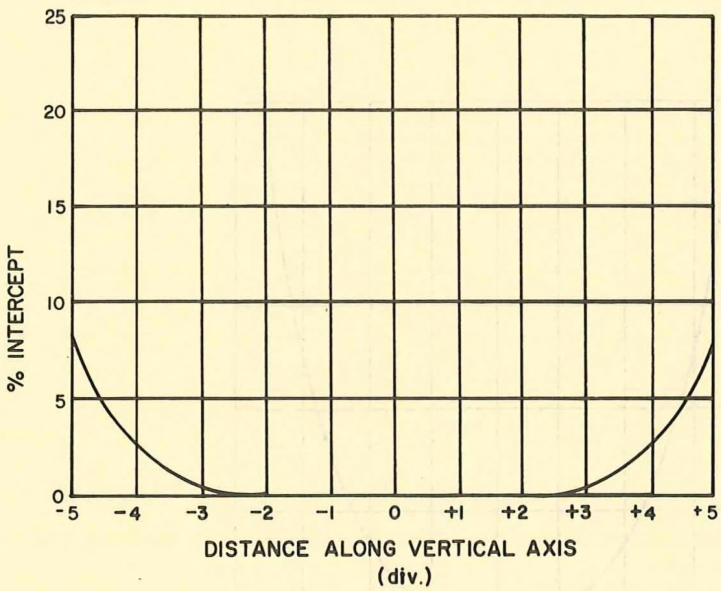


DEFLECTION PLATE I_b INTERCEPT:

Taken at normal viewing currents of 1-2 μamps.



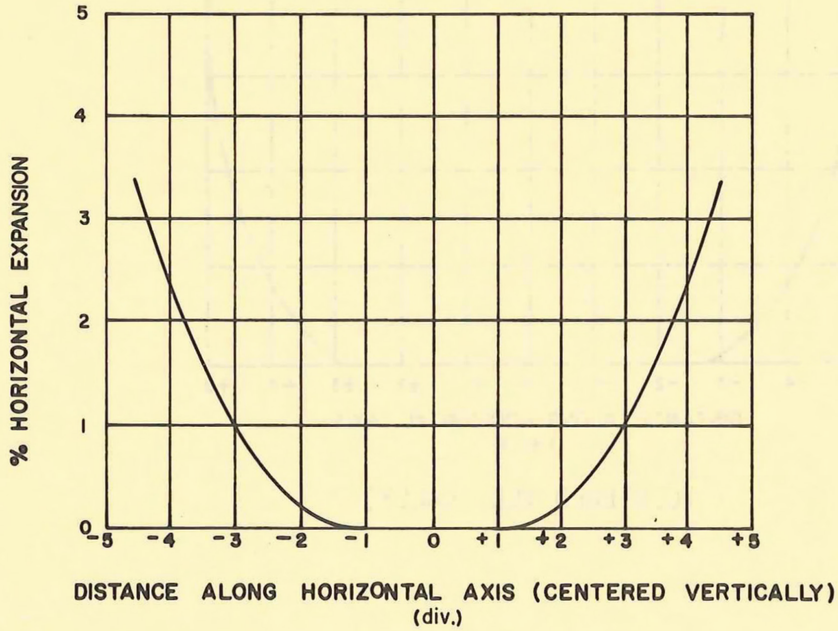
(CENTERED VERTICALLY)

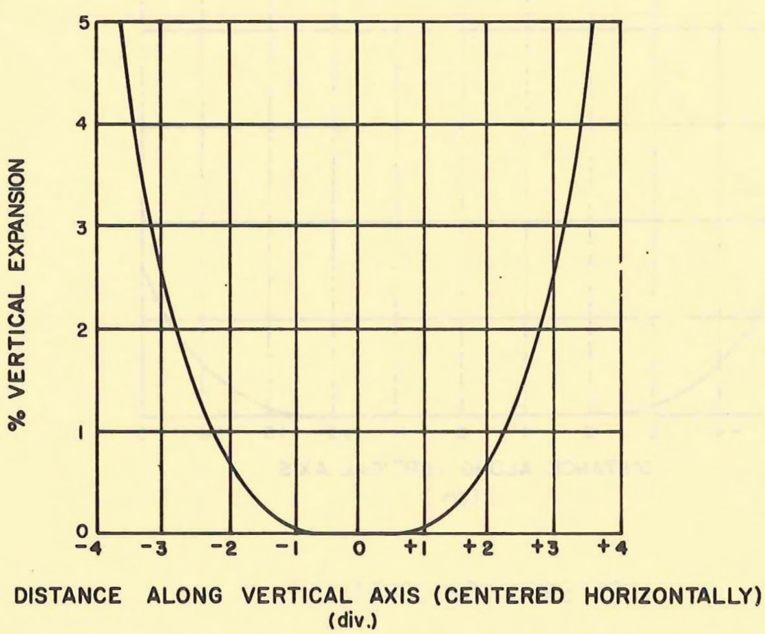


(CENTERED HORIZONTALLY)

LINEARITY CHARACTERISTICS:

Percent departure from the deflection factor measured at the axis.





MAINTENANCE

CONTENTS-MAINTENANCE

MODIFICATION SUMMARY

315

HIGH VOLTAGE TRANSFORMER
SECONDARY VOLTAGE INCREASED TO INSURE TRACE CUTOFF — See SQB — M457

Effective Prod SN not given

DESCRIPTION:

The intensity control does not completely extinguish the CRT trace when the sweep is running. The problem is due to not enough negative voltage from the HV supply. The number of turns on the HV transformer secondary winding was increased. The part number of the HV transformer remains unchanged.

Parts Required for Field Installation:

See Part listed below.

R (?)	1 M 1/2 W 10%	302-0105-00

INSTALLATION INSTRUCTIONS:

Install a 1 M 1/2 W resistor between -150 V and the junction of R914 (100k) and R913 (5.6 M). NOTE: This resistor drops the average level of blanking voltage at low end of negative high voltage to CRT grid.

UNBLANKING CF RESISTOR RELOCATED
TO PREVENT SLIGHT TRACE FOLD OVER AT THE START OF THE SWEEP — See SQB — M460

Effective Prod SN 175 — Usable in field instruments SN 101-174

DESCRIPTION:

To prevent feed through of unblanking signal on the sweep waveform which caused a slight fold over at the start of the sweep. Relocate R240, 22k 2W resistor from its place near R318, to a point on the chassis near V210.

Parts Removed:

Post,	PB 3/4 12 (2)	no number
Terminal	TET 24C (2)	no number
Screw	6-32 x 5/16 (2)	211-0507-00

Parts Added:

Post, ceramic 3/4	129-0009-00
Nut, 6-32 x 1/4	210-0407-00

Parts Required for Field Installation:

See Parts listed below.

Strip, ceramic 1-notch (2)	124-0100-00
Grommet, 1/4	348-0002-00
Spacer, cer. strip (2)	361-0007-00
Wire, #22 solid 10-1/2in. white-red	175-0522-00
Wire, #22 solid 2in. white-brown-red-brown	175-0522-00

continued

INSTALLATION INSTRUCTIONS:

Relocate R240,22k 2W resistor,from the terminal board at the rear of the sweep chassis to the area between V210 and V211 on the tube side of the chassis.

Drill holes as required to mount ceramic strips and to provide grommet through which resistor hookup wires may be passed.

TIME BASE GENERATOR FAST SWEEP SPEED LINEARITY IMPROVED BY SHIELDING CATHODE LEAD OF V213A — See SQB — M474

Effective Prod SN 175 — Usable in field instruments SN 101-174

DESCRIPTION:

To prevent the sawtooth signal from coupling to the cathode of the constant current tube V213A. This stray coupling caused non-linearity on the highest sweep ranges on some instruments. Change cathode lead to shielded wire. Also see M474B.

Parts Removed:		Parts Added:	
Wire, #22 solid 10 in. white-blue	175-0522-00	Cable, Belden 8411	175-0004-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace the white-blue wire, between pin 3 of V213 and the TIME/DIVISION switch, with a 10 in. 10 in. length of Belden 8411 cable. Run cable on underside of sweep chassis next to the bulkhead.

TIME BASE GENERATOR AND TRIGGER

FAST SWEEP SPEED LINEARITY AND STABILITY IMPROVED BY CHANGING VARIOUS COMPONENTS

See SQB

M474B

Effective Prod SN 175

Usable in field instruments SN 101-174

DESCRIPTION:

Various components in the Time Base Generator were changed to improve sweep linearity and sweep and trigger stability at fast sweep speeds.

Parts Removed:

C272	22pF cer	281-0510-00
C276	3-12pF var	281-0007-00
C300	5-25pF var	281-0010-00
C303	4.7pF cer	281-0501-00
R282C	60k 1/2W 1%	309-0067-00

Parts Added:

C272	47pF cer	281-0518-00
C276	1.5-7 pF var	281-0006-00
C303	0.5-5pF var	281-0001-00
R282C	56.5k 1/2W 1%	309-0040-00
R291	3.3k 1/2W 10%	302-0332-00

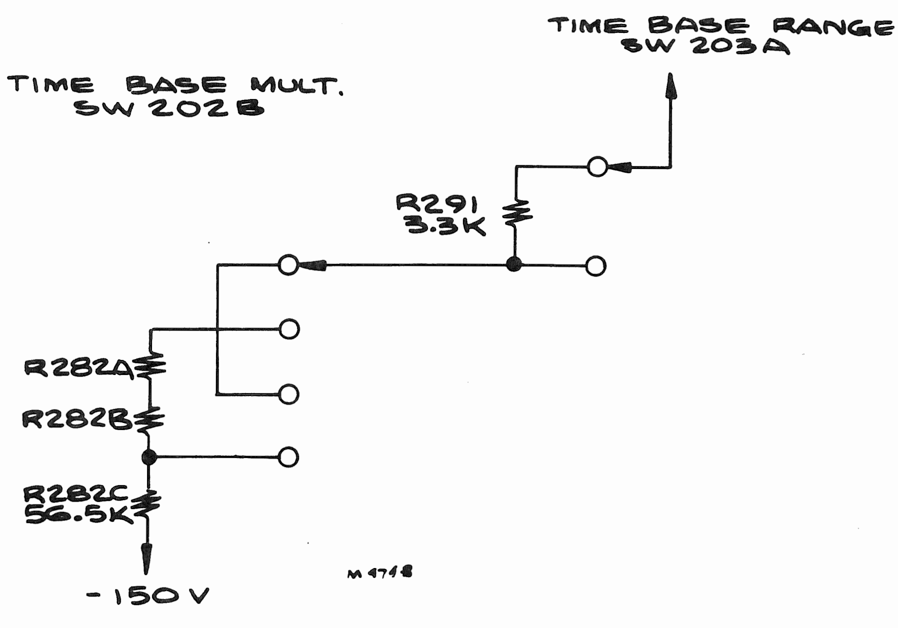
Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Change the following to new values:

C272 (at pin 1 of V213A) from 22pF to 47pF
C276 (at pin 6 of V214B) from 3-12pF to 1.5-7pF
C303 (at pin 3 of V224A) from 4.7pF to 0.5-5pF
R282C (on Time Base Multiplier switch) from 60k to 56.5k 1%
Remove C300 (near V222)
Add R291 to Time Base Range switch as shown in schematic



TIME BASE GENERATOR OSCILLATIONS PREVENTED BY ADDITION OF SUPPRESSOR RESISTOR — See SQB — M475

Effective Prod SN 175
w/exceptions 111, 134, 140, 143, 146, 149, 150, 156, 157, 160, 163-73

Usable in field instruments SN 101-174

DESCRIPTION:

To prevent oscillation in the sawtooth output cathode follower, add a 47Ω 1/2 W resistor in series with grid lead at pin 7 of V222B.

Parts Removed:

Parts Added:

R265	47Ω 1/2 W 10%	302-0470-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Add a 47Ω 1/2 W resistor, in series with grid lead, at pin 7 of V222B.

TIME BASE GENERATOR OSCILLATIONS PREVENTED BY ADDITION OF SUPPRESSOR RESISTOR — See SQB — M475A

Effective Prod SN 175

Usable in field instruments SN 101-174

DESCRIPTION:

To prevent oscillation in the +gate output cathode follower V214A, add a 47Ω 1/2W suppressor resistor in series with grid lead, pin 9 of V214A.

Parts Removed:

Parts Added:

R239	47Ω 1/2 W 10%	302-0470-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Add a 47Ω 1/2 W resistor in series with grid lead at pin 9 of V214A.

VERTICAL AMP INPUT CAPACITANCE STABILIZED FROM CABINET EFFECTS BY MOUNTING C1 RIGIDLY — INFORMATION ONLY — M478

Effective Prod SN 175

DESCRIPTION:

To stabilize the input capacitance from cabinet effects, mount C1 rigidly to Vertical Amplifier chassis using a plastic clamp.

Parts Removed:

Parts Added:

Bolt, spade 3/8 in.		214-0059-00
Nut, 6-32 x 1/4	(2)	210-0407-00
Lockwasher, int #6	(2)	210-0006-00

POWER SUPPLY THERMAL CUTOUT ADDED TO PREVENT DAMAGE DUE TO OVERHEATING — See SQB — M479

Effective Prod SN 175

Usable in field instruments SN 101-174

DESCRIPTION:

To prevent damage to components due to overheating, add a thermal cutout in series with the unswitched AC lead to the power transformer.

Parts Removed:

Parts Added:

TK401	Thermal Cutout	260-0157-00

Parts Required for Field Installation:

See 'Parts Added' and parts listed below.

Wire, #18 yel-bn-bn-bn (6in.)		175-0504-00
Screw, 6-32 x 5/16in.	(2)	211-0507-00
Nut, Kepts 6-32	(2)	210-0457-00

INSTALLATION INSTRUCTIONS:

Mount the thermal cutout on the bulkhead power supply chassis in the area just behind V403 (12B4). Use 6-32 hardware. Unsolder the yel-bn-bn-bn wire and the wh-gy from pin 1 of the power transformer and resolder them to one side of the thermal cutout. Solder a length of yel-bn-bn-bn wire, between pin 1 of the power transformer and the other side of the cutout.

CABINET STAND RUBBER BUMPER ADDED TO PREVENT SCRATCHING OF SUPPORTING SURFACES	INFORMATION ONLY	M513

Effective Prod SN 245

DESCRIPTION:

8-1/4 in. length of X-200 extruded rubber bumper material added to edge of stand to prevent scratching of supporting surfaces.

Parts Removed:

Parts Added:

Extrusion rubber (8-1/4in) no number

PREAMPLIFIER FREQUENCY RESPONSE IMPROVED BY ADDING AND CHANGING OF VARIOUS COMPONENTS	See SQB	M498

Effective Prod SN 268

Usable in field instruments SN 101-267

DESCRIPTION:

Preamplifier transient response improved by:

1. Adding an RC time constant in series with R15
2. Removing R19 (reinstalled in M507)
3. Changing value of R36
4. Adding a plate decoupling cap to V2B. Install M507 at same time.

Parts Removed:

R19	6.8 k 1/2 W	302-0683-00
R36	220Ω 1/2 W	302-0221-00

Parts Added:

* C13	0.01 μF disc	283-0002-00
* C16	0.02 μF disc	283-0004-00
R16	12Ω 1/2 W	302-0120-00
* R36	150Ω 1/2 W	302-0151-00

Parts Required for Field Installation:

See 'Parts Added' with asterisks and part listed below.

R16	10Ω 1/2 W	302-0100-00

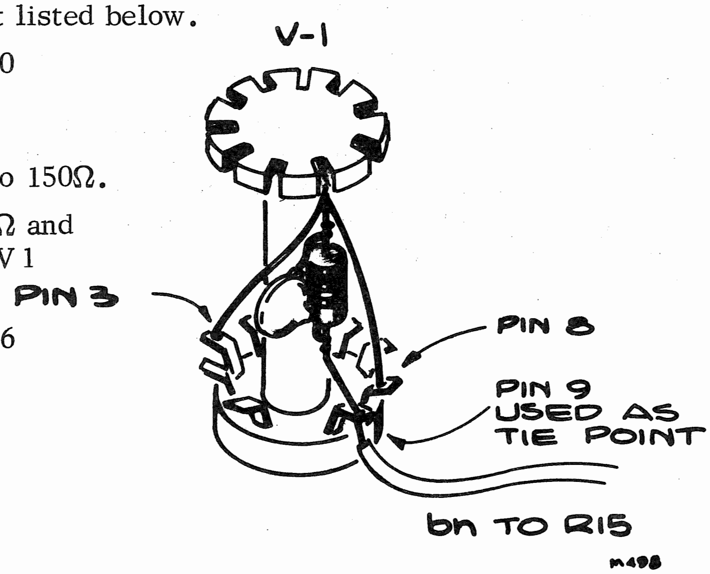
INSTALLATION INSTRUCTIONS:

a) Change R36 (across L2) from 220Ω to 150Ω.

b) Install a network of R16 and C16 (10Ω and 0.02 μF in parallel), in series with V 1 cathode lead to R15. See drawing.

c) Install C13, 0.01 μF discap from pin 6 of V2B to ground.

d) Recalibrate Vertical Preamplifier.



CRT CHANGED TO P2 PHOSPHOR AS STANDARD — INFORMATION ONLY — M522

Effective Prod SN 280

DESCRIPTION:

Provide the standard production instrument with a P2 CRT. Change from 3WP1 to 3WP2 except for special customer requests.

Parts Removed:			Parts Added:		
V806	3WP1	154-0058-00	V806	3WP2	154-0059-00

VERTICAL AMPLIFIER TRANSIENT RESPONSE IMPROVED BY ADDING SEVERAL NEW COMPONENTS — See SQB — M507

Effective Prod SN 299
w/exceptions 200, 206, 236, 238, 242, 244, 249, 255, 257-8, 260, 264, 267, 269, 272, 277, 282, 289, 292-297

Usable in field instruments SN 101-298

DESCRIPTION:

Improve Vertical Amplifier response by adding:

1. RF bypass caps to the heater string and to plate of V8B.
2. R19 6.8k 1/2W across L1.
3. R59 10Ω 1/2W parasitic suppressor resistor to grid of V8B.

Parts Removed:

Parts Added:

C26	0.01 μF discap	283-0002-00
C27	0.01 μF discap	283-0002-00
C17	0.01 μF discap	283-0002-00
C18	0.01 μF discap	283-0002-00
R19	6.8k 1/2W 10%	302-0682-00
R59	10Ω 1/2W 10%	302-0100-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTION:

a) Add C26, 0.01 μF, between pin 5 of V2 and ground.
b) Add C27, 0.01 μF, between pin 4 of V2 and ground.
c) Add C17, 0.01 μF, between pin 4 of V10 and ground.
d) Add C18, 0.01 μF, between pin 6 of V8 and ground.
e) Add R19, 6.8k resistor, across L1, if not already present.
f) Add R59, 10Ω resistor, in series with grid lead at pin 7 of V8B.
g) Recalibrate the Vertical Amplifier.

HV POWER SUPPLY RECTIFIERS FAILURE REDUCED BY INCREASING FILAMENT VOLTAGES — INFORMATION ONLY — M517

Effective Prod SN not given

DESCRIPTION:

Reduce HV rectifier failure by increasing the filament voltage. T801 HV transformer turns ratio changed. Part number remains unchanged.

FRONT PANEL GROUND POST ADDED FOR USE WITH VERTICAL INPUT CONNECTOR — See SQB — M525

Effective Prod SN 346 — Usable in field instruments SN 101-345

DESCRIPTION:

To facilitate connections etc., a ground post was added just below the UHF INPUT connector.

Parts Removed:	Parts Added:	
	Post, grounding	129-0020-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Drill a 3/16 in. hole 1 in. below the center of the Vertical Input connector and mount the ground post.

CABINET STUDS CHANGED TO PREVENT BUCKLING OF CABINET BACK — INFORMATION ONLY — M528

Effective Prod SN not given

DESCRIPTION:

To prevent buckling of the cabinet back, the fastening studs were lengthened.

Parts Removed:		Parts Added:	
Stud 98-05-5-15 (2)	no number	Stud, 98-05-5-22 (2)	no number

POWER SUPPLY RESISTORS ADDED TO IMPROVE VERTICAL PREAMPLIFIER STABILITY — See SQB — M539-1

Effective Prod SN 348 — Usable in field instruments SN 101-347

DESCRIPTION:

Improve stability of the Vertical Amplifier when in the preamp position by increasing the time constant in the grid circuit of the voltage regulator feedback amplifier in the +225 V and +350 V supplies.

Also see M539-3, following M548.

Parts Removed:

Parts Added:

* R446	2.2 M 1/2 W	302-0225-00
* R469	2.2 M 1/2 W	302-0225-00

Parts Required for Field Installation:

See 'Parts Added' with asterisks.

INSTALLATION INSTRUCTIONS: Refer to drawing.

a) Remove wires between CSB-11, 12 and 13.

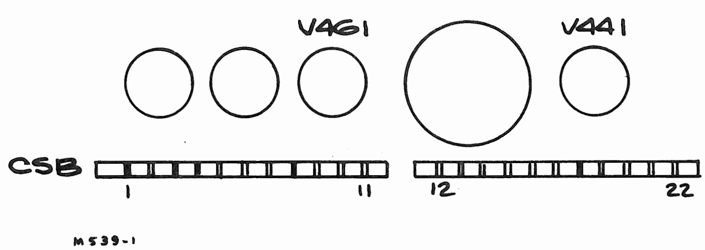
b) Replace tubing covered wire, between pin 1 of V461 and CSB-11, with a 2.2 M 1/2 W resistor (R469).

c) Add a length of bare wire between CSB-11 and CSB-13 (dress this wire away from CSB-12).

d) Remove bare wire between CSB-18 and CSB-19.

e) Add a 2.2 M 1/2 W resistor (R446) between pin 1 of V441 and CSB-19.

f) Check accuracy of +225 and +350 V supplies.



POWER SUPPLY FAILURE PREVENTED BY INCREASING THE VOLTAGE RATING OF C461 — INFORMATION ONLY — M539-2

Effective Prod SN 348

DESCRIPTION:

Failure of C461 prevented by increasing the voltage rating from 400 V to 600 V

Parts Removed:			Parts Added:		
C461	0.01 μF 400 V	281-0510-00	C461	0.01 μF 600 V	281-0511-00

VERTICAL AMPLIFIER RESISTOR VALUE CHANGED TO IMPROVE TRANSIENT RESPONSE — INFORMATION ONLY — M518

Effective Prod SN 351

DESCRIPTION:

Change R16 from 12Ω to 10Ω. The value is more correct for the average production instrument.

This mod is an addendum to M498.

Parts Removed:			Parts Added:		
R16	12Ω 1/2 W 10%	302-0120-00	R16	10Ω 1/2 W 10%	302-0100-00

VERTICAL AMPLIFIER GAIN INCREASED BY REMOVING 10Ω RESISTORS IN VERTICAL OUTPUT STAGE — See SQB — M532-1

Effective Prod SN 351 — Usable in field instruments SN 101-350

DESCRIPTION:

Increase gain in Vertical Amplifier by removing the 10Ω resistors in the cathode circuit of Vertical Amplifier output stage. Perform this mod only where inadequate gain is a problem.

Parts Removed:			Parts Added:
R72	10Ω 1/2 W 10%	302-0100-00	
R74	10Ω 1/2 W 10%	302-0100-00	
R91	10Ω 1/2 W 10%	302-0100-00	
R94	10Ω 1/2 W 10%	302-0100-00	

INSTALLATION INSTRUCTIONS:

Replace R72, R74, R91, R94 (10Ω 1/2 W resistors) each with a length of bare wire.

VERTICAL AMPLIFIER COMPONENTS CHANGED TO CUT PRODUCTION COSTS — INFORMATION ONLY — M532-2

Effective Prod SN 351

DESCRIPTION:

Production costs cut by changing R59 from 12Ω to 10Ω and removing several mechanical components.

Parts Removed:

R59	12Ω 1/2 W 10%	302-0120-00
Post, ceramic 3/4in.		129-0009-00
Nut, 6-32 x 1/4		210-0407-00
Lockwasher, int #6		210-0006-00
Post, 1-1/2 TB1B1		no number

Parts Added:

R59	10Ω 1/2 W 10%	302-0100-00
Post, PB 1-1/2 TB1A		no number

VERTICAL AMPLIFIER HUM DECREASED BY COUPLING C20 TO +100 V INSTEAD OF GROUND — See SQB — M499-1

Effective Prod SN 357

Usable in field instruments SN 101-356

DESCRIPTION:

Decrease visible hum on trace from Vertical Amplifier by coupling C20 to +100 V instead of ground.

Parts Removed:

C20	0.01 μF discap	283-0002-00

Parts Added:

C20	0.01 μF PT 400 V	285-0510-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Change C20, 0.01 μF discap (at pin 2 of V8A), to a 0.01 μF 400 V tubular capacitor and move the end which goes to ground to +100 V.

VERTICAL AMPLIFIER POSITION AND 5X MULTIPLIER ADJUSTMENT RANGE IMPROVED BY CHANGING DIVIDER RATIOS — INFORMATION ONLY — M499-2

Effective Prod SN 357

DESCRIPTION:

1. VERTICAL POSITION range is improved by changing the value of R66 and R70 (POSITION CONTROL) and adding a 22k resistor in shunt with R70.

2. 5X Multiplier adjustment range improved by changing the value of R52.

Parts Removed:			Parts Added:		
R52	1k 1/2W 10%	302-0102-00	R52	1.2k 1/2W 10%	302-0122-00
R66	18k 1/2W 10%	302-0183-00	R66	22k 1/2W 5%	301-0223-00
R70	20k pot	311-0018-00	R70	250k pot	311-0032-00
			R69	22k 1/2W 5%	301-0223-00

TIME BASE TIMING CAPACITOR CHANGED TO PREVENT NON-LINEAR SWEEP — See SQB — M519-1

Effective Prod SN 357 — Usable in field instruments SN 101-356

DESCRIPTION:

Prevent non-linear sweep due to 'soak effect' of C280C, when the Time/Division switch is in the 1 millisec position. Change C280C from a 0.01μF paper tubular to a 0.01 μF mica.

Parts Removed:			Parts Added:		
C280C	0.01 μF PTM 400 V	285-0510-00	C280C	0.01 μF mica 300 V	no number

Parts Required for Field Installation:

C280C 0.01 μF 600 V PTM 285-0511-00

INSTALLATION INSTRUCTIONS:

Replace C280C, 0.01μF 400 V capacitor with a 0.01 μF 600V capacitor, (or replace all the timing series with Mylar* capacitors by installing Parts Replacement Kit 050-0002-00.

* Du Pont Registered Trademark

VERTICAL AMPLIFIER DC SHIFT COMPENSATION CONTROL ADDED

See SQB

M540

Effective Prod SN 357

Usable in field instruments SN 101-356

DESCRIPTION:

To compensate for vertical DC shift, add an LC network to the plate circuit of the Vertical Amplifier output tubes.

Parts Removed:

R80	2.5k 10W
R84	2.5k 10W

Parts Added:

* C86	20 μF 150 V	290-0008-00
* C88	20 μF 150 V	290-0008-00
* R80	2.7k 10W	308-0019-00
* R84	2.7k 10W	308-0019-00
R86	39k 1/2W 10%	302-0393-00
R88	39k 1/2W 10%	302-0393-00
* R87	1 M pot	311-0040-00
Plate, mtg.		386-0323-00

Parts Required for Field Installation:

See 'Parts Added' with asterisks and parts listed below.

R86	33k 1/2W 10%	302-0333-00
R88	33k 1/2W 10%	302-0333-00
Nut,	3/8-32x1/2 (2)	210-0413-00
Lockwasher, 3/8 ID		210-0012-00
Screw, 6-32x5/8 Phil (2)		211-0522-00
Screw, 6-32x5/16 PHS (2)		211-0507-00
Nut, 6-32x5/16 (2)		210-0407-00
Strip, ceramic		124-0100-00
Spacer, strip		361-0007-00
Rod, spacer		385-0020-00
Wire, #22 wh-bn-bk-bn (7-1/2in)		175-0522-00

INSTALLATION INSTRUCTIONS:

a) Mount and wire parts on mounting plate 386-0323-00 as indicated in Fig. 1.

b) Change R80 (at L4 and L6) and R84 (at L5 and L7) from 2.5k 10W to 2.7k 10W.

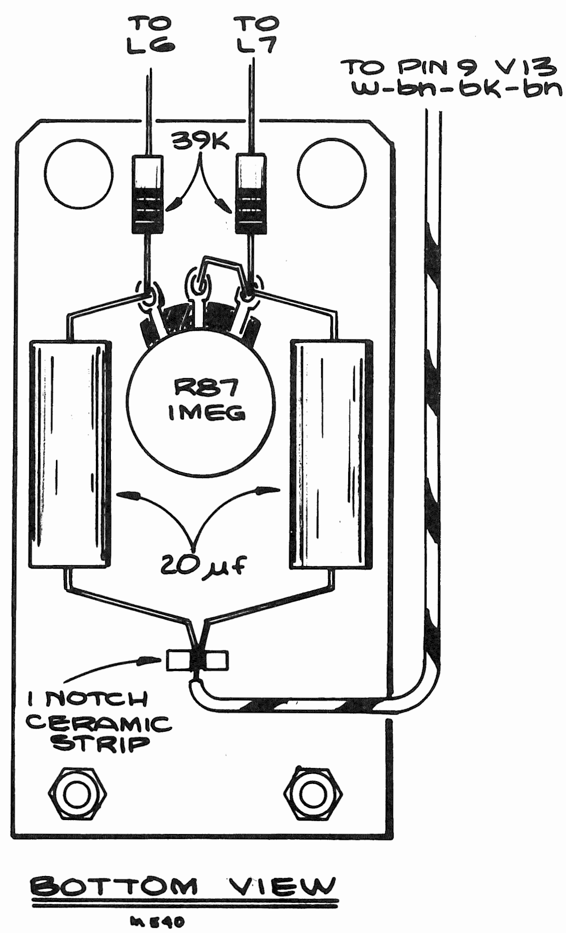


FIG. 1

continued

INSTALLATION INSTRUCTIONS (cont)

c) Mount the DC Shift Comp plate to the support bar above the CRT socket as shown in Fig. 2.

d) Wire as shown in Fig. 2.

e) Refer to your Instruction Manual and adjust L3, L4, L5, L6 and L7.

f) Set the DC Shift Comp control as follows: Set the AMPLITUDE control to the DC 0.1 VOLTS/DIVISION position and the MULTIPLIER to 2. Advance the STABILITY control until the time base is free running and center the trace vertically. Connect a lead from CAL OUT to INPUT and switch the CALIBRATOR control alternately from the OFF position to the 1-volt position. Adjust the DC Shift Comp control, R87, until the base line of the display does not shift position as the calibrator is switched off and on.

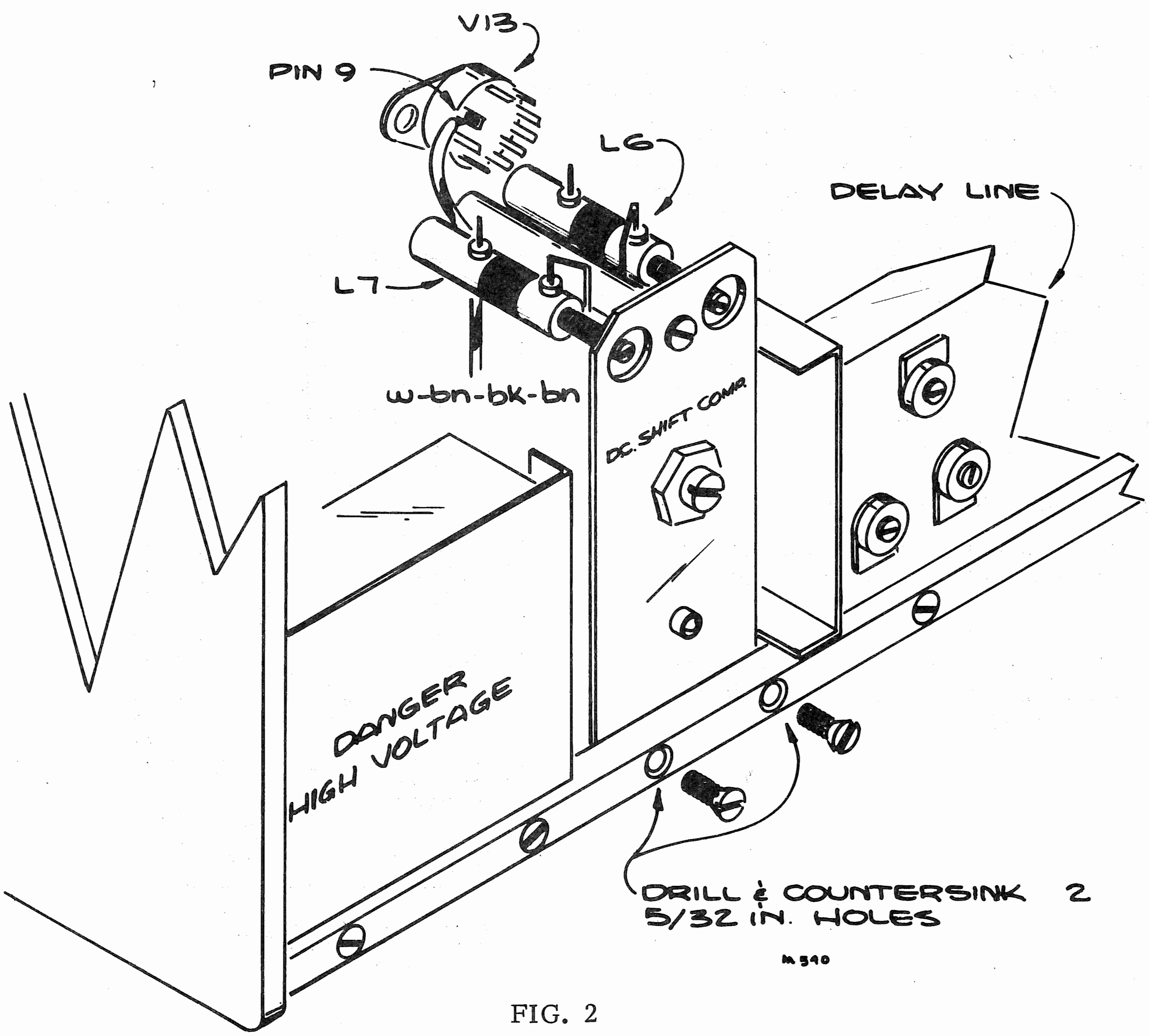


FIG. 2

VERTICAL AMPLIFIER TRANSIENT RESPONSE IMPROVED

See SQB — M515

Effective Prod SN 363 — Usable in field instruments SN 101-362

DESCRIPTION:

Vertical Amplifier transient response improved by adding High Frequency bypass capacitor, C23, to Delay Line circuit.

Parts Removed:

Parts Added:

C23	0.01 μF discap	283-0002-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Add C23, 0.01 μF, in parallel with C21, 6.25 μF.

TIME BASE MAG CENTERING AND HORIZ POSITION CONTROLS RANGE IMPROVED BY CHANGING DIVIDER RESISTOR RATIOS

INFORMATION ONLY — M544

Effective Prod SN 363 — Usable in field instruments SN 101-362

DESCRIPTION:

1. Improves the range of the Mag Centering adjustment by changing the divider ratio of R305 and R306.

2. Improves the range of HORIZ POSITION control by changing the value of R287 and selecting R272 and R273.

Parts Removed:			Parts Added:		
R272	18k 1 W 10%	304-0183-00	R272	18k 1 W -8 + 0%)	312-0537-00
R273	47k 2 W 10%	306-0473-00	R273	47k 2 W -5+5%)	
R287	8.2k 1/2 W 10%	302-0822-00	R287	4.7k 1/2 W 10%	302-0472-00
R305	68k 1 W 10%	304-0683-00	R305	22k 1 W 10%	304-0223-00

VERT PREAMP OSCILLATIONS PREVENTED BY ADDITION OF INPUT SUPPRESSOR RESISTOR — See SQB — M548

Effective Prod SN 363 — Usable in field instruments SN 101-362

DESCRIPTION:

Prevent spurious oscillations in the preamplifier by adding a 47Ω resistor in series with the Vertical Input connector.

Parts Removed:

Parts Added:

* R8	47Ω 1/2 W 10%	302-0470-00
Post, ceramic		129-0009-00

Parts Required for Field Installation:

See 'Parts Added' with asterisk.

INSTALLATION INSTRUCTIONS:

Add a 47Ω resistor (R8) in series with C1 at the INPUT connector.

POWER SUPPLY RESISTORS CHANGED TO IMPROVE VERTICAL PREAMPLIFIER STABILITY — See SQB — M539-3

Effective Prod SN 381 — Usable in field instruments SN 101-380

DESCRIPTION:

Decrease the values of the +350 V supply feedback amplifier to decrease noise and improve stability in the preamplifier.

See Mod M539-1 and 2 following M528.

Parts Removed:			Parts Added:		
R467	1.8 M 1/2 W 1%	309-0020-00	R467	800 k 1/2 W 1%	309-0110-00
R468	750 k 1/2 W 1%	309-0010-00	R468	333 k 1/2 W 1%	309-0053-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Change R467, 1.8 M 1/2 W 1% to 800 k 1/2 W 1%.

b) Change R468, 700 k 1/2 W 1% to 333 k 1/2 W 1%.

c) Check accuracy of +350 V supply.

TIME BASE PRODUCTION COST REDUCED BY CHANGING C280 C — INFORMATION ONLY — M519-2

Effective Prod SN 395

DESCRIPTION:

To reduce cost of timing capacitor C280 C , replace the 0.01 μF mica with a 0.01 μF 600 V PTM.

See M519-1 which follows M499-2.

Parts Removed:				Parts Added:		
C280C	0.01 μF mica 300 V	no number		C280C	0.01 μF PTM 600 V	285-0511-00

TIME BASE CIRCUIT NUMBERING SYSTEM CHANGED FOR PEAKING COILS WITH SHUNT RESISTORS — INFORMATION ONLY — M533

Effective Prod SN 450

DESCRIPTION:

1. Changed numbering system for peaking coils with shunt resistors.
2. Changed method of making peaking coil for trigger circuit.

Use a pi winding instead of a flat winding for L246. Part numbers of coils remain unchanged.

Parts Removed:			Parts Added:		
L221 R221	150 μH coil) wound on 1.5 k)	108-0026-00	LR-2 LR-3	150 μH coil 70 μH coil	108-0026-00 108-0027-00
L246 R246	70 μH coil) wound on 4.7 k)	108-0027-00			

POWER SUPPLY RECTIFIER STUD CROSS-THREADING PREVENTED BY CHANGING TO BRASS SCREWS — INFORMATION ONLY — M549

Effective Prod SN not given

DESCRIPTION:

Cross-threading of selenium rectifier studs prevented by changing from aluminum to brass screws.

Parts Removed:			Parts Added:		
Screw,	8-32x2 alum.(2)	no number	Screw,	8-32x2 RHB(2)	no number
Screw,	8-32x2-7/16 " (2)	no number	Screw,	8-32x2-1/4 RHB(3)	no number
Screw,	8-32x2-5/16 "	no number			

VERTICAL AMPLIFIER CONSTRUCTION SIMPLIFIED BY ELIMINATING INSULATED POT MOUNTING — INFORMATION ONLY — M563

Effective Prod SN not given

DESCRIPTION:

To simplify construction of Vertical Amplifier, the insulated Bakelite* pot mounting bracket for sensitivity adjust R90, is replaced with an aluminum bracket and shaft coupling.

Parts Removed:		Parts Added:	
Plate, Bakelite	BB315-3	Bracket, alum	406-0021-00
Bar, 1-1/2 x 1/4 alum	PA32-16	Coupling, 7/8 x 1/2	CN28
Coupling, Nat Bakelite	CI32	Nut, 6-32 x 1/4 (2)	210-0407-00
Screw, 6-32 x 5/16 RHB(2)	no number	Lockwasher, int #6 (2)	210-0006-00

REAR PANEL AND FAN RING MADE INTEGRAL PART TO IMPROVE STRENGTH, APPEARANCE AND REDUCE COST — INFORMATION ONLY — M564

Effective Prod SN not given

DESCRIPTION:

Fan ring formed into integral part with the rear panel to make fewer parts, and improve strength and appearance.

Part number of rear panel remains unchanged.

Parts Removed:		Parts Added:
Ring, fan	RF315	
Rivet, 1/8 x 1/4 (4)	SR511-2	
Screw, 6-32 x 5/16 BHB(4)	no number	
Nut, 6-32 x 1/4	210-0407-00	
Lockwasher, int #6	210-0006-00	

POWER TRANSFORMER SUPPORT RING THICKNESS INCREASED 1/8" TO INSURE CLEARANCE BETWEEN WINDINGS AND CERAMIC STRIP STUDS — INFORMATION ONLY — M589

Effective Prod SN not given

DESCRIPTION:

To insure clearance between the transformer windings and ceramic strip studs,on the High Voltage chassis, the thickness of the transformer ring was increased 1/8". Part number of transformer ring remains unchanged.

*Union Carbide Corp. Registered Trademark

TIME BASE TROUBLE-SHOOTING TIME DECREASED BY TIGHTENING TOLERANCES IN MULTI CIRCUIT — INFORMATION ONLY — M608

Effective Prod SN 490

DESCRIPTION:

Decrease trouble-shooting time of Time Base circuit by making it possible to adjust the Multi Stability to either of two states. Control the feedback divider closer in tolerance and increase adjustment range of pot by changing it to a larger value.

Parts Removed:			Parts Added:		
R251	150 k 1/2 W 10%	302-0154-00	R251	150 k 1/2 W 1%	309-0049-00
R253	100 k 1/2 W 10%	302-0104-00	R253	95 k 1/2 W 1%	309-0044-00
R254	50 k pot	311-0023-00	R254	100 k pot	311-0026-00

POWER SUPPLY FUSE CHANGED TO 3AG WHICH IS MORE READILY AVAILABLE — INFORMATION ONLY — M599

Effective Prod SN 542

DESCRIPTION:

4AG fuses not readily available at electrical supply houses. Change fuses and fuse holder to 3AG type.

Parts Removed:		Parts Added:	
Holder, fuse 4AG	352-0001-00	Holder, fuse 3AG	352-0002-00
Fuse, 4AG 5A (117 V)	159-0010-00	Fuse, 3AG 5A (117 V)	159-0006-00
Fuse, 4AG 2A (234 V)	no number	Fuse, 3AG 2A (234 V)	159-0023-00

LOWER FRAME BARS INCREASED IN THICKNESS TO PREVENT BENDING OF THE FRONT PANEL TOP FLANGE — INFORMATION ONLY — M580

Effective Prod SN 563

DESCRIPTION:

To support the front end of the instrument solidly in the cabinet and prevent bending of the front panel top flange, the thickness of the members was increased.

Part numbers of bars remain unchanged.

DELAY LINE COIL LEAD SHORTS PREVENTED BY ADDING A CERAMIC POST TO DELAY LINE CHASSIS | INFORMATION ONLY | M649

Effective Prod SN not given

DESCRIPTION:

Shorting of the delay line coil leads is prevented by adding a ceramic post to the inside of the Delay Line chassis to support the input lead from V4.

Parts Removed:		Parts Added:	
Grommet 1/4"	348-0002-00	Post, ceramic	129-0009-00
		Nut, 2-56 x 3/16 (2)	210-0405-00
		Lockwasher ext #2	210-0002-00

VERTICAL AMPLIFIER PARASITIC OSCILLATIONS PREVENTED BY THE ADDITION OF A 47Ω RESISTOR | See SQB | M650

Effective Prod SN 582 | Usable in field instruments SN 101-581

DESCRIPTION:

To prevent occasional parasitic oscillation in V3 and V4, replace the ground wire at pin 2 or 9 (grid) of V4 with a 47Ω 1/2W resistor (R39).

Parts Removed:	Parts Added:		
	R39	47Ω 1/2W 10%	302-0471-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace the ground wire at pins 2 or 9 of V4 with a 47Ω 1/2W resistor (R39).

DELAY LINE TUNING RANGE IMPROVED BY DECREASING THE VALUE OF C502A AND C502B	INFORMATION ONLY	M652

Effective Prod SN 591

DESCRIPTION:

To improve the tuning range of the delay line trimmers. Change C502A and C502B from 5-25pF to 3-12pF.

Parts Removed:			Parts Added:		
C502A	5-25pF	281-0010-00	C502A	3-12pF	281-0009-00
C502B	5-25pF	281-0010-00	C502B	3-12pF	281-0009-00

FAN MOTOR SHOCKMOUNTS CHANGED TO IMPROVE SHOCK CHARACTERISTICS	INFORMATION ONLY	M635

Effective Prod SN 606

DESCRIPTION:

To improve fan motor shock characteristics, change from round type shockmounts to square type.

Parts Removed:		Parts Added:	
Shockmount, round (4)	348-0008-00	Shockmount, square (4)	348-0009-00

FUSE HOLDER CAPS MARKED WITH CURRENT RATING	INFORMATION ONLY	M651

Effective Prod SN not given

DESCRIPTION:

To indicate the proper size fuse to be used in the instrument, the current rating of the fuse is silkscreened on the fuseholder cap.

VERTICAL AMPLIFIER NOMENCLATURE CHANGED TO BE CONSISTENT WITH THE INSTRUCTION MANUAL	INFORMATION ONLY	M669

Effective Prod SN not given

DESCRIPTION:

To provide consistent nomenclature between the instrument and Instruction Manual, change the information for R55 from 'Vert Atten Adj' to 'Vert Amp DC BALANCE'.

HV TRANSFORMER REMOVAL FACILITATED BY USE OF CAPTIVE TYPE NUTS — INFORMATION ONLY — M679

Effective Prod SN 615

DESCRIPTION:

To facilitate the removal and replacement of the High Voltage transformer without removing the High Voltage chassis, change mounting hardware to use 6-32 pem (or captive) nuts.

Parts Removed:		Parts Added:	
Screw, 4-40x3/16 BHB (2)	no number	Screw, 6-32x3/16 BHB (2)	no number
Nut, 4-40x3/16 (2)	210-0406-00	Nut, 6-32 captive (2)	210-0435-00
Lockwasher, int #4 (2)	210-0004-00		

BULKHEAD AND BACK PLATE STRENGTH IMPROVED WITH USE OF STEEL SCREWS — INFORMATION ONLY — M689

Effective Prod SN 625

DESCRIPTION:

Improve strength of mechanical assembly, by mounting back plate to frame bars and bulkhead chassis to back plate with steel screws.

Parts Removed:		Parts Added:	
Screw, 8-32 x 3/8 BHB(4)	no number	Screw, 8-32 x 3/8 BHS	212-0023-00
Screw, 6-32 x 5/16 BHB(2)	no number	Screw, 8-32 x 5/16 BHS	212-0004-00

TIME BASE GEN TIMING ACCURACY AND RELIABILITY IMPROVED BY USE OF MYLAR CAPACITORS IN TIMING CIRCUIT — See SQB — M674

Effective Prod SN 722

Usable in field instruments SN 101-721

DESCRIPTION:

To improve the sweep timing accuracy and reliability, C280A, B and C are replaced with a single unit Mylar* type containing the three capacitors. C280D is also replaced with the Mylar type.

Parts Removed:			Parts Added:		
C280A	1 μF selected	no number	C280A	1 μF)	
C280B	0.1 μF selected	no number	C280B	0.1 μF)	291-0001-00
C280C	0.01 μF selected	no number	C280C	0.01 μF)	
C280D	0.001 μF selected	no number	C280D	0.001 μF	291-0008-00

* Du Pont Registered Trademark

continued

Parts Required for Field Installation:

Parts Replacement Kit 050-0002-00

INSTALLATION INSTRUCTIONS:

Refer to kit instructions for installation procedure.

HIGH VOLTAGE SUPPLY REGULATION MAINTAINED AT HIGH INTENSITY SETTINGS BY CHANGING GRID BIAS SUPPLY DIODE RESISTORS — See SQB — M713

Effective Prod SN 753 — Usable in field instruments SN 101-752

DESCRIPTION:

Reduce the possibility of the High Voltage supply going out of regulation when the INTENSITY control is increased to its maximum. Change the diode resistors on the grid bias supply.

Parts Removed:			Parts Added:		
R912	5.6 M 2 W	306-0565-00	R912	6.8 M 2W	306-0685-00
R913	5.6 M 2 W	306-0565-00	R913	6.8 M 2 W	306-0685-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R912 and R913, 5.6 M 2 W resistors (on the Focus and Intensity board at the rear of the CRT), with 6.8 M 2 W resistors.

VERTICAL PREAMPLIFIER HUM REDUCED BY MOVING C9 GROUND POINT TO FRONT PANEL GROUND POST — See SQB — M762-1

Effective Prod SN 764 — Usable in field instruments SN 101-763

DESCRIPTION:

To reduce hum in the Vertical Preamplifier, return the AC ground for V2A grid to the front panel. Ground the 6.25 μF capacitor C9 to the front panel ground post. If your is below SN 346 and has no ground post, install M525.

Parts Removed:	Parts Added:			
	*	R26	47Ω 1/2 W 10%	302-0470-00
		Post, ceramic 1/2"		129-0009-00

continued

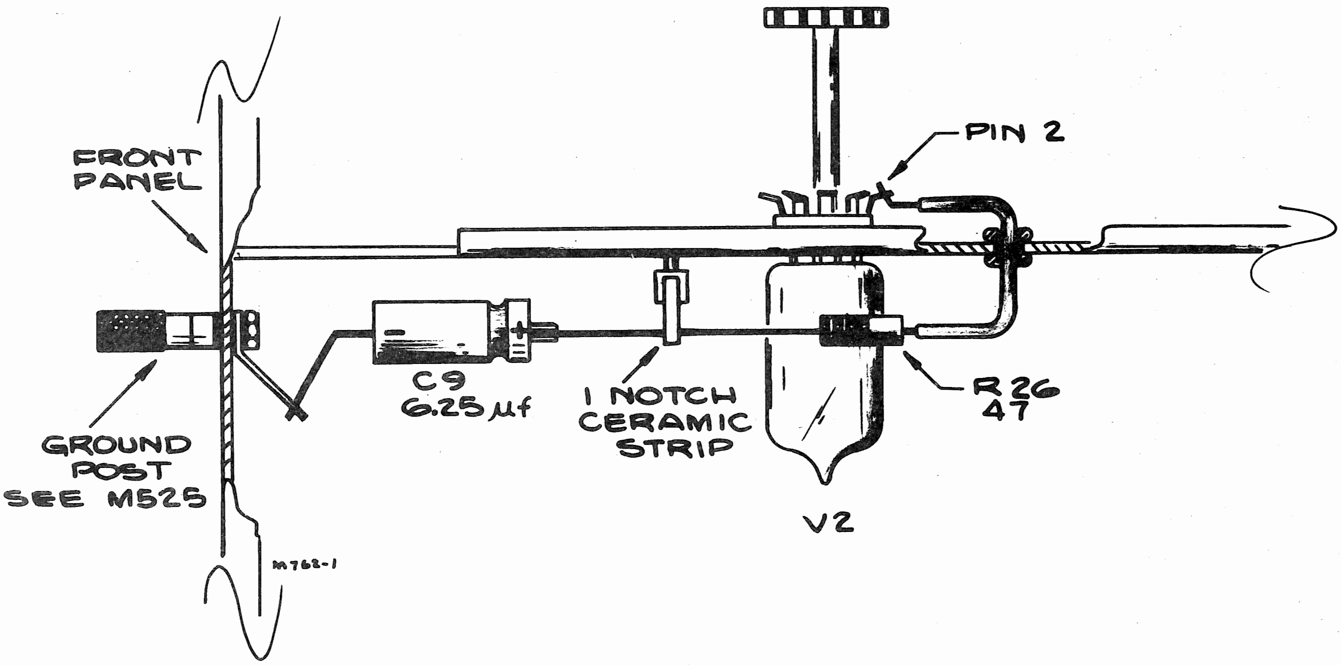
Parts Required for Field Installation:

See 'Parts Added' with asterisks and parts listed below.

Strip, ceramic 1-notch	124-0100-00
Spacer, ceramic strip	361-0007-00
Lug, solder SE10	210-0206-00

INSTALLATION INSTRUCTIONS:

Refer to drawing and rewire C9, (6.25μF) and add R26 (47 Ω).



TIME BASE TRIGGER AMPLITUDE DISCRIMINATOR OSCILLATIONS SUPPRESSED BY ADDITION OF 47 Ω RESISTOR R207

M762-2

See SQB

Effective Prod SN 764

Usable in field instruments SN 101-763

DESCRIPTION:

Suppress parasitic oscillations in the Trigger Amplitude Discriminator circuit by adding a 47 Ω (R207) in V201A grid lead at pin 2.

Parts Removed:

Parts Added:

R207	47 Ω 1/2 W 10%	302-0470-00

Parts Required for Field Installation:

See 'Parts Added'.

continued

INSTALLATION INSTRUCTIONS:

Replace the wire between pin 2 of V201A and the TRIGGER AMPLITUDE DISCRIMINATOR control with a 47Ω 1/2W resistor (R207).

TIME BASE MULTIPLIER SWITCH RESISTOR R282G CHANGED TO 1 WATT TO REDUCE COST AND IMPROVE APPEARANCE — INFORMATION ONLY — M699

Effective Prod SN 790

DESCRIPTION:

To reduce cost and improve appearance of the TIME BASE MULTIPLIER switch, change R282G from 2 Watt to 1 Watt.

Parts Removed:			Parts Added:		
R282G	18.6M 2W 1%	no number	R282G	18.6M 1W 1%	310-0109-00

FRONT PANEL TITLE AND SERIAL NUMBER MODIFIED FOR CONVENIENCE — INFORMATION ONLY — M700

Effective Prod SN not given

DESCRIPTION:

To place the instrument serial number in a more convenient location, the serial number is moved from the bottom of the front panel to just beneath the instrument type. Also, the instrument title is laid out so that 'special' numbers may be added when necessary.

GRATICULE COVER CHANGED TO CASTING IN ORDER TO SUPPORT A CAMERA — INFORMATION ONLY — M725

Effective Prod SN not given

DESCRIPTION:

To provide a graticule cover on which a viewing hood and camera may be mounted, change the cover from stamped aluminum to cast aluminum.

Parts Removed:		Parts Added:	
Cover,graticule 0.040 alum	no number	Cover,graticule cast	200-0035-00

POTENTIOMETER EXTENSION SHAFT CONNECTIONS IMPROVED BY USE OF CONNECTOR CLIPS	INFORMATION ONLY	M753

Effective Prod SN not given

DESCRIPTION:

To improve shaft connections to the pots which are mounted on the back of switches, modify the extension shafts and the pot shafts and add a pot connector clip.

Parts Removed:		Parts Added:	
Shaft, SE4-308	384-0015-00	Shaft, SE4-230H	384-0022-00
Shaft, SE4-320	384-0005-00	Shaft, SE4-308H	384-0021-00
Shaft, SE4-604	384-0006-00	Shaft, SE4-529H	384-0023-00
Spacer, switch (4) OAK	#8980		

TIME BASE GEN TUBE RELIABILITY IMPROVED BY ELEVATING FILAMENTS	See SQB	M768

Effective Prod SN 806 — Usable in field instruments SN 101-805

DESCRIPTION:

Reduce failure in the following tubes by elevating their filaments to +160 V: V202, V210, V223, V224, V422, and V442.

Parts Removed:

Parts Added:

R292	1 M 1/2 W 10%	302-0105-00
R293	2.7 M 1/2 W 10%	302-0275-00

Parts Required for Field Installation:

See 'Parts Added' and part listed below.

Wire, #22 solid 4-3/4" 175-0522-00
(white-red-red-green)

INSTALLATION INSTRUCTIONS:

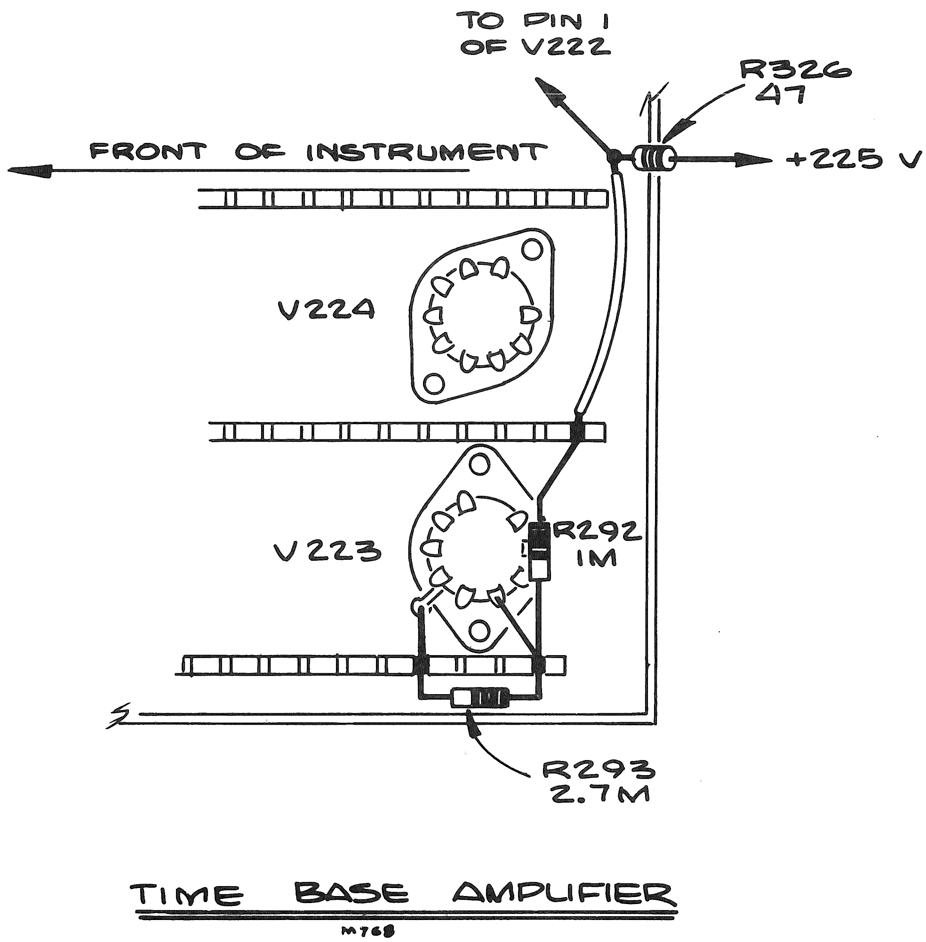
a) Remove strap between V442, pins 3 and 8.

b) Remove strap between V442, pin 8 and 270 k 1/2 W resistor - white-red-red-black wire junction.

c) Add strap between V442 pin 3 and 270 k 1/2 W resistor - white-red-red-black junction.

d) Add R292, 1 M and R293, 2.7 M as shown in drawing on next page.

continued



CERAMIC POST AND TURRET STUD REPLACED WITH SPRING PIN FOR ECONOMY | INFORMATION ONLY | M787

Effective Prod SN not given

DESCRIPTION:

To save labor costs, the solid ceramic post and ceramic turret stud is replaced with a spring pin stud.

Parts Removed:		Parts Added:	
Stud, 6-32 x 1/2 (4)	355-0001-00	Pin, spring, Sel-lok (4)	166-0058-00

POWER CORD ATTACHMENT SIMPLIFIED AND IMPROVED BY USE OF STRAIN RELIEF BUSHING	INFORMATION ONLY	M797

Effective Prod SN 1081

DESCRIPTION:

To simplify and improve the power cord attachment, remove the power cord mounting assembly from the frame bracket and install a strain relief bushing.

Parts Removed:		Parts Added:	
Board, BB315-4	386-0279-00	Washer, 5/8 x 1	210-0837-00
Clamp, cable 5/16	343-0004-00	Bushing, strain relief	358-0025-00
Screw, 6-32 x 5/16 BHB	211-0507-00		
Screw, 6-32 x 1/2	211-0511-00		
Lockwasher, int #6 (2)	210-0006-00		
Washer, #6 L (2)	210-0803-00		
Nut, 6-32 x 1/4 (2)	210-0407-00		

POWER SUPPLY SUPPORT BRACKET HOLE ALIGNMENT IMPROVED BY USE OF SLOT HOLES	INFORMATION ONLY	M798

Effective Prod SN 1123

DESCRIPTION:

To improve hole alignment in the Power Supply support bracket, change mounting holes to slots and use a flat washer between the bracket and the lockwasher.

Parts Removed:		Parts Added:	
		Washer, #6L	210-0803-00

FRONT PANEL FUSE RATING REMOVED FROM RACKMOUNT PANEL TO ELIMINATE NEED FOR A SPECIAL 220V PANEL	INFORMATION ONLY	M816-1

Effective Prod SN not given

DESCRIPTION:

Eliminate the need for a special 220 V operation panel, by removing the "5A" fuse designation from the rackmount front panel.

FRONT SUBPANEL PILOT LIGHT HOLE ENLARGED TO ELIMINATE NEED FOR REAMING | INFORMATION ONLY | M816-2

Effective Prod SN not given

DESCRIPTION:

Eliminate the need to ream the pilot light holes when assembling instrument. Enlarge these holes to 3/4".

VERTICAL OUTPUT AMPLIFIER DC SHIFT COMP RANGE EXTENDED BY CHANGING RESISTOR VALUES | INFORMATION ONLY | M1155

Effective Prod SN 1692

DESCRIPTION:

To extend the range of the DC shift comp control necessitated by a change of 12BY7 vertical tube characteristics, change the value of R86 and R88 from 39k to 33k.

Parts Removed:			Parts Added:		
R86	39k 1/2W 10%	302-0393-00	R86	33k 1/2W 10%	302-0333-00
R88	39k 1/2W 10%	302-0393-00	R88	33k 1/2W 10%	302-0333-00

TIME BASE AMPLIFIER RESISTOR CHANGED FROM 10W TO 8W TO REDUCE COST | INFORMATION ONLY | M1142

Effective Prod SN 1810

DESCRIPTION:

Dissipation rating of 10 W not needed for R310 and R318 (20 k wire wounds). Change to 8 W to reduce cost.

Parts Removed:			Parts Added:		
R310	20k 10W	308-0025-00	R310	20k 8W	308-0011-00
R318	20k 10W	308-0025-00	R318	20k 8W	308-0011-00

TIME BASE GENERATOR TIMING ACCURACY IMPROVED BY CHANGING 0.001 μF CAPACITOR TO MYLAR	INFORMATION ONLY	M1255

Effective Prod SN 1937

DESCRIPTION:

To further improve accuracy and reliability of the sweep timing, change C280D (0.001 μF) to Mylar * type. See M674.

Parts Removed:			Parts Added:		
C280D	0.001 μF select	295-0040-00	C280D	0.001 μF nylon	291-0008-00

* Du Pont Registered Trademark

FRONT PANEL KNOBS CHANGED TO IMPROVE APPEARANCE AND QUALITY AND REDUCE COST	INFORMATION ONLY	M1242

Effective Prod SN 1996

DESCRIPTION:

To improve quality and appearance of the knobs used on front panel controls, Type 310 style knobs are used. The new knobs can be produced faster and more economically.

Parts Removed:		Parts Added:	
Knob, (2)	366-0011-00	Knob, (2)	366-0028-00
Knob, (1)	366-0012-00	Knob, (4)	366-0029-00
Knob, (4)	366-0013-00	Knob, (4)	366-0031-00
Knob, (5)	366-0014-00	Knob, (5)	366-0033-00
Knob, (4)	366-0015-00	Knob, (1)	366-0037-00

VERTICAL AMPLIFIER MULTIPLIER SWITCH CHANGED TO ALLOW USE OF LENGTHENED SHAFT OF 10-1 POT	INFORMATION ONLY	M1263-1

Effective Prod SN 2138
w/exceptions 2057, 2062, 2063, 2065, 2068 and 2069

DESCRIPTION:

The switch mounted pot shafts were lengthened and standardized at 3/8". The following changes were made to the VERTICAL AMPLIFIER MULTIPLIER switch SW2 to accommodate the longer shaft pots:

1. The rear spacers were changed from 21/32" to 3/4".
2. Strut screws were changed from 1-1/8" to 1-1/4" long.

continued

Parts Removed:			Parts Added:		
R54	2250Ω pot 1/4"	311-0009-00	R54		311-0071-00
SW2	Vert Mult	260-0031-00	SW2	Vert Mult	260-0141-00

TIME BASE TRIGGER SELECTOR SWITCH CHANGED TO ALLOW USE OF LENGTHENED SHAFT OF THE STABILITY POTENTIOMETER

See SQB

M1263-2

Effective Prod SN 2192

Usable in field instruments SN 101-2191

DESCRIPTION:

The switch mounted pot shafts were lengthened and standardized at 3/8". The following change were made to the TRIGGER SELECTOR switch to accommodate the longer shaft pots: 1) The outer shaft was shortened from 1/4" to 3/32" beyond the rear wafer; 2) 1/8" inner shaft changed from 3-1/16" to 2-31/32". (Measurements taken from edge of hole to front end of shaft).

NOTE: Parts Replacement Kit 050-0149-00 is available to facilitate installation of 260-0140-00 pre-modified instrument.

Parts Removed:			Parts Added:		
R231	100 k pot 1/4"	311-0024-00	R231	100k pot 3/8"	311-0026-00
SW201	SELECTOR	260-0089-00	SW201	SELECTOR	260-0140-00
Shaft	1/8"x3-1/16"	384-0027-00	Shaft	1/8" x 2-31/32"	384-0077-00

TIME BASE MULTIPLIER SWITCH CHANGED TO ALLOW USE OF LENGTHENED SHAFT OF THE 10-1 POTENTIOMETER

INFORMATION ONLY

M1263-3

Effective Prod SN 2212

DESCRIPTION:

The switch mounted pot shafts were lengthened and standardized at 3/8". The following changes were made to the TIME BASE MULTIPLIER switch SW202 to accommodate the longer shaft pots: 1) The outer shaft was shortened from 7/32" to 3/32" beyond the rear wafer; 2) The rear spacer was changed from 21/32" to 3/4"; 3) The 1/8" inner shaft was changed from 3-5/16" to 3-7/32". (Measurements taken from front edge of hole to front end of shaft).

Parts Removed:			Parts Added:		
R283	500 k pot 1/8"	311-0036-00	R283	500 k pot 3/8"	311-0072-00
SW202	T.B. MULT	260-0087-00	SW202	T.B. MULT	260-0139-00
Shaft,	1/8" x 3-5/16"	384-0076-00	Shaft,	1/8" x 3-7/32	384-0115-00

+100 V AND +350 V SUPPLY ACCURACY INSURED BY CHANGING DIVIDER RESISTORS — See SQB — M1391

Effective Prod SN 2381 — Usable in field instruments SN 101-2380

DESCRIPTION:

Improve the accuracy of the + 100 V and 350 V supplies by changing R424 from 143 k to 150 k and R467 from 780 k to 800 k. Also, see M1476 for further change in +100 V supply.

Parts Removed:			Parts Added:		
R424	143 k 1/2 W 1%	309-0092-00	R424	150 k 1/2 W 1%	309-0049-00
R467	780 k 1/2 W 1%	309-0011-00	* R467	800 k 1/2 W 1%	309-0110-00

Parts Required for Field Installation:

See 'Parts Added' with asterisks and parts listed below.

R424	220 k 1/2 W 1%	309-0052-00
R425	150 k 1/2 W 1%	309-0049-00

INSTALLATION INSTRUCTIONS:

Change R424 (located over V422 socket) from 143 k to 220 k; R425, (located over V422 socket) from 100 k to 150 k; and R467, (located over V442 socket) from 780 k to 800 k.

POWER SUPPLY THERMAL CUT OUT SWITCH CHANGED TO HIGHER VALUE TO PERMIT OPERATION AT HIGHER AMBIENT TEMPERATURES — INFORMATION ONLY — M1278

Effective Prod SN 2486
w/exception 2473-6 and 2479

DESCRIPTION:

To allow operation of the instrument in an ambient temperature of 110° F, the Thermal Cut out TK401 was changed from 155° ±5° F to 160° ±5° F.

Parts Removed:			Parts Added:		
TK401	155° ±5° F	260-0071-00	TK401	160° ±5° F	260-0157-00

SCALE ILLUMINATION CIRCUIT CHANGED TO ALLOW COMPLETE EXTINCTION OF LIGHT — See SQB — M1439

Effective Prod SN 2487 — Usable in field instruments SN 101-2486

DESCRIPTION:

The Scale Illumination circuit was rewired to allow complete extinction of the bulbs. This is improtant for some photographic applications.

See Before and After schematics.

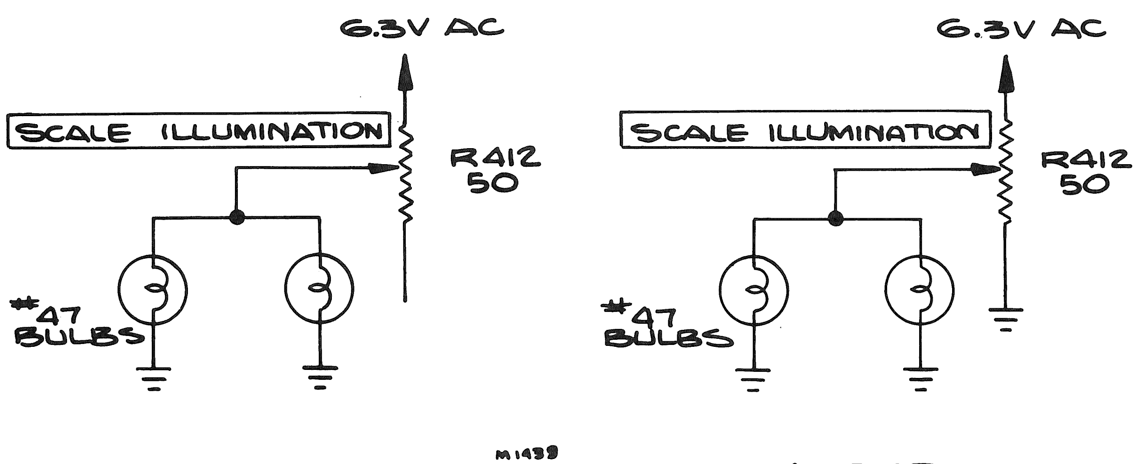
Parts Removed:	Parts Added:	
	Lockwasher, int 3/8"	210-0012-00
	Lug, solder 3/8"	210-0207-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Install a 3/8" solder lug and internal lockwasher between the sub-panel and the Scale Illumination potentiometer. Solder the lug to the vacant terminal.



BEFORE — AFTER

+100 V SUPPLY VOLTAGE BROUGHT WITHIN SPECIFICATION BY CHANGING DIVIDER RESISTOR VALUES — See SQB — M1476

Effective Prod SN 2559 — Usable in field instruments SN 2381-2558

DESCRIPTION:

The output voltage of the +100 V supply had been consistently running 2 to 4 Volts low. By changing the values of the voltage divider resistor, R424 and R425, the output of the supply was brought within specifications.

For instruments SN 101-2380, See M1391.

Parts Removed:			Parts Added:		
R424	150 k 1/2 W 1%	309-0049-00	R424	220 k 1/2W 1%	309-0052-00
R425	100 k 1/2 W 1%	309-0045-00	R425	150 k 1/2 W 1%	309-0049-00

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Change the value of R424 from 150 k to 220 k and the value of R425 from 100 k to 150 k. These resistors are located near V422 socket.

TIME BASE RANGE SWITCH WIRING CHANGED TO PREVENT WAVEFORM SHRINKAGE — See SQB — M1502

Effective Prod SN 2660 — Usable in field instruments SN 101-2659
w/exceptions 2573, 2577, 2579, 2582 -3 and 2592

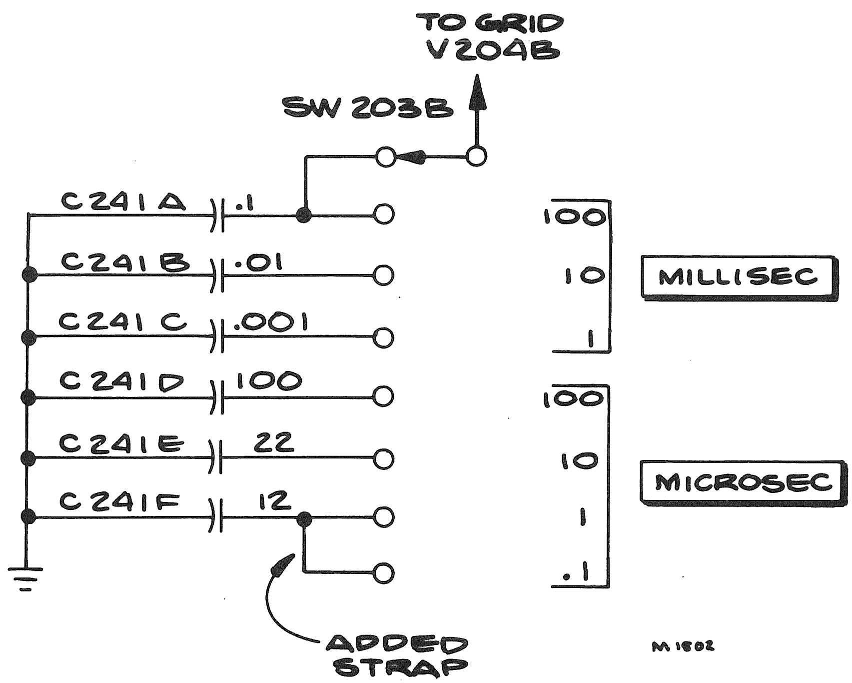
DESCRIPTION:

To overcome shrinkage in the sweep waveform at the fastest sweep range with a free running-untriggered-sweep. The problem was due to inadequate hold off time in the 0.1 MICROSEC position, and was cured by adding a strap between the 1 and 0.1 MICROSEC positions of SW203B.

INSTALLATION INSTRUCTIONS:

Add a wire strap between the 1 and 0.1 MICROSEC positions of the Time Base Range switch SW203B. See schematic on following page.

continued



DELAY LINE CAPACITOR VALUE CHANGED TO INSURE OPTIMUM SETTING

INFORMATION ONLY

M1507

Effective Prod SN 2608

DESCRIPTION:

To allow optimum setting of C501 Delay Line capacitor, its value was changed from 1.5-7 pF to 3-12 pF.

Parts Removed:			Parts Added:		
C501	1.5-7 pF	281-0006-00	C501	3-12 pF	281-0009-00

GRATICULE STUDS CHANGED TO FACILITATE REPLACEMENT | INFORMATION ONLY | M1570

Effective Prod SN not given

DESCRIPTION:

To facilitate the replacement of damaged or corroded graticule studs, without removing the instrument front and subpanel, a new graticule stud was designed which can be mounted with a 10-32 x 3/8" screw instead of having to be crimped on.

Parts Removed:		Parts Added:	
Stud, graticule (4)	no number	Stud, graticule 10-32 thread (4)	355-0043-00
		Screw, 10-32 x 3/8"	212-0507-00

DF:CH:fb

FIELD MODIFICATION KIT

TEKTRONIX, INC.

FIELD MODIFICATION 315 - 540

K315AE INSTALLATION INSTRUCTIONS

DISCONTINUED
SEE NUMERICAL PARTS RECORD (NPR) FOR DISPOSITION

1. Replace the two 10 watt, 2.5K ohm plate load resistors (R80 and R84) with the two 10 watt, 2.7K ohm resistors furnished with the kit.

2. Drill a hole for a 6-32 machine screw (#27 drill) through the Vertical amplifier chassis at a point (between tube socket V13 and the inboard lip of the VA Chassis) midway between the screws supporting L6 and L7. Be especially careful when drilling not to drill through into a cable of wires passing under this point.

3. Put a 5/16" X 6-32 binder head machine screw through the hole (drilled in step #2) with its threads projecting toward the top of the scope; place over the threads a 6-32 outside-star lockwasher and screw on the bakelite stand-off post tightly.

4. Place on top of the stand-off post the other outside-star lockwasher.

5. Put a 5/16" X 6-32 binder head screw through the hole (in the D.C. Shift Comp. bracket assembly) which is located halfway between the two $\frac{1}{2}$" holes in the bracket. The head of this screw should be on the side of the bracket which has printing on it. Then, with the bracket assembly extending over the CRT socket but under the $\frac{1}{2}$" X $\frac{1}{2}$" aluminum scope frame rod, start the screw into the end of the stand-off post.

6. This step involves drilling and countersinking two holes through the $\frac{1}{2}$" X $\frac{1}{2}$" aluminum scope frame rod to support the other end of the bracket assembly. These holes should be made with a #27 drill for the two 5/8" X 6-32 Flat-head screws furnished and should be spaced 1 3/8" apart between centers to match the holes already drilled in the outboard edge of the bracket. The holes should be drilled in a place where, when the bracket is mounted, it will be square with the scope frame. After drilling the holes countersink the tops of the holes with an 82° countersink to a depth sufficient to allow the tops of the flat head screws to be flush with the surface of the rod.

7. Fasten the bracket to the scope frame rod using the flat head screws, lockwashers and nuts.

8. Solder the brown-black wire from the bracket assembly to pin 9 of V13.

9. Solder on 33K, $\frac{1}{2}$ watt resistor (R86 or R88) to the top terminal of L6 and solder the other 33K resistor to the top terminal of L7.

10. With the scope thoroughly warmed up apply the Cal voltage to the input terminal. Set sensitivity to .1 volt per division DC and set Cal voltage at 1 volt. Adjust the vertical positioning until the bottom edges of the signal displayed follow the centerline. Then, switching the Cal alternately between off and 1 volt, adjust the D.C. Shift Comp. Control (R87) until the undeflected sweep (occurring when the Cal if off) coincides with the position of the bottom extremes of the signal displayed.

DISCONTINUED

SEE NUMERICAL PARTS RECORD (NPR) FOR DISPOSITION

FIELD MODIFICATION KIT

INSTRUCTIONS FOR INSTALLING PTM MODIFICATION

Type 315D Oscilloscope

1. Kit list consists of:
   1 - 47 ohm, 1/2W, Comp., 10%, Resistor
   1 - 4.7 K ohm, 1/2W, Comp., 10%, Resistor
   1 - 0.001 Mfd., PTM, 600V, 20%, Capacitor
   1 - Single pole - Single throw switch
   1 - Aluminum tab panel marked PTM - Normal
   1 - 12" Orange, green, brown wire, #20
   1 - 12" Red, white wire, #20

2. Drill a ½ inch hole through the panel and subpanel, located 3-1/32 inches from the left side of the scope and 1½ inch from the bottom.

3. Install the SPST Switch, with the contacts toward the bottom of the Scope. Place the aluminum tab next to the panel, over the switch, screw on nut and tighten.

4. Solder the 4.7K Resistor across the Switch contacts. Remove the 47 ohm Resistor (R222), located between the ceramic terminal strips in terminals 7, from the front. Remove jumper between outside terminal 7 and trigger selector switch contact.

5. Solder the 47 ohm Resistor, supplied in Kit, between the inside terminal 7 and the Switch contact.

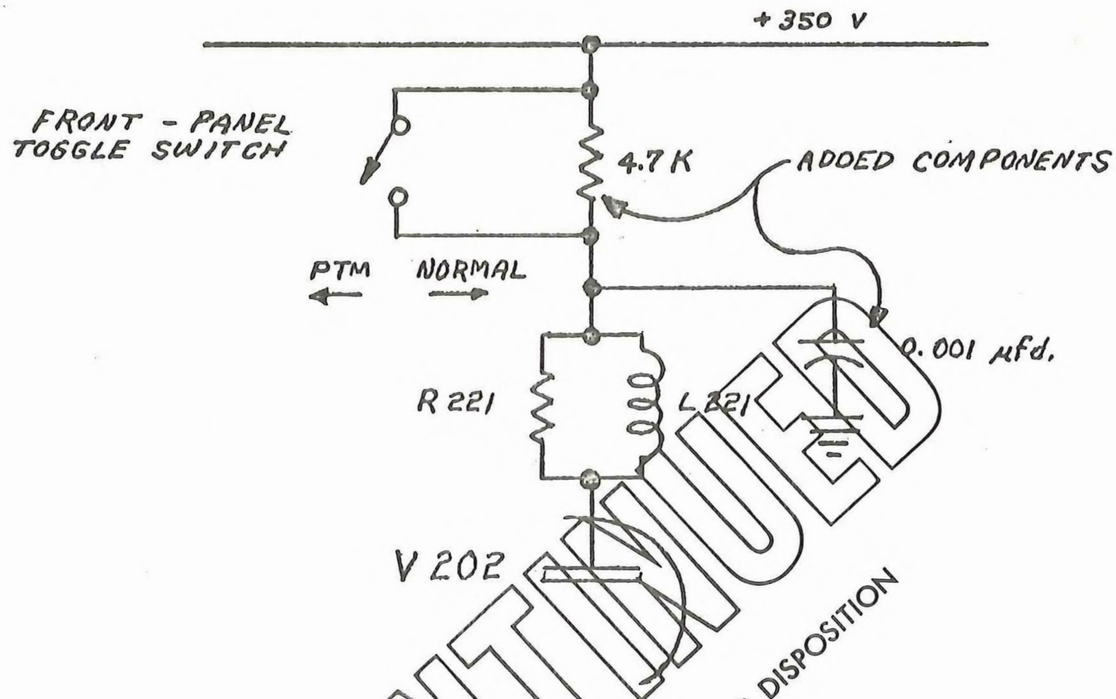
6. Move from terminal 8 to terminal 7: (1) jumper going to pin 3 of V202, (2) orange, green, brown lead, (3) 0.01 Mfd., 600V, Capacitor.

7. Solder an orange, green, brown lead from one side of installed SPST switch to +350 Volt contact located on outside of trigger selector switch.

8. Solder a red, white lead from the other side of the installed SPST switch to the outside terminal 8 - one side of R221, L221.

9. Solder the 0.001 Mfd., 600V, Capacitor from the outside terminal 8 to any ground lug.

10. If desired, correct the schematic.


+350 V
FRONT - PANEL
TOGGLE SWITCH
4.7 K
ADDED COMPONENTS
PTM
NORMAL
0.001 μfd.
R 221
L 221
V 202

FIELD MODIFICATION KIT

DISCONTINUED

SEE NUMERICAL PARTS RECORD (NPR) FOR DISPOSITION

INSTRUCTION SHEET

Subject: Converting Type 315D's from 50-800 cps AC Power to 50-60 cps

Kit: MS-15 Tek No. 040-009

This kit enables the owner of a 315D to take advantage of the higher efficiency and quieter operation that a shaded pole induction motor provides over a 65 volt DC motor and its associated rectifier.

KIT LIST

		Tek Nos.
1 ea.	315 AC motor assembly consisting of:	
	1 ea. MTR34 Motor	147-001
	1 ea. #9721-1, 4-pin plug	134-009
	1 ea. BR315-6 Plate mounting	386-307
	1 ea. BR315-13 Motor spacer	406-100
	1 ea. 8-32 x 2-1/4" RHS screw	212-014
	2 ea. 6-32 x 3/8" spade bolt	214-012
	1 ea. 8-32 x 5/16" nuts	210-409
	1 ea. #8 Int. lockwasher	210-008
	4 ea. 6-32 x 1/4" nuts	210-407
1 ea.	55-5C Fan blade	369-001
20 ins.	4-111 #18 wire color-coded yellow-brown-white	
4 ea.	#8 Int. lockwasher	210-008
4 ea.	8-32 x 5/16" nuts	210-409

The following detailed information outlines the method of using a MS15 Kit to replace the DC motor and its rectifier with a 50-60 cps shaded-pole induction motor.

SERIAL NUMBER QUALIFICATIONS

1. Instruments with Serial Numbers below 135, except 129, 132 and 133, do not require conversion unless they have been returned to the factory for a DC fan motor conversion.

   Serial Numbers from 129 through 149 (except 130, 131 and 134).

   1. Remove the fan blade by loosening the set screw.

   2. Remove the four nuts from the machine screws fastening the motor bracket.

   3. Clip the two leads feeding the DC motor from terminals 14 and 17 on the power transformer.

   4. Remove the DC motor assembly from the oscilloscope.

   5. A. Clip the male socket from the AC motor leads.

      B. Solder two lengths of wire (10") to power connections of the AC motor, tape these connections.*

   6. Install AC motor assembly and run wires through grommet down to power transformer. Connect the leads to terminals 1 and 3 on the power transformer.

   *Note: If the instrument was modified previously to convert it from 50-60 cps operation to 50-800 cps operation, the old wires may yet be in place with taped ends. The need for new wires, Item 5, will depend on the length of the old wires.

   7. Replace the fan blade and tighten set-screw.

Serial Numbers from 150 through 187.

1. Same as 1 above.

2. Same as 2 above.

3. Disconnect the two wires (color-coded green) which are connected to selenium rectifier and tape the ends.

4. Same as 4 above.

5. Install AC motor assembly in scope.

6. Untape the ends of the two wires (color-coded green) which are taped to the green wires, and solder to the motor leads. Tape these joints.

7. Same as 7 above.

Serial Numbers 188 and higher.

1. Same as 1 above.

2. Same as 2 above.

3. Unplug the DC motor.

4. Same as 4 above.

5. Plug in the AC motor.

6. Mount the AC motor assembly in the scope.

7. Same as 7 above.

DISCONTINUED

SEE NUMERICAL PARTS RECORD (NPR) FOR DISPOSITION

FIELD MODIFICATION KIT

INSTRUCTION SHEET

Subject: Converting Type 315D's from 50-60 cps AC Power to 50-800 cps.

All Type 315D Oscilloscopes could be used on any AC power line frequency between 50 and 800 cps were it not for the limitations imposed by the ventilating fan motor.

For this reason, two different ventilating fan motors are used in Type 315D scopes -- one, a shaded-pole induction motor for 50-60 cps operation; the other, a 65 volt DC motor. Power for the DC motor is obtained from a special 37.5 volt (RMS) secondary winding on the transformer through a bridge-connected selenium rectifier. (Note that the DC voltage supplied to the motor is less than 65 volts -- this to reduce the speed of the fan with a corresponding reduction of noise and vibration.)

Due to the presence of brushes, the DC motor will probably require more maintenance and attention than the AC shaded-pole motor. However, it is a necessary compromise to enable the use of a Type 315D on all power line frequencies between 50 and 800 cps.

The following detailed information outlines the method of using a kit, MU-15, to replace the 50-60 cps induction motor with a DC fan motor suitable for use with all line frequencies between 50 and 800 cps.

An MU-15 kit consists of a DC motor and a bridge-connected selenium rectifier mounted on a support bracket plus the necessary mounting hardware. (See the attached schematic). Depending upon the serial number of the Type 315D, the steps involved are as follows:

SERIAL NUMBERS BELOW 135 (Except #129, 132, and 133):

1. Kit MU-15 cannot be used to convert any Type 315D with serial numbers below 135 except #129, 132, and 133.

2. Instruments with serial numbers below 135 can probably be converted at the factory and correspondence is invited if any customer wishes the conversion made.

SERIAL NUMBERS FROM 135 THROUGH 149 (INCLUDING #129, 132, and 133):

1. Remove the fan blade;
2. Remove the four nuts from the machine screws fastening the AC motor bracket;
3. Clip the old AC motor leads and permanently tape up each of them;
4. Remove the whole AC motor assembly;
5. On the DC motor assembly, unsolder and remove the two power input wires. (Do not disturb the wiring between the selenium rectifier and the DC motor).
6. Solder two new leads, each about 14" long, to the terminals of the selenium rectifier that were bared in 5. above;
7. Mount the DC motor assembly in the scope;
8. Run the two leads down to the 37.5 volts (RMS) winding of the transformer -- terminals 14 and 17;
9. Replace the fan blade and tighten setscrew.

SERIAL NUMBERS FROM 150 THROUGH 187:

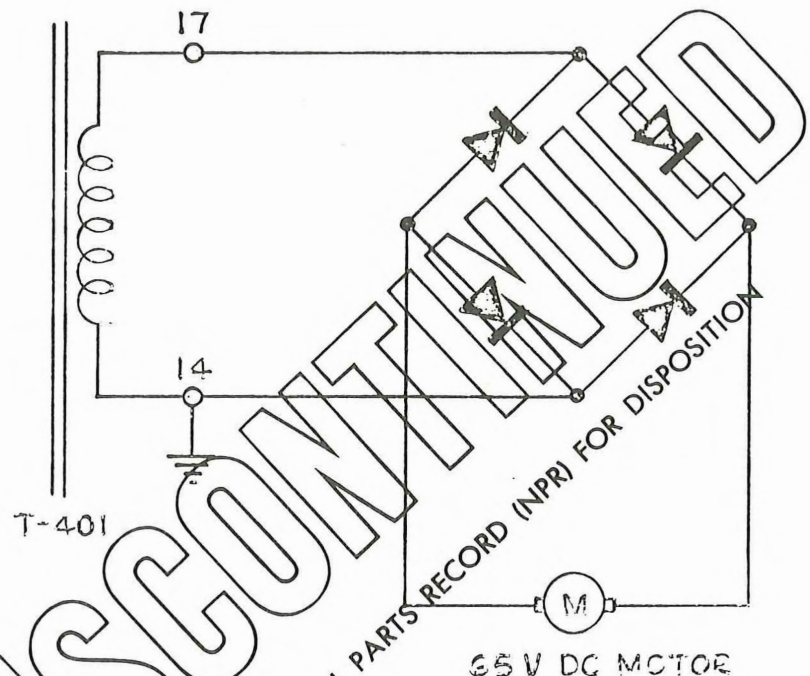
1. Remove the fan blade;
2. Remove the four nuts from the machine screws fastening the AC motor bracket;
3. Clip the old AC motor leads (color coded gray) and permanently tape up each of them;
4. Remove the whole AC motor assembly;
5. On the DC motor assembly, unsolder and remove the two power input wires. (Do not disturb the wiring between the selenium rectifier and the DC motor).
6. In the scope, untape the two wires (color coded green) which were taped to the gray AC wires;
7. Mount the DC motor assembly in the scope;
8. Solder the two wires (color coded green) to the selenium rectifier terminals that were bared in 5. above;
9. Replace the fan blade and tighten setscrew.

SERIAL NUMBERS 188 AND HIGHER:

1. Remove the fan blade;
2. Remove the four nuts from the machine screws fastening the AC motor bracket;
3. Unplug the old motor;
4. Remove the whole motor assembly;
5. Plug in the new DC motor;
6. Mount the DC motor assembly in the scope;
7. Replace the fan blade and tighten setscrew.

Kit, MU-15, is available from the factory at a price of $22.50, with transportation charges prepaid to destination by surface carrier.

Schematic of DC fan motor and selenium rectifier assembly used in TEKTRONIX Type 315D Oscilloscopes:



MODIFICATION KIT

SILICON RECTIFIER

For Tektronix Type 315D Oscilloscopes
All serial numbers

DESCRIPTION

This modification replaces the following selenium rectifiers used in the Tektronix Type 315D Oscilloscope with silicon rectifiers, offering more reliability and longer life:

SR401A, B	P/N 106-0003-00
SR420	P/N 106-0004-00
SR440	P/N 106-0017-00
SR460	P/N 106-0005-00

040-0220-00

Publication:
Instructions for 040-0220-00
September 1967

Supersedes:
May 1966

PARAMETERS

PARTS LIST

Quantity	Part Number	Description			
(1 ea)		Assembly, silicon rectifier, consisting of:			
4 ea	124-0091-00	Strip, cer, 3/4 x 11 notches, clip-mounted			
12 ea	152-0066-00	Diode, silicon,	500-750 mA	400 PIV	
## 4 ea	152-0040-00	Diode, silicon,	500 mA	600 PIV	
1 ea	210-0204-00	Lug, solder, DE6			
1 ea	210-0407-00	Nut, hex, 6-32 x 1/4			
3 ea	210-0478-00	Nut, resistor mounting			
3 ea	210-0601-00	Eyelet, resistor mounting			
1 ea	211-0504-00	Screw, 6-32 x 1/4 PHS, Phillips			
3 ea	211-0507-00	Screw, 6-32 x 5/16 PHS, Phillips			
3 ea	211-0553-00	Screw, 6-32 x 1-1/2 RHS, Phillips			
1 ea	308-0012-00	Resistor, WW,	40 Ω	10W	
1 ea	308-0151-00	Resistor, WW,	25 Ω	10W	
1 ea	308-0153-00	Resistor, WW,	100 Ω	10W	
8 ea	361-0007-00	Spacer, nylon molded, 0.063			
1 ea	387-0018-00	Plate, silicon rectifier subpanel			
1 ea	(162-0504-00)	Tubing, plastic, #20	7/8 in.	black	
1 ea	(175-0514-00)	Wire, #22 solid,	5-1/2 in.	black-brown-green-brown	
1 ea	(175-0514-00)	Wire, #22 solid,	6 in.	black-brown-green-brown	
1 ea	(175-0522-00)	Wire, #22 solid,	3-1/2 in.	white-black	
1 ea	(175-0522-00)	Wire, #22 solid,	3-1/2 in.	white	
1 ea	166-0030-00	Spacer, aluminum, 0.180 x 1/4 x 3/16			
1 ea	166-0033-00	Spacer, aluminum, 0.180 x 1/4 x 3/8			
1 ea	210-0457-00	Nut, Keps, 6-32 x 5/16			
2 ea	210-0803-00	Washer, flat, 6L x 3/8			
1 ea	211-0511-00	Screw, 6-32 x 1/2 PHS, Phillips			
1 ea	211-0516-00	Screw, 6-32 x 7/8 PHS, Phillips			
1 ea	214-0210-00	Spool, w/3 ft. silver-bearing solder			
1 ea	308-0068-00	Resistor, WW,	2.4 k	20W	
1 ea	308-0190-00	Resistor, WW	1.8 k	25W	
1 ea	343-0002-00	Clamp, cable, 3/16			

INSTRUCTIONS

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

( ) 1. Remove the selenium rectifier mounting plate from the instrument.

( ) 2. Unsolder all wires to the selenium rectifiers.

( ) 3. Temporarily mount the silicon rectifier assembly on the back panel of the instrument (as shown in Fig. 2) with the two 6-32 x 5/16 screws from the kit.

( ) 4. Carefully cut the lacing on the two sections of cable back to the point where they join together.

( ) 5. Dress the cable towards the bottom ceramic strip as in Fig. 2.

( ) 6. Place the following eight wires from the cable through the cable clamp from the kit:

(2) white-yellow	white-gray
white	white-violet
(2) white-orange	white-black

( ) 7. Dress the above wires upward and mount the cable clamp, as shown in Fig. 2, step 7. Use the hardware (from kit) shown in Fig. 1.

( ) 8. Dress the remaining six wires from the cable beneath the bottom ceramic strip.

( ) 9. Solder the wires to the ceramic strips, as shown in Fig. 2.

( ) 10. Locate R443 and R465 (top of instrument, at rear). Replace them with the resistors (from kit) indicated below. Use the old mounting hardware.

( ) R443 -- replace the 3.5k 20 w WW resistor with the 2.4k 20 w WW resistor.

( ) R465 -- replace the 1.5k 25 w WW resistor with the 1.8k 25 w WW resistor.

( ) 11. Check for wiring errors. Turn the instrument on and check for proper operation of the power supply.

NOTE: If adjustments are made to the power supply, it will be necessary to check the calibration of the rest of the instrument.

( ) 12. Remove the silicon rectifier assembly from its temporary position and mount it in the same place as the old selenium rectifier assembly.

( ) Fasten the assembly to the rear panel with the 6-32 x 5/16 screws used in step 3.

( ) Fasten the assembly to the support post with the 6-32 x 1/2 screw from the kit.

NOTE: On some instruments it will be necessary to place a 3/16 spacer (from kit) between the assembly and support post.

THIS COMPLETES THE INSTALLATION

( ) Insert the Manual Parts List and Schematic in your Instruction Manual.

BE:ls

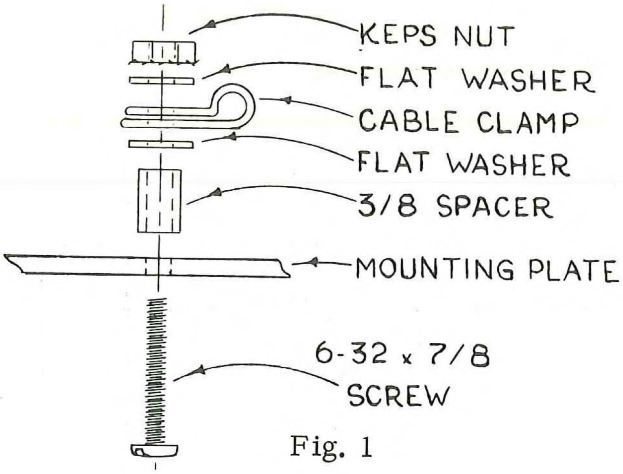

KEPS NUT
FLAT WASHER
CABLE CLAMP
FLAT WASHER
3/8 SPACER
MOUNTING PLATE
6-32 x 7/8
SCREW

Fig. 1

##

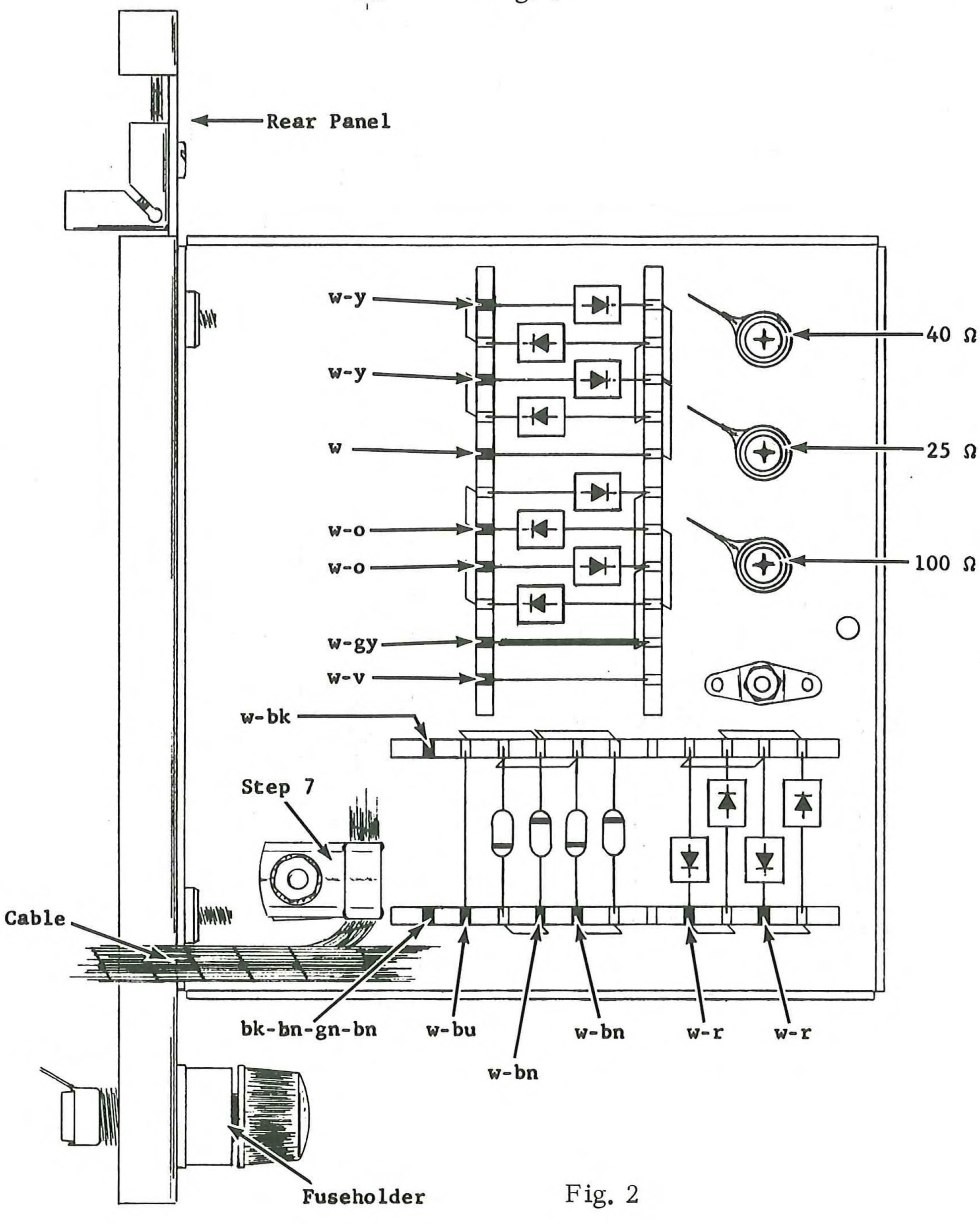
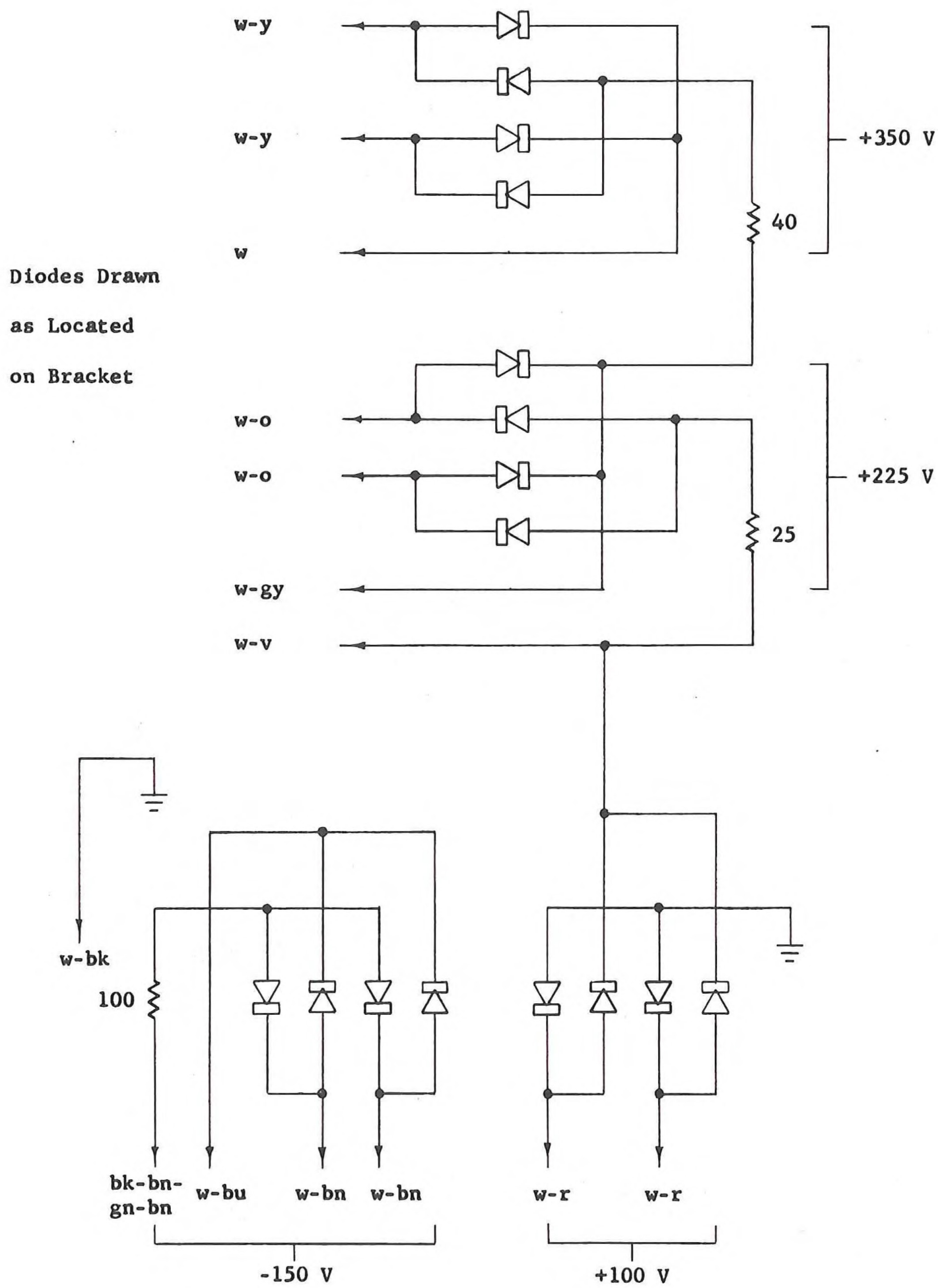

Rear Panel
w-y
w-y
w
w-o
w-o
w-gy
w-v
w-bk
40 Ω
25 Ω
100 Ω
Step 7
Cable
bk-bn-gn-bn
w-bu
w-bn
w-bn
w-r
w-r
Fuseholder

Fig. 2

BRACKET WIRING



SILICON RECTIFIER

Type 315 -- All serial numbers

Installed in Type 315 SN _______ Date _______

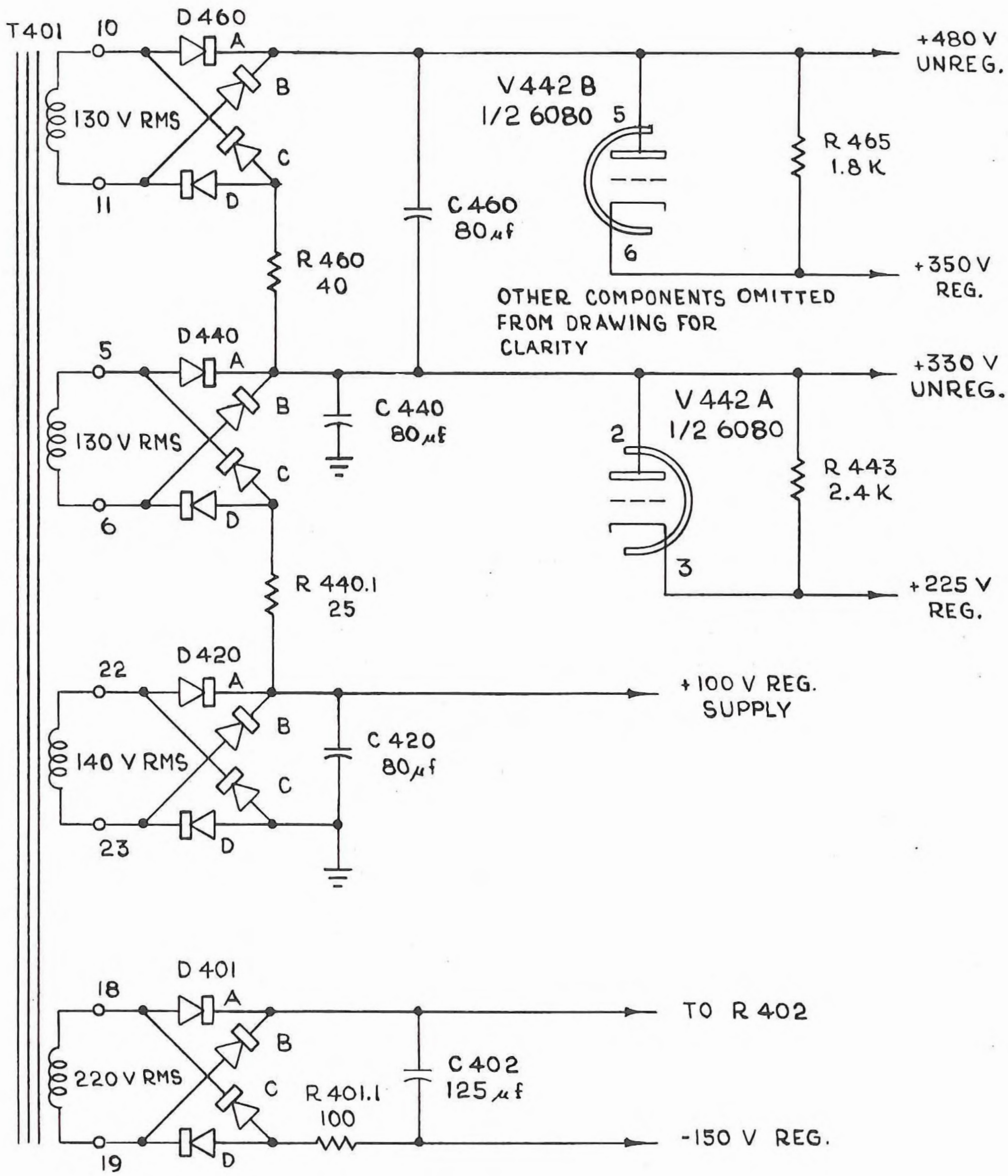
GENERAL INFORMATION

This modification replaces the selenium rectifiers used in the Tektronix Type 315 Oscilloscope with silicon rectifiers, offering more reliability and longer life.

ELECTRICAL PARTS LIST

Values fixed unless marked variable. Only new parts listed.

Ckt. No.	Part Number	Description			
		DIODES			
##D401A, B, C, D (4)	152-0040-00	500 mA	silicon	600 PIV	
D420A, B, C, D (4)	152-0066-00	500-750 mA	silicon	400 PIV	
D440A, B, C, D (4)	152-0066-00	500-750 mA	silicon	400 PIV	
D460A, B, C, D (4)	152-0066-00	500-750 mA	silicon	400 PIV	
		RESISTORS			
R401.1	308-0153-00	100 Ω	10W	WW	5%
R440.1	308-0151-00	25 Ω	10W	WW	5%
R443	308-0068-00	2.4 k	20W	WW	5%
R460	308-0012-00	40 Ω	10W	WW	5%
R465	308-0190-00	1.8 k	25W	WW	5%


T401
10
D460
A
B
C
D
11
130 V RMS
C460
80µf
R460
40
V442 B
1/2 6080
5
6
R465
1.8 K
+480 V
UNREG.
+350 V
REG.
OTHER COMPONENTS OMITTED
FROM DRAWING FOR
CLARITY
5
D440
130 V RMS
6
C440
80µf
V442 A
1/2 6080
2
3
R443
2.4 K
+330 V
UNREG.
+225 V
REG.
R440.1
25
22
D420
140 V RMS
23
C420
80µf
+100 V REG.
SUPPLY
18
D401
220 V RMS
19
R401.1
100
C402
125µf
TO R402
-150 V REG.

MAINTENANCE NOTES

VERTICAL AMPLIFIER RESPONSE, sn below 357

FMR-11A 9-21-53

Some difficulties have been encountered with spiking of the leading edge of a squarewave display in Type 315's, serial numbered below 357. This is usually the result of cathode interface in the 12BY7 tubes used in the output stage of the vertical amplifier.

This effect may be reduced to a minimum by using Sylvania 12BY7 tubes.

As is often the case, in removing one undesired effect, we introduce another. The Sylvania tubes introduce more dc shift than the others, and for most applications, steps should be taken to compensate for this effect.

The phenomenon of dc shift in vacuum tubes is not thoroughly understood, but the effect noticed is a long-time-constant decay of the cathode emission.

When a signal with dc component is impressed on an amplifier with dc shift, the amplitude begins to decay from the initial level toward a final level which may be as much as 8 percent less, depending on the type of amplifier tube. The time required for the deflection to fall to final level is in the order of one second. This problem arises in a number of pentode types.

In Type 315 after serial 357, "dc shift" has been corrected to a large extent by a compensating network in the plate circuit of the 12BY7's.

A kit, Tek 040-007, includes the necessary components and tubes for this modification.

ELEVATED HEATER POTENTIAL

FMR-17B 11-4-54

Dependability of 6BQ7's in the Type 315 Sweep Circuit can be improved by changing the elevated heater potential of V202, V210, V223, and V224 to 160 volts. This can be done as follows:

1. Remove strap between pins 3 and 8 of V442 (tube type 6080).
2. Remove strap between pin 8 of V442 and one end of R441, a 270k, 1/2w resistor.
3. Place an insulated strap between the end of R441 --- previously unsoldered --- and pin 3 of V442.
4. Place a 1 megohm, 1/2w, 10%, composition resistor between pins 3 and 8 of V442.
5. Place a 2.7 megohm, 1/2w, 10%, composition resistor between pin 8 of V442 and a tube socket ground lug.
6. Solder all connections.

The modification applies to all Type 315s below serial number 805.

BINDING HORIZ POSITION POTS

FEI-13A 11-13-56

The potentiometer that is used in the horizontal-positioning control binds somewhat when the shaft is turned very slowly. The potentiometer has a value of 20k and must be capable ok a wide-range circuit function.

This problem is normally not obvious unless the instrument is being used in the sweep magnifier position and the scope operator is attempting a fine horizontal-positioning adjustment. It is nearly impossible to set the trace to any desired point-in fact, it kinda' bounces along.

Buck Murphy in Tek San Francisco called this problem to our attention. He suggested using a concentric potentiometer arrangement similar to that used in Type 530- and 540- Series scopes. The new potentiometer, a couple of resistors and some wire rearrangement solved the problem.

At this time we do not plan to work up an official modification kit. The complete informatkon is available and if we receive enough demand for the concentric arrangement, an official mod kit will be prepared for field distribution.

T31P CRT IN 315 --- NOT PRACTICAL

FQD 9-57

Can the cathode-ray tube for the Type 316 be used in the Type 315 scope if provisions are made for the new-type connection for the vertical and horizontal plates?

The Type T31P crt used in the Type 316 is not a practical replacement in the Type 315 for the Type 3WP crt.

Here are some of the reasons for this:

1. Deflection sensitivities are increased in the T31P to the point that calibration ranges are insufficient in the Type 315, especially on the faster sweep speeds. The T31P sensitivities are 19 v/di horizontally and 8.5 v/div virtically.
2. For proper operation, separate focus and astigmatism supply provisions should be made.
3. A new crt shield should be installed.
4. Sweep and vertical modifications required by reason of No. 1 probably are not worthwhile from a value-received standpoint.

INTERCHANGEABILITY OF SR756 AND SR440

FQD 3-58

Can the following selenium rectifiers be used interchangeable: SR756, Tek 106-014, used in the 531 with SR440, Tek 106-017 used in the 315?

They are the same electrically but differ in lug arrangement. It is a bit inconvenient but can be done.

NON-LINEARITY PROBLEM SOLVED

FQD 5-59

Call report from John Mulvey:

Trouble here was a slight non-linearity in the sweep of a 315D. This showed up as a squiggle at the start of the sweeps, synchronized to the square-wave calibrator. This was du to the slight drop in 350 V supply to the sweep generator and sweep gating circuits which were decoupled by 47-ohm resistors and .01 μfd capacitors. On checking their two others, found the symptoms to be characteristic of all of them, that is, "normal". Found we could almost completely eliminate the effect by running Pin 1 of V222 directly to the +225 V supply rather than to the decoupled +225 V supply. Worked out to be a very simple mod involving the addition of a short strap and moving on lead.

6DJ8 CONVERSION

FMR 157 4-6-61

Type 6DJ8 tubes are improved versions of Type 6BQ7A tubes. They offer better performance, greater reliability, and more consistent characteristics from tube to tube and between sections of one tube. We recommend 6DJ8's direct replacements for 6BQ7A's even in those circuits now employing aged and checked 6BQ7A's.

In most cases you need not make any circuit changes. A few minor adjustments are usually necessary, however. These adjustments are described in your instruction manual and amount to no more than routine calibration for the circuits in which the tubes were replaced.

T310P CRT 3-4-63

Pius Scherr to Chet Murphy

I tried a T310P CRT in an early Type 310 scope (s/n 599) to see if we can tolerate the minimum length spec. The length spec of the T310P is 11-7/16 in. ±1/8. The CRT I used was near the minimum length and appeared to work okay as a replacement for the 3WP for all Type 310 scopes.

There is a replacement problem in using the T310P in the Type 315 and 360 . After talking with Ed Srebnik (CRT Prod Eng Mgr) Connie Wilson (CRT Tube Design) LeMoyne Warner (Comp Select.) et al and considering the pros and cons, it appears we should use the T310P for replacement purposes since the 3WP wouldn't be a cure-all anyhow. The 3WP would still have to be checked to meet electrical and mechanical specs required for Tek scopes and there was a considerable reject rate when this was done before.

There is a length problem in using the T310P as a replacement for the 3WP in Type 315 and 360 instruments. It appears the minimum length will have to be 11-1/2 in. so the CRT socket can be installed properly. Also, when installing th T310P in the Type 315 the CRT shield support bracket screws have to be changed to flat-head screws to provide clearance at the neck of the CRT. The neck of the T310P is about 1/4 in. larger in diameter that the 3WP and rides on the screw heads in some cases.

Since an 050 kit will be required to take care of this problem and the setting up of new Tek numbers of CRTs with a minimum length of 11-1/2 in, I'd suggest contacting Dick Forsyth to get this taken care of.

SECTION 4
MAINTENANCE

GENERAL INFORMATION

Replacement of Components

Tektronix will supply replacement components at current net prices. However, since most of of the components are standard electronic and radio parts we suggest that you get them from your local dealer if you can. Be sure to consult your instruction manual first to see what tolerances are required.

We specially select some of the components, whose values must fall within prescribed limits, by sorting through our regular stocks. The components so selected will have standard RETMA color-code marks showing the values and tolerances of the stock from which they were selected, but they will not in general be replaceable from dealers stocks.

Such selected parts, as well as the parts we manufacture at Tektronix, are identified in the parts lists either by notes or by our own stock numbers. Order these parts from the Tektronix factory in Portland, Oregon.

Parts-Ordering Information

You will find a serial number on the frontispiece of this manual. This is the serial number for which this manual was prepared. Be sure that the manual number matches the number of the instrument when you order parts.

A Tektronix instruction manual usually contains hand-made changes to diagrams and parts lists, and sometimes, text. These changes are in general, only appropriate to the instrument whose serial number appears on the manual frontispiece. The hand-made changes show changes that have been made to the instrument after the printing of the manual.

We make some of the instrument changes during the factory test procedure. Our technicians hand-tailor the circuits, if it seems appropriate, to provide the widest possible latitude of operation. Other changes are made to include the latest circuit improvements as they are developed in our engineering department, or when improved components become available. In any event, the changes are to your benefit. We have tried to give you the best instrument we can.

Soldering Precaution

The solder used on the ceramic terminals in this instrument must contain a small percentage of silver. If for any reason you resolder, be sure that the solder you use contains silver. Silver-bearing solder is used in printed-circuit techniques, and is therefore available from all solder manufacturers. Repeated use of ordinary tin-lead solder will dissolve the fused bond of silver that makes the solder adhere to the porcelain, especially if the soldering iron is quite hot.

Cooling

The Type 315D Oscilloscope is cooled by filtered forced air. The air filter is washable aluminum wool coated with adhesive. If it gets too dirty it will restrict the flow of cooling air and may cause the instrument to overheat.

To clean the filter, run hot water through it from the side that was inside. Or slosh it around in hot soapy water and rinse it in clean water. Then dry it thoroughly and coat it with new adhesive. When new, the filter is coated with "Filter Coat", a product of the Research Products Corporation. Pint cans are available under the name "Handi-Koter" from some air-conditioner suppliers. Other adhesive materials are no doubt satisfactory.

The fan motor bearings will require oiling every few months or every thousand hours of operation. Use a good grade of light machine oil, and apply only a drop or two.

Removal of the Case

Set the oscilloscope face downward on a padded flat surface, turn the two fasteners on the back appproximately 1/4 turn to the left, and lift off the case. The power cord is not removable so it must be fed through the hole as the cabinet is removed.

CAUTION: Voltages high enough to be dangerous are present in this instrument. Since much maintenance must necessarily be performed with the case removed, great care should be taken to avoid contact with bare leads. Use only insulated tools, stand on a dry floor, and if possible, keep one hand in your pocket.

POWER SUPPLY

Line Voltage

The power supply of the Type 315D Oscilloscope will operate satisfactorily over the voltage ranges 105 to 125 volts and 210 to 250 volts.

The power transformer is wound with two 117-volt primaries. When the instrument leaves the factory, the primaries are ordinarily connected in parallel for 117-volt operation. If operation from 234-volt lines is desired, remove the jumpers on the power transformer between terminal 1 and terminal 2, and between terminal 3 and terminal 4. Now connect terminal 2 and 3 together. With the line still connected to terminals 1 and 4, the instrument is ready for 234-volt operation.

The fuse normally supplied when the Type 315D is wired for 117-volt operation is 5-amp, 250-volt "Slo-Blo". For proper protection on 234-volt operation, this fuse should be changed to 2 1/2-amp, 250-volt "Slo-Blo".

Line Frequency

The Type 315D is supplied in two different models, for universal line frequency 50 to 800 cycles, or for 50- to 60-cycle operation. The only difference between these models is in the fan motor supplied. The universal 50-800-cycle model uses a dc series-wound motor with a full-wave selenium bridge rectifier. A 37 1/2-volt winding on the power transformer supplies the power to the rectifier. (NOTE: A few of the early instruments did not have this winding but rather used a half-wave rectifier and a series resistor connected directly to the 117-volt line.)

Change of Fan Motor

The 60-cycle model uses a standard 60-cycle shaded-pole 117-volt motor. This motor, having no brushes, will run quieter and the life should be longer than the dc model. This motor is recommended where the universal feature is not needed. The mounting plates are identical on the two motors so it is possible to change from one to the other if the need should arise. If wired for the 60-cycle motor, the motor wires (grey) should go to terminals 1 and 3. If wired for universal line frequency, the wires should go to terminals 14 and 17. A name plate on the back of the instrument indicates the line frequency. This plate should be changed if the motor is changed.

DC Voltages

All dc voltages are regulated and are referred to the -150-volt supply. In order for the instrument to perform properly, it is necessary for the minus 150-volt supply to be within plus or minus 2% of this value. The voltage should be checked with an accurate voltmeter and corrected if necessary by adjusting potentiometer R410 marked ADJUST -150 V (screwdriver adjust), located on the center bulkhead. This check should always be made if the 5651 tube V401 is changed.

High Voltage

The calibration of the TIME BASE and VERTICAL AMPLITUDE controls are dependent on the acceleration voltage applied to the cathode-ray tube. If it is suspected that the calibrations are off, the high-voltage supply should be checked with an accurate meter of at least 20,000 ohms-per-volt sensitivity. The supply voltage should be adjusted to -1800 volts (for serial numbers before 350) or -1650 (for serial numbers above 350) from the cathode (pin 3) of the crt to ground by means of the potentiometer R817 marked H.V. ADJUST. If more convenient, this reading may be made from the plate of V804 (heavy green lead) to ground. V804 is the lower rectifier tube located under the shield.

Calibrator

Before adjustments are made on the vertical amplifier, it is well to check the output adjustment of the calibrator. Inasmuch as the clipper, cathode-follower V602A, remains conducting even with the CALIBRATOR switch in the OFF position, it is possible to adjust the voltage accurately with a dc voltmeter.

An accurate voltmeter of at least 1000 ohms-per-volt sensitivity should be connected to the cathode (pin 3) of V602A. (This is the yellow lead going to the back of the CALIBRATOR switch.) The switch should be turned to the OFF position and R612 (screwdriver potentiometer marked CAL ADJ on the main bulkhead) adjusted to a reading of +100 volts. The calibration voltage will then be accurate on all settings.

VERTICAL AMPLIFIER

NOTE: A warm-up period of approximately 15 minutes to stabilize the characteristics should precede adjustments of the vertical amplifier. Also best results will be obtained if the adjustments are made in the following order:

Amplifier Gain Adjustment

Set the AMPLITUDE selector switch to the dc position, .1 VOLT/DIV. Set the MULTIPLIER to 1; set the CALIBRATOR TO 1. Connect a lead between CAL OUTPUT and INPUT, with the STABILITY control advanced so the time base is free running. Adjust the VERT POSITION control until the bottom of the display coincides with the lowest small mark on the graticule. Then adjust R90 (screwdriver adjustment in center of AMPLITUDE knob) until the top of the display coincides with the top small mark on the graticule (10 division). The CALIBRATOR voltage should be set to .1 and the display should occupy one scale division at any setting of the VERT POSITION control.

2X MULTIPLIER Adjustment

The CALIBRATOR should again be set to 1 volt and the MULTIPLIER set to 2. R51 (located on the outside of the bracket supporting the MULTIPLIER switch) is adjusted to give a display of 5 divisions.

5X MULTIPLIER Adjustment

Next set the MULTIPLIER switch to 5, adjust R53 (located on the inside of the bracket) to give a display of 2 divisions. With the MULTIPLIER switch in the 10-1 (red) position, a full rotation of the center (red) knob will now give a display of 10 divisions in the full-clockwise position and approximately 1 division in the counterclockwise position.

Attenuator DC Balance

Now turn the CALIBRATOR to OFF and position the trace to the center of the screen. As the red knob (10-1) on the MULTIPLIER is rotated, there should be no change in position. If there is a change in position, R55, VERT AMP DC BAL (located on side of vertical amplifier chassis) should be adjusted until there is no change in position as the red knob is rotated.

NOTE: This adjustment as well as the PRE AMP GAIN ADJ may require an occasional touching up as the tubes age. Therefore holes have been provided in the sides of the cabinet to allow access to these controls.

PREAMP GAIN Adjustment

Set the CALIBRATOR to .1 volt, set the AMPLITUDE to .01 VOLTS/DIVISION, MULTIPLIER to 1. Adjust R15, labeled PRE AMP GAIN ADJ, located on side of vertical amplifier chassis, to give a display of 10 scale divisions.

Input Attenuator and Probe

The various input attenuators in the Type 315D are of the resistor-capacitor type. The resistor divider ratio is equal to the capacitor divider ratio, and therefore the voltage division is constant for any frequency from dc to well above the requirements of the instrument. Adjustments of these attenuators is readily made while observing their square-wave response. The self-contained calibrator in the Type 315D is a suitable square-wave source, and thus a check of the attenuators is always available. When the variable capacitors in the attenuators are properly adjusted, a square wave will be correctly reproduced by the oscilloscope. If the capacitive divider has a lower attenuation than the resistive divider, a spike will appear on the leading edge of the square wave. If the capacitive divider has a higher attenuation, the corner of the leading edge will be rounded. The following adjustment procedure is recommended:

Shield

1. Lay a sheet of metal on the top of the instrument to simulate the presence of the case.

C3 Adjust

2. Set the CALIBRATOR to 10 volts. Set the AMPLITUDE to AC, 1 VOLT/DIV and the MULTIPLIER to 2. With the TRIGGER SELECTOR set to +INT, SLOW RISE, adjust the TIME BASE to display 8 to 10 cycles of the CAL waveform across the screen. Adjust C3, the rear trimmer, on the side of the switch.

C15 Adjust

3. Turn the MULTIPLIER to the 10-1 position (red), set the center knob full counterclockwise, and set the CALIBRATOR to 100 volts. Adjust C15, located on the chassis just in the rear of the MULTIPLIER switch, until no overshoot is observed. (NOTE: It may be necessary to repeat step 2 after this adjustment as there is some interaction.)

C6 Adjust

4. Set the AMPLITUDE to 10, AC, set the MULTIPLIER to 2, set the CALIBRATOR to 100. Adjust C6 (located on the rear of the switch, and adjusted through the hole in the chassis).

Probe Adjust (C101)

5. Remove the wire connecting CAL OUT and INPUT, and connect the probe; place the tip of the probe in CAL OUT. Set AMPLITUDE to .1 VOLT/DIV, MULTIPLIER on 2, and set the CALIBRATOR on 10. Adjust C101, located on the probe body.

C2 Adjust

6. Set AMPLITUDE to 1 VOLT/DIV, MULTIPLIER on 2. Set CALIBRATOR to 100 volts. Adjust C2, located on the side of AMPLITUDE switch.

C5 Adjust

7. Set AMPLITUDE to 10 VOLTS/DIV, MULTIPLIER on 1, with the CALIBRATOR at 100 volts. Adjust C5, located on the front of the AMPLITUDE switch, through the hole on the chassis.

C10 Adjust

8. Set AMPLITUDE to .01 VOLTS/DIV, MULTIPLIER on 2, with the CALIBRATOR on 1 volt. Adjust C10, located near V1 on the front of the vertical amplifier chassis.

HIGH-FREQUENCY COMPENSATION

The following describes the adjustment procedure for high-frequency compensation in the Type 315D. The adjustments are not extremely critical. However, they do require considerable care to obtain optimum results. Also since once adjusted, they are fairly stable, readjustment should not be attempted without first eliminating other possible sources of wave-form distortion, including defective tubes or a deficient signal source. A suitable square wave generator or pulser is necessary in making any high-frequency adjustments of the Type 315D. The square-wave generator risetime must not exceed .04 microseconds. A Tektronix Type 104A or Type 105 Square-wave Generator will provide a suitable signal. All connections between the generator and the oscilloscope should be coaxial type and MUST be properly terminated, preferably at both ends of the cable.

INSTRUCTION MANUAL
(Calibration Procedure Addendum)

Page 4-5

TYPE: 315D

Hum Balance Adj. - R98

1. Set the amplitude control to AC - .01

2. Ground the input with an alligator clip or a very short ground lead.

3. Adjust hum balance control for minimum hum on the trace.

Dan Welch/Ron Breaker
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Disconnect Delay Network

1. In the Type 315D, the DELAY NETWORK must be disconnected before any adjustments are made on the vertical amplifier. This can be done as follows:

Disconnect the red lead (delay line input) from pin 6 (plate) of V4.

Disconnect the purple lead (delay line output) from pin 7 (grid) of V8B.

Connect a jumper from pin 6 of V4 to pin 7 of V8B. This lead should be no longer than necessary and should be kept well away from the chassis.

Connect a 1000-ohm, 1-watt, resistor from pin 7 of V8B to the +100-volt bus. The +100-volt bus is located on the terminal of C21, which is on the bracket below the delay network.

Amplitude of Test Signal

2. Apply a square wave of 750 kc to 1 mc to the input of the Type 315 oscilloscope. Adjust the amplitude of the square wave so that it causes a deflection of 5 to 6 divisions with the MULTIPLIER on 1 or 2.

3. Adjust the TIME BASE to display 3 or 4 cycles of the square wave.

Compensating Coil Adjustments

4. Observe the leading edge of the square wave. Adjust L3, L4, L5, L6, and L7, if necessary, for the best waveform with the least overshoot on the leading edge of the wave. All of these adjustments interact to some extent so only a small adjustment should be made to any one coil at a time. NOTE: If the above steps are properly made, the waveform should look very good at this point. However, there may be a few remaining small wrinkles. This should not cause concern as they will disappear when the delay line is re-installed.

Preamp Adjust

5. Insert a 10-to-1 pad in the signal lead from the generator, or reduce its output sufficiently that it will not overload the preamplifier. Set the AMPLITUDE to .01 VOLT/DIV, adjust L1 and L2 for best waveform. NOTE: These adjustments are not very critical and it may require a large change in inductance to show any change in waveform. The two coils should be adjusted so that the slugs are both in about the same position.

6. The delay network should be reconnected.

DC Shift Comp

(For instruments having S/N 357 or higher).

Set the AMPLITUDE control to the DC .1 VOLTS/DIVISION position and the MULTIPLIER to 2. Advance the STABILITY control until the time base is free running and center the trace vertically. Connect a lead from CAL OUT to INPUT and switch the CALIBRATOR control alternately from the OFF position to the 1-volt position. Adjust the DC SHIFT COMP control, R87, until the base line of the display does not shift position as the calibrator is switched off and on.

DELAY NETWORK

The delay network is a 9-section, M-derived artificial transmission line providing a signal delay of .25 microsecond. An accurate impedance match between sections must be maintained to prevent reflections. Each section is adjusted by means of a variable capacitor (C501 to C522). The effects of these adjustments are distributed over the first .5 microsecond of the signal.

CAUTION: Adjustment of the delay network should not be attempted without first verifying normal transient response of the output amplifier as explained under "HIGH-FREQUENCY COMPENSATION". Otherwise the delay network adjustments may be set to compensate for deficiencies in the output stage. This will cause a loss in overall bandwidth of the instrument. The following methods of adjustment will give satisfactory results:

Delay Network Test Signal

1. Apply a 100-kc square wave to the input of the oscilloscope with the AMPLITUDE set on .1 VOLT/DIV. Set the TIME BASE to 1 MICROSECOND/DIVISION.

2. Adjust the DELAY NETWORK trimmers (C501 to C522) for the smallest ripple or irregularity on the first .5 microsecond of the square wave. The position of the irregularity determines which capacitor needs to be adjusted. Try adjusting one of the center capacitors to see where it produces its effect.

Leading Edge

3. Change the TIME BASE to 5 or 10 MICROSECONDS/DIVISION and observe the squareness of the leading corner. If the corner (first .5 microsecond) is higher in amplitude than the remainder of the square wave, repeat step 2, but setting all the capacitors at a higher capacitance. If lower, repeat using lower capacitor settings. It may be found that only part of the corner will slope up or down. In this case, only part of the capacitors will need to be increased or decreased.

Delay Network Terminating Resistor

If a square corner cannot thus be obtained, an incorrect termination resistor, R521 is indicated. To check this termination, turn off the 315D and allow the tubes to cool. Then measure R521 between pin 7 of V8B and the +100-volt bus (located on terminal of capacitor C21) with an accurate bridge. If it is outside the range of 1100 ohms +or-1%, replace with a composition resistor selected to be within these limits. (R521 is located in the delay-network chassis, which must be removed to replace the resistor.)

ASTIGMATISM

For best focus of both horizontal and vertical lines, the final anode of the cathode-ray tube must be returned to a voltage approximately equal to the dc voltage on the deflection plates. A preliminary setting of the ASTIGMATISM control (R920), located on the back plate of the instrument, may be made by connecting a voltmeter between ground and the center arm of this control, and adjusting to +190 volts. Because of variations in individual cathode-ray tubes, the best setting may differ slightly from this value, so final adjustment should be made while a signal is being observed. This setting should be made simultaneously with the front-panel FOCUS control because these controls interact to some extent.

TIME BASE

A complete procedure for the adjustment and calibration of the time base is outlined here. However, in normal servicing, only necessary adjustments should be made.

Timing Capacitors

We manufacture our own timing capacitors with the characteristics needed to maintain sweep-time accuracy and linearity. The capacitance ratio between capacitors used is accurate within half of one per cent so that the time-base calibrations will be right at all speeds. Most capacitors change value with voltage, temperature, and age. Variation of capacitance with voltage is particularly undesirable because it causes nonlinearity of the time-base sawtooth. Our timing capacitors are especially free from this voltage effect. They also have minimum temperature and aging variations.

Timing capacitors C280A, C280B, and C280C are enclosed as a unit in a sealed can. If you need to replace any one of them, you must replace all three. C280-D may be composed of two capacitors, chosen to have the right characteristics and capacitance value when connected in parallel. We therefore recommend that you obtain replacements for this capacitor from Tektronix. Be sure to include the instrument serial number with your order.

Multivibrator Stability

1. Set STABILITY control (red coaxial knob) full clockwise. Adjust MULTI STABILITY (R254, screwdriver potentiometer on side of sweep deck) about half way between the points where the sweep stops on the left of the screen and where it stops on the right of the screen. NOTE: It may not be possible to make it stop on both sides. If not, adjust it to where it stops on one side or the other, then back it off approximately 1/4 turn.

Sweep Length

2. With the sweep free running at 1 MILLISEC/DIVISION adjust SWEEP LENGTH (R261, screwdriver adjustment on side of sweep deck) until the sweep just covers the ruled portion of the graticule (approximately 10 1/2 divisions).

Trigger Sensitivity

3. Set the TRIGGER SELECTOR to +LINE or -LINE. Set the time base RANGE to 10 MICROSECONDS/DIVISION. Set the TIME BASE MULTIPLIER to 1. Set the VERTICAL AMPLIFIER AMPLITUDE to .1 VOLT/DIVISION, MULTIPLIER on 1. Advance the STABILITY control (red knob) until a trace appears. Now turn the STABILITY control back (counterclockwise) until the trace disappears, or drops suddenly in intensity. If the trace disappears, adjust the TRIGGER AMPLITUDE DISCRIMINATOR until a dim trace is displayed. The time base is now triggered by the ac line frequency. Connect the 10X probe cable to the INPUT and touch the probe to the cathode of V203 (pin 3 and 8). This lead appears at the terminal board just back of the TRIGGER SELECTOR switch on the underside of the sweep chassis. Adjust TRIG SENS (R223, screwdriver control, located on side of the sweep chassis) until a series of oscillations are observed on the trace, then back off the control to the point where the oscillations just disappear.

V201 Balance

4. Set the TRIGGER AMPLITUDE DISCRIMINATOR to 0 (center), and set the STABILITY control full counterclockwise. Connect a dc voltmeter between ground and the grid of the pentode section of V202, pin 2, and rotate the TRIGGER SELECTOR switch from the +EXT to the -EXT positions. The voltages in the two switch positions should be nearly equal at 190 volts. If there is a difference of over five volts it indicates either that the phase-inverter tube, V201, is not balanced, or that the plate resistors for this tube are not equal. V201 should be exchanged if necessary for a tube which gives as nearly equal voltage as obtainable with the switch in the two positions, and the resistors, R208 and R209, should be checked.

Internal -Trigger DC Level

5. With the controls set as in step 4, rotate the TRIGGER SELECTOR switch from the -INT to +INT, and if necessary, adjust R202 (a screwdriver adjustment on side of TRIGGER SELECTOR switch) until the average of the two voltages is the same as the average voltage measured in step 4.

A. Set the AMPLITUDE selector to one of the AC positions. Connect a wire between INPUT and CAL OUTPUT. Set the CALIBRATOR and the AMPLITUDE control so that a vertical deflection of approximately 0.2 division is displayed. Set TRIGGER SELECTOR to +INT or -INT, SLOW RISE. Set the STABILITY control just below the point where the sweep free runs. Set the TRIGGER AMPLITUDE DISCRIMINATOR to 0 (center). Adjust INT TRIG DC LEVEL (R202, screwdriver adjustment on side of TRIGGER SELECTOR switch) until the point of triggering occurs as close as possible to the zero setting of the TRIGGER SELECTOR DISCRIMINATOR. This point should be checked on both +INT and -INT settings of the TRIGGER SELECTOR. When a proper adjustment is made, the point of triggering will be at about the same rotation from zero with either positive or negative settings.

NOTE: For the following step and for all time-base calibration adjustments, either a suitable time-mark generator or an accurately calibrated oscillator is required. A suitable instrument is the Tektronix Type 180 Time-Mark Generator.

V213 Check (Constant-Current Tube)

6. Set the marker generator for one-microsecond marks. Set the TIME BASE to 1 MICROSEC/DIVISION, and the MULTIPLIER to 1. Display a stable trace of the time marks, and watch the trace as you short out R279 (15-ohm resistor in heater lead to V213A, located on bakelite

board on back of sweep chassis). Keep R279 shorted for at least 30 seconds. If any change occurs in the time base replace the constant-current tube, V213. A tube should be selected for this position which shows no change as the heater voltage is changed. A tube with low emission or with high heater-to-cathode leakage in this tube will cause an error in the timing of the 5 SEC/DIVISION range. If this trouble is suspected, switch to 1 SEC/DIVISION and MULTIPLIER to 5, and advance the STABILITY control to get a recurrent sweep. Time the full 10-centimeter transit time first with the line voltage near 105 volts and second with the line voltage increase to the vicinity of 125 volts. Any difference in the timing with a change in line voltage indicates cathode-to-heater leakage in the constant-current tube.

Time Base Calibration

7. Set the TIME BASE RANGE on 1 MILLISECOND/DIVISION. Connect the time-mark generator to the vertical INPUT and select time marks of 1 millisecond. Adjust SWEEP CAL (R286, screwdriver adjust on side of sweep chassis) until 10 marks correspond with 10 scale divisions.

Magnifier Gain

8. With the time marks and TIME BASE set as in step 7, turn the 5X MAGNIFIER (red knob center of RANGE switch) to the ON position (clockwise rotation). The HORIZ POSITION should be set so that the center 20 per cent of the display is on the screen of the tube. Adjust MAG GAIN (R314, screwdriver adjustment on side of sweep chassis) until 2 time marks correspond with 10 scale divisions. A more accurate adjustment may be obtained if the generator is set to 100 MICROSECONDS. Then 20 time marks will occupy 10 divisions. The linearity of the sweep should be carefully checked by noting if each time mark corresponds with a graticule division. If there is any indication that the sweep is not linear, the horizontal output tubes (V224 and V223) should be changed.

Mag. Centering

9. With the same setup as in step 7, position the trace to the right with the HORIZ POSITION control, until the second time mark as displayed on the screen is centered over the center line of the graticule (magnified sweep). Now turn the 5X MAGNIFIER switch to OFF (counterclockwise) and reposition the trace with MAG CENTERING (R306, screwdriver adjust, on side of sweep chassis) until the second time mark is centered on the screen. When this adjustment has been properly made, there will be no movement of the display in the center of the screen as the 5X MAGNIFIER is switched on or off. In other words, the trace will be magnified equally in both directions from center.

> NOTE: At this point it is recommended that all time-base ranges slower than 1 MILLISEC/DIVISION be checked in each of the three MULTIPLIER positions. There should be no error greater than two per cent except at 1, 2, and 5 SEC/DIVISION settings, where the error should not exceed four per cent. Any greater error indicates defective timing resistors or capacitors, or, in the case of the slowest time bases, heater-to-cathode leakage in V213A excessive.

Trace Linearity

10. If the linearity of the time base has deteriorated proceed as follows to adjust C290, C260, C276, and C303, as well as the timing circuits. These capacitors are located on the under side of the sweep deck.

C280E Adjust (Preliminary)

11. Set the TIME BASE RANGE to 10 MICROSEC/DIVISION, MULTIPLIER to 1, and display 10-microsecond time marks. Adjust C280E so that the last eight markers correspond with the last eight graticule divisions.

C290 Adjust

12. Turn 5X MAGNIFIER clockwise (on). Adjust C290 so that the first two markers occupy the same number of graticule divisions as the last two markers.

C280E Adjust

13. Turn 5X MAGNIFIER counterclockwise (off). Readjust C280E so that all 10 markers correspond with the 10 graticule divisions.

C303 Adjust (Preliminary)

14. Set TIME BASE RANGE to 1 MICRO-

SECOND/DIVISION and display one-microsecond time marks. Adjust C303 for best linearity at start of sweep.

NOTE: With the RANGE set to 1 MICROSEC/DIVISION the timing accuracy should be checked at the X2 and the X5 MULTIPLIER settings. Any error greater than 2% indicates resistors R282A or R2828B are defective. If there is any discrepancy it should be averaged between the settings by a compromise setting of C280E. Do not confuse timing error with non-linearity of the sweep.

C280G Adjust

15. Set TIME BASE RANGE to .1 MICROSECOND/DIVISION, set MULTIPLIER to 5, and display one-microsecond time marks. Adjust C280G so that the last four markers correspond with the last eight graticule divisions.

C260 Adjust

16. Set MULTIPLIER to 1 and display a 10-mc sine wave. Adjust C260, if necessary, so that no foldover occurs at end of sweep at normal intensity setting. C260 setting should be as near minimum capacitance as possible.

C303 Adjust

17. Readjust C303 so that 10 cycles occupy 10 graticule divisions. Repeat 15 and 17 as there is a slight interaction between their adjustments.

C276 Adjust

18. Set MULTIPLIER to 2. Adjust C276 for best linearity at start of sweep.

TIME BASE TROUBLE SHOOTING

First, check the power-supply voltages, and if necessary adjust the -150-volt supply which is the reference voltage for the other regulated supplies. Also if necessary adjust the -1650-volt accelerating voltage.

Second, check the 47-ohm, 1/2-watt resistors on the vertical terminal strip on the bottom of the sweep chassis for evidence of overheating and for open circuits.

Third, check the heaters of the tubes on the sweep chassis. Each tube, except the 6AK6, has two separate cathodes. Examine them to make sure both cathodes are hot.

Fourth, set the front-panel STABILITY control full counterclockwise, and the 5X MAGNIFIER control clockwise (on). Set the SWEEP LENGTH and MAGNIFIER GAIN screwdriver-adjustable controls full counterclockwise. The SWEEP LENGTH control, R271, and the MAGNIFIER GAIN control, R315, are accessible from the right side in the row of controls near the bottom of the instrument.

Fifth, read test-point voltages at the points shown in the following list, as the MULTI STABILITY pot is alternately turned first full clockwise, and then full counterclockwise. The MULTI STABILITY pot, R254, is also mounted on the control strip at the bottom of the instrument, accessible from the right side.

Turning the MULTI STABILITY pot clockwise sets the time-base circuit in the stable state that is present at the start of the sweep. Turning it counterclockwise sets the circuit in the stable state present at the end of the sweep.

Take the readings on a sensitive voltmeter with a resistance of 10,000 ohms per volt or higher. The voltages given are nominal in most cases.

VOLTAGE TO GROUND

Test Point	Multi Stab. CW	Multi Stab. CCW	Probable Cause of Trouble
pin 8 V210B	150v ±10v	225v	V211
pin 7 V205B	-17v ± 4v	0v	V205, V213
pin 7 V204B	100v	15v	V205, V204
pin 8 V204B	105v	20v	V204
pin 2 V204A	85v	10v	V203, V204
pin 1 V212A	215v	175v	V212, V213

V205 may be gassy without disturbing the foregoing voltages.

pin 2	V214	-11v	-12v	V214, V215
pin 1	V215A	-11v	28v	V214, V215
pin 2	V215B	-5v	-6v	V214, V215
pin 1	V220	-5v	-6v	V214, V215
pin 5	V220	35v	100v	V220
pin 3	V221A	40v	100v	V221

Set Multi. Stab. CCW

V221B, between pins 7 and 8   6v   V221
V222A, between pins 2 and 3   6v   V222
pin 7   V224B   0v   (Adjusted by varying HORIZ. POSITION)

pin 6	V224B	190v	V224, V223
pin 3	V223B	196v	V224, V223
pin 6	V223B	190v	V224, V223
pin 3	V223A	196v	V224, V223

Feed a 10-volt signal from the CAL terminal through a blocking capacitor to pin 7 of V221. This should give a horizontal trace at least 10 cm long.

Because of the interdependence of the various parts of the time base circuits, failure of one tube may interrupt the whole time-base operation so that comparison of waveforms may not be possible. The foregoing procedure will help especially in these cases when the time base will not operate at all.

ALTERNATE PROCEDURE FOR ALIGNING INPUT ATTENUATOR AND PROBE

Preliminary Steps

1. Set C15 to half capacitance and lay a sheet of metal on the top of the instrument to simulate the presence of the case.

C3 Adjust

2. Set the CALIBRATOR to 10 volts. Set the amplitude to AC, 1 V/DIV and the MULTIPLIER to 1. With the TRIGGER SELECTOR set to +INT, SLOW RISE, adjust the time base to 200 MICROSEC/DIV. Adjust C3, the rear trimmer on the side of the switch.

C6 Adjust

3. Set the AMPLITUDE control to AC, 10 VOLTS/DIV, set the MULTIPLIER to 1, set the calibrator to 100. Adjust C6 (located on the rear of the switch, and adjusted through the hole in the chassis).

Probe Adjust C101

4. Remove the wire connecting CAL OUT and INPUT, and connect the probe, place the tip of the probe in CAL OUT. Set AMPLITUDE to .1 VOLT/DIVISION, MULTIPLIER on 1, and set the calibrator on 10. Set TIME BASE to 2 MILLISEC/DIV. Adjust C101, located on the probe body.

C15 Adjust

5. Turn the multiplier to the 10-1 position (red), set the center knob full counterclockwise, and set the CALIBRATOR to 100 volts. Adjust C15, located on the chassis just in the rear of the multiplier switch, until a flat top is observed.

Adjust C2, C5, and C10 according to previous instructions.

PARTS REPLACEMENT KIT

MYLAR TIMING CAPACITORS

For Tektronix Type 315 Oscilloscopes:
Serial numbers 101-721

050-0002-00

DESCRIPTION

Mylar* timing capacitors 291-0001-00 and 291-0008-00 replace 295-0033-00 (Timing Series 7).

These new Mylar timing capacitors replace the former PMC and PTM timing capacitors, resulting in improved accuracy of sweep timing and linearity, plus extended capacitor life.

NOTE: If the serial number of your instrument is above those listed, or if this kit has been installed, disregard the instructions as P/N's 291-0001-00 and 291-0008-00 are direct replacements.

Publication:
Instructions for 050-0002-00
March 1966

Supersedes:
September 1963

*Du Pont registered trademark.

PARTS LIST

Qty.	Part Number	Description		
1 ea	210-0006-00	Lockwasher, int. #6		
1 ea	210-0202-00	Lug, solder, SE6		
2 ea	210-0407-00	Nut, hex, 6-32 x 1/4		
1 ea	291-0001-00	Capacitor, Mylar timing,	1 x 0.1 x 0.01 μF	
1 ea	291-0008-00	Capacitor, Mylar timing,	0.001 μF	±1/2%
1 ea	(175-0510-00)	Wire, #20 solid,	5-1/4 in.	white-green
1 ea	(175-0510-00)	Wire, #20 solid,	5 in.	white-orange

INSTRUCTIONS

( ) 1. Remove C280A (1 μF capacitor) mounted on the sweep chassis, inward from V204 and V211.

( ) 2. Mount new Mylar timing capacitor, 291-0001-00 (common terminal toward front of instrument) in the position vacated by the old 1 μF capacitor. It will be necessary to enlarge the mounting holes, using a rat-tail file.

( ) 3. Remove the 0.1 μF, 0.001 μF, and 0.001 μF timing capacitors from the SWEEP RANGE switch, noting their respective positions on the switch.

( ) 4. Remove the remaining 82 pF capacitor, which is mounted in parallel with C280E trimmer, and replace it on the two adjacent contacts upwards of its original position.

NOTE: This is a physical location change only.

NOTE: The following method is used to identify the RANGE SWITCH terminals:

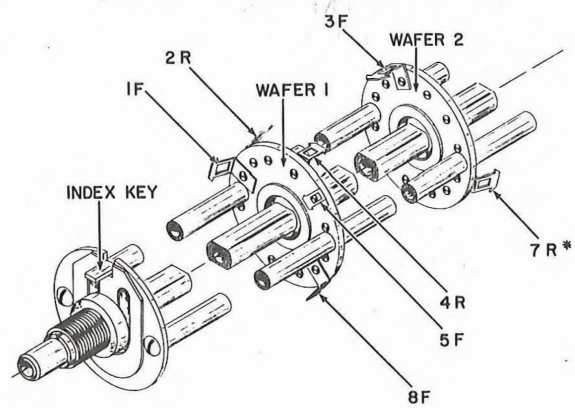
Wafers are numbered from front to rear.

Contact positions are numbered 1 through 12 relative to the index key as shown in drawing.

Contacts have an 'F' or 'R suffix which denotes that they are on the front or rear of the wafer.

Example: W2-7R (denoted by * on drawing) is contact #7 on the rear of wafer 2.

(TYPICAL SWITCH CONFIGURATION)



( ) 5. Solder wire, originally connected to rear terminal of old 1 μF capacitor (removed in step 1), to "C" terminal on new timing capacitor. Other end is soldered to W3-5R and 6R.

( ) 6. Solder wire, originally connected to front terminal of old 1 μF capacitor (removed in step 1), to 1 μF terminal on new timing capacitor. Other end is soldered to W4-5R and 6R.

( ) 7. Solder the 5 in. white-orange wire (from kit) to contact W4-7R and dress it through grommet to the 0.1 μF terminal on new timing capacitor.

INSTRUCTIONS (cont)

( ) 8. Solder the 5-1/4 in. white-green wire (from kit) to contact W4-8R and dress it through grommet to the 0.01 μF terminal on new timing capacitor.

( ) 9. Observe the shorting strap connecting contacts W3-5R and W3-6R. Solder another strap from W3-6R to 7R and 8R to make the four contacts a common point.

( ) 10. Install new 0.001 μF Mylar capacitor (from kit) in the position previously occupied by the old 0.001 μF capacitor, between contacts W3-9R and W4-9R.

THIS COMPLETES THE INSTALLATION.

( ) Recheck your work.

( ) Correct your Instruction Manual as required.

( ) Refer to your Instruction Manual and recalibrate your instrument as required.

GG:cet

PARTS REPLACEMENT KIT

CRT CONVERSION

050-0141-01

For the following Tektronix Oscilloscopes:

Types 310 serial numbers 101-7139
315D serial numbers 101-2978
360 serial numbers 101-2576

DESCRIPTION

The Type 3WP___ CRT used in the Types 310, 315D, and 360 Oscilloscopes is replaced by a Type T3100___ CRT. Replacement of the CRT socket by a 136-0081-00 socket is required to install the new CRT.

Four of the binding head screws used in the Type 315D CRT shield are replaced with flat head screws to allow clearance for the new T3100___ CRTs.

This kit does not include the CRT.

NOTE: If the serial number of your instrument is above those listed, or if this kit has been installed, disregard the instructions as the T3100___ CRT is a direct replacement.

Publication:
Instructions for 050-0141-01
July 1967

Supersedes:
050-0141-00

PARTS LIST

Quantity	Part Number	Description
1 ea	136-0081-00	Socket, tube, CRT
4 ea	211-0559-00	Screw, 6-32 x 3/8 FHS, 100° Phillips

INSTRUCTIONS

A. FOR TYPE 315D INSTRUMENTS:

( ) 1. Remove the cathode ray tube (CRT).

( ) 2. Remove the HV shield (337-0016-00) from the top rear, left side of the instrument.

( ) 3. Remove the DC Shift Comp bracket over the rear of the CRT shield.

NOTE: Position the bracket up and toward the opposite side of the instrument.

( ) 4. Unsolder the CRT socket leads, noting their locations in respect to color-code.

( ) 5. Replace the four CRT shield mounting screws, indicated in the drawing, with the four flat head screws from the kit.

( ) 6. Cut the leads of the new socket to match those on the old socket.

NOTE: The new socket has a white-red lead in place of one of the two brown filament leads on the old socket.

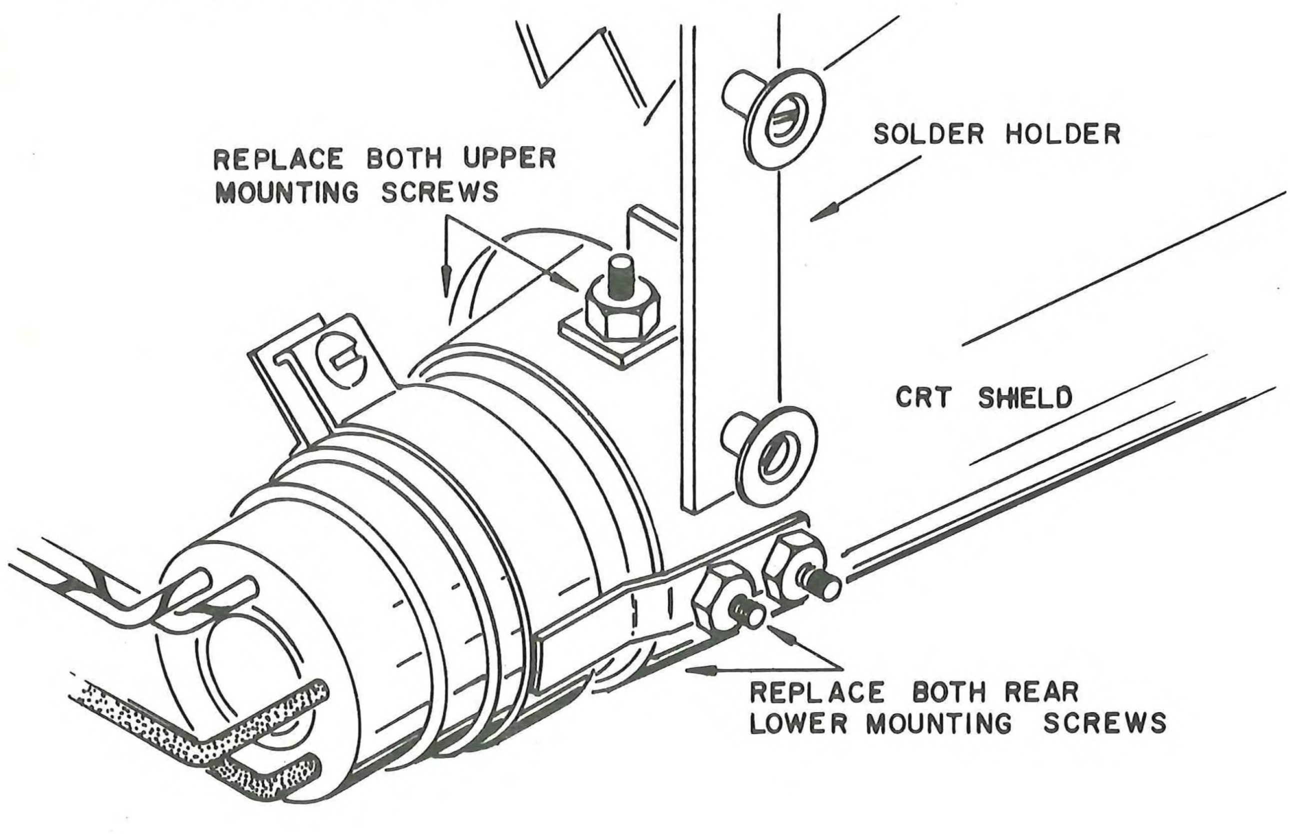
( ) 7. Install the new CRT socket in the instrument.

( ) 8. Replace the DC Shift Comp bracket and HV shield previously removed.

( ) 9. Install the CRT.

THIS COMPLETES THE INSTALLATION FOR TYPE 315D INSTRUMENTS.

( ) Check wiring for accuracy.



B. FOR TYPE 360 INSTRUMENTS:

( ) 1. Remove the cathode ray tube.

( ) 2. Remove the two HV shields.

( ) 3. Remove the CRT socket leads, noting their locations in respect to color-code.

( ) 4. Cut the leads of the new socket to match those on the old socket.

NOTE: There is a white-red lead on the new socket that replaces one of the two brown filament leads on the old socket.

( ) 5. Install the new CRT socket.

( ) 6. Replace both the HV shields previously removed.

( ) 7. Install the CRT.

THIS COMPLETES THE INSTALLATION FOR TYPE 360 INSTRUMENTS.

( ) Check wiring for accuracy.

C. FOR TYPE 310 INSTRUMENTS:

( ) 1. Remove the cathode ray tube.

( ) 2. Remove the CRT socket leads, noting their locations in respect to color-code.

( ) 3. Cut the leads of the new socket to match those on the old socket.

NOTE: There is a white-red lead on the new socket that replaces one of the two brown filament leads on the old socket.

( ) 4. Install the new CRT socket.

( ) 5. Install the new CRT.

THIS COMPLETES THE INSTALLATION FOR TYPE 310 INSTRUMENTS.

( ) Check wiring for accuracy.

BE:ls

PARTS REPLACEMENT KIT

CRT CONVERSION (T3100_)

TEKTRONIX®

For the following Tektronix Oscilloscopes:

Type 315D serial numbers 101-up
Type 360 serial numbers 101-2576

DESCRIPTION

The Type 3WP_ CRT used in the Types 315D and 360 Oscilloscopes is replaced by a Type T3100_ CRT. Replacement of CRT socket 136-023 by 136-081 is required to install the new CRT.

Four of the binding head screws used in the Type 315D CRT shield are replaced with flat head screws to allow clearance for the new T3100_ CRT's.

This kit does not include the CRT.

DISCONTINUED

SEE NUMERICAL PARTS RECORD (NPR) FOR DISPOSITION

050-141

Publication:
Instructions for 050-141
June 1964

PARTS LIST

Quantity	Description	Part Number
1 ea.	Socket, tube, CRT	136-081
4 ea.	Screw, 6-32 x 3/8 FHS 100° Phillips	211-559

INSTRUCTIONS

A. FOR TYPE 315D INSTRUMENTS:

1. Remove the following from the instrument:

( ) the cathode ray tube (CRT).

( ) the HV shield (337-016) from the top rear, left side of the instrument.

( ) the DC Shift Comp bracket over the rear of the CRT shield. NOTE: Position the bracket up and toward the opposite side of the instrument.

( ) 2. Unsolder the CRT socket leads, noting their locations in respect to color-code.

( ) 3. Replace the four CRT shield mounting screws, indicated in the drawing, with the four flat head screws from the kit.

( ) 4. Cut the leads of the new socket to match those on the old socket. NOTE: The new socket has a white-red lead in place of one of the two brown filament leads on the old socket.

( ) 5. Install the new CRT socket in the instrument.

( ) 6. Replace the DC Shift Comp bracket and HV shield previously removed.

( ) 7. Install the CRT.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 315D INSTRUMENTS.

( ) Check wiring for accuracy.

B. FOR TYPE 360 INSTRUMENTS:

1. Remove the following from the instrument:

( ) the cathode ray tube.

( ) the two HV shields.

( ) the CRT socket leads, noting their locations in respect to color-code.

( ) 2. Cut the leads of the new socket to match those on the old socket. NOTE: There is a white-red lead on the new socket that replaces one of the two brown filament leads on the old socket.

( ) 3. Install the new CRT socket.

( ) 4. Replace both the HV shields previously removed.

( ) 5. Install the CRT.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 360 INSTRUMENTS.

( ) Check wiring for accuracy.

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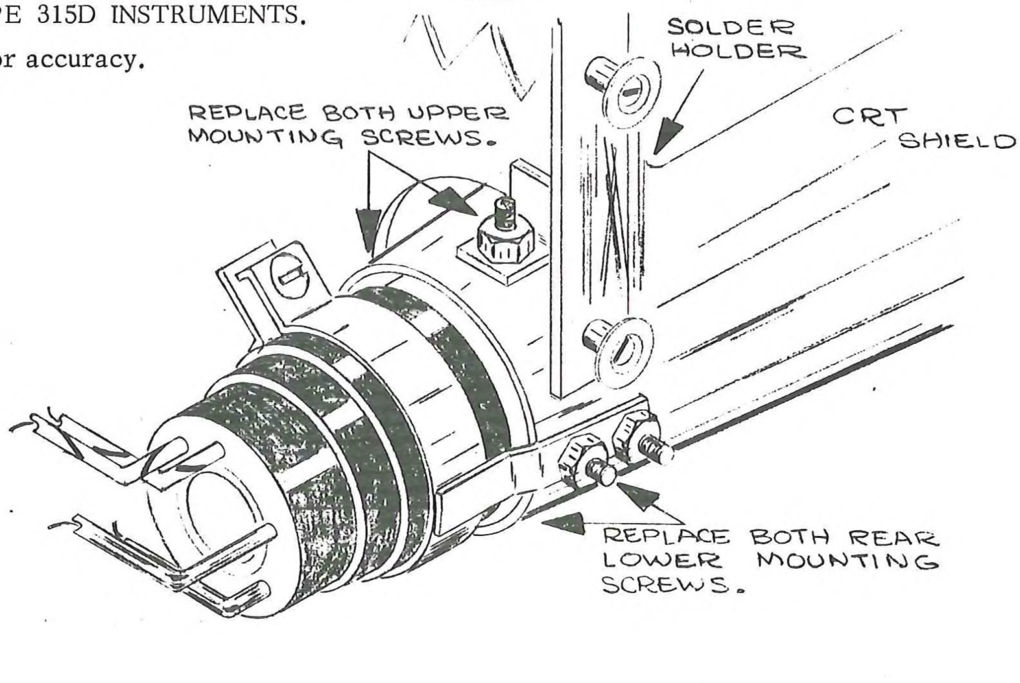

PARTS REPLACEMENT KIT

CRT CONVERSION (T3100_)

050-141

For the following Tektronix Oscilloscopes:

Type 315D serial numbers 101-up
Type 360 serial numbers 101-2576

DESCRIPTION

The Type 3WP_ CRT used in the Types 315D and 360 Oscilloscopes is replaced by a Type T3100_ CRT. Replacement of CRT socket 136-023 by 136-081 is required to install the new CRT.

Four of the binding head screws used in the Type 315D CRT shield are replaced with flat head screws to allow clearance for the new T3100_ CRT's.

This kit does not include the CRT.

Publication:
Instructions for 050-141
June 1964

PARTS LIST

Quantity	Description	Part Number
1 ea.	Socket, tube, CRT	136-081
4 ea.	Screw, 6-32 x 3/8 FHS 100° Phillips	211-559

INSTRUCTIONS

A. FOR TYPE 315D INSTRUMENTS:

1. Remove the following from the instrument:

( ) the cathode ray tube (CRT).

( ) the HV shield (337-016) from the top rear, left side of the instrument.

( ) the DC Shift Comp bracket over the rear of the CRT shield. NOTE: Position the bracket up and toward the opposite side of the instrument.

( ) 2. Unsolder the CRT socket leads, noting their locations in respect to color-code.

( ) 3. Replace the four CRT shield mounting screws, indicated in the drawing, with the four flat head screws from the kit.

( ) 4. Cut the leads of the new socket to match those on the old socket. NOTE: The new socket has a white-red lead in place of one of the two brown filament leads on the old socket.

( ) 5. Install the new CRT socket in the instrument.

( ) 6. Replace the DC Shift Comp bracket and HV shield previously removed.

( ) 7. Install the CRT.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 315D INSTRUMENTS.

( ) Check wiring for accuracy.

B. FOR TYPE 360 INSTRUMENTS:

1. Remove the following from the instrument:

( ) the cathode ray tube.

( ) the two HV shields.

( ) the CRT socket leads, noting their locations in respect to color-code.

( ) 2. Cut the leads of the new socket to match those on the old socket. NOTE: There is a white-red lead on the new socket that replaces one of the two brown filament leads on the old socket.

( ) 3. Install the new CRT socket.

( ) 4. Replace both the HV shields previously removed.

( ) 5. Install the CRT.

THIS COMPLETES THE INSTALLATION FOR THE TYPE 360 INSTRUMENTS.

( ) Check wiring for accuracy.

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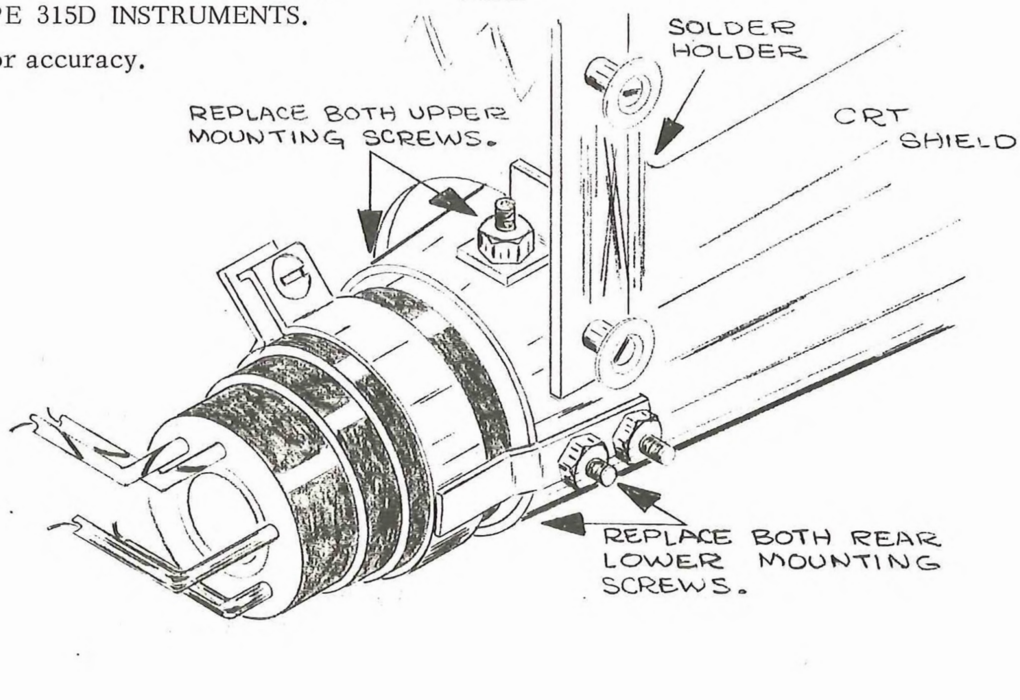


PARTS REPLACEMENT KIT

STABILITY CONTROL

For Tektronix Type 315D Oscilloscopes
Serial numbers 101-2191

050-149

DESCRIPTION

STABILITY potentiometer, part number 311-456 replaces 311-024 in the above listed instruments. The new potentiometer is superior mechanically, allowing for easier replacement.

NOTE: If this kit has been installed, disregard the instructions as P/N 311-456 is a direct replacement.

NOTE: If the serial number of your instrument is above those listed, disregard the instructions and use P/N 311-026 as a direct replacement.

Publication:
Instructions for 050-149
March 1966

Supersedes:
February 1964

PARTS LIST

Quantity	Description	Part Number
1 ea.	Lockwasher, int. 3/8 x 1/2	210-012
1 ea.	Lockwasher, int. 3/8 x 11/16	210-013
2 ea.	Nut, hex, 3/8-32 x 1/2	210-413
1 ea.	Potentiometer, comp, 100k 2w var 20%	311-456
1 ea.	Coupling, pot	376-014
1 ea.	Rod (shaft), extension, steel	384-114
12 in.	Wire, solder, silver-bearing	

INSTRUCTIONS

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

( ) 1. Remove red and black knobs from Trigger switch. Loosen nut on switch shaft and position switch up away from chassis as far as leads will permit.

NOTE: On some instruments it may be necessary to temporarily relocate some components mounted on the ceramic strips directly behind SW201. Unsolder C326 from out board ceramic strip and push it down on the chassis between the socket of V205 and the switch. Unsolder R236 from out board ceramic strip and move it out of the way. See drawing.

( ) 2. Remove old potentiometer and hardware.

( ) 3. Install new potentiometer, hardware and coupling (all from kit) as shown in drawing, tighten nut and replace knobs. Replace inner shaft with shaft from kit, if necessary.

NOTE: Due to different spacing on the switch wafers it may be necessary to mount the pot using a nut on each side of the Switch plate. If so use the thin lockwasher (210-012) from kit.

( ) 4. Solder C326 and R236 in ceramic strip.

( ) 5. Tighten switch mounting nut and replace knobs.

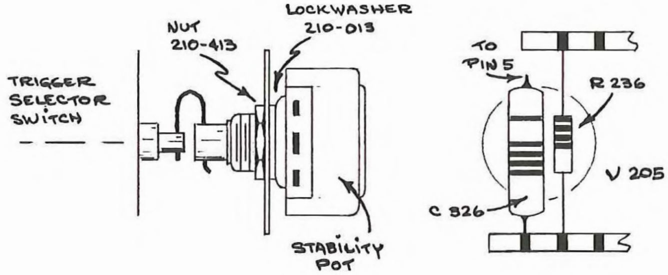
THIS COMPLETES THE INSTALLATION

( ) Check the potentiometer for smooth operation.

( ) Correct your Manual Parts List to read

R231, 100k, 2w, var, comp, 20%, 311-456

JT:cc



MODIFICATION KIT

3-WIRE POWER CORD

For Tektronix Type 315D Oscilloscope
Serial numbers 101-up

DESCRIPTION

The two-wire power cord 161-002 is replaced by the three-wire power cord 161-017.

The replacement cord is made of improved material and has a ground wire to reduce hazard of shock.

An adapter is also supplied with the new power cord.

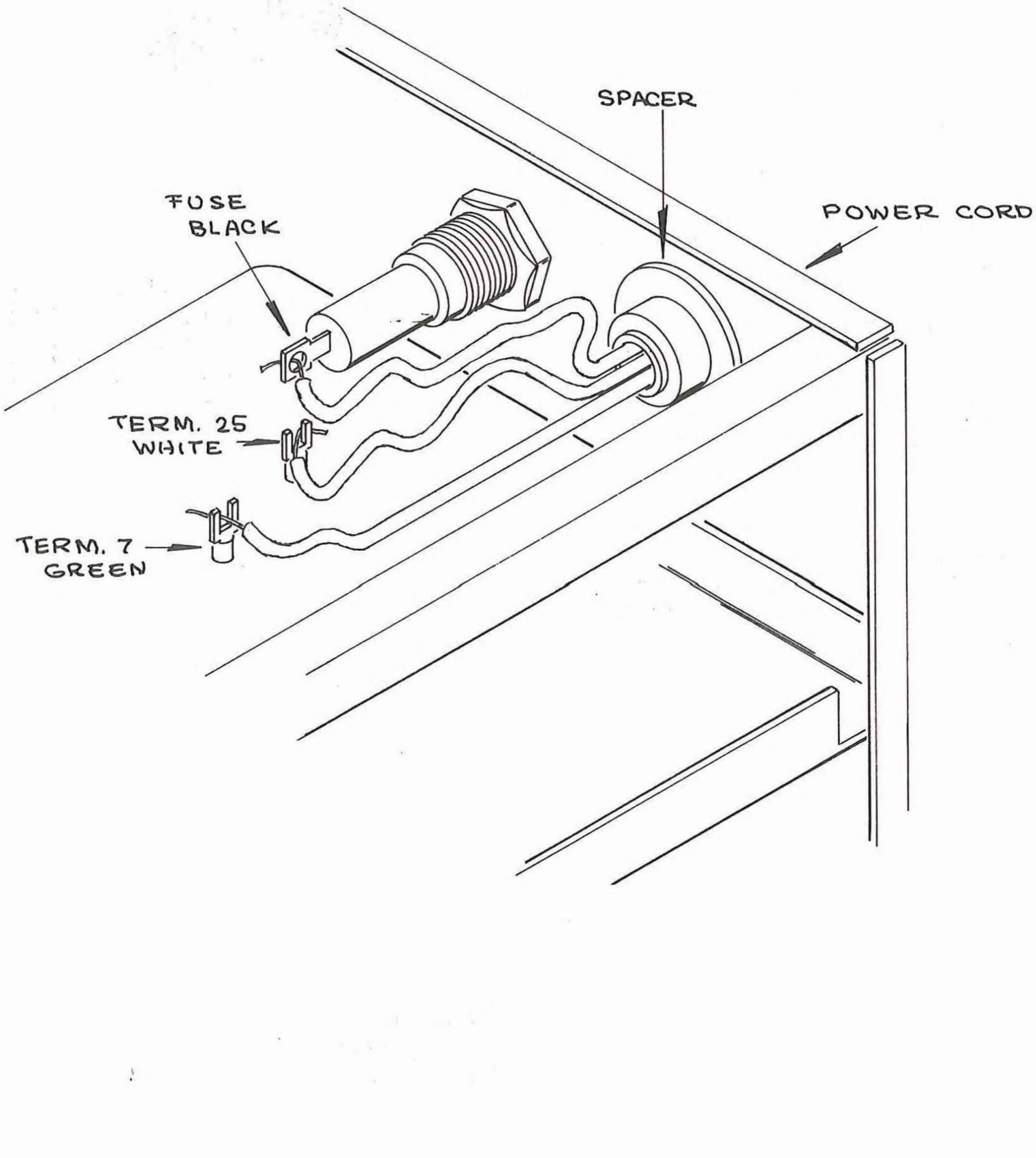
NOTE: If the s/n of your instrument is above those listed or if this kit has already been installed, disregard the instructions as P/N 161-017 is a direct replacement.

050-213

Publication:
Instructions for 050-213
October 1964

PARTS LIST

Quantity	Description	Part Number
1 ea.	Adapter, power cord, 3-wire to 2-wire	103-013
1 ea.	Cord, 3-wire, 8 ft.	161-017
1 ea.	Spacer, connector, alum, 5/8 ID x 1-1/8 OD x 0.051	210-837
1 ea.	Bushing, Heyco, strain relief	358-025



A. REMOVAL OF POWER CORD FROM INSTRUMENTS BETWEEN S/N 101-1080

( ) 1. Remove the instrument from its cabinet.

( ) 2. Unsolder the white wire from terminal #25 on the power transformer.

( ) 3. Unsolder the black wire from the fuse holder.

( ) 4. Remove the cord from the cable clamp and instrument.

( ) 5. Remove the black bakelite board and mounting hardware.

B. REMOVAL OF POWER CORD FROM INSTRUMENTS S/N 1081-UP

( ) 1. Remove the instrument from its cabinet.

( ) 2. Unsolder the white wire from terminal #25 on the power transformer.

( ) 3. Unsolder the black wire from the fuse holder.

( ) 4. Cut the power cord off at the bushing and pull the remaining cord through it.

( ) 5. Remove the bushing and its spacer. (The bushing and spacer from the kit will be used to install the new cord.)

C. INSTALLATION OF NEW 3-WIRE POWER CORD

( ) 1. Place the 'Heyco' bushing near the end of the cord.

( ) 2. Place the smaller end through the mounting hole in the chassis.

( ) 3. Place the spacer (from kit) over the bushing, on the inside of the chassis, while the bushing is clamped into place. (A pair of pliers will aid in squeezing the bushing together when inserting it in the mounting hole.)

( ) 4. Solder the black wire to the end terminal of the fuse holder.

( ) 5. Solder the white wire to terminal #25 on the power transformer.

( ) 6. Solder the green ground wire to terminal #7 on the power transformer.

THIS COMPLETES THE INSTALLATION

( ) Check wiring for accuracy.

( ) Re-install the instrument in the cabinet.

( ) Correct your Instruction Manual as required.

GG/JT:1s

PARTS REPLACEMENT KIT

SILICON DIODES REPLACE 106-005

For the following Tektronix Instruments:

Type 315D All serial numbers
Type 180A s/n 5001-6385

DESCRIPTION

152-066 Silicon Diodes replace 106-005 selenium stack which is no longer being manufactured. The silicon diodes offer better reliability and longer life.

If you wish to replace all the selenium stacks at one time, order Modification Kit 040-214, for Type 180A, or 040-220, for Type 315D.

NOTE: If the serial number of your instrument is above those listed or if this kit has already been installed, disregard the instructions and use P/N 152-066 as a direct replacement.

050-226

Publication:
Instructions for 050-226
January 1965

PARTS LIST

Quantity	Description				Part Number
1 ea.	Assembly, Silicon rectifier, consisting of:				
	4 ea. Diode, silicon 1N3194				152-066
	1 ea. Resistor,	10Ω	1/2w	10%	302-100
	1 ea. Bracket, mounting				Special
1 ea.	Washer, steel, flat 6L x 3/8 x 0.032				210-803
1 ea.	Screw, 6-32 x 3/8 BHS				211-510
1 ea.	Spool, w/3ft. of silver-bearing solder				214-210

INSTRUCTIONS

( ) 1. Remove selenium stack SR741 (180A), SR701 (180A) or SR460 (315D).

FOR TYPE 180A ONLY

( ) 2. Connect wires to silicon rectifier assembly (from kit) as shown in Fig. 1.

( ) Orient assembly as shown in Fig. 2. If replacing SR701, do not connect the bare wire to SR721 until step 3.

( ) 3. Mount silicon rectifier assembly in instrument using a #6-32 x 3/8 screw and flat washer from the kit. Orient as indicated in Fig. 2 or 3.

( ) Connect bare wire to SR701 as shown in Fig. 2.

FOR TYPE 315D ONLY

( ) 4. Connect wires to the rectifier assembly as shown in Fig. 4.

THIS COMPLETES THE INSTALLATION

( ) Make the necessary corrections to the Parts List in your Instruction Manual.

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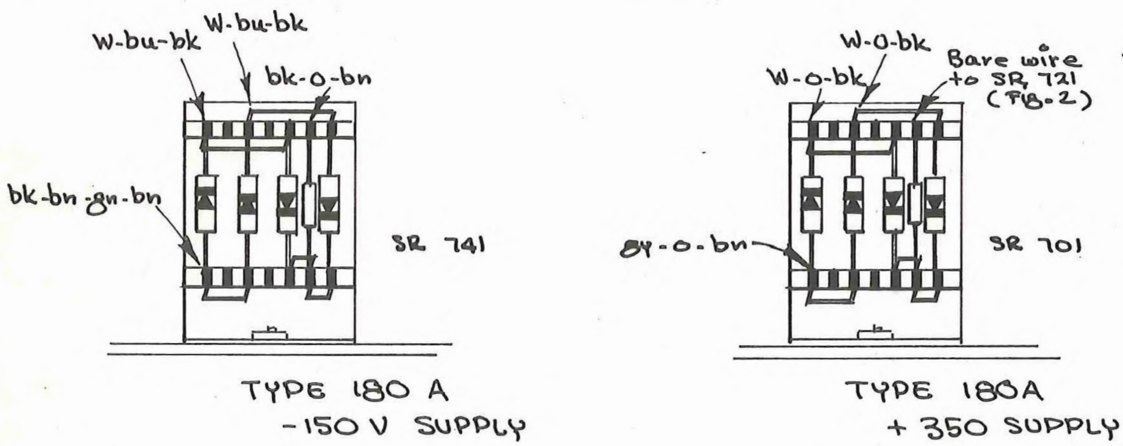
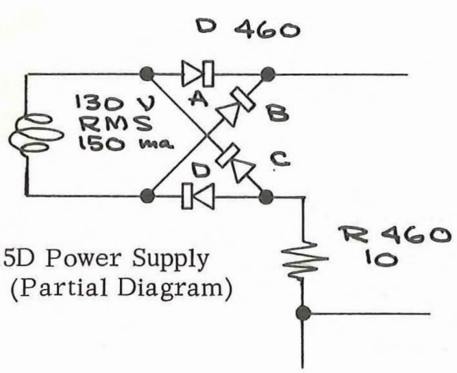
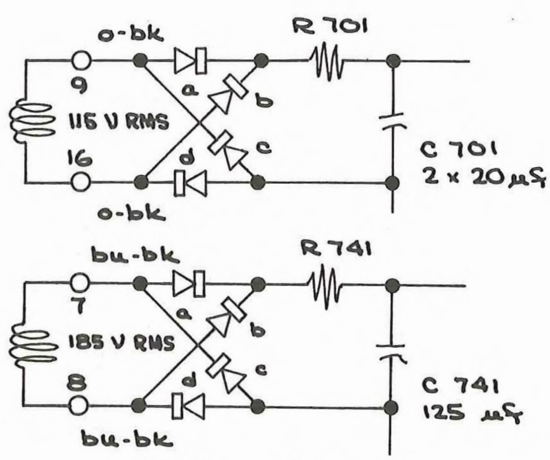


Fig. 1



315D Power Supply
(Partial Diagram)



180A Power Supply
(Partial Diagram)

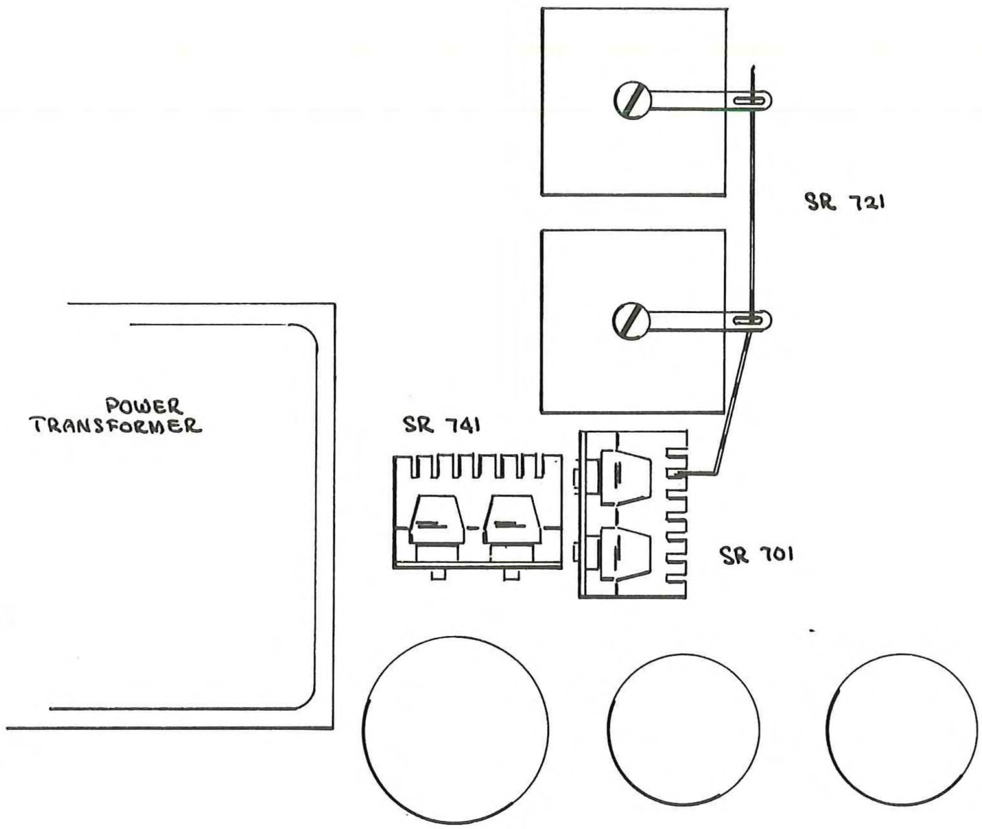


Fig. 2

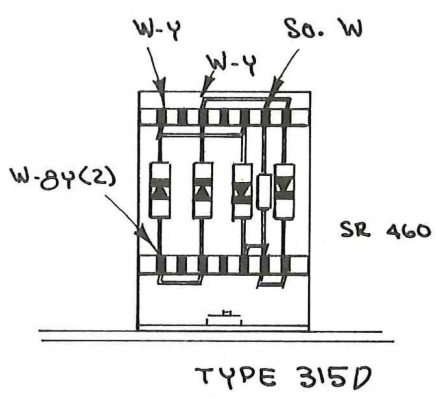


Fig. 3

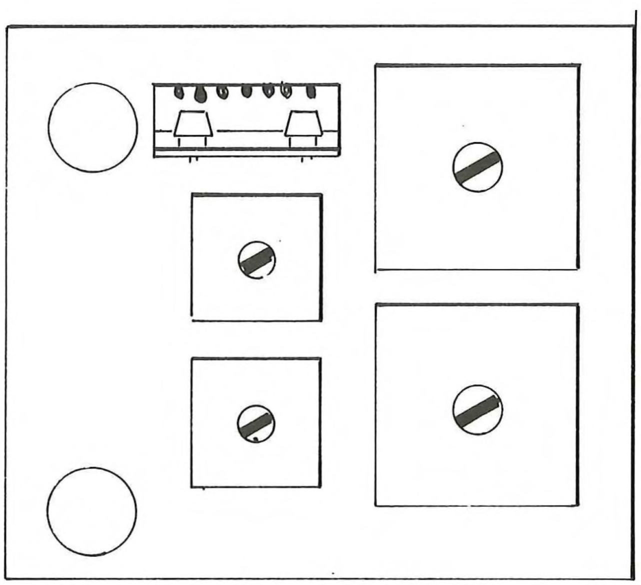


Fig. 4

PARTS REPLACEMENT KIT

SILICON RECTIFIERS FOR DC FAN

TEKTRONIX ®

For the following Tektronix Oscilloscopes:

Types 315D	SN 101-up	RM15	SN 101-820
515	SN 101-1000	RM16	SN 101-580
515A	SN 1001-4029	RS 16	SN 101-up
		RM17	SN 101-309

DESCRIPTION

050-0228-00

The selenium rectifier 106-0006-00, which is no longer available, is replaced by silicon diodes. An assembly is provided which includes four silicon diodes (152-0066-00) and mounting bracket.

NOTE: If the serial number of your instrument is above those listed, or if this kit has been installed, disregard the instructions as PN 152-0066-00 is a direct replacement.

Publication:
Instructions for 050-0228-00
April 1967

Supersedes:
February 1965

PARTS LIST

Quantity	Part Number	Description
(1 ea)		Assembly, silicon rectifier, consisting of:
2 ea	124-0088-00	Strip, cer, 3/4 x 4-notch (large), clip-mounted
4 ea	152-0066-00	Diode, silicon, 1N3194 400PIV
1 ea	210-0006-00	Lockwasher, steel, int #6
1 ea	210-0803-00	Washer, steel #6L, 3/8 x 0.032
1 ea	211-0507-00	Screw, 6-32 x 5/16 PHS, Phillips
4 ea	361-0007-00	Spacer, nylon molded, 0.063
1 ea	385-0080-00	Rod, hex, 1/4 x 7/16
1 ea	406-0531-00	Bracket, silicon rectifier mounting
1 ea	210-0006-00	Lockwasher, steel, int #6
1 ea	210-0803-00	Washer, steel #6L, 3/8 x 0.032
1 ea	211-0507-00	Screw, 6-32 x 5/16 PHS, Phillips
1 ea	214-0210-00	Spool, w/3 ft. silver-bearing solder
2 ea		Wire, #22 solid, 175-0522-00, white 3 in.
2 ea		Wire, #22 solid, 175-0522-00, white-red 3 in.

INSTRUCTIONS

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

A. TO REPLACE SELENIUM RECTIFIER IN THE FOLLOWING INSTRUMENTS: See Fig. 1
Type 515 SN 101-1000; Type 515A SN 1001-4029

( ) 1. Replace the selenium rectifier on the Power chassis with the assembly from the kit. Position the assembly as shown, using a lockwasher (from kit) between the assembly and the chassis.

( ) 2. Solder the two white and two white-red wires (from kit) between the assembly and the adjacent ceramic strip as shown.

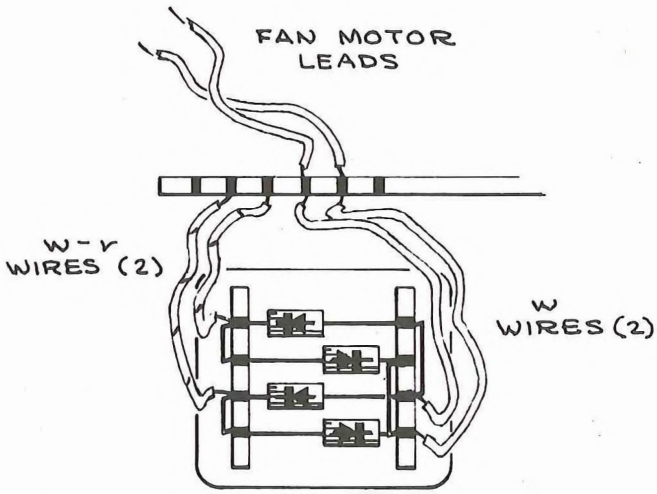


FIG. 1

INSTRUCTIONS (cont)

B. TO REPLACE SELENIUM RECTIFIER IN TYPE 315D: See Fig. 2

( ) 1. Unsolder and remove the selenium rectifier and its mounting bracket.

( ) 2. Install the silicon assembly (from kit), using the rear mounting hole of the two used for the selenium mounting bracket. Position the assembly as shown.

( ) 3. Solder the wires removed from the selenium rectifier to the new assembly as shown.

C. TO REPLACE SELENIUM RECTIFIER IN THE FOLLOWING INSTRUMENTS: See Fig. 3
Types RM15 SN 101-820; RM16 SN 101-580; RS16 SN 101-up; RM17 SN 101-309

( ) 1. Replace the selenium rectifier stack with the silicon rectifier assembly from the kit.

( ) 2. Wire the new assembly as shown.

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

( ) Correct your Instruction Manual Parts List and Power Supply schematic as necessary.

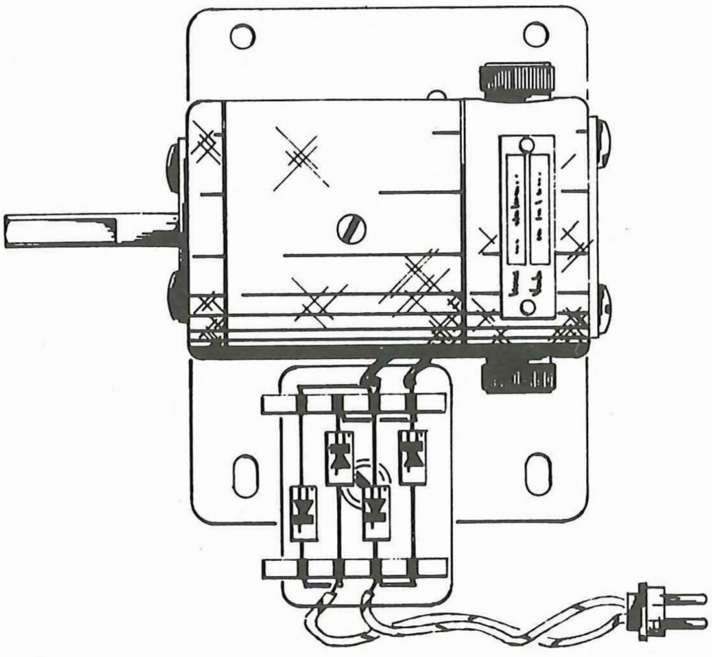


FIG. 2

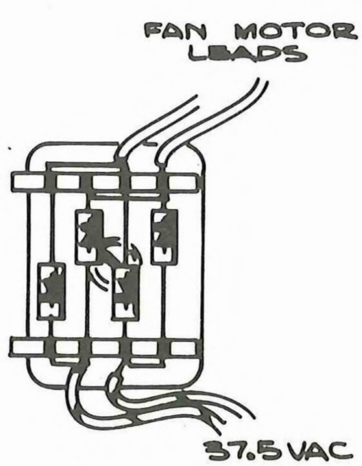


FIG. 3

DF:ls

SECTION 5
PARTS LIST

Abbreviations

Cer.	ceramic	m	milli or 10
Comp.	composition	Ω	ohm
EMC	electrolytic, metal cased	PMC	paper, metal-cased
f	farad	Poly.	polystyrene
GMV	guaranteed minimum value	Prec.	precision
h	henry	PT	paper tubular
k	kilohm or 10 ohms	v	working volts dc
meg	megohm or 10 ohms	Var.	variable
μ	micro or 10	w	watt
$\mu\mu$	micromicro or 10	WW	wire wound

Special Notes and Symbols

X000	Part first added at this serial number
000X	Part removed at this serial number
(Mod. w/)	Simple replacement not recommended. Modify for later instruments and change other listed parts to match.

Bulbs

Ckt. No.	S/N Range	Description		Part Number
B280		Neon	Type NE2	150-009
B310		Neon	Type NE2	150-009
B319		Neon	Type NE2	150-009
B401		Incandescent, #47		150-001
B402		Incandescent, #47		150-001
B403		Incandescent, #47		150-001

Capacitors

Ckt. No.	S/N Range	Description					Part Number
C1		.1 μf	PT	Fixed	600 v	20%	285-528
C2	101-643	5-20 $\mu\mu$f	Cer.	Var.	500 v		281-032
	644 - up	4.5-25 $\mu\mu$f	Cer.	Var.	500 v		281-010
C3		1.5-7 $\mu\mu$f	Cer.	Var.	500 v		281-005

C4		27 $\mu\mu$f	Cer.	Fixed	500 v	20%	281-513
C5	101-643	5-20 $\mu\mu$f	Cer.	Var.	500 v		281-032
	644 - up	4.5-25 $\mu\mu$f	Cer.	Var.	500 v		281-010
C6		1.5-7 $\mu\mu$f	Cer.	Var.	500 v		281-005
C7		330 $\mu\mu$f	Mica	Fixed	500 v	20%	283-518
C9		6.25 μf	EMC	Fixed	300 v	-20+50%	290-000
C10	101-643	5-20 $\mu\mu$f	Cer.	Var.	500 v		281-032
	644 - up	4.5-25 $\mu\mu$f	Cer.	Var.	500 v		281-010
C11		6.25 μf	EMC	Fixed	300 v	-20+50%	290-000
C12		.22 μf	PT	Fixed	400 v	20%	285-533
C13	X268 - up	.01 μf	Cer.	Fixed	500 v	GMV	283-002
C14		.01 μf	Cer.	Fixed	500 v	GMV	283-002
C15		1.5-7 $\mu\mu$f	Cer.	Var.	500 v		281-005
C16	X268-299	.02 μf	Cer.	Fixed	500 v	GMV	283-004
	300 - up	.01 μf	Cer.	Fixed	500 v	GMV	283-002
C17	X300 - up	.01 μf	Cer.	Fixed	500 v	GMV	283-002
C18	X300 - up	.01 μf	Cer.	Fixed	500 v	GMV	283-002
C20		.01 μf	PT	Fixed	400 v	20%	285-510
C21		6.25 μf	EMC	Fixed	300 v	-20+50%	290-000
C22		.01 μf	PT	Fixed	400 v	20%	285-510
C23	X363 - up	.01 μf	Cer.	Fixed	500 v	GMV	283-002
C25		.01 μf	Cer.	Fixed	500 v	GMV	283-002
C26	X300 - up	.01 μf	Cer.	Fixed	500 v	GMV	283-002
C27	X300 - up	.01 μf	Cer.	Fixed	500 v	GMV	283-002
C86	X357 - up	20 μf	EMC	Fixed	150 v	-20+50%	290-008
C88	X357 - up	20 μf	EMC	Fixed	150 v	-20+50%	290-008
C101	101-643X	3-12 $\mu\mu$f	Cer.	Var.	500 v		281-007
C200		.047 μf	PT	Fixed	400 v	20%	285-519
C201		.001 μf	Cer.	Fixed	500 v	GMV	283-000
C202		12 $\mu\mu$f	Cer.	Fixed	500 v	10%	281-506

C212		.001 µf	Cer.	Fixed	500 v	GMV	283-000
C221		.001 µf	Cer.	Fixed	500 v	GMV	283-000
C223		470 µµf	Cer.	Fixed	500 v	20%	281-525
C227		22 µµf	Cer.	Fixed	400 v	20%	281-510
C241A	101-643X	.1 µf	PT	Fixed	400 v	20%	285-526
C241B	101-643X	.01 µf	PT	Fixed	400 v	20%	285-510
C241C	101-643X	.001 µf	PT	Fixed	600 v	20%	285-501
C241D	101-643X	100 µµf	Cer.	Fixed	500 v	20%	281-523
C241E	101-643X	22 µµf	Cer.	Fixed	400 v	20%	281-510
C241F	101-643X	12 µµf	Cer.	Fixed	500 v	20%	281-506
C244		4.7 µµf	Cer.	Fixed	500 v	+or-1µµf	281-501
C250		47 µµf	Cer.	Fixed	500 v	20%	281-518
C251		12 µµf	Cer.	Fixed	500 v	10%	281-506
C260	101-643	5-20 µµf	Cer.	Var.	500 v		281-032
	644 - up	4.5-25 µµf	Cer.	Var.	500 v		281-010
C261		47 µµf	Cer.	Fixed	500 v	20%	281-518
C262		8 µµf	Cer.	Fixed	400 v	+or-.5 µµf	281-503
C263		.001 µf	Cer.	Fixed	500 v	GMV	283-000
C272	101-174	22 µµf	Cer.	Fixed	400 v	20%	281-510
	175 - up	47 µµf	Cer.	Fixed	500 v	20%	281-518
C276	101-174	3-12 µµf	Cer.	Var.	500 v		281-007
	175 - up	1.5-7 µµf	Cer.	Var.	500 v		281-006
C280A		1 µf	PMC	Fixed	400 v	Selected)	
C280B		.1 µf	PT	Fixed	400 v	Selected)	Timing Series See Text
C280C	101-356	.01 µf	PT	Fixed	400 v	Selected)	291-001
	357-394	.01 µf	Mica	Fixed	300 v	Selected)	
	395 - up	.01 µf	PT	Fixed	600 v	Selected)	
C280D		.001 µf	PT	Fixed	600 v	Selected	Timing Series See Text 291-014
C280E		7-45 µµf	Cer.	Var.	500 v		281-012
C280F	101-643	82 µµf	Cer.	Fixed	500 v	20%	Use 281-528
	644 - up	82 µµf	Cer.	Fixed	500 v	10%	281-528

C280G		3-12 $\mu\mu$f	Cer.	Var.	500 v		281-007
C282		.01 μf	PT	Fixed	400 v	20%	285-510
C290		1.5-7 $\mu\mu$f	Cer.	Var.	500 v		281-005
C291		4.7 $\mu\mu$f	Cer.	Fixed	500 v	+or-1 $\mu\mu$f	281-501
C300	101-174X	5-25 $\mu\mu$f	Cer.	Var.	500 v		281-010
C303	101-174	4.7 $\mu\mu$f	Cer.	Fixed	500 v	+or-1 $\mu\mu$f	281-501
	175 - up	.5-5 $\mu\mu$f	Poly.	Var.	500 v		281-001
C325		.01 μf	PT	Fixed	600 v	20%	285-511
C326		.01 μf	PT	Fixed	400 v	20%	285-510
C327		.01 μf	PT	Fixed	400 v	20%	285-510
C328		.01 μf	PT	Fixed	400 v	20%	285-510
C401		2x40 μf	EMC	Fixed	250 v	-20+50%	290-040
C402		125 μf	EMC	Fixed	350 v	-20+50%	290-044
C403		.01 μf	PT	Fixed	400 v	20%	285-510
C404		.01 μf	PT	Fixed	400 v	20%	285-510
C420		2x40 μf	EMC	Fixed	250 v	-20+50%	290-041
C421		.01 μf	PT	Fixed	400 v	20%	285-510
C422A		1/3 3x10 μf	EMC	Fixed	450 v	-20+50%)	
C422B		1/3 3x10 μf	EMC	Fixed	450 v	-20+50%)	290-033
C422C		1/3 3x10 μf	EMC	Fixed	450 v	-20+50%)	
C440		2x40 μf	EMC	Fixed	450 v	-20+50%	290-043
C441		.01 μf	PT	Fixed	400 v	20%	285-510
C460		2x40 μf	EMC	Fixed	250 v	-20+50%	290-040
C461	101-347	.01 μf	PT	Fixed	400 v	20%	285-511
	348 - up	.01 μf	PT	Fixed	600 v	20%	285-511
C501	101-2687	1.5-7 $\mu\mu$f	Cer.	Var.	500 v		281-006
	2688 - up	3-12 $\mu\mu$f	Cer.	Var.	500 v		281-009
C502A-E							
	101-590	5-25 $\mu\mu$f	Cer.	Var.	500 v		281-010
C502A-B							
	591 - up	3-12 $\mu\mu$f	Cer.	Var.	500 v		281-009

C502C-E	591 - up	5-25 $\mu\mu$f	Cer.	Var.	500 v		281-011
C511A-F		5-25 $\mu\mu$f	Cer.	Var.	500 v		281-011
C521A-F		5-25 $\mu\mu$f	Cer.	Var.	500 v		281-011
C522		1.5-7 $\mu\mu$f	Cer.	Var.	500 v		281-006
C601		220 $\mu\mu$f	Mica	Fixed	500 v	20%	283-514
C602		220 $\mu\mu$f	Mica	Fixed	500 v	20%	283-514
C603		8 $\mu\mu$f	Cer.	Fixed	500 v	25%	281-503
C604		47 $\mu\mu$f	Cer.	Fixed	500 v	20%	281-518
C802		.001 μf	Cer.	Fixed	500 v	GMV	283-000
C804		.001 μf	PT	Fixed	600 v	20%	285-501
C805		.001 μf	PT	Fixed	600 v	20%	285-501
C815		.0068 μf	PT	Fixed	3000 v	20%	285-508
C816		.0068 μf	PT	Fixed	3000 v	20%	285-508
C817		.022 μf	PT	Fixed	400 v	20%	285-515
C818		.0068 μf	PT	Fixed	3000 v	20%	285-508
C901		.015 μf	PT	Fixed	3000 v	20%	285-513
C902		.015 μf	PT	Fixed	3000 v	20%	285-513

Fuses

Fuse	5 amp	3AG	Slo-Blo for 117V Operation	159-006
Fuse	2 amp	3AG	Slo-Blo for 234V Operation	159-023

Inductors

L1	101-643	2.2-3.9 μh	Var.	CV222	114-007
	644 - up	19-35 μh Var.	CV193		114-005
L2	101-643	19-35 μh Var.	CV193		114-005
	644 - up	2.2-3.9 μh	Var.	CV222	114-007
L3		4.8-8.5 μh	Var.	CV482	114-020
L4		28-50 μh Var.	CV283		114-013
L5		28-50 μh Var.	CV283		114-013

L6	101-643	53-96 μh	Var.	CV513	114-021
	644 - up	53-96 μh	Var.	CV513	114-021
L7	101-643	53-96 μh	Var.	CV513	114-021
	644 - up	53-96 μh	Var.	CV513	114-021
L221	101-449X	150 μh	Fixed	Wound on R221	108-026
L246	101-449X	70 μh	190 turns of #39 wire, on 4.7 k, 2 w resistor		108-027
LR2	X450 - up	150 μh	Fixed	Wound on 1.5 k, 1 w res.	108-026
LR3	X450 - up	70 μh	190 turns of #39 wire on 4.7 k, 2 w resistor		108-027

Resistors

R1		900 k	1 w	Fixed	Prec.	1%	310-097
R2		111 k	1/2 w	Fixed	Prec.	1%	309-046
R3		990 k	1 w	Fixed	Prec.	1%	310-098
R4		10.1 k	1/2 w	Fixed	Prec.	1%	309-034
R5		1 meg	1/2 w	Fixed	Prec.	1%	309-014
R7		1 meg	1/2 w	Fixed	Prec.	1%	309-014
R8	X363 - up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R10		100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R11		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R12		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R13		22 k	2 w	Fixed	Comp.	10%	306-223
R14		27 k	2 w	Fixed	Comp.	10%	306-273
R15		200 Ω	2 w	Var.	Comp.	20%	311-004
R16	X268-350	12 Ω	1/2 w	Fixed	Comp.	10%	302-120
	351 - up	10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R19	X300 - up	6.8 k	1/2 w	Fixed	Comp.	10%	302-682
R20		600 k	1/2 w	Fixed	Prec.	1%	309-004
R21		610 k	1/2 w	Fixed	Prec.	1%	309-006
R23		4.3 k	2 w	Fixed	Comp.	5%	305-432
R24		5.6 k	2 w	Fixed	Comp.	10%	306-562
R25		5.6 k	2 w	Fixed	Comp.	10%	306-562

R26	X764 - up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R30		1 k	2 w	Fixed	Comp.	10%	306-102
R31		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R32		27 k	2 w	Fixed	Comp.	10%	306-273
R33		33 k	2 w	Fixed	Comp.	10%	306-333
R34		100 k	1/2 w	Fixed	Comp.	10%	302-104
R35		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R36	101-267	220 Ω	1/2 w	Fixed	Comp.	10%	302-221
	268 - up	150 Ω	1/2 w	Fixed	Comp.	10%	302-151
R39	X582 - up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R40		2.2 k	1 w	Fixed	Comp.	10%	304-222
R41		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R42		1 k	1/2 w	Fixed	Comp.	10%	302-102
R44		8 k	5 w	Fixed	WW	5%	308-007
R45		8 k	5 w	Fixed	WW	5%	308-007
R46		27 Ω	1/2 w	Fixed	Comp.	10%	302-270
R50		470 Ω	1/2 w	Fixed	Comp.	10%	302-471
R51		2.5 k	1/10 w	Var.	Comp.	20%	311-010
R52	101-350	1 k	1/2 w	Fixed	Comp.	10%	302-102
	351 - up	1.2 k	1/2 w	Fixed	Comp.	10%	302-122
R53		10 k	1/10 w	Var.	Comp.	20%	311-017
R54		2250 Ω	2 w	Var.	Comp.	20%	311-071
R55		5 k	2 w	Var.	Comp.	20%	311-011
R59	101-350	12 Ω	1/2 w	Fixed	Comp.	10%	302-120
	351 - up	10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R60		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R61		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R62		12 k	2 w	Fixed	Comp.	10%	306-123
R63		470 k	1/2 w	Fixed	Comp.	10%	302-474
R64		12 k	2 w	Fixed	Comp.	10%	306-123

R65		220 k	1/2 w	Fixed	Prec.	1%	309-052
R66	101-350	18 k	1/2 w	Fixed	Comp.	10%	302-183
	351 - up	22 k	1/2 w	Fixed	Comp.	5%	301-223
R69	X351-643	22 k	1/2 w	Fixed	Comp.	5%	301-223
	644 - up	22 k	1/2 w	Fixed	Comp.	10%	302-223
R70	101-350	20 k	2 w	Var.	Comp.	20%	311-018
	351 - up	250 k	2 w	Var.	Comp.	20%	311-032
R71		27 Ω	1/2 w	Fixed	Comp.	10%	302-270
R72	101-350X	10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R73		27 Ω	1/2 w	Fixed	Comp.	10%	302-270
R74	101-350X	10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R75		2 k	5 w	Fixed	WW	5%	308-003
R76		2 k	5 w	Fixed	WW	5%	308-003
R80	101-356	2.5 k	10 w	Fixed	WW	5% (non-induct.) Use Mod Kit	040-007
	357 - up	2.7 k	10 w	Fixed	WW	5% (non-induct.) Use Mod Kit	308-019
R81		6.8 k	1/2 w	Fixed	Comp.	10%	302-682
R82		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R83		750 Ω	10 w	Fixed	WW	5%	308-016
R84	101-356	2.5 k	10 w	Fixed	WW	5% (non-induct.) Use Mod Kit	040-007
	357 - up	2.7 k	10 w	Fixed	WW	5% (non-induct.) Use	308-019
R85		6.8 k	1/2 w	Fixed	Comp.	10%	302-682
R86	X357-1691	39 k	1/2 w	Fixed	Comp.	10%	302-393
	1692 - up	33 k	1/2 w	Fixed	Comp.	10%	302-333
R87	X357 - up	1 meg	2 w	Var.	Comp.	20%	311-040
R88	X357-1691	39 k	1/2 w	Fixed	Comp.	10%	302-393
	1692 - up	33 k	1/2 w	Fixed	Comp.	10%	302-333
R90		100 Ω	2 w	Var.	Comp.	20%	311-003
R91	101-350X	10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R92		27 Ω	1/2 w	Fixed	Comp.	10%	302-270

R93		27 Ω	1/2 w	Fixed	Comp.	10%	302-270
R94	101-350X	10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R95		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R97		100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R98		100 Ω	2 w	Var.	Comp.	20%	311-003
R101	101-643X	9 meg	1/2 w	Fixed	Comp.	10%	Use 301-915
R200		1 meg	1/2 w	Fixed	Comp.	10%	302-105
R201		1 meg	1/2 w	Fixed	Comp.	10%	302-105
R202		10 k	1/10 w	Var.	Comp.	20%	311-017
R203		50 k	1/2 w	Fixed	Prec.	1%	309-090
R204		100 k	1/2 w	Fixed	Prec.	1%	309-045
R207	X764 - up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R208		4.7 k	1 w	Fixed	Comp.	10%	304-472
R209		4.7 k	1 w	Fixed	Comp.	10%	304-472
R210		18 k	2 w	Fixed	Comp.	10%	306-183
R211		47 k	1/2 w	Fixed	Comp.	10%	302-473
R212		100 k	2 w	Var.	Comp.	20%	311-025
R215		100 k	1/2 w	Fixed	Comp.	10%	302-104
R216		560 k	1/2 w	Fixed	Comp.	10%	302-564
R217		390 k	1/2 w	Fixed	Comp.	10%	302-394
R220		2.2 k	1/2 w	Fixed	Comp.	10%	302-222
R221		1.5 k	1 w	Fixed	Comp.	10%(with L221)	304-152
R222		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R223		500 Ω	2 w	Var.	Comp.	20%	311-005
R224		22 k	1 w	Fixed	Comp.	10%	304-223
R225		22 k	1 w	Fixed	Comp.	10%	304-223
R226		150 k	1/2 w	Fixed	Prec.	1%	309-049
R227		95 k	1/2 w	Fixed	Prec.	1%	309-044

R230		39 k	1/2 w	Fixed	Comp.	10%	302-393
R231		100 k	2 w	Var.	Comp.	20%	311-026
R232		18 k	2 w	Fixed	Comp.	10%	306-183
R233		2.2 k	1/2 w	Fixed	Comp.	10%	302-222
R234		470 k	1/2 w	Fixed	Comp.	10%	302-474
R235		680 k	1/2 w	Fixed	Comp.	10%	302-684
R236		470 Ω	1/2 w	Fixed	Comp.	10%	302-471
R239	X175 - up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R240		22 k	2 w	Fixed	Comp.	10%	306-223
R241		22 k	1/2 w	Fixed	Comp.	10%	302-223
R242		10 k	1 w	Fixed	Comp.	10%	304-103
R243		390 k	1/2 w	Fixed	Comp.	10%	302-394
R244		470 k	1/2 w	Fixed	Comp.	10%	302-474
R245		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R246		4.7 k	2 w	Fixed	Comp.	10%(with L246)	306-472
R247		4.7 k	2 w	Fixed	Comp.	10%	306-472
R248		100 k	1 w	Fixed	Comp.	10%	304-104
R250		150 k	1/2 w	Fixed	Prec.	1%	309-049
R251	101-489	150 k	1/2 w	Fixed	Comp.	10%	302-154
	490 - up	150 k	1/2 w	Fixed	Prec.	1%	309-049
R252		4.7 k	2 w	Fixed	Comp.	10%	306-472
R253	101-489	100 k	1/2 w	Fixed	Comp.	10%	302-104
	490 - up	95 k	1/2 w	Fixed	Prec.	1%	309-044
R254	101-489	50 k	2 w	Var.	Comp.	20%	311-023
	490 - up	100 k	2 w	Var.	Comp.	20%	311-026
R255		120 k	1/2 w	Fixed	Prec.	1%	309-091
R260		700 k	1/2 w	Fixed	Prec.	1%	309-008
R261		50 k	2 w	Var.	Comp.	20%	311-023
R262		47 k	1 w	Fixed	Comp.	10%	304-473
R263		1 meg	1/2 w	Fixed	Comp.	10%	302-105

R264		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R265	X175 - up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R270		500 k	1/2 w	Fixed	Prec.	1%	309-003
R271		100 k	1 w	Fixed	Comp.	10%	304-104
R272	101-643	18 k	1 w	Fixed	Comp.	10%	304-183
	644 - up	18 k	1 w	Fixed	Comp.	-8+0%	312-537
R273	101-643	47 k	2 w	Fixed	Comp.	10%	306-473
	644 - up	47 k	2 w	Fixed	Comp.	-5+5%	312-537
R274		22 k	2 w	Fixed	Comp.	10%	306-223
R275		4.7 k	1/2 w	Fixed	Comp.	10%	302-472
R276		3.9 k	1/2 w	Fixed	Comp.	10%	302-392
R279		15 Ω	1 w	Fixed	Comp.	10%	304-150
R280		22 k	2 w	Fixed	Comp.	10%	306-223
R281		22 k	2 w	Fixed	Comp.	10%	306-223
R282A		183 k	1/2 w	Fixed	Prec.	1%	309-050
R282B		60 k	1/2 w	Fixed	Prec.	1%	309-041
R282C	101-174	60 Ω	1/2 w	Fixed	Prec.	1%	309-067
	175 - up	56.5 k	1/2 w	Fixed	Prec.	1%	309-040
R282D		1.84 meg	1/2 w	Fixed	Prec.	1%	309-021
R282E		608 k	1/2 w	Fixed	Prec.	1%	309-005
R282F		608 k	1/2 w	Fixed	Prec.	1%	309-005
R282G	101-789	18.6 meg	2 w	Fixed	Prec.	1%	Use 310-109
	790 - up	18.6 meg	1 w	Fixed	Prec.	1%	310-109
R282H		6.12 meg	1/2 w	Fixed	Prec.	1%	309-088
R282J		6.12 meg	1/2 w	Fixed	Prec.	1%	309-088
R283		500 k	2 w	Var.	Comp.	20%	311-072
R284		18 k	2 w	Fixed	Comp.	10%	306-183
R285		10 k	1 w	Fixed	Comp.	10%	304-103
R286		10 k	2 w	Var.	WW	20%	311-015
R287	101-362	8.2 k	1/2 w	Fixed	Comp.	10%	302-822
	363 - up	4.7 k	1/2 w	Fixed	Comp.	10%	302-472

R288		20 k	2 w	Var.	Comp.	20%	311-018
R289		1.75 meg	1/2 w	Fixed	Prec.	1%	309-019
R290		2.44 meg	1/2 w	Fixed	Prec.	1%	309-024
R291		3.3 k	1/2 w	Fixed	Comp.	10%	302-332
R292	X782 - up	1 meg	1/2 w	Fixed	Comp.	10%	302-105
R293	X782 - up	2.7 meg	1/2 w	Fixed	Comp.	10%	302-275
R300	101-643	200 k	1/2 w	Fixed	Prec.	1%	309-051
	644 - up	220 k	1/2 w	Fixed	Prec.	1%	309-052
R301		47 k	1 w	Fixed	Comp.	10%	304-473
R302		47 k	1 w	Fixed	Comp.	10%	304-473
R303		700 k	1/2 w	Fixed	Prec.	1%	309-008
R304		433 k	1/2 w	Fixed	Prec.	1%	309-001
R305	101-362	68 k	1 w	Fixed	Comp.	10%	304-683
	363 - up	22 k	1 w	Fixed	Comp.	10%	304-223
R306	101-643	10 k	2 w	Var.	WW	20%	311-015
	644 - up	10 k	2 w	Var.	Comp.	20%	311-016
R308		22 k	2 w	Fixed	Comp.	10%	306-223
R310	101-1809	20 k	10 w	Fixed	WW	10%	308-025
	1810 - up	20 k	8 w	Fixed	WW	5%	308-011
R311		30 k	10 w	Fixed	WW	10%	308-027
R315		500 Ω	2 w	Var.	Comp.	20%	311-005
R316		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R317		18 k	2 w	Fixed	Comp.	10%	306-183
R318	101-1809	20 k	10 w	Fixed	WW	10%	308-025
	1810 - up	20 k	8 w	Fixed	WW	5%	308-011
R319		68 k	2 w	Fixed	Comp.	10%	306-683
R325		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R326		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R327		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R328		47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R401		39 k	1/2 w	Fixed	Comp.	10%	302-393

R402		47 k	1/2 w	Fixed	Comp.	10%	302-473
R403		12 k	1/2 w	Fixed	Comp.	10%	302-123
R404		1 meg	1/2 w	Fixed	Comp.	10%	302-105
R405		1 k	1/2 w	Fixed	Comp.	10%	302-102
R406		33 k	1/2 w	Fixed	Comp.	10%	302-333
R407		1 meg	1/2 w	Fixed	Comp.	10%	302-105
R408		2 k	20 w	Fixed	WW	5%	308-031
R409		220 k	1/2 w	Fixed	Comp.	10%	302-224
R410		100 k	2 w	Var.	Comp.	20%	311-026
R411		270 k	1/2 w	Fixed	Comp.	10%	302-274
R412		50 Ω	2 w	Var.	WW	20%	311-055
R420		39 k	1/2 w	Fixed	Comp.	10%	302-393
R421		270 k	1/2 w	Fixed	Comp.	10%	302-274
R422		1 meg	1/2 w	Fixed	Comp.	10%	302-105
R423		100 k	1/2 w	Fixed	Comp.	10%	302-104
R424	101-2380	143 k	1/2 w	Fixed	Prec.	1%	309-048
	2381-2558	150 k	1/2 w	Fixed	Prec.	1%	309-049
	2559 - up	220 k	1/2 w	Fixed	Prec.	1%	309-052
R425	101-2558	100 k	1/2 w	Fixed	Prec.	1%	309-045
	2559 - up	150 k	1/2 w	Fixed	Prec.	1%	309-049
R440		1.5 meg	1/2 w	Fixed	Comp.	10%	302-155
R441		270 k	1/2 w	Fixed	Comp.	10%	302-274
R442		56 k	1/2 w	Fixed	Comp.	10%	302-563
R443		3.5 k	20 w	Fixed	WW	5%	308-032
R444		220 k	1/2 w	Fixed	Prec.	1%	309-052
R445		143 k	1/2 w	Fixed	Prec.	1%	309-092
R446	X348 - up	2.2 meg	1/2 w	Fixed	Comp.	10%	302-225
R461		27 k	1/2 w	Fixed	Comp.	10%	302-273
R462		150 k	2 w	Fixed	Comp.	10%	306-154
R463		1.8 meg	1/2 w	Fixed	Comp.	10%	302-185

R464		1.8 meg	1/2 w	Fixed	Comp.	10%	302-185
R465		1.5 k	25 w	Fixed	WW	5%	308-040
R467	101-380	1.8 meg	1/2 w	Fixed	Prec.	1%	309-020
	381 - up	800 k	1/2 w	Fixed	Prec.	1%	309-110
R468	101-380	750 k	1/2 w	Fixed	Prec.	1%	309-010
	381 - up	333 k	1/2 w	Fixed	Prec.	1%	309-053
R469	X348-643	2.2 meg	1/2 w	Fixed	Prec.	1%	Use 302-225
	644 - up	2.2 meg	1/2 w	Fixed	Comp.	10%	302-225
R521		1.1 k	1 w	Fixed	Prec.	1%	310-092
R601		100 k	1/2 w	Fixed	Comp.	10%	302-104
R603		820 k	1/2 w	Fixed	Comp.	10%	302-824
R604		100 k	1/2 w	Fixed	Comp.	10%	302-104
R605		820 k	1/2 w	Fixed	Comp.	10%	302-824
R610		100 k	1 w	Fixed	Comp.	10%	304-104
R611		56 k	1/2 w	Fixed	Comp.	10%	302-563
R612		50 k	2 w	Var.	Comp.	20%	311-023
R620		18 k	1/2 w	Fixed	Prec.	1%	309-036
R621		1.8 k	1/2 w	Fixed	Prec.	1%	309-030
R622		180 Ω	1/2 w	Fixed	Prec.	1%	309-072
R623		20 Ω	1/2 w	Fixed	Prec.	1%	309-064
R802		1 meg	1/2 w	Fixed	Comp.	10%	302-105
R803		47 k	2 w	Fixed	Comp.	10%	306-473
R804		1.5 k	1/2 w	Fixed	Comp.	10%	302-152
R805		47 k	1/2 w	Fixed	Comp.	10%	302-473
R816		1.2 meg	1/2 w	Fixed	Comp.	10%	302-125
R817		2 meg	2 w	Var.	Comp.	20%	311-042
R901		27 k	1/2 w	Fixed	Comp.	10%	302-273
R902		1.5 meg	1/2 w	Fixed	Comp.	10%	302-155
R903		2 meg	1/2 w	Var.	Comp.	20%	311-043

R904		3.9 meg	2 w	Fixed	Comp.	10%	306-395
R905		1 meg	1/2 w	Fixed	Comp.	10%	302-105
R910		1 meg	1/2 w	Var.	Comp.	20%	311-041
R911		1.5 meg	1/2 w	Fixed	Comp.	10%	302-155
R912	101-752	5.6 meg	2 w	Fixed	Comp.	10%	306-565
	753 - up	6.8 meg	2 w	Fixed	Comp.	10%	306-685
R913	101-752	5.6 meg	2 w	Fixed	Comp.	10%	306-565
	753 - up	6.8 meg	2 w	Fixed	Comp.	10%	306-685
R914		100 k	1/2 w	Fixed	Comp.	10%	302-104
R920		20 k	2 w	Var.	Comp.	20%	311-018

Switches

			unwired	wired
SW1	2 wafer, 7 position, rotary	AMPLITUDE	260-045	262-016
SW2	1 wafer, 4 position, rotary	MULTIPLIER	260-141	
SW201	3 wafer, 10 position, rotary	TRIG. SELECTOR	260-140	262-018
SW202	4 wafer, 4 position, rotary	SW. MULTIPLIER	260-139	262-019
SW203	4 wafer, 8 position, rotary	SW. RANGE	260-054	262-020
SW204	1 wafer, 2 position, rotary	5X Magnifier	(part of SW203)	
SW401	single pole, signle throw, toggle	POWER	260-066	
SW601	1 wafer, 5 position	CALIBRATOR	260-033	262-021

Transformers

T401	Plate and Heater Supply		T315PA2	120-012
	Primary	117/234 vac, 50/800 cycle		
	Secondaries:	130 vac	150 ma	
		130 vac	300 ma	
		140 vac	375 ma	
		220 vac	150 ma	
		6.3 vac	1.2 amp	
		6.3 vac	4 amp	
		6.3 vac	6 amp	
		6.3 vac	3.5 amp	
		6.3 vac	2.5 amp	
T801	CRT Supply		T3150A2	120-011

Thermal Cut-Outs

TK401	X175-2485	Thermal Cut-Out	155° +or-5° F.	260-071
	2468 - up	Thermal Cut-Out	160° +or-5° F.	260-157

Vacuum Tubes

V1	6BQ7A		154-028
V2	6BQ7A		154-028
V3	6CL6		157-007
V4	6CL6		157-007
V8	6BQ7A		154-028
V10	12BY7		154-047
V11	12BY7		154-047
V12	12BY7		154-047
V13	12BY7		154-047
V201	12AT7		157-009
V202	6U8		154-033
V203	6BQ7A		154-028
V204	6BQ7A		154-028
V205	12AT7		154-039
V210	6BQ7A		154-028
V211	6BQ7A		154-028
V212	6BQ7A		154-028
V213	12AT7	Selected	157-010
V214	6U8		154-033
V215	6AL5		154-016
V220	6AK6		154-015
V221	6BQ7A		154-028
V222	6BQ7A		154-028

V223		6BQ7A		154-028
V224		6BQ7A		154-028
V401		5651		154-052
V402		6AU6		154-022
V403		12B4		154-044
V404		12B4		154-044
V421		6AU6		154-022
V422		6AS5		154-018
V441		6AU6		154-022
V442		6080		154-056
V461		6AU6		154-022
V601	101-643	12AT7		154-039
	644 - up	12AU7		154-039
V602		12AT7		154-039
V801		12AT7		154-039
V803		6AQ5		154-017
V804		5642		154-051
V805		5642		154-051
V806	101-279	3WP1	CRT	154-058
	280 - up	3WP2	CRT	154-059

MECHANICAL PARTS LIST

CONTENTS

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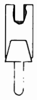
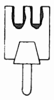
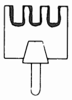
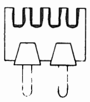
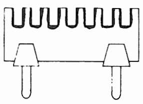
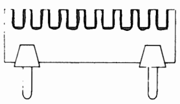
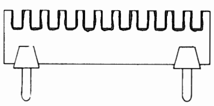
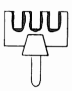
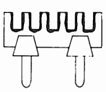
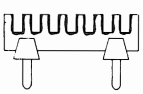
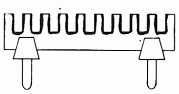
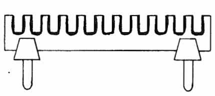
"CERAMIC STRIPS AND MOUNTINGS"

	Strip, 3/4 in. by 1 notch	124-0100-00
	Strip, 3/4 in. by 2 notches	124-0086-00
	Strip, 3/4 in. by 3 notches	124-0087-00
	Strip, 3/4 in. by 4 notches	124-0088-00
	Strip, 3/4 in. by 7 notches	124-0089-00
	Strip, 3/4 in. by 9 notches	124-0090-00
	Strip, 3/4 in. by 11 notches	124-0091-00
	Strip, 7/16 in. by 3 notches	124-0092-00
	Strip, 7/16 in. by 5 notches	124-0093-00
	Strip, 7/16 in. by 7 notches	124-0094-00
	Strip, 7/16 in. by 9 notches	124-0095-00
	Strip, 7/16 in. by 11 notches	124-0106-00
	Spacer, 5/32 in., 361-007 1/4 in., 361-008 3/4 in.	361-0009-00
	Stud, Clip, Molded Nylon	335-0046-00

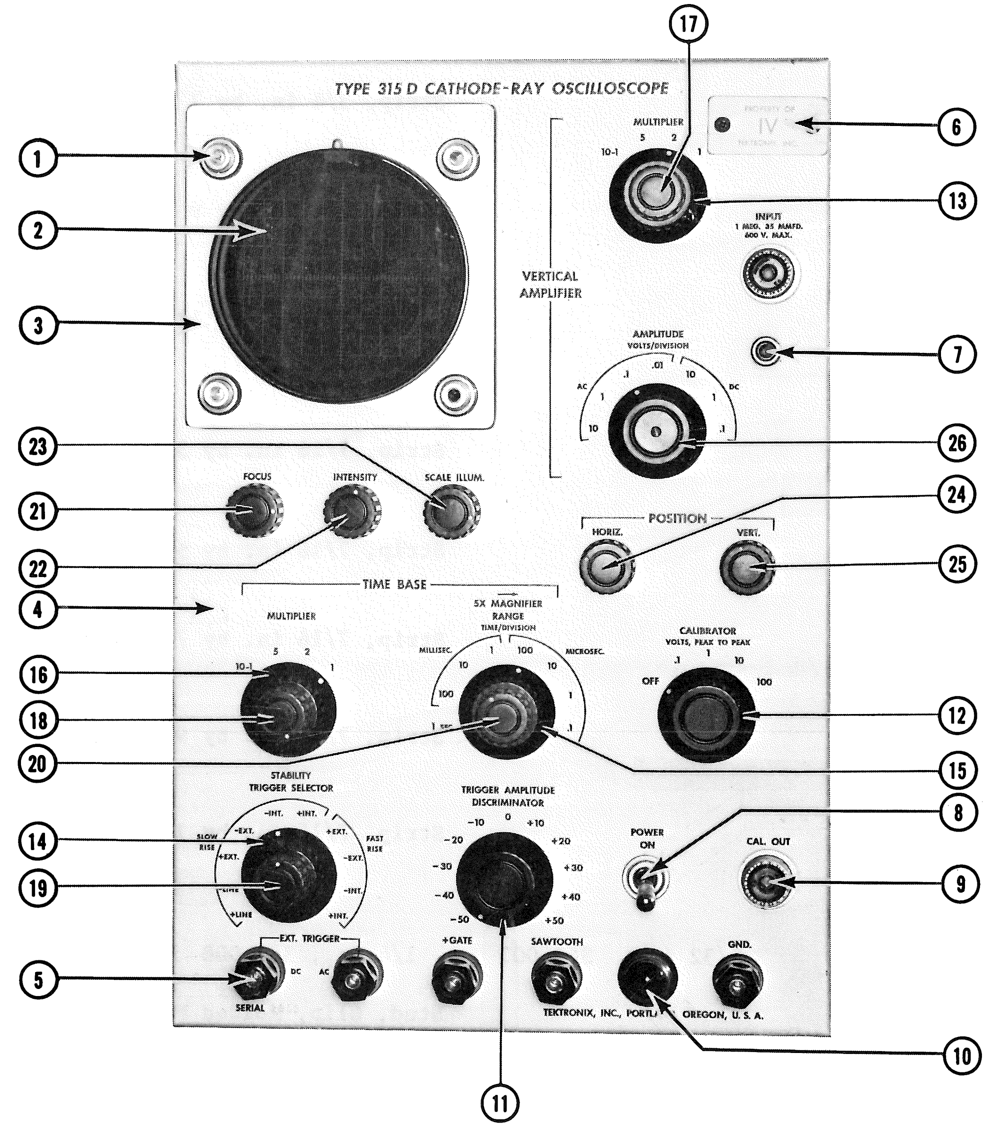
NOTE: Clip-mounted ceramic strips are direct replacements for hardware mounted strips previously used in Tektronix instruments.

When ordering strips for replacement, please include a description of part, part number, instrument type and serial number.

Each strip has the necessary studs mounted to it; but spacers must be ordered separately.

315D MECHANICAL PARTS

FRONT VIEW

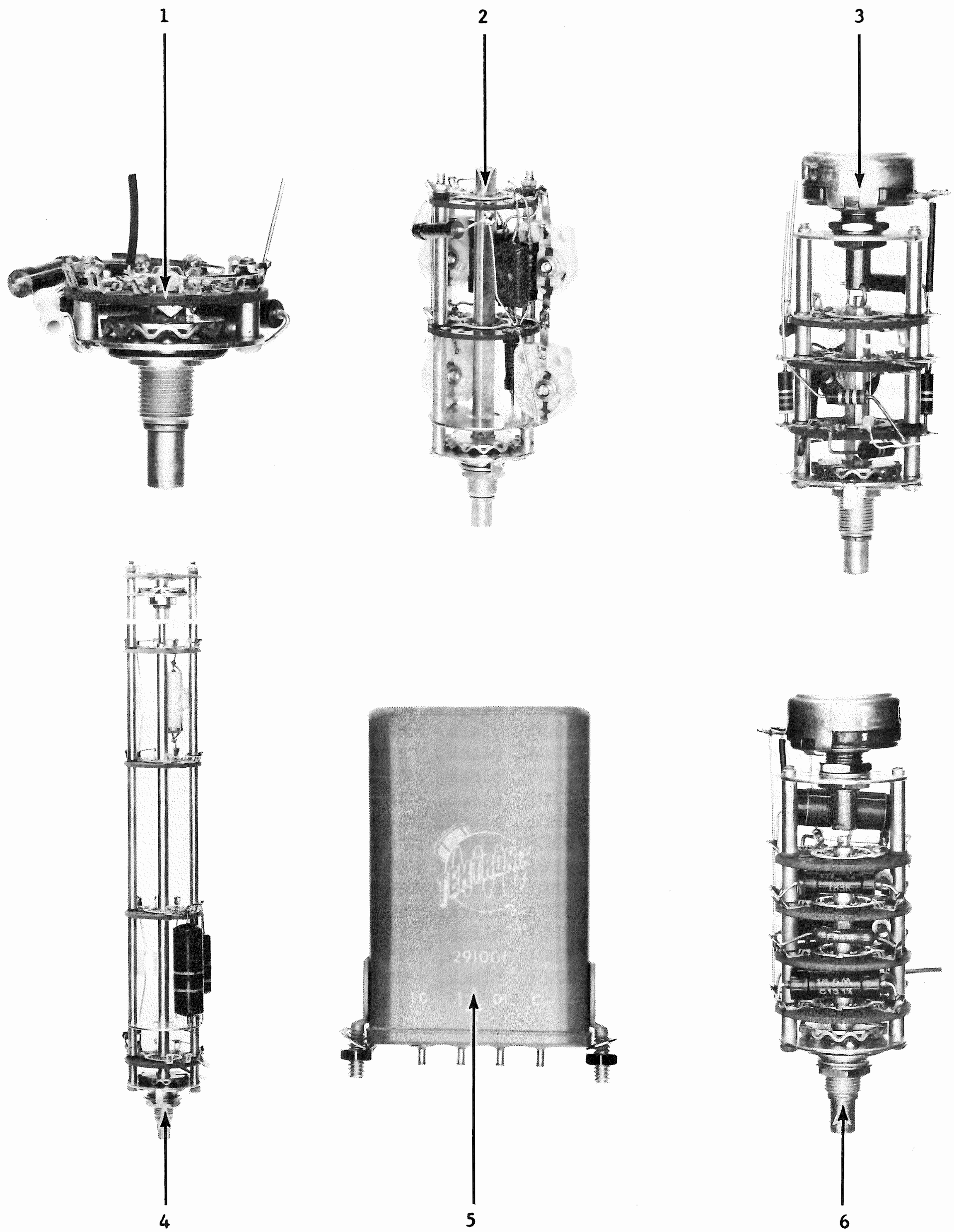


FRONT VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	355-0043-00			4	STUD
	210-0424-00			4	NUT, graticule
	210-0816-00			4	WASHER (under cover)
2	331-0005-00			1	GRATICULE
	378-0505-00			2	FILTER, light
3	200-0035-00			1	COVER, graticule
4	333-0045-00			1	PANEL, front
5	129-0001-00			5	POST, binding
6	- - - - - -				INDENTIFICATION TAG (Factory Use Only)
7	129-0020-00			1	POST, binding assembly
8	260-0134-00			1	SWITCH
9	131-0012-00			1	CONNECTOR, coaxial
10	136-0025-00			1	SOCKET, light, pilot
	378-0518-00			1	JEWEL, red
11	366-0011-00	101	1995	1	KNOB, black, TRIGGER AMPLITUDE DISCRIMINATOR
	366-0028-00	1996		1	KNOB, black, TRIGGER AMPLITUDE DISCRIMINATOR
12	366-0011-00	101	1995	1	KNOB, black, CALIBRATOR
	366-0028-00	1996		1	KNOB, black, CALIBRATOR
13	366-0013-00	101	1995	1	KNOB, black, MULTIPLIER
	366-0029-00	1996		1	KNOB, black, MULTIPLIER
14	366-0013-00	101	1995	1	KNOB, black, TRIGGER SELECTOR
	366-0029-00	1996		1	KNOB, black, TRIGGER SELECTOR
15	366-0013-00	101	1995	1	KNOB, black, RANGE TIME/DIVISION
	366-0029-00	1996		1	KNOB, black, RINGE TIME/DIVISION
16	366-0013-00	101	1995	1	KNOB, black, MULTIPLIER
	366-0029-00	1996		1	KNOB, black, MULTIPLIER
17	366-0015-00	101	1995	1	KNOB, red, MULTIPLIER
	366-0031-00	1996		1	KNOB, red, MULTIPLIER
18	366-0015-00	101	1995	1	KNOB, red, MULTIPLIER
	366-0031-00	1996		1	KNOB, red, MULTIPLIER
19	366-0015-00	101	1995	1	KNOB, red, STABILITY
	366-0031-00	1996		1	KNOB, red, STABILITY
20	366-0015-00	101	1995	1	KNOB, red, 5X MAGNIFIER
	366-0031-00	1996		1	KNOB, red, 5X MAGNIFIER
21	366-0014-00	101	1995	1	KNOB, black, FOCUS
	366-0033-00	1996		1	KNOB, black, FOCUS
22	366-0014-00	101	1995	1	KNOB, black, INTENSITY
	366-0033-00	1996		1	KNOB, black, INTENSITY
23	366-0014-00	101	1995	1	KNOB, black, SCALE ILLUM.
	366-0033-00	1996		1	KNOB, black, SCALE ILLUM.
24	366-0014-00	101	1995	1	KNOB, black, HORIZ.
	366-0033-00	1996		1	KNOB, black, HORIZ.
25	366-0014-00	101	1995	1	KNOB, black, VERT.
	366-0033-00	1996		1	KNOB, black, VERT
26	366-0012-00	101	1995	1	KNOB, black, AMPLITUDE
	366-0037-00	1996		1	KNOB, black, AMPLITUDE

315D MECHANICAL PARTS

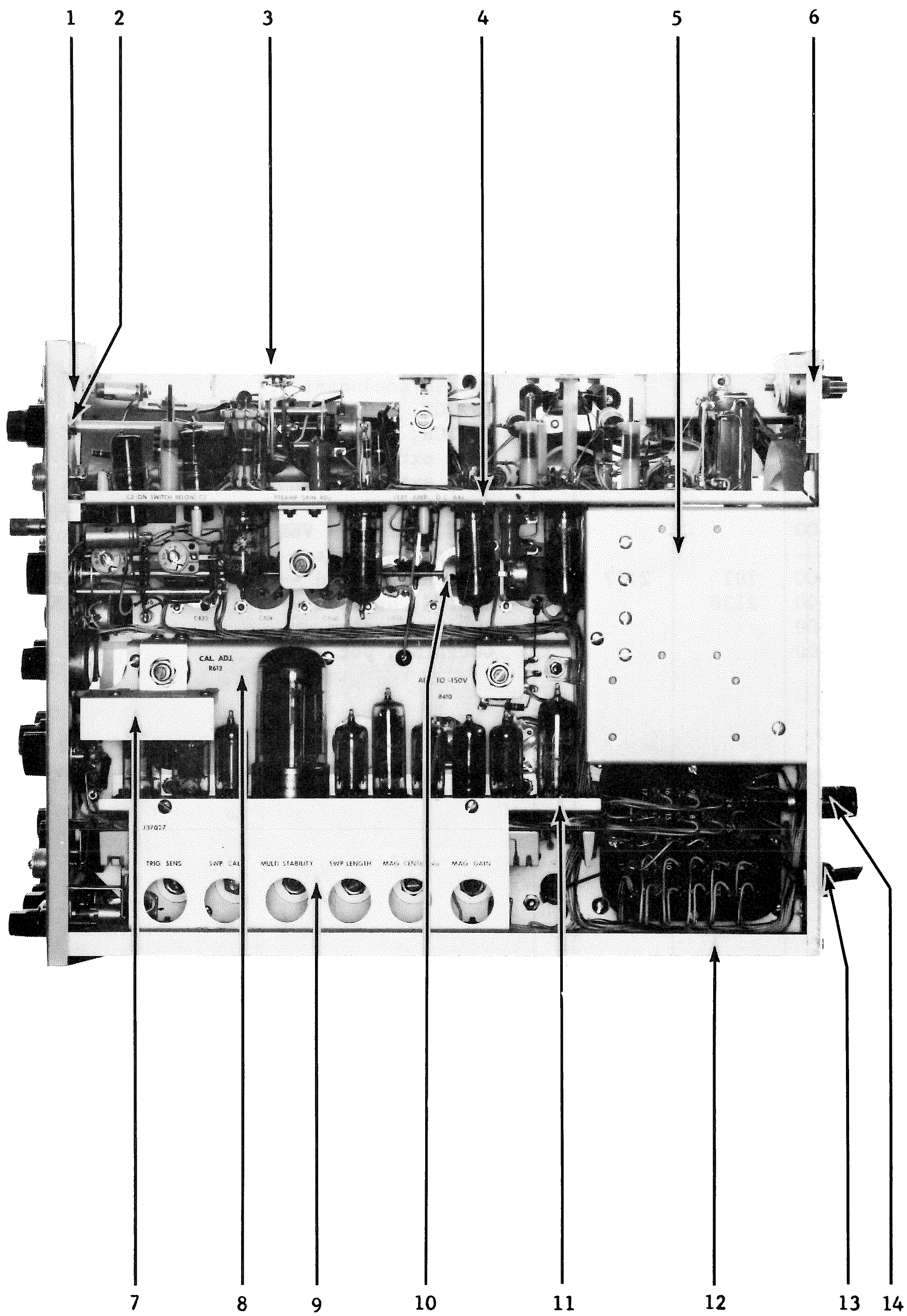
SWITCHES



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	262-0021-00			1	SWITCH, wired -- CALIBRATOR
	- - - - - -			-	switch includes:
	260-0033-00			1	SWITCH, unwired -- CALIBRATOR
2	262-0016-00			1	SWITCH, wired -- AMPLITUDE
	- - - - - -			-	switch includes:
	260-0045-00			1	SWITCH, unwired -- AMPLITUDE
3	262-0018-00			1	SWITCH, wired -- TRIGGER SELECTOR
	- - - - - -			-	switch includes:
	260-0089-00	101	2191	1	SWITCH, unwired -- TRIGGER SELECTOR
	260-0140-00	2192		1	SWITCH, unwired -- TRIGGER SELECTOR
	384-0077-00	101	2191	1	ROD, extension
	384-0114-00	2192		1	ROD, extension
	376-0014-00			1	COUPLING, pot
4	262-0020-00			1	SWITCH, wired -- SWEEP RANGE
	- - - - - -			-	switch includes:
	260-0054-00			1	SWITCH, unwired -- SWEEP RANGE
5	- - - - - -			1	CAPACITOR
6	262-0019-00			1	SWITCH, wired -- SWEEP MULTIPLIER
	- - - - - -			-	switch includes:
	260-0087-00	101	2211	1	SWITCH, unwired -- SWEEP MULTIPLIER
	260-0139-00	2212		1	SWITCH, unwired -- SWEEP MULTIPLIER
	384-0076-00	101	2211	1	ROD, extension
	384-0115-00	2212		1	ROD, extension
	376-0014-00			1	COUPLING, pot
7	262-0022-00			1	SWITCH, wired -- VERTICAL MULTIPLIER
	- - - - - -			-	switch includes:
	260-0031-00	101	2137	1	SWITCH, unwired -- VERTICAL MULTIPLIER
	260-0141-00	2138		1	SWITCH, unwired -- VERTICAL MULTIPLIER
	384-0023-00			1	ROD, extension
	376-0014-00			1	COUPLING, pot

315D MECHANICAL PARTS

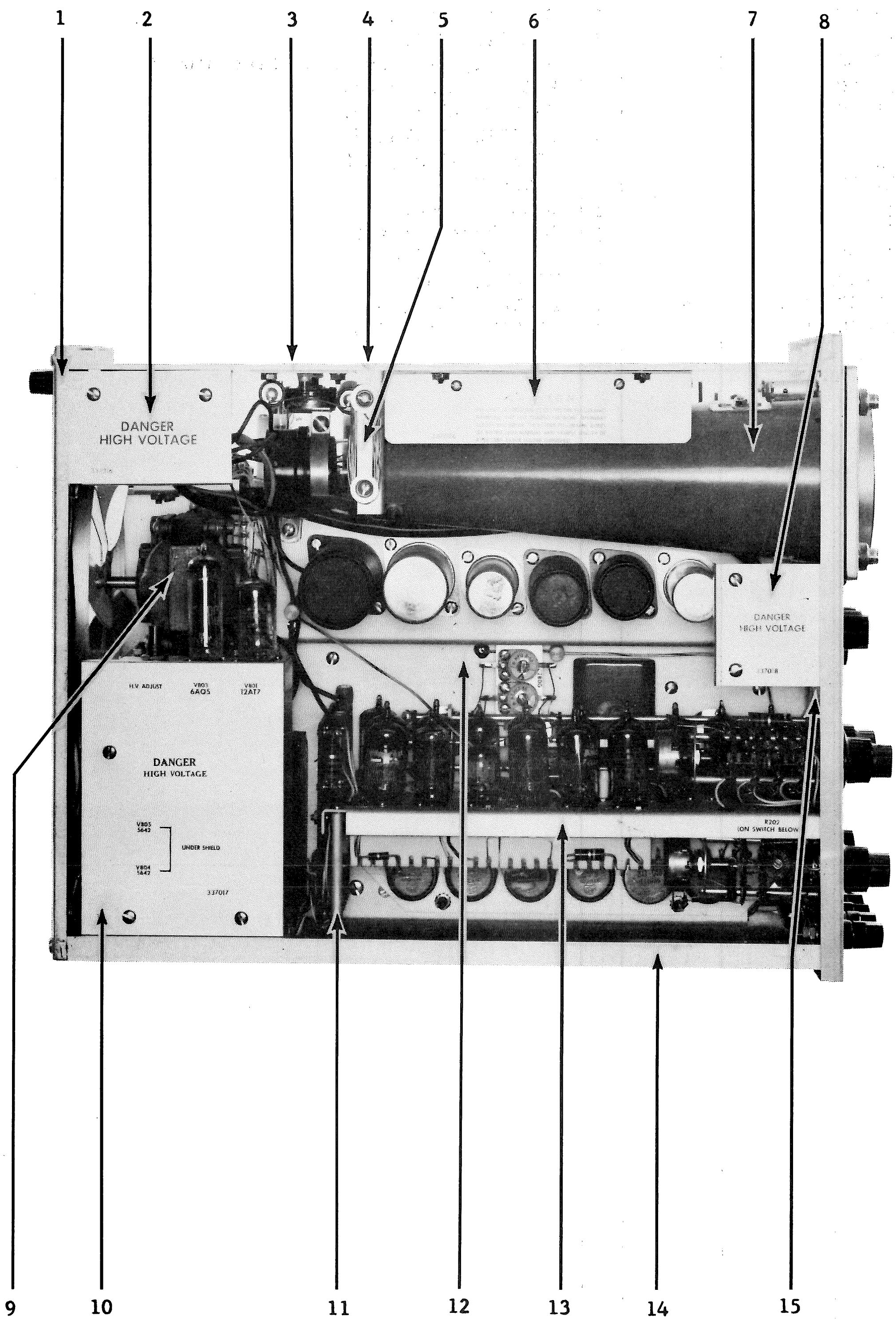
RIGHT SIDE VIEW



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	386-0299-00			1	PLATE, sub-panel
2	358-0029-00			1	BUSHING
3	381-0032-00			1	BAR, top right
4	Page 50			1	CHASSIS, V.A.
5	406-0088-00			1	BRACKET, Selenium Rectifier mounting
6	387-0525-00			1	PLATE, back, alum.
7	337-0019-00			1	SHIELD, alum., cal.
8	Page 48			1	CHASSIS, bulkhead
9	337-0027-00			1	SHIELD, alum., R.S.
10	376-0014-00			1	COUPLING
11	Page 52			1	CHASSIS, power
12	381-0033-00			1	BAR, bottom right
13	385-0025-00			1	BUSHING, nylon
	210-0837-00			1	WASHER, alum.
14	352-0001-00	101	541	1	HOLDER, fuse, 4AG
	352-0002-00	542		1	HOLDER, fuse, 3AG

315D MECHANICAL PARTS

LEFT SIDE VIEW

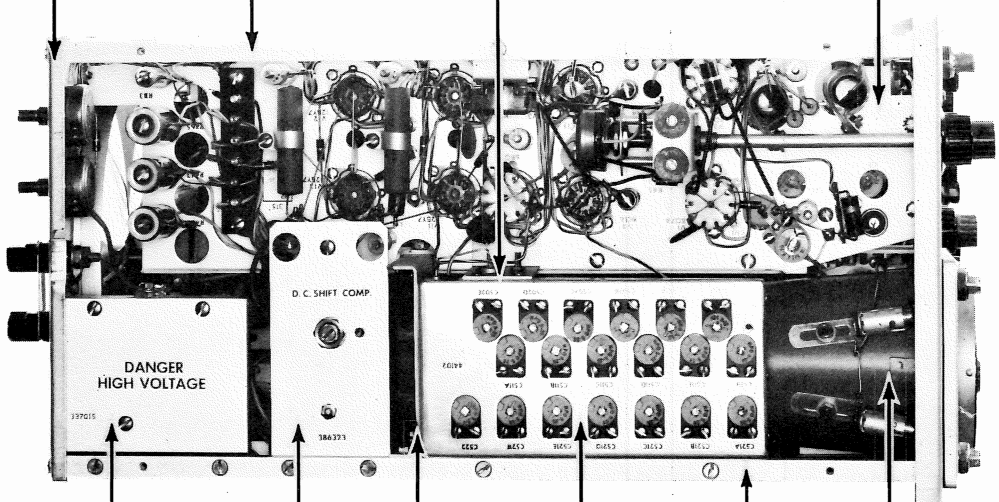


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	387-0525-00			1	PLATE, back, alum.
2	337-0016-00			1	SHIELD, Frequency & Intensity, alum.
3	381-0035-00			1	BAR, top left
4	211-0522-00			1	SCREW, 6-32 x 5/8 inch, FHS
5	406-0047-00			1	BRACKET, CRT shield support
6	337-0026-00			1	SHIELD, Delay Line, alum.
7	337-0050-00			1	SHIELD, CRT, complete assembly
8	337-0018-00			1	SHIELD, alum.
9	147-0001-00			1	MOTOR, fan
	348-0008-00	±101	±606	4	SHOCKMOUNT, round
	348-0009-00	±607		4	SHOCKMOUNT, square
10	337-0017-00			1	SHIELD, power support
11	385-0027-00			1	ROD, alum., 1/4 x 2-13/32 inches
12	Page 48			1	CHASSIS, bulkhead
13	Page 40			1	CHASSIS, sweep
14	381-0034-00			1	BAR, bottom left
15	386-0299-00			1	PLATE, sub-panel

315D MECHANICAL PARTS

TOP VIEW

1 2 3 4

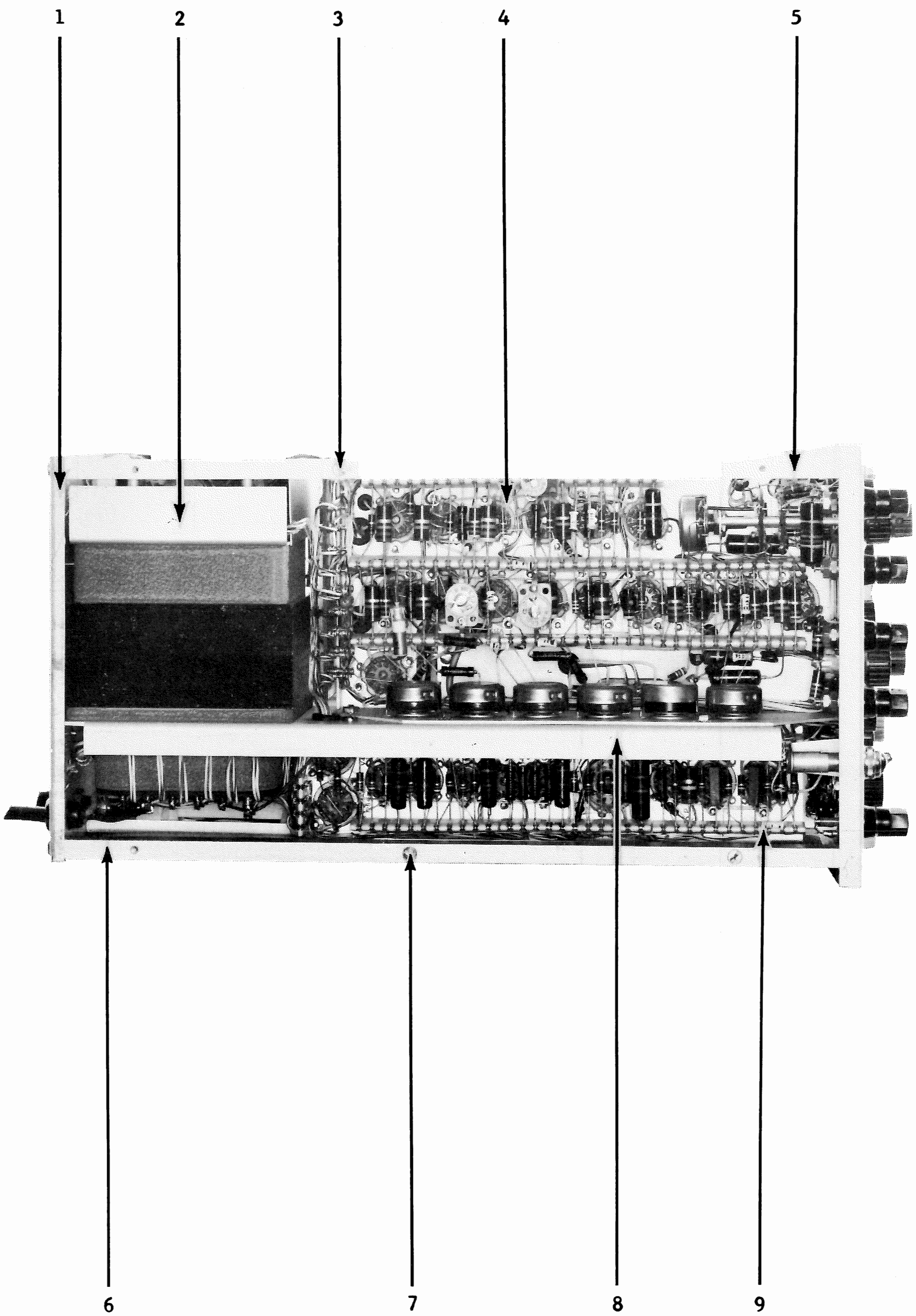


5 6 7 8 9 10

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	387-0525-00			1	PLATE, back, alum.
2	381-0032-00			1	BAR, top right
3	406-0048-00			1	BRACKET, alum.
4	Page 44			1	CHASSIS V.A.
5	337-0015-00			1	SHIELD, Frequency & Intensity, alum.
6	386-0323-00			1	PLATE, D.C. Shift
7	406-0047-00			1	BRACKET, CRT shield support
8	Page 52			1	DELAY LINE
9	381-0035-00			1	BAR, top left
10	337-0050-00			1	SHIELD, CRT, complete assembly

315D MECHANICAL PARTS

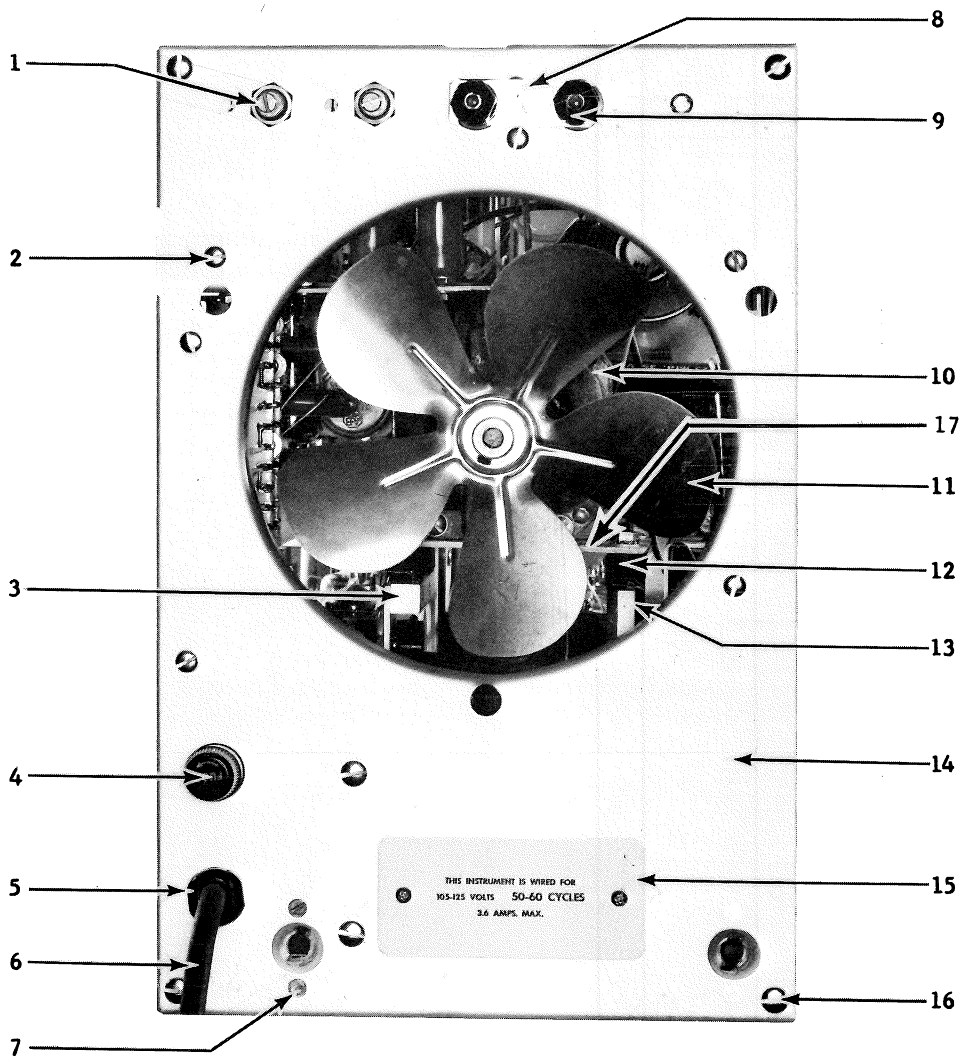
BOTTOM VIEW



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	397-0525-00			1	PLATE, back, alum
2	Page 46			1	CHASSIS, H.V.
3	211-0523-00			1	SCREW, 6-32 x 7/8 inch, FHS
4	Page 40			1	CHASSIS, sweep
5	381-0034-00			1	BAR, bottom left
6	381-0033-00			1	BAR, bottom right
7	211-0523-00			1	SCREW, 6-32 x 7/8 inch, FHS
8	Page 48			1	CHASSIS, bulkhead
9	Page 52			1	CHASSIS, power

315D MECHANICAL PARTS

REAR VIEW

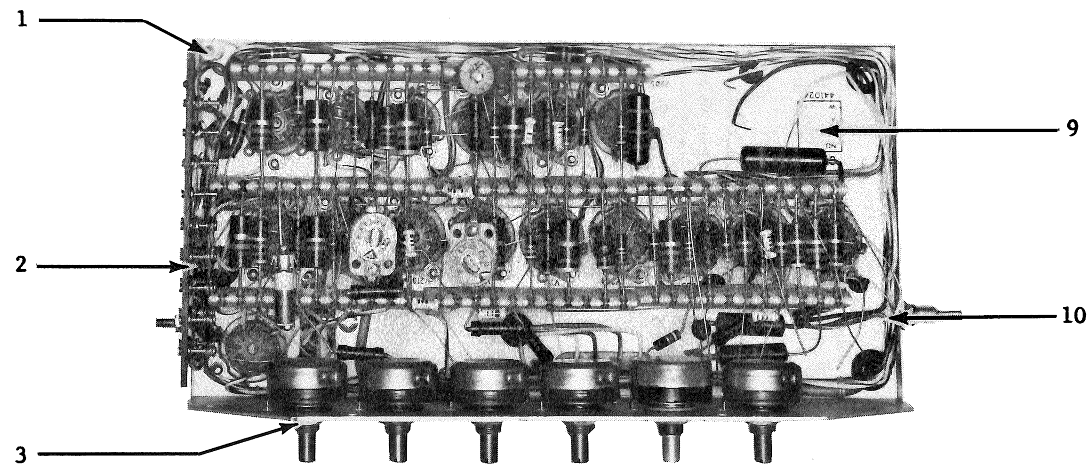


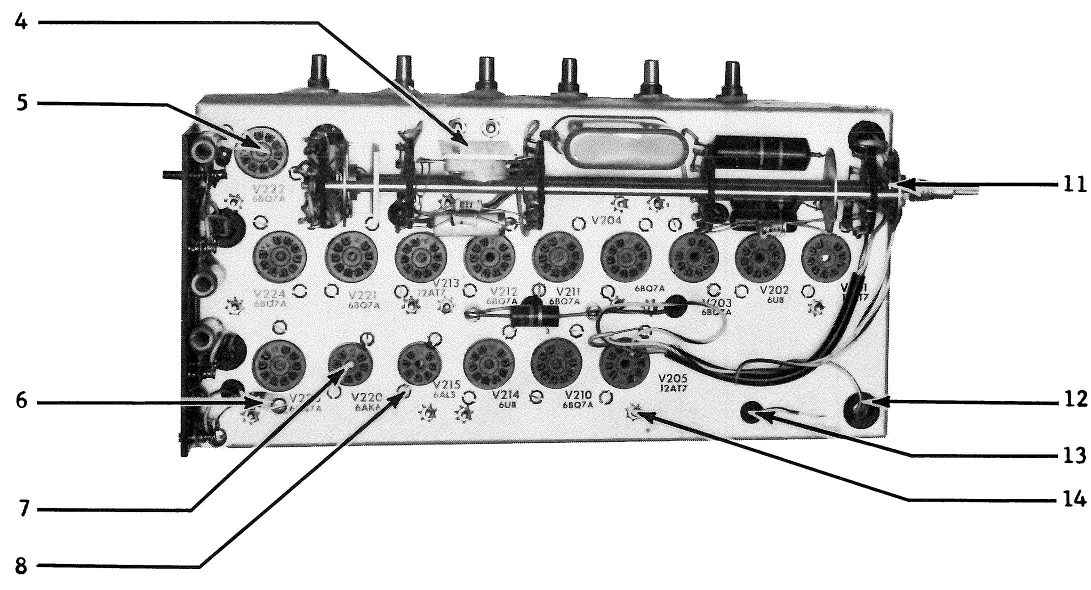
B

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	210-0413-00			1	NUT, pot, 3/8-32 x 1/2 inch
2	211-0510-00			1	SCREW, 6-32 x 3/8 inch, BHS
3	381-0002-00			1	BAR, alum., 3/8 inch square x 2-3/4 inches
4	352-0001-00	101	541	1	HOLDER, fuse, 4 AG
	352-0002-00	542		1	HOLDER, fuse
5	358-0025-00			1	BUSHING, nylon
	210-0837-00			1	WASHER, alum.
6	161-0002-00			1	CORD, power
7	211-0023-00			1	SCREW, 4-40 x 1/4 inch, FHS
8	386-0374-00			1	STRAP, connecting
9	129-0001-00			1	POST, binding
10	147-0001-00			1	MOTOR, fan
11	369-0001-00			1	FAN, blade, 1/4 inch bore
12	348-0008-00	±101	606	4	SHOCKMOUNT, round
	348-0009-00	±607		4	SHOCKMOUNT, square
13	385-0009-00			1	ROD, hex., 3/8 x 1-3/8 inches
14	387-0525-00			1	PLATE, back, alum.
15	334-0530-00			1	TAG
	213-0035-00			1	SCREW, 4-40 x 1/4 inch
16	212-0023-00			1	SCREW, 8-32 x 3/8 inch, BHS
17	386-0307-00			1	PLATE, fan mounting

315D MECHANICAL PARTS

SWEEP

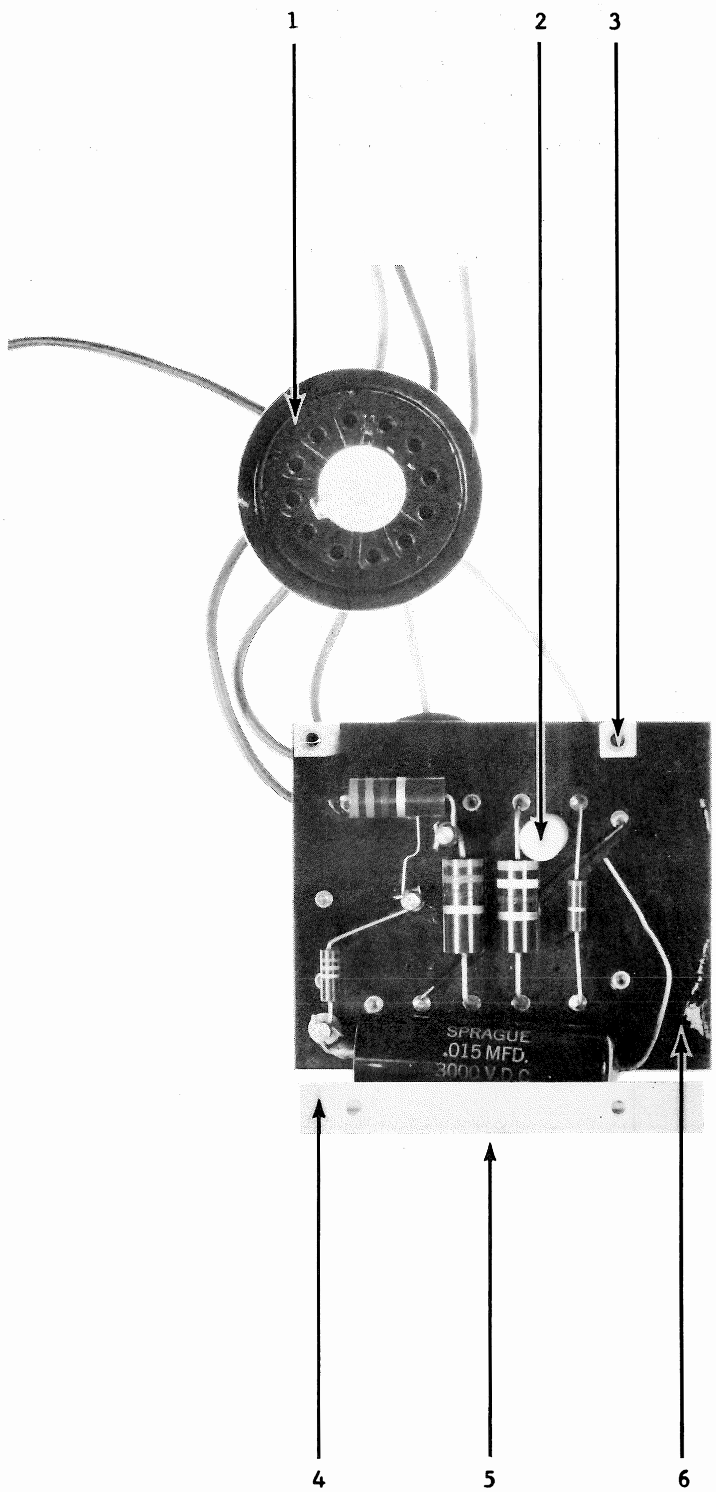




REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	385-0027-00			1	ROD, alum., 1/4 x 2-13/32 inch
2	392-0029-00			1	BOARD, terminal, bakelite
3	210-0413-00			6	NUT, pot, 3/8-32 x 1/2 inch
4	406-0051-00			1	BRACKET, cap mounting
5	136-0015-00			14	SOCKET, STM9G
6	210-0202-00			1	LUG, solder, SE6 w/2 wire holes
7	136-0008-00			2	SOCKET, STM7G
8	211-0033-00			32	SCREW, 4-40 x 5/16 inch, Pan HS, w/lockwasher
9	441-0024-00			1	CHASSIS
10	179-0044-00			1	CABLE, harness
11	Page 28			1	SWITCH
12	348-0004-00			4	GROMMET, rubber, 3/8 inch
13	348-0002-00			2	GROMMET, rubber, 1/4 inch
14	210-0405-00			16	NUT, 2-56 x 3/16 inch
	210-0002-00			16	LOCKWASHER, external, #2

315D MECHANICAL PARTS

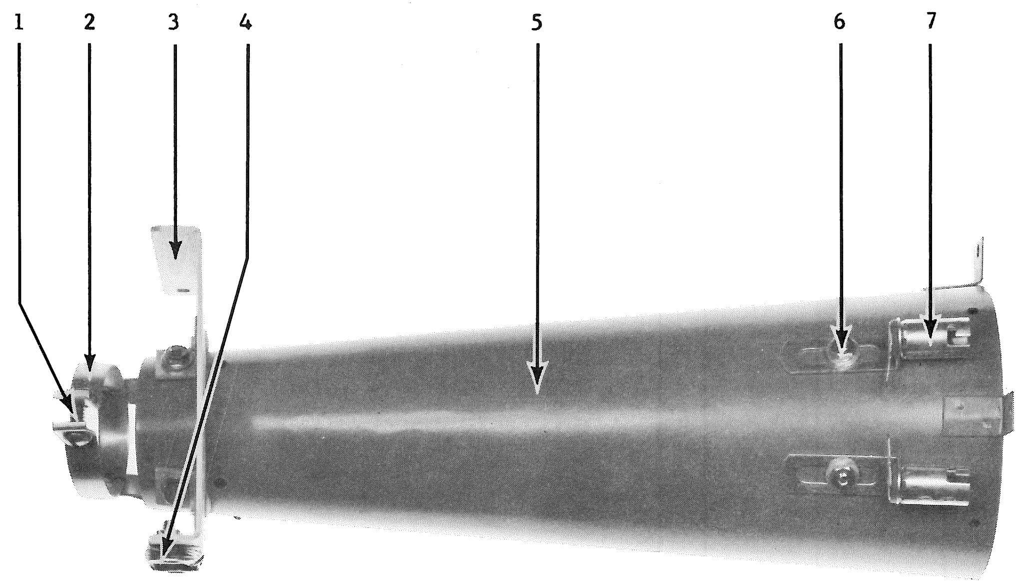
F & I

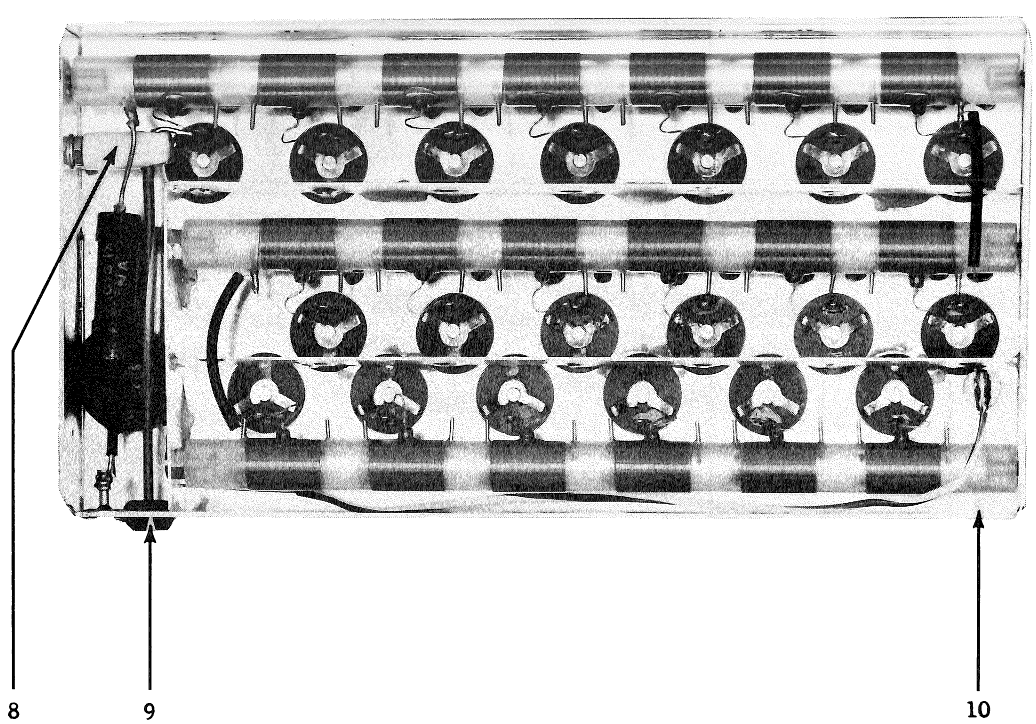


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	136-0023-00			1	SOCKET, STM12
2	385-0017-00			1	ROD, nylon, 5/16 diameter x 1-5/32 inch
3	381-0020-00			2	BAR, alum., 1/4 square x 31/32 inch
4	406-0049-00			1	BRACKET
5	343-0001-00			1	CLAMP, plastic, 1/8 inch
6	392-0028-00			1	BOARD, terminal, bakelite

315D MECHANICAL PARTS

CRT SHIELD AND DELAY LINE



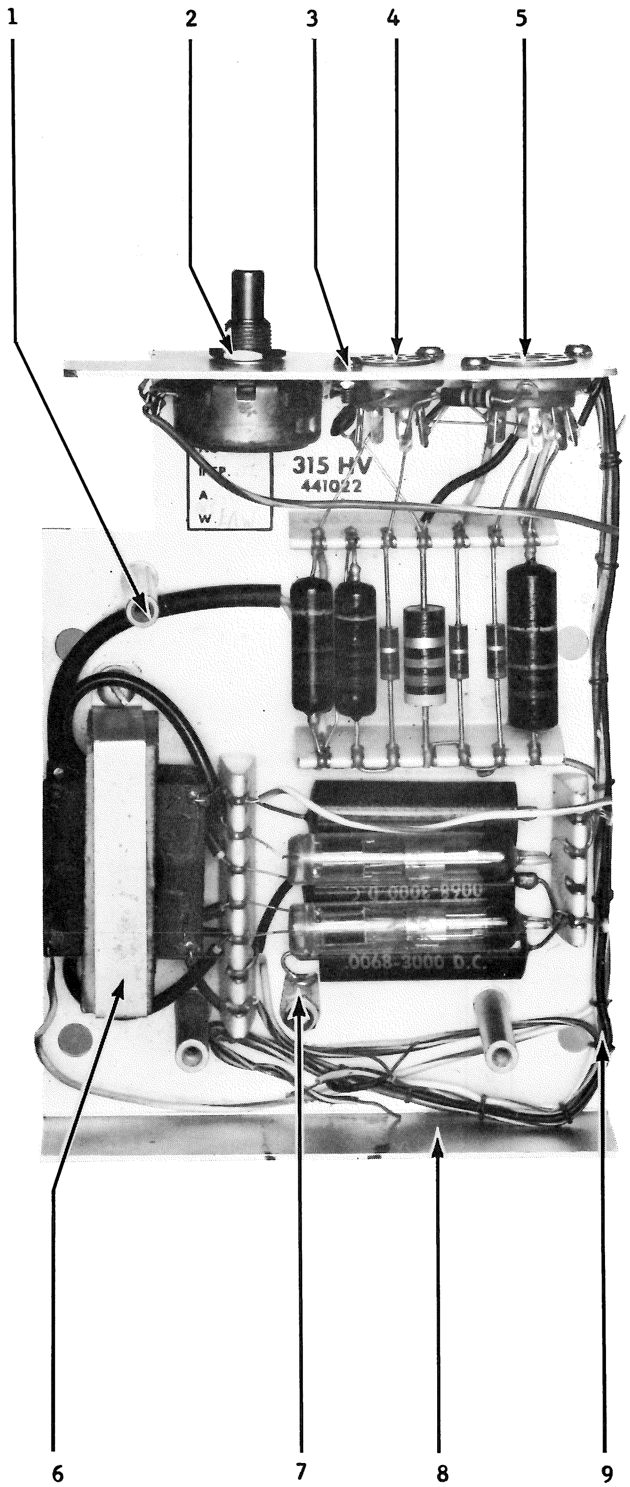


CRT SHIELD AND DELAY LINE

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	212-0548-00			1	SCREW, 10-32 x 7/8 inch, RHS
	210-0501-00			1	NUT, 10-32 square
2	343-0029-00			1	CLAMP, stainless, steel
3	406-0047-00			1	BRACKET, alum.
4	210-0809-00			1	WASHER, centering, 25 watt
5	337-0101-00			1	SHIELD
	337-0050-00			1	COMPLETE ASSEMBLY
6	211-0534-00			2	SCREW, w/lockwasher, 6-32 x 5/16 inch, PHS
	210-0803-00			2	WASHER, #6L, flat
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
7	136-0001-00			2	SOCKET, graticule lamp
8	129-0009-00			1	POST, connecting, ceramic
9	348-0002-00			1	GROMMET, rubber, 1/4 inch
10	441-0021-00			1	CHASSIS
	636-0401-00			1	COMPLETE ASSEMBLY

315D MECHANICAL PARTS

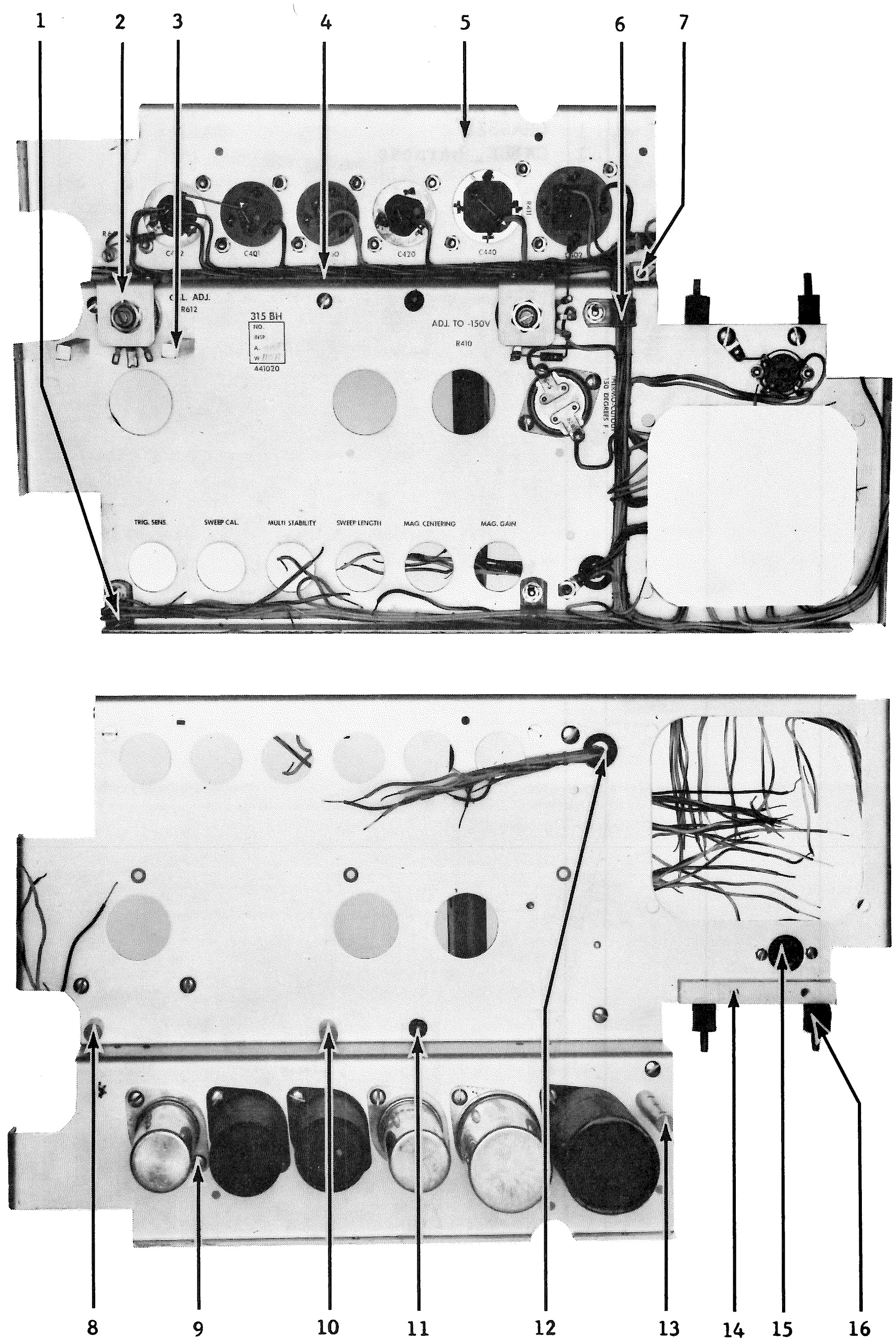
HIGH VOLTAGE



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	385-0024-00			3	ROD, alum., 1/4 diameter x 1-3/8 inches
2	210-0413-00			1	NUT, pot, 3/8-32 x 1/2 inch
3	211-0033-00			4	SCREW, 4-40 x 5/16 inch, Pan HS, w/lockwasher
4	136-0008-00			1	SOCKET, STM7G
5	136-0015-00			1	SOCKET, STM9G
6	346-0003-00			1	STRAP, mounting
7	210-0203-00			1	LUG, solder, SE6, long
8	441-0022-00			1	CHASSIS
9	179-0047-00			1	CABLE, harness

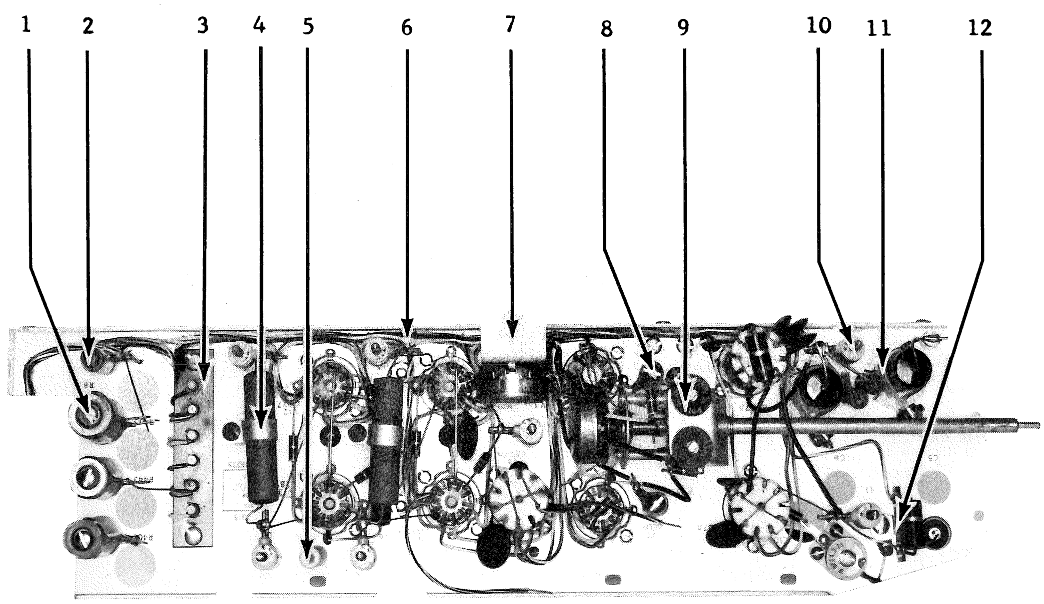
315D MECHANICAL PARTS

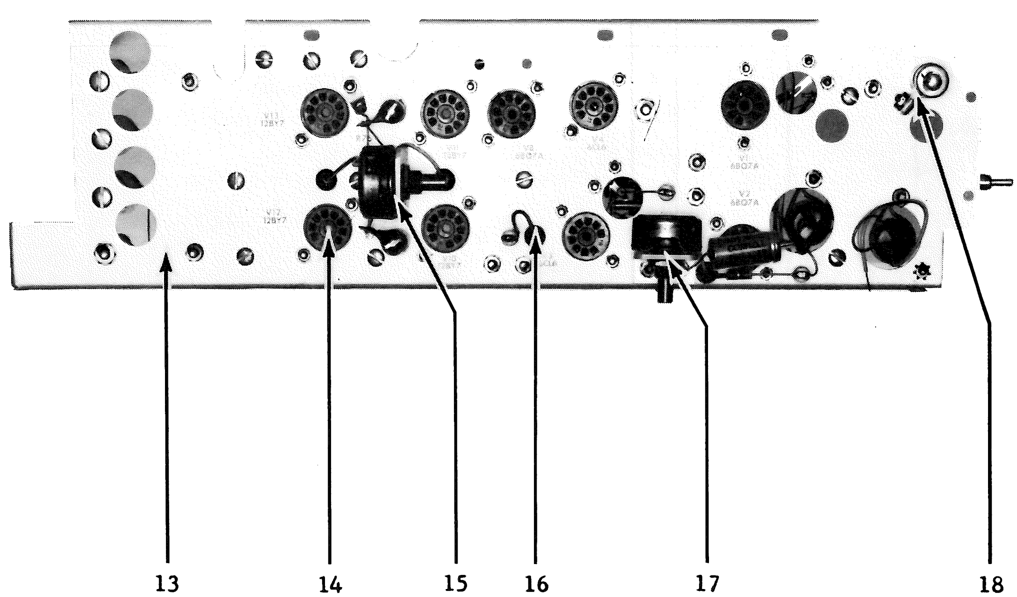
BULKHEAD



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	343-0003-00			2	CLAMP, plastic, 1/4 inch
2	406-0016-00			1	BRACKET, alum.
3	381-0024-00			2	BAR, alum., 1/4 square x 2-1/4 inches
4	179-0045-00			1	CABLE, harness
5	441-0020-00			1	CHASSIS
6	343-0004-00			1	CLAMP, plastic, 5/16 inch
7	381-0031-00			1	BAR, alum., 1/4 square x 3 11/16 inch
8	385-0073-00			1	ROD, nylon, 5/16 diameter x 3/4 inch
9	211-0507-00			6	SCREW, 6-32 x 5/16 inch, BHS
10	385-0073-00			1	ROD, nylon, 5/16 diameter x 3/4 inch
11	348-0002-00			1	GROMMET, rubber, 1/4 inch
12	348-0005-00			1	GROMMET, rubber, 1/2 inch
13	385-0055-00			1	ROD, nylon, 5/16 diameter x 2-3/8 inch
14	381-0002-00			1	BAR, alum., 3/8 inch square x 2-3/4 inches
15	136-0020-00			1	SOCKET, 4 pin
16	348-0008-00	±101	±606	4	SHOCKMOUNT, round
	348-0009-00	±607		4	SHOCKMOUNT, square

VERTICAL AMPLIFIER

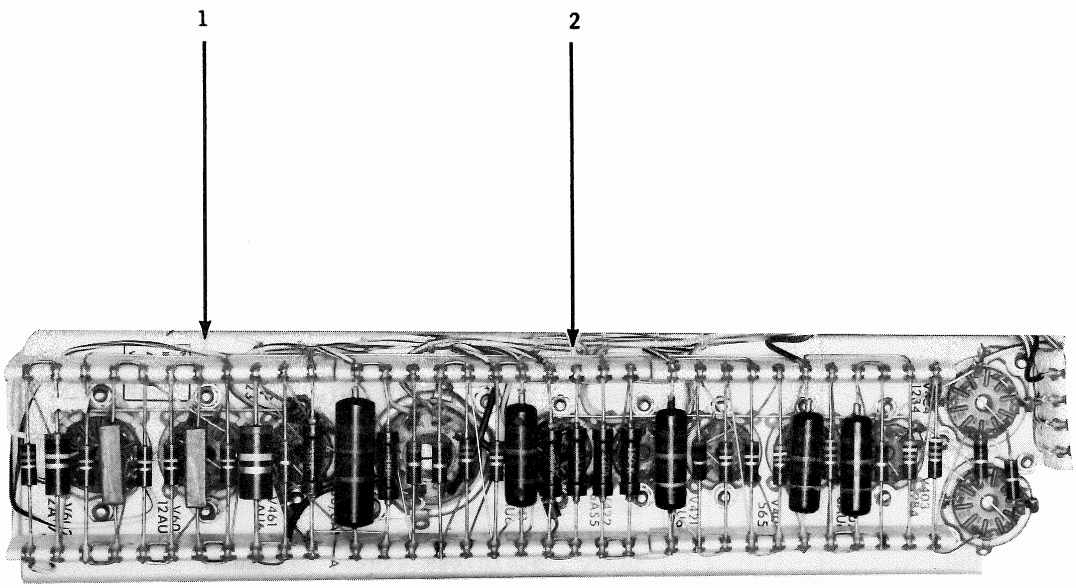


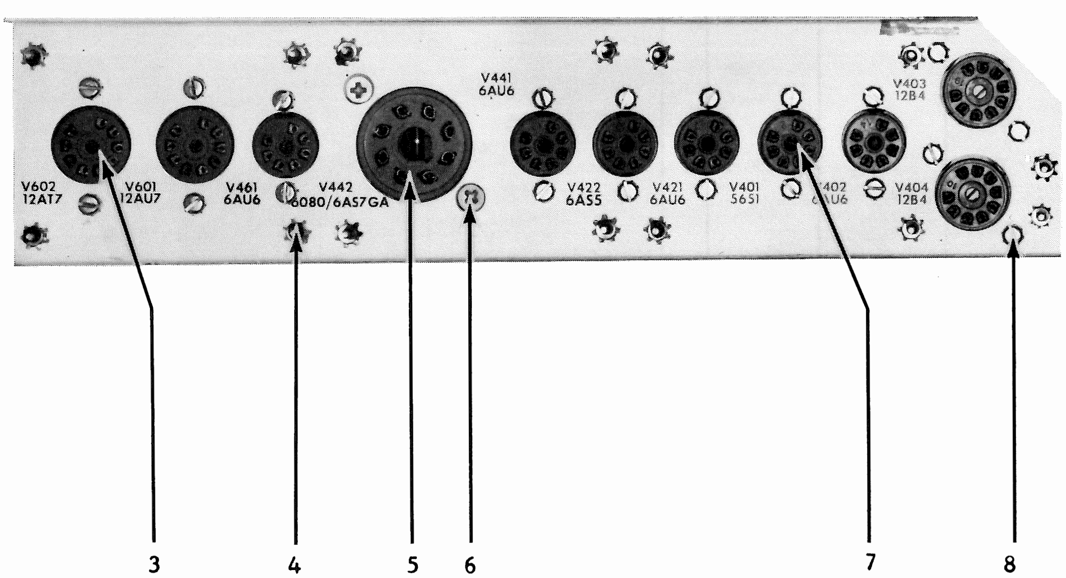


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	212-0037-00			3	SCREW, 8-32 x 1-3/4 inch, Fil HS
	210-0808-00			3	WASHER, centering
	210-0462-00			3	NUT, resistor mounting, alum., hex.
2	211-0553-00			3	SCREW, 8-32 x 2-1/4 inch, RHS
	210-0601-00			3	EYELET, tapered barrel
	210-0478-00			3	NUT, resistor mounting, alum., hex.
3	392-0013-00			1	BOARD, terminal, bakelite
4	343-0015-00			2	CLAMP, stainless steel 1/2 inch
5	385-0027-00			1	ROD, plastic, 1/4 x 1/2-13/32 inch
6	179-0048-00			1	CABLE, harness
7	406-0017-00			1	BRACKET, alum.
8	211-0553-00			1	SCREW, 8-32 x 1-1/2 inch, RHS
	210-0601-00			1	EYELET, tapered barrel
	210-0478-00			1	NUT, resistor mounting, alum., hex.
9	406-0065-00			1	BRACKET, alum.
10	276-0503-00			5	COIL FORM
11	343-0007-00			1	CLAMP, plastic, 5/8 inch
12	131-0023-00			1	CONNECTOR, terminal, tie point, 2 pt.
13	441-0025-00			1	CHASSIS
14	136-0015-00			8	SOCKET, STM9G
15	406-0133-00			1	BRACKET, pot, alum.
16	348-0002-00			2	GROMMET, rubber, 1/4 inch
17	406-0018-00			1	BRACKET, pot, alum.
18	343-0015-00			1	CLAMP, stainless steel, 1/2 inch

315D MECHANICAL PARTS

POWER

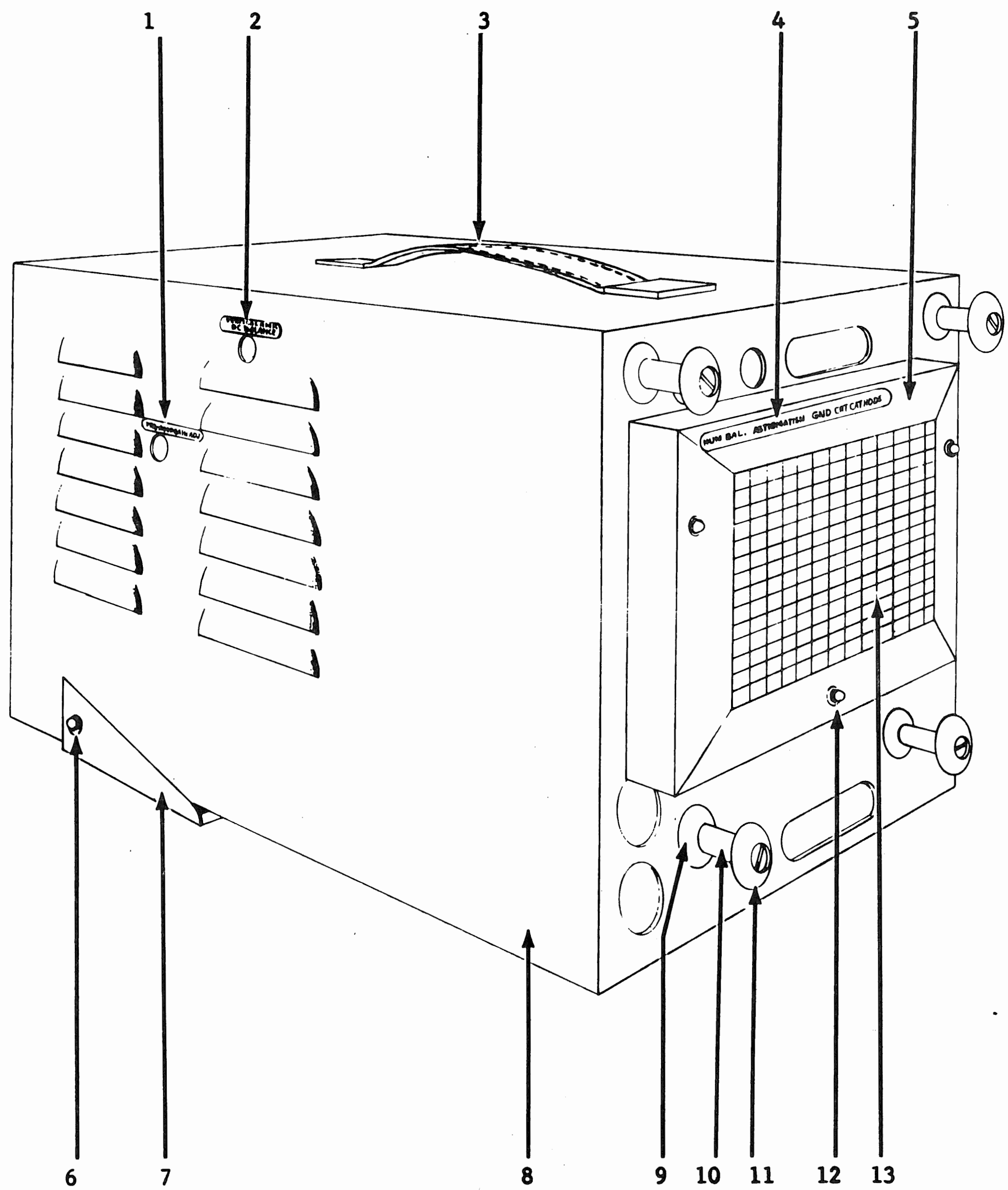




REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	441-0023-00			1	CHASSIS
2	179-0046-00			1	CABLE, harness
3	136-0015-00			4	SOCKET, STM9G
4	210-0405-00			14	NUT, 2-56 x 3/16 inch
	210-0002-00			14	LOCKWASHER, external, #2
5	136-0011-00			1	SOCKET, STM8, ground
6	211-0541-00			2	SCREW, 6-32 x 1/4 inch, FHS Phillips
7	136-0008-00			5	SOCKET, STM7G
8	211-0033-00			20	SCREW, 4-40 x 5/16 inch Pan HS w/lockwasher

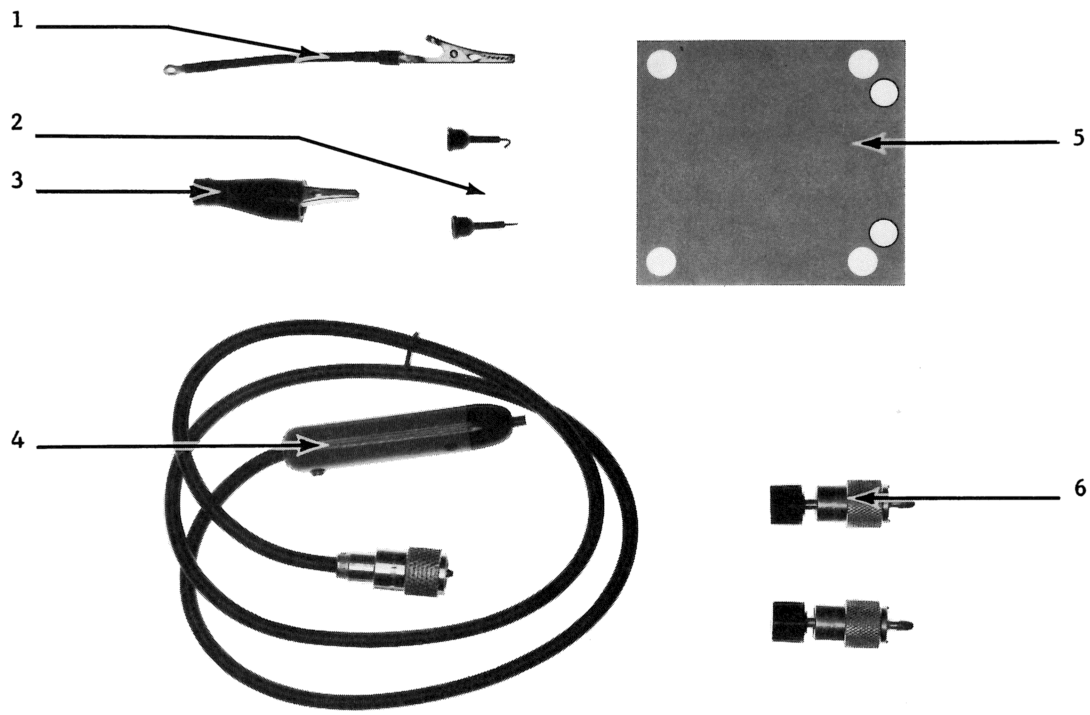
315D MECHANICAL PARTS

CABINET PARTS



CABINET PARTS

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	334-0524-00			1	TAG
2	334-0526-00			1	TAG
3	367-0001-00			1	HANDLE, Pakawa leather
4	334-0535-00			1	TAG
5	380-0001-00			1	HOUSING, air filter
6	210-0402-00			2	NUT, cap, hex., 8-32 inch
7	406-0106-00			1	STAND, scope, alum.
8	437-0009-00			1	CABINET
9	432-0002-00			1	BASE, alum.
10	385-0011-00			1	ROD, alum., 3/8 x 1-1/16 inches
11	348-0001-00			4	GROMMET, rubber, 1 inch
12	210-0401-00			3	NUT, cap, hex., 6-32 inch
13	378-0015-00			1	FILTER, air



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	175-0014-00			1	CABLE, ground lead
2	206-0008-00			1	TIP, w/hook shank
	206-0009-00			1	TIP, w/straight shank
3	344-0005-00			1	CLIP
4	010-0001-00			1	PROBE, P510A
5	378-0505-00			1	FILTER, light, green
6	013-0004-00			1	ADAPTER, binding post

FACTORY CALIBRATION PROCEDURE

315

CONTENTS:

Publication:
061-039
July 1956

For 315, all serial numbers.

INTRODUCTION:

This isn't a field recalibration procedure as is the procedure in your instruction manual. This is a guide in calibrating brand-new instruments, just assembled instruments that have never been turned on before. Therefore it calls out many procedures and adjustments that are rarely required for subsequent recalibration.

Even though we wrote this procedure primarily for our own factory test department, it's valuable to others also if used with some caution:

1. **Special test equipment**, if mentioned, is not available from Tektronix unless it's listed also in our current catalog. This special equipment is used in our test department to speed calibration. Usually you can either duplicate its function with standard equipment in your facility, devise alternate approaches, or build the special test equipment yourself.

2. **Factory circuit specifications** are not guaranteed unless they also appear as catalog or instruction manual specifications. Factory circuit specs usually are tighter than advertised specs. This helps insure the instrument will meet or exceed advertised specs after shipment and during subsequent field recalibrations over several years of use. Your instrument may not meet factory circuit specs but should meet catalog or instruction manual specs.

3. **Presetting internal adjustments**, if mentioned, usually is unnecessary. This is helpful for "first-time" calibration only. If internal adjustments are preset, you'll have to perform a 100% recalibration. So don't preset them unless you're certain a "start-from-scratch" policy is the best.

This CONDITIONAL calibration procedure should be used as a guide only, and not accepted as final authority on specifications or procedures.

ABBREVIATIONS:

a	amp
ac	alternating current
approx	approximately
b	base
bulb	light, lamp, etc.
c	collector
ccw	counterclockwise or full counterclockwise
cer	ceramic
cm	centimeter
comp	composition (resistor)
cps	cycles per second
crt	cathode ray tube
cw	clockwise or full clockwise
db	decibel
dc	direct current
div	division
e	emitter
emc	electrolytic, metal cased (capacitor)
emt	electrolytic, metal tubular
fil	filament
freq	frequency
gmv	guaranteed minimum value (capacitor)
gnd	chassis ground
h	henry
hv	high voltage
inf	infinity
int	internal
k	kilo (10^3)
k	kilohm
m	milli (10^{-3})
ma	milliamp
max	maximum
mc	megacycle
meg	megohm
mh	millihenry
mid r	midrange or centered
min	minimum
mm	millimeter
mpt	metalized, paper tubular (capacitor)
msec	millisecond
mt	mylar, tubular (capacitor)
mv	millivolt
μ	micro (10^{-6})
μf	microfarad
μh	microhenry
μsec	microsecond
n	nano (10^{-9})
nsec	nanosecond
Ω	ohm
p	pico (10^{-12})
pbt	paper, "bathtub" (capacitor)
pcc	paper covered can (capacitor)
pf	picofarad ($\mu\mu$f)
piv	peak inverse voltage
pmc	paper, metal cased (capacitor)
poly	polystyrene
pot	potentiometer
prec	precision (resistor)
pt	paper, tubular (capacitor)
ptm	paper, tubular molded (capacitor)
ptp	peak-to-peak
sec	second
sn	serial number
term	terminal
tub	tubular (capacitor)
unreg	unregulated
v	volt
var	variable
w	watt
WW	wire wound
x-former	transformer

TYPE 315 CALIBRATION PROCEDURE

Equipment required:

1. Test Scope, 5-mc passband (Type 315 or equivalent)
2. Marker Generator, Type 180
3. Fast-rise Square-wave Generator, Type 105
4. 20,000 Ohms/v meter
5. Constant-amplitude signal generator, Type 190
6. Delay line dummy load (1.1-k precision resistor)
7. Variable line supply, 105-125 v.

Power-Off Checks:

1. Visually inspect for burned or damaged wiring and for evidence of overheated components.
2. Center all "Screwdriver Adj" pots.
3. Disconnect delay line and tape the bare ends of the leads, they are at +100 v jumper pin 6 of V4 to pin 7 of V8 and connect junction through 1.1k precision resistor to +100 v supply.
4. Check Power Supply resistance to ground. A convenient point is the terminal board at rear of sweep chassis. Typical readings are:

SUPPLY	WIRE	RESISTANCE
-150	0-1-5-1	5k
+100	9-1-0-1	20k
+225	9-2-2-1	20k
+350	9-3-5-1	30k

Because of the electrolytic capacitors, the ohmmeter should be connected in the same polarity as the power supply being checked.

POWER ON:

(Instrument upside down)

1. Set "adj to -150 v", located on left hand center side, for -150 v measured on 0-1-5-1 wire.
2. Check 100 v supply (±2v)

3. Check 225-v supply (±5 v)

4. Check 350-v supply (not less than 335 v)

5. Adjust "HV Adjust" for -1650 v measured at orange lead on F&I board.

6. a. Check voltage at center connection of TRIGGER AMPLITUDE DISCRIMINATOR for swing (+50 to -50 v "ext trig").

   b. With TRIGGER AMPLITUDE DISCRIMINATOR centered, check for balance of V201. The voltage at pin 2 of V202 should be the same in "+ext" and "-ext" within 5 v. If not, select V201.

   c. With the TRIGGER AMPLITUDE DISCRIMINATOR centered, adjust R202 "Int. trig. dc level" (mini-pot located on TRIGGER SELECTOR switch) so that the voltage at Pin 2, V202 is the same in "+int" and "-int" of the TRIGGER SELECTOR switch.

To accomplish balance, there must be at least +70 v at the junction of R203 and C202 (connected to the plate, pin 6 of V3). Select V3 to get 70 v at this point.

7. With CALIBRATOR off, set "cal adj", located at center left front, for 100 v at pin 3 of V602 (top of R620 on CALIBRATOR). To check CALIBRATOR duty cycle, the voltage at this point should drop to 50 volts (within 10%) when CALIBRATOR is switched to any range.

8. Return scope to upright position;

9. Adjust "Astig Pot", located top center of back frame, for 185 v (center arm).

10. With no trigger present and STABILITY CW, RANGE TIME/DIVISION to 100 µSec/div, adjust "Multi Stability" (located lower right side), for center of free run. Check STABILITY control for ability to stop free run.

11. With line trigger and "Trig Sens" CW, (located at lower right side), adjust STABILITY just below multi free run. Turn "Trig Sens" slowly CCW and observe point at which sweep "blinks". Adjust "Trig Sens" 20 degrees CCW from this point.

12. Set "Swp Length", located at lower right side, for 10-1/2 divisions.

13. Rotate CRT until the sweep is parallel to the horizontal graticule lines. Push CRT tight to graticule and clamp. With no signal input, check the range of VERTICAL POSITION. (Off the scope in both directions) Select V4 for vertical-position range.

14. Check DC balance of the vertical amplifier:

    a. Jumper plates of the 12BY7 output tubes

    b. Jumper grids of same. (select 12BY7's for balance)

    c. Jumper pin 7 to pin 2 of V8. (select V8 for balance)

    d. Sweep should center for each step (plus or minus 1/2 div.).

15. Check for input grid current (with volts/div switch on .1 DC pos., Ground the input terminal. Trace should not shift more than 1/4 div). To correct for grid current, select V3. If V3 is changed, recheck step 6.

16. Short input terminal to ground and check Vert Amp for hum and microphonics.

17. Switch MULTIPLIER to 10-1 and adjust "Vert Amp DC", (located at upper right-hand side, center), so that the VARIABLE VERTICAL ATTENUATOR does not shift the trace.

18. Set MAIN AMP gain.

    a. MULTIPLIER to X1

    b. AMPLITUDE V/DIV to .1 AC

    c. CALIBRATOR to 1 v

    d. Patch CAL OUTPUT to VERTICAL INPUT. MAIN AMP SENSITIVITY is adjusted by small screw in center of AMPLIFIER V/DIV switch. Adjust for 10 divisions deflection.

19. Set MULTIPLIER GAIN

    a. Amplitude V/div to .1

    b. CALIBRATOR to 1

    c. Patch CAL OUT to VERT IN.

    d. Switch MULTIPLIER to 2X and adjust R51 for 5 divisions deflection.

    e. Switch MULTIPLIER to 5X and adjust R53 for 2 divisions deflection.

    f. Switch MULTIPLIER to 10-1

    g. Check deflection for 10 divisions with VARIABLE CONTROL CW and less than 1 div with VARIABLE CONTROL CCW.

20. Set PREAMP GAIN

a. MULTIPLIER to X1

b. AMPLITUDE V/DIV to .01

c. CALIBRATOR to .1

d. Patch CAL OUTPUT to VERTICAL INPUT and adjust "Preamp gain adj" for 10 divisions deflection.

21. a. Check all DC input ranges for deflection sensitivity versus CALIBRATOR output.

b. If DC positions disagree with AC positions by more than 2%, change 12BY7's and repeat steps 14 through 21.

22. Set DC Shift Compensation

a. MULTIPLIER X1

b. AMPLITUDE V/DIV 10 DC

c. CALIBRATOR 100 V

d. Patch CAL OUTPUT to VERTICAL INPUT. Switch calibrator through its ranges. The trace reference should not shift.

e. Adjust "DC Shift Comp." to compensate for drift.

23. Check Power-supply ripple and regulation (Line voltage from 105 to 125). Typical values are:

a.	-150 v	10 mv
	100 v	10 mv
	225 v	10 mv
	350 v	100 mv
	330 v unregulated	20 v (gray white)
	480 v unregulated	30 v (white)

24. Check Front Panel Waveforms

a. Gate 25 v peak to peak

b. Sweep 135 v peak to peak

25. Compensate the probe and Vert. Atten. Adjust for best square wave as follows:

	Input	Volts/div	Adjust
a.	1 kc square wave from 105	1 v/div X1	C3 (side rear of v/div switch)
b.	1 kc square wave from 105	10 v/div X1	C6 (top of v/div switch)
c.	Cal and Probe	.1 v/div X1	Adjust probe
d.	Cal and Probe	.1 v/div X10 (CCW)	C15

Repeat c. and d. until inter-action is overcome

e.	Cal and Probe	1 v/div X10 (CCW)	C2 (side front v/div switch)
f.	Cal and Probe	10 v/div X1	C5 (top of v/div switch)
g.	Cal and Probe	.01 v/div X10	C10

26. Sync approximately one cycle of the Calibrator waveform and turn up the INTENSITY until the leading edge and the point of trigger is visible. Adjust R202 "Int Trig DC level" (mini-pot located on TRIGGER SELECTOR switch) until "+int" and "-int" triggers on the same percentage of the waveform.

27. Check external trigger sensitivity for 1 volt on fast-rise plus and minus, AC and DC.

28. Jumper calibrator output to CRT cathode terminal and check for blanking.

29. With a 1-mc square wave from the Type 105 properly terminated (.1v/div X1) adjust the high frequency compensations in the vertical amplifier. (L3, L4, L5, L6 and L7). Adjust for compromise between best rise time and flat top.

30. Remove the 1.1-k precision resistor, and connect the delay line. With a 450-kc square wave from the Type 105 properly terminated, tune the delay line for best square-wave. (.1 v/div X1)

31. Using the same input, adjust the preamp compensations for best square wave. (.01 v/div X1) (L1 and L2)

32. Check the band width of the main amp and preamp. (Not more than 3db down at 5 megacycles).

33. Set Sweep timing (3%)

Sweep	Markers	Adjust
a. 1 msec X1	1 msec	(mag off) sweep cal. (mag on) mag gain mag center

Check sweep linearity (nonlinearity probably indicates trouble in time base and sweep will not time)

Sweep	Markers	Adjust
b. 1 msec X1 X2 X5 X10	10 msec	(no adjustment-check V213 and/or timing cond.)
c. 100 μsec	100 μsec	(no adjustment)
d. 10 μsec	10 μsec	C280 E for 3rd thru 10th pip.
f. 1 μsec	1 μsec	C290
g. 1.0 μsec X2 X5 X10	10 μsec 10 μsec 10 μsec	(no adj.)
h. .1 μsec X5	1 μsec	C280G
i. .1 μsec X1	10 mc	C303 3rd thru 10th pip. C276 first 2 pips.
j. .1 μsec X1	10 mc	C260 to correct fold over on end of sweep.

If no 10-mc sync, check V205

Repeat steps d. through j.

k. Check all other sweeps for 3% (1 sec/div, 5%)

34. Increase intensity and check for blooming (regulation of -1650 supply)

315 TIME BASE TROUBLE SHOOTING PROCEDURE

Adjust -150v

Check 100v, 225v, and 300v

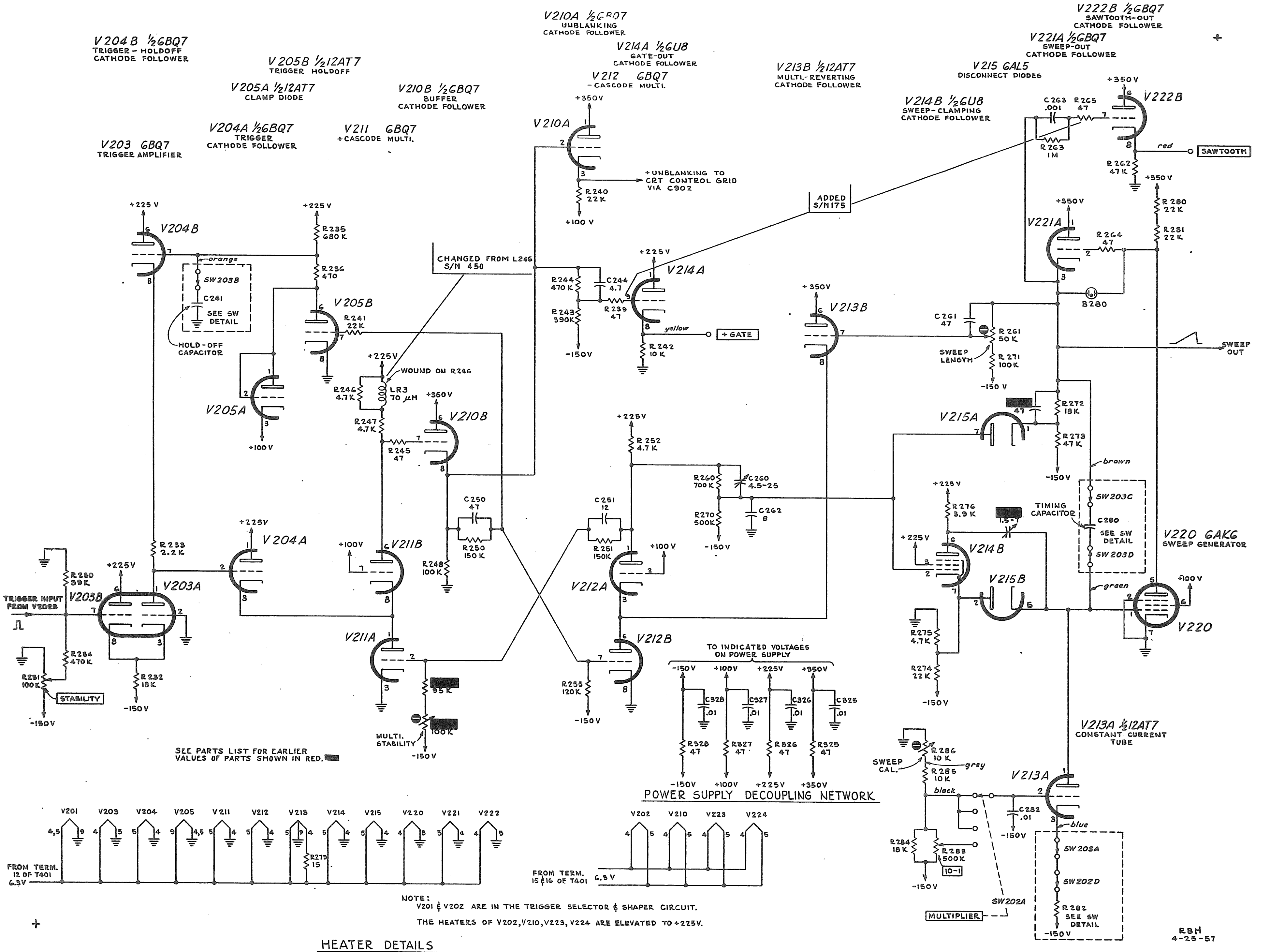
Adjust -1650 volts

Check 47 ohm, 1/2w resistors on terminal board of sweep chassis for overheating and/or opens

Check sweep-chassis filaments for opens. Two separate filaments in each tube except 6AK6.

Set "Sweep Length" CCW and "Stability" CCW.
Sweep Speec to 1 millisec/div

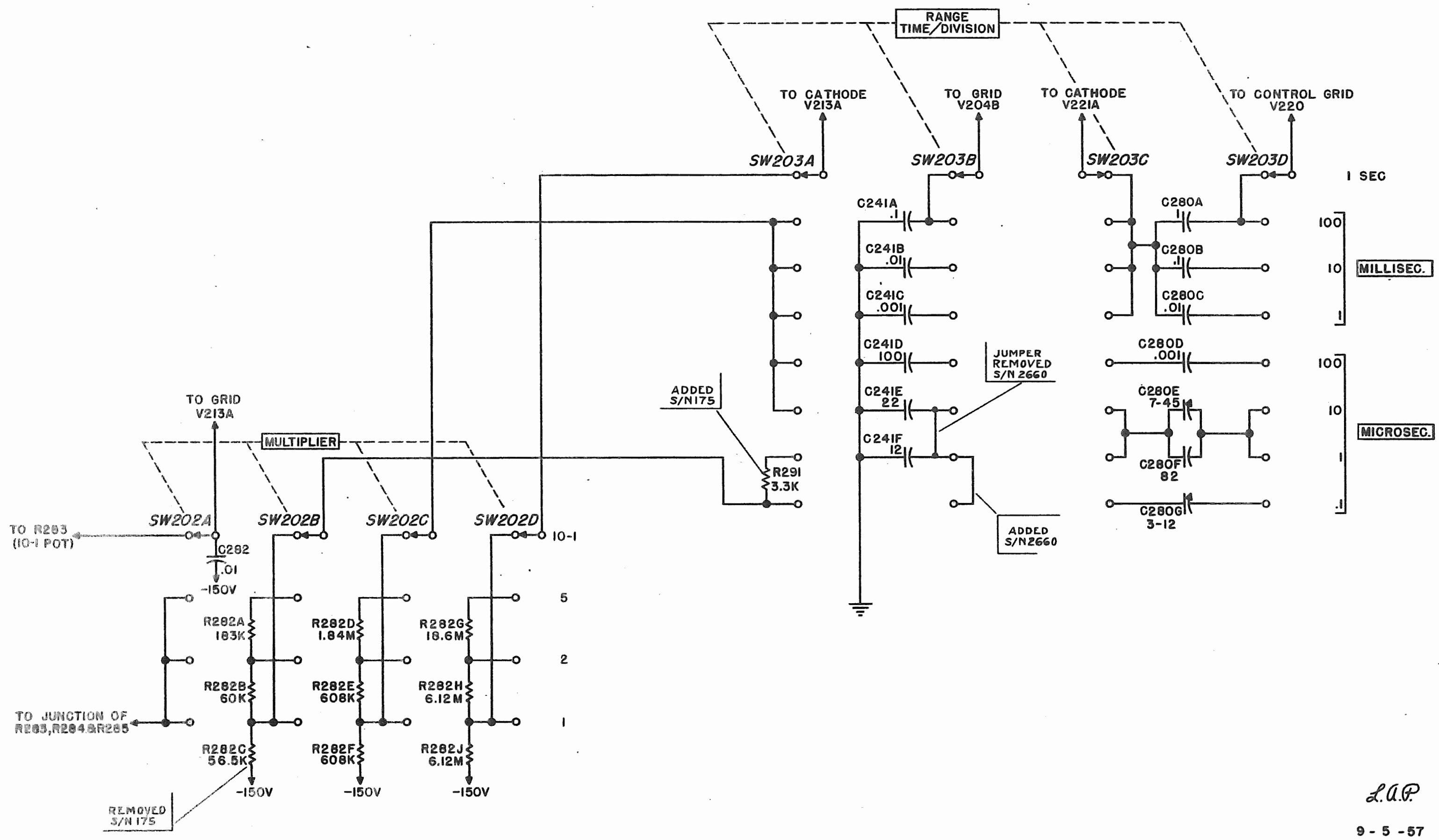
Test Point	Multi-Stab CW	CCW	Tube to suspect
--			
Multi and Hold Off			
Remove V213			
P6/V211	145 ±10v	225v	V211, V210, V203 (Check L246 for open)
P8/V210	150 ±10v	225v	V210
P7/V205	-17v	0	V205
P6/V205	100v	15v	V205, V204
P8/V204	105v	20v	V204
P1/V203	85v	10v	V203, V204
P1/V212	215v	145v (10v)	V212
Sweep Trigger and Miller Sweep			
Replace V213 and pull V212 - Multi Stab CW			
P2/V214	-11v		V215, V214
P7/V214	-5v		V214
P5/V215	-5v		V215, V213, V220
P5/V220	35v		V220
P3/V221	40v		V221



TYPE 315 CATHODE-RAY OSCILLOSCOPE

A A

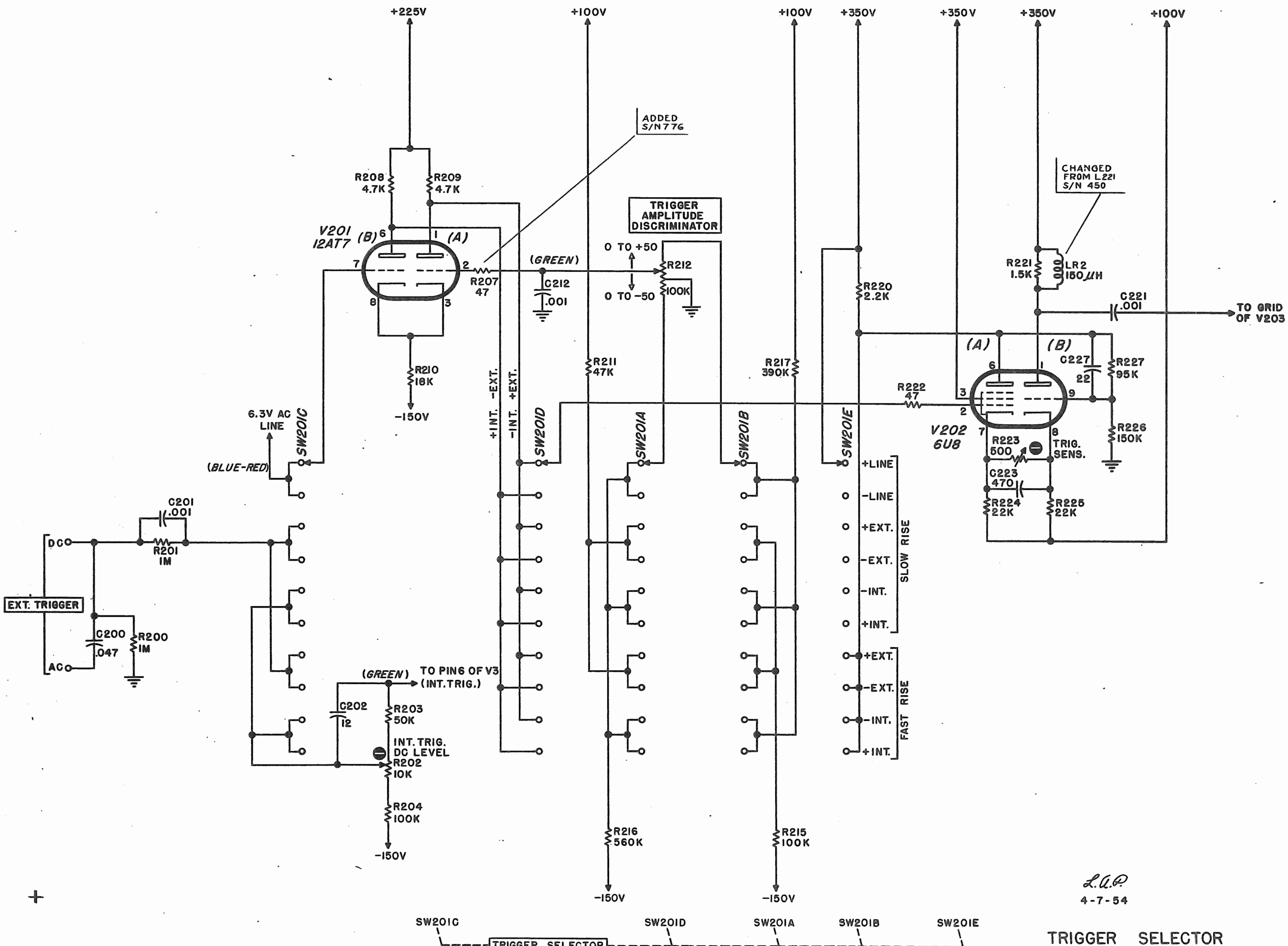
TIME-BASE GENERATOR



TYPE 315 CATHODE-RAY OSCILLOSCOPE

A A

TIME BASE
RANGE & MULTIPLIER SWITCH DETAIL

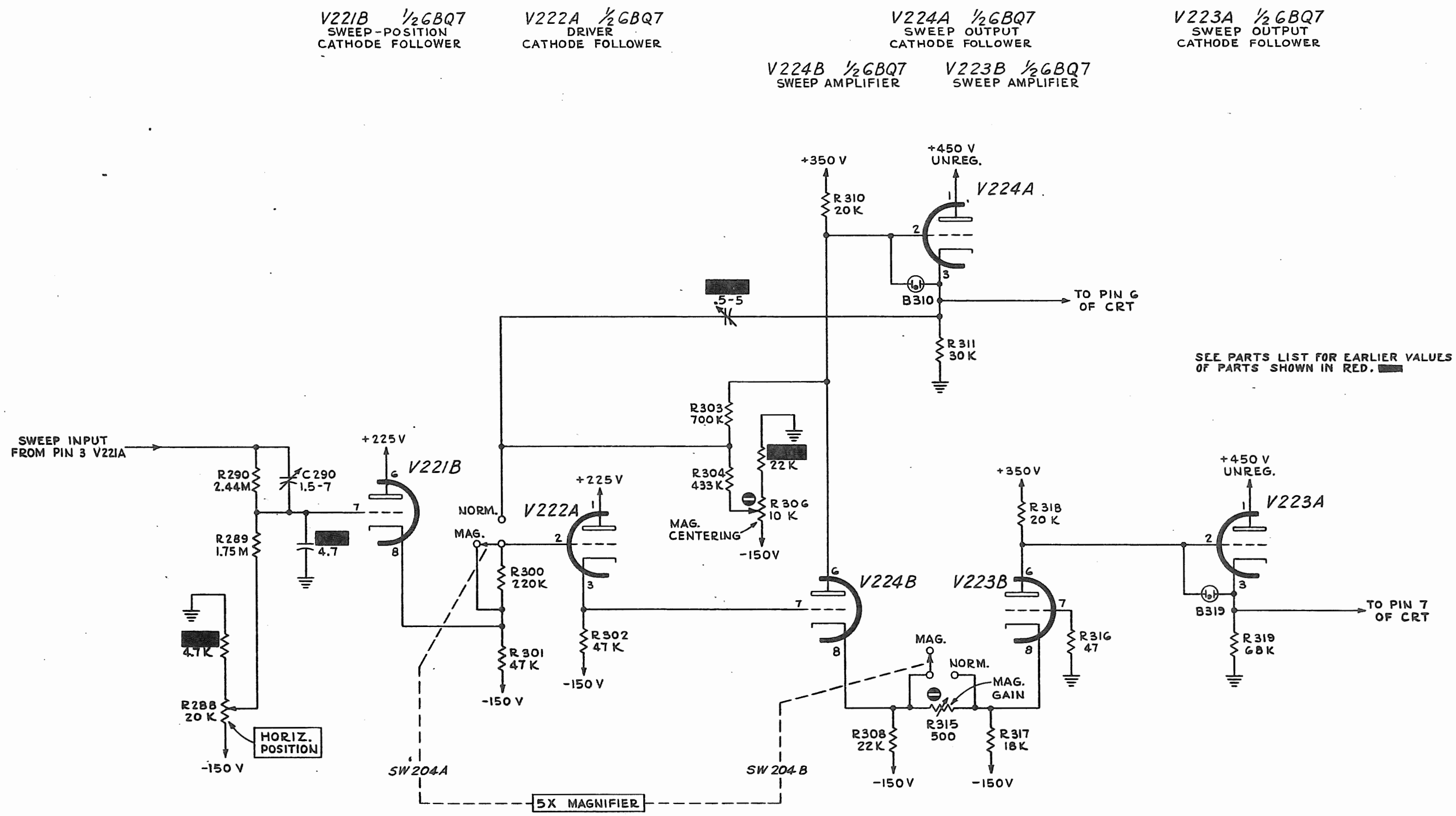


L.A.P.
4-7-54

TYPE 315 CATHODE-RAY OSCILLOSCOPE

TRIGGER SELECTOR & SHAPER

A A



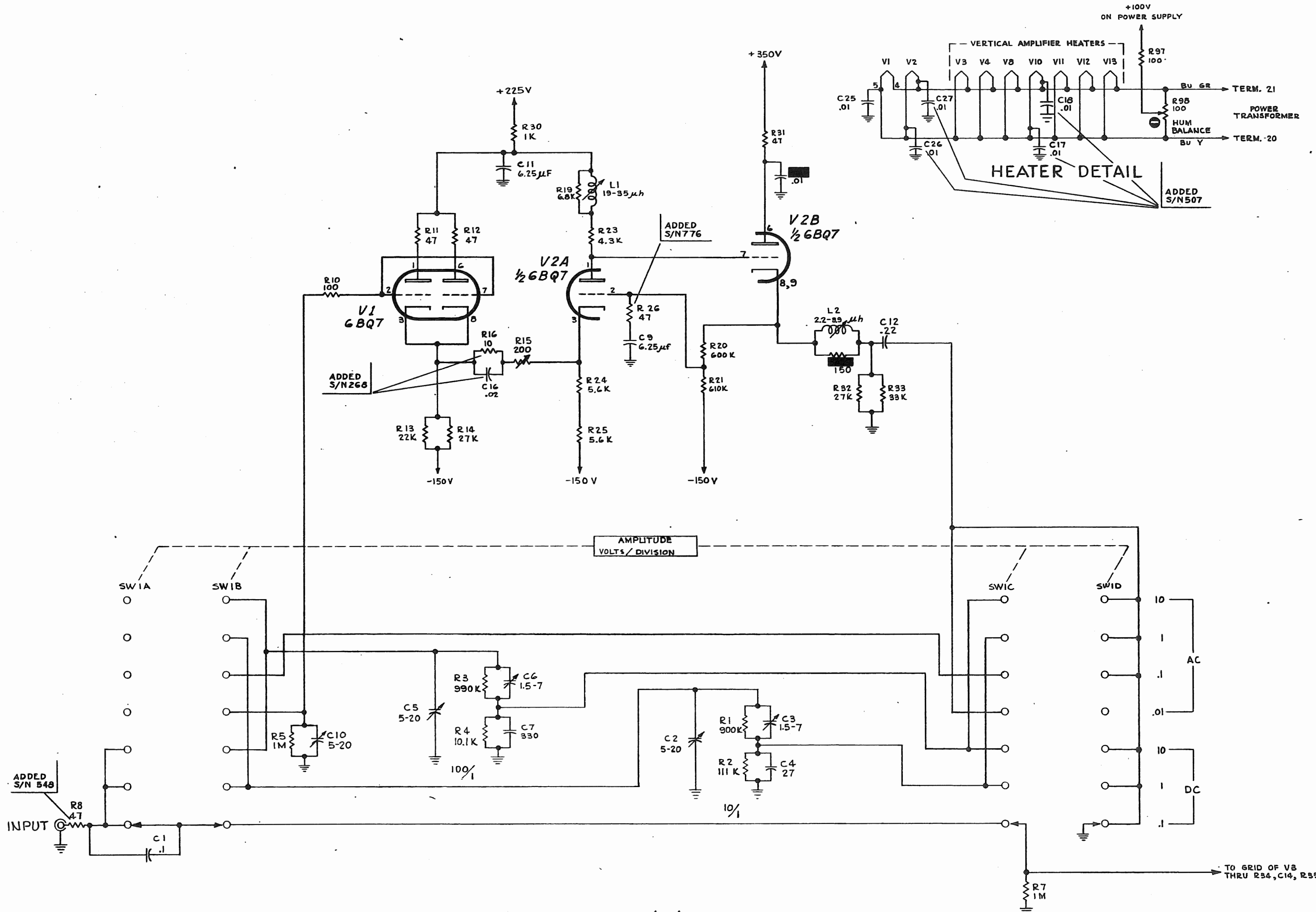
NOTE:
ALL REGULATED VOLTAGES ARE DECOUPLED. FOR DETAILS SEE TIME BASE

RBH
4-25-57

TYPE 315 CATHODE-RAY OSCILLOSCOPE

TIME BASE AMPLIFIER

A A

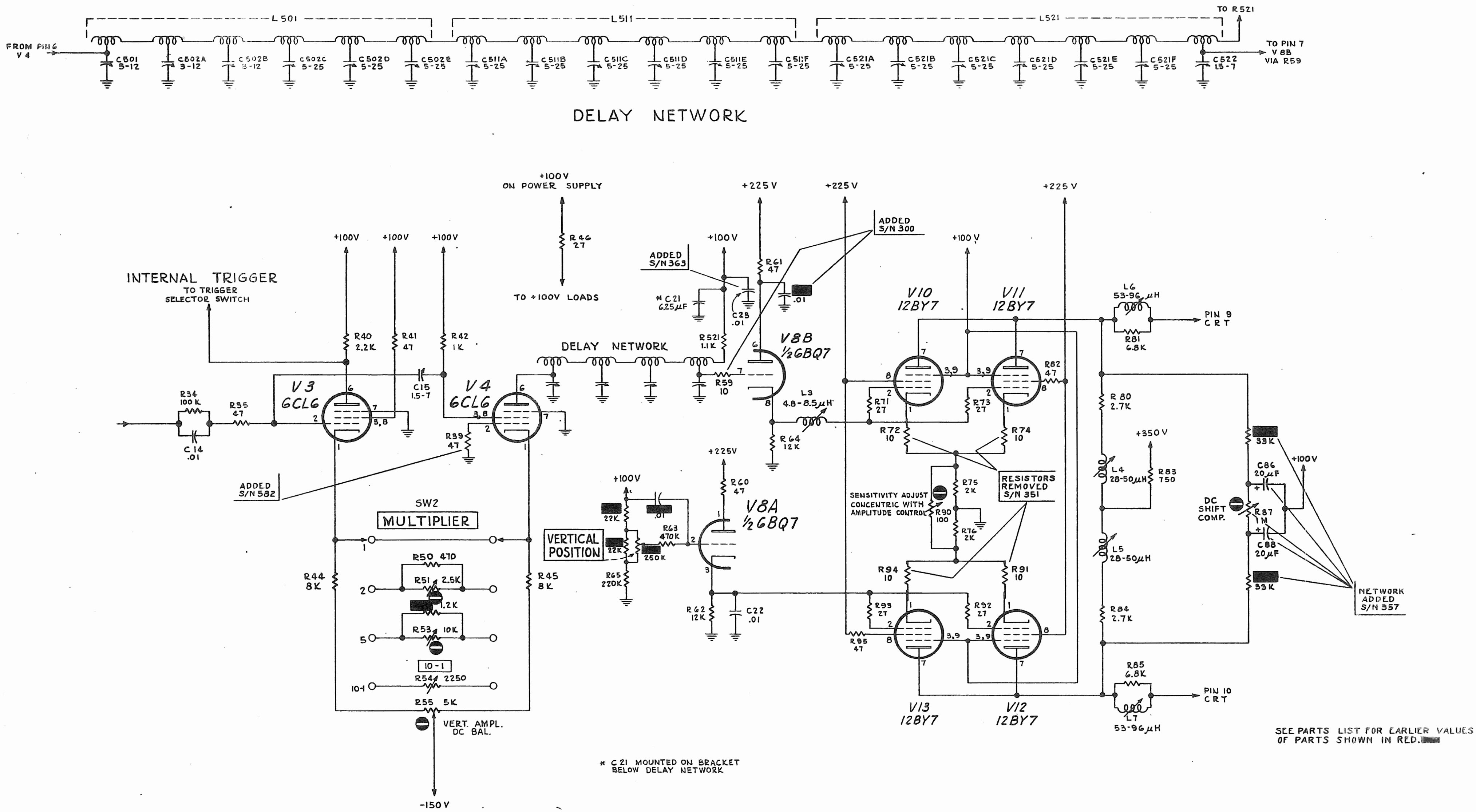


TYPE 315 CATHODE-RAY OSCILLOSCOPE

A A

PREAMP

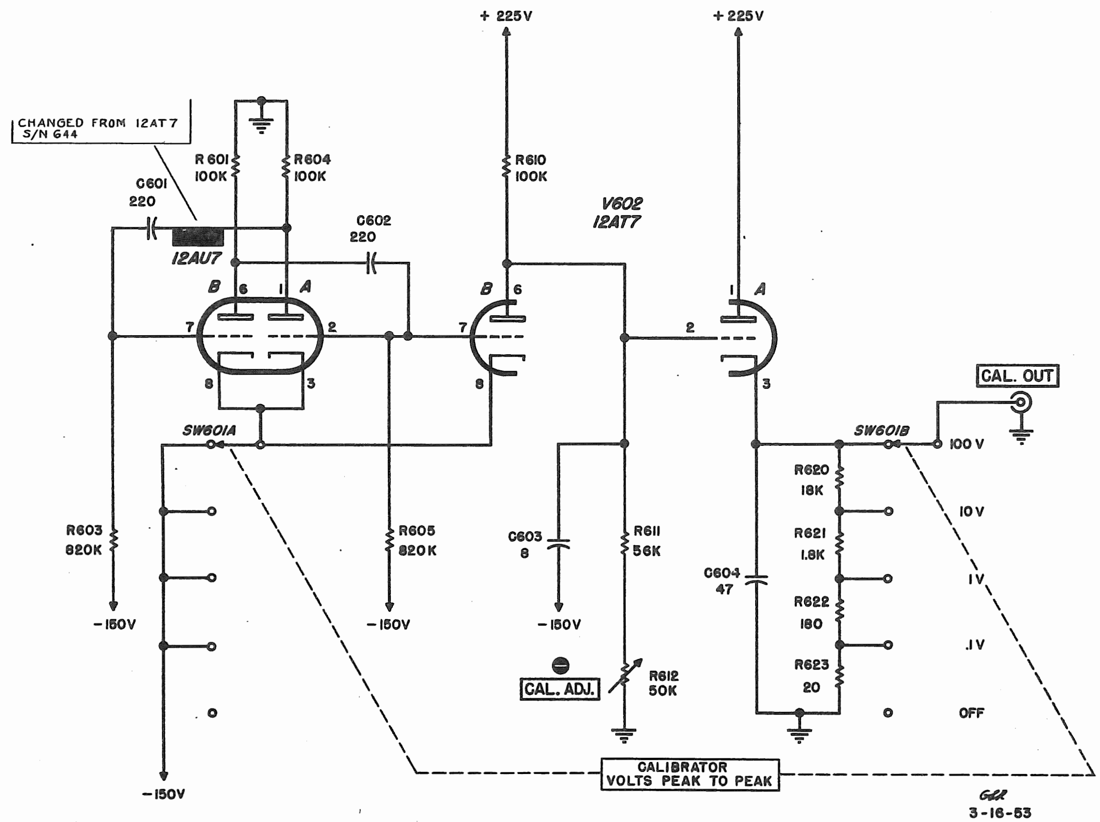
3-9-56 RBH



TYPE 315 CATHODE-RAY OSCILLOSCOPE A A

VERTICAL AMPLIFIER

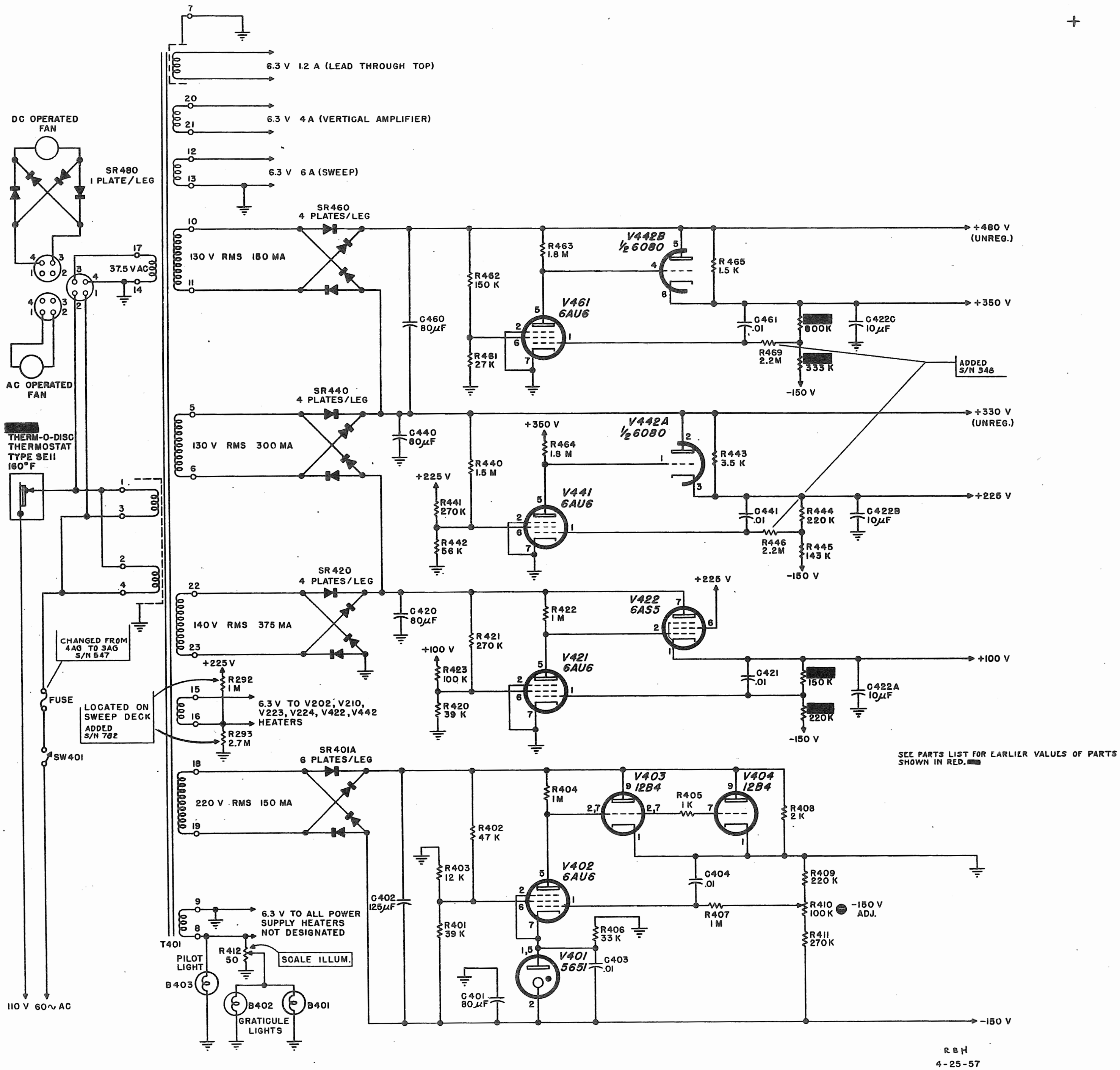
4-25-57
RBH



TYPE 315 CATHODE-RAY OSCILLOSCOPE

CALIBRATOR

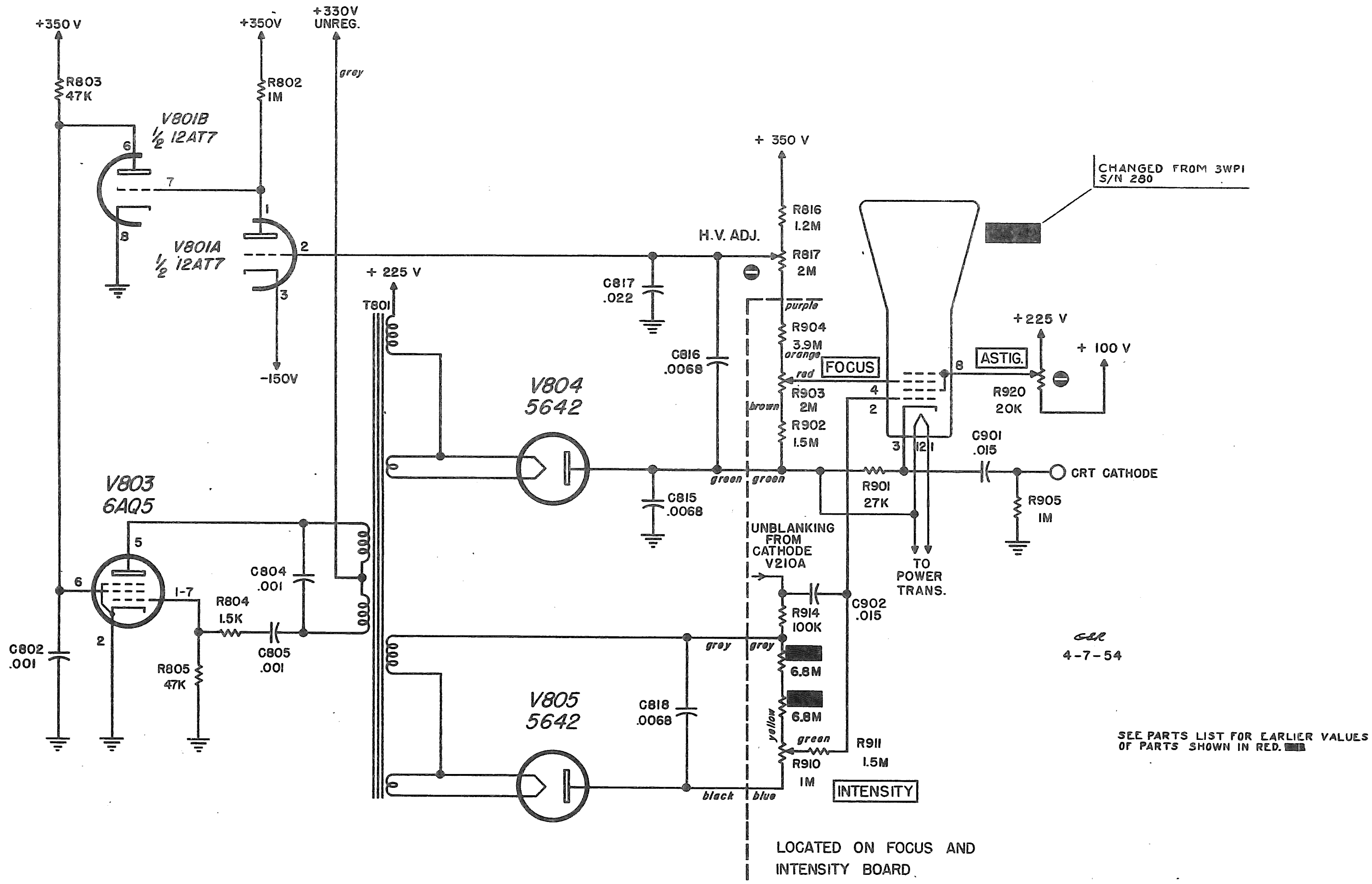
A A



TYPE 315 CATHODE-RAY OSCILLOSCOPE

POWER SUPPLY

A A



TYPE 315 CATHODE-RAY OSCILLOSCOPE

HIGH VOLTAGE AND CRT CIRCUITS