TEKTRONIX®

TYPE AUG 2 1977

517/517A

OSCILLOSCOPES

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

Serial Number _____

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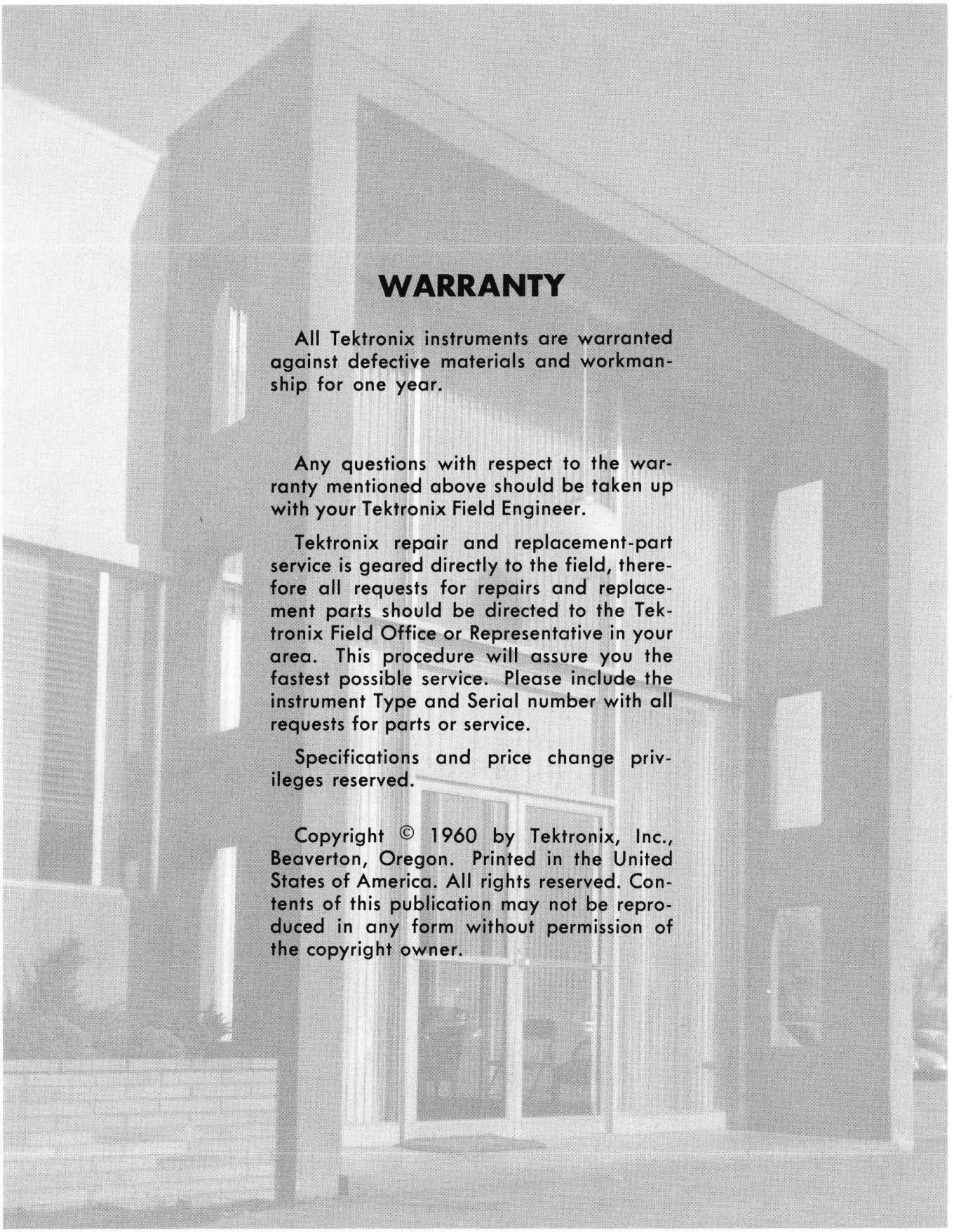


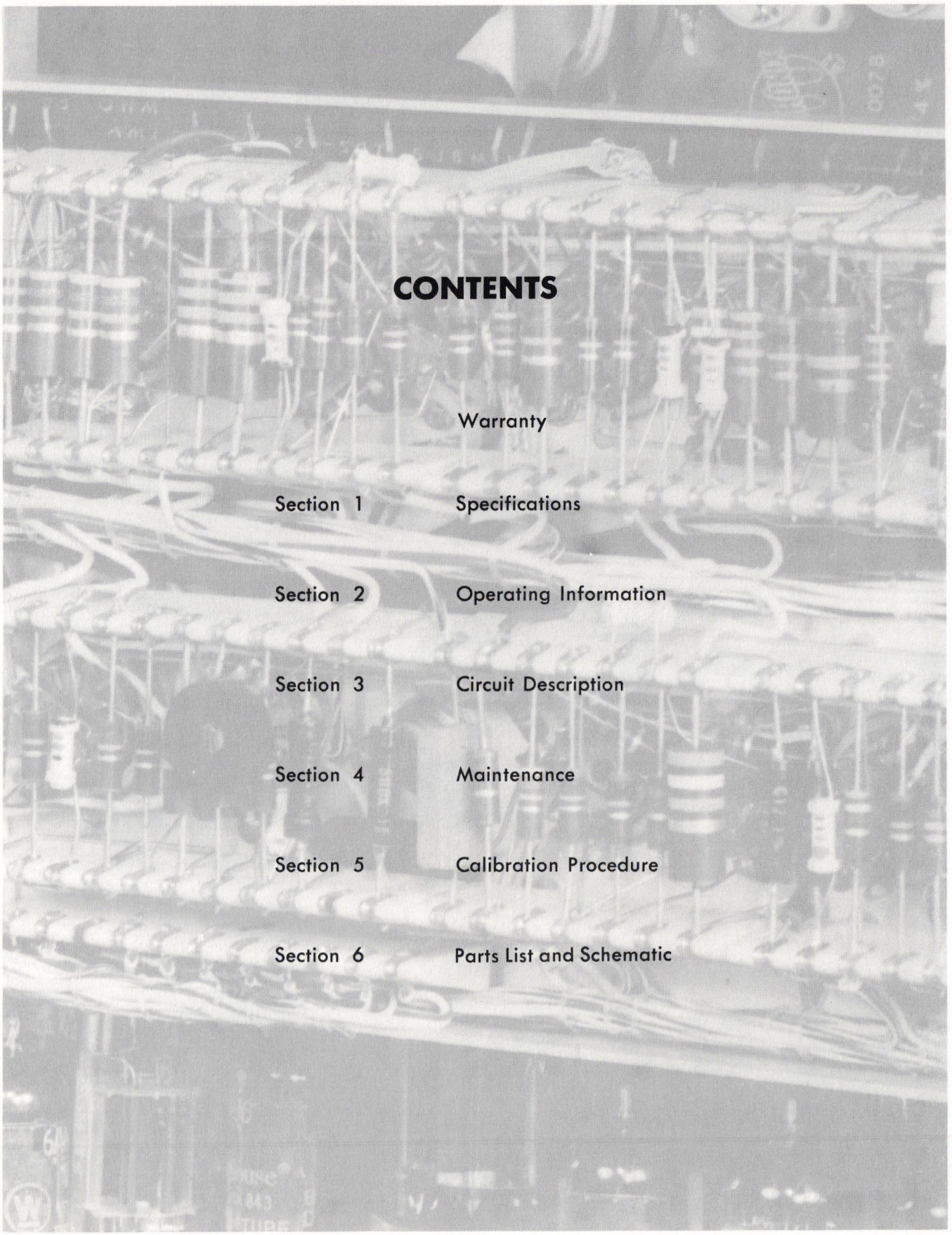
WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year.

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

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

Specifications and price change privileges reserved.



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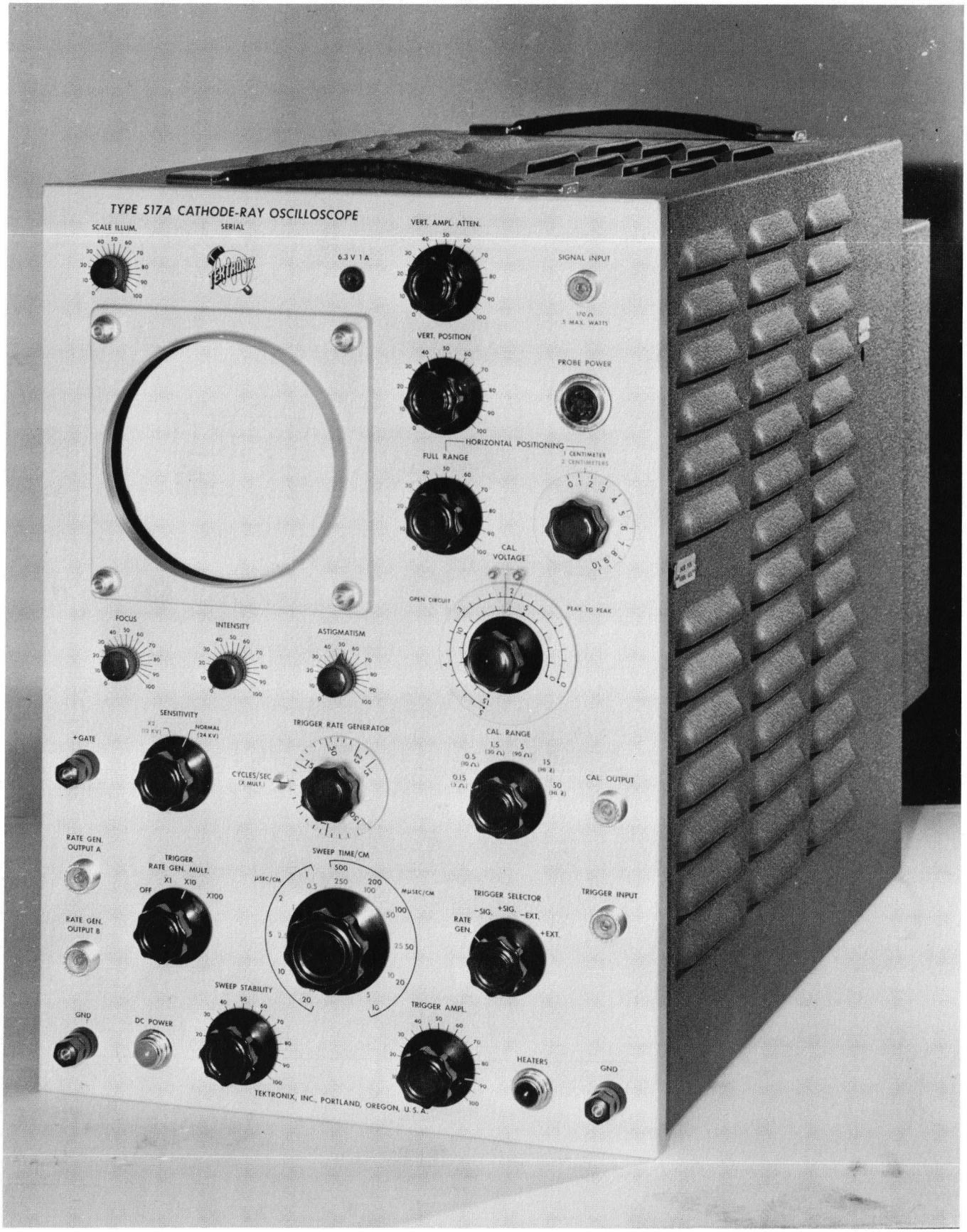
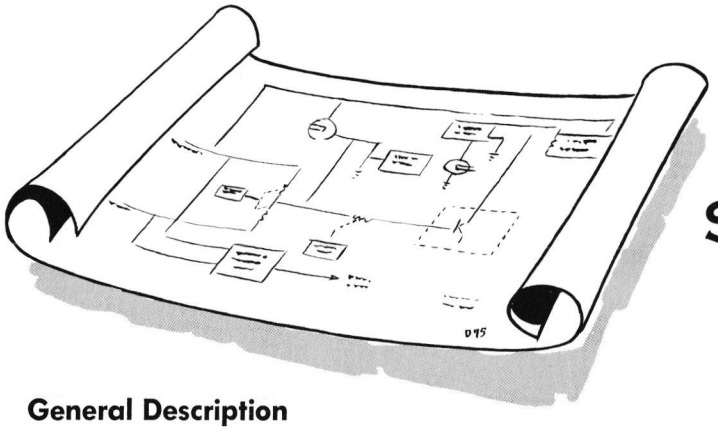




SECTION 1

SPECIFICATIONS

General Description

The Tektronix Type 517 and 517A Oscilloscopes are wideband high-voltage cathode-ray oscilloscopes designed primarily for observing and photographically recording waveforms having extremely short rise times.

The use of a 24-kv accelerating potential on a metallized cathode-ray tube permits photographic recording of single sweeps at the maximum writing-rate permitted by their vertical amplifier and sweep circuits. Distributed vertical amplifiers provide a risetime of 7 nanoseconds and sensitivity of .05 volts/cm. Both amplitude and time calibrations are provided. Sufficient time delay is incorporated in the vertical amplifier to permit viewing the leading edge of the waveform which triggers the sweep.

The Type 517 and 517A consist of two units, indicator and power supply, mounted on a Scopemobile, thus making a convenient mobile unit. If desired, the units may be lifted off the Scopemobile for bench use.

SPECIFICATIONS

Vertical Amplifier System

Type—5 stages of distributed amplification; 4th and 5th stages push-pull.

Transient Response

Risetime—7 nanoseconds. Free of ringing and overshoot.

Sensitivity

Vertical amplifier without probe—.05 v/cm.

With Cathode Follower probe—.1 v/cm.

Attenuator

A continuous control with a range of attenuation from 1X to 2X is provided in the vertical amplifier. Three screw-on attenuators are provided for use in conjunction with a cathode-follower probe. A step attenuator with a characteristic impedance of 170 ohms is also provided.

Input Impedance

Direct—170 Ω resistive

Looking into probe—12 megohm resistor paralleled by 5 $\mu\mu$f capacitor.

Higher impedance values depend upon capacitive attenuator used ahead of probe.

Signal Delay

Delay Line (RG63U coaxial cable)—65 nsec delay

Inherent delay of distributed amplifiers—55 nsec

Total Delay time—120 nsec.

Amplitude Calibrator

Pulse generator output of about 25 kc available at front panel, with six ranges from .15 to 50 v peak full scale. Accuracy within 4 percent of full scale.

Sweep Circuit

Type

Triggered, hard-tube bootstrap sweep circuit with inverter to produce balanced deflection.

Rates

11-position switch selects 10, 20, 50, 100, 200 or 500 MμSEC/CM and 1, 2, 5, 10 or 20 μSEC/CM.

Maximum displacement error—2% for 7 cm sweep length.

Sweep Starting Time

Approximately 90 nsec for the average instrument. Total signal delay of approx. 120 nsec permits sweep to be triggered and underway before signal is applied to vertical deflection plates.

Duty Cycle Limitation

Duty cycle of sweep system automatically limited to about 30% to avoid exceeding dissipation limits of some of circuit components. The limiting system serves purely a protective function and does not provide a frequency dividing operation.

MAXIMUM REPETITION RATES	
Sweep Time	Max. Repetition Rate
20 μsec/cm	1.5 kc
10 μsec/cm	3 kc
5 μsec/cm	6 kc
2 μsec/cm	10 kc
1 μsec/cm	20 kc
500 mμsec/cm	50 kc
200 mμsec/cm	50 kc
100 mμsec/cm	50 kc
50 mμsec/cm	50 kc
20 mμsec/cm	50 kc
10 mμsec/cm	80 kc

Triggering

A trigger amplifier in conjunction with a selector switch permits the sweep circuit to be triggered from:

(a) an external source of either polarity
(b) internal trigger rate generator
(c) the observed signal

The trigger amplifier is connected ahead of a signal delay cable which permits complete observation of the signal at the highest sweep speed. Any signal giving 0.5 cm deflection, or an external 0.3 v peak signal, will trigger the sweep.

Horizontal Position Vernier

In addition to the normal horizontal positioning control, a vernier control calibrated in millimeters provides accurate measurements over a range of 1 cm for use in measuring rise time, etc.

Trigger Rate Generator

A trigger selector switch permits the sweep to be triggered from the rate generator which also provides external pulses with the following characteristics:

Polarity	positive
Length	0.4 μsec
Risetime	0.15 μsec
Output Level	60 v with 200 Ω internal impedance 20 v with 50 Ω internal impedance
Repetition rate	15-15,000 cps variable in 3 ranges within 5% of full scale

Gate Out

Twenty-five volt positive pulse with duration approximately equal to time of the sweep, and rise time 0.03 μsec, from a cathode-follower source-impedance of 200 ohms.

Power Supplies

CRT Accelerating Voltage

An oil-sealed supply of the a-f oscillator type provides 24 kv (+20 kv and −4 kv) for the normal accelerating potentials. A front-panel selector switch gives an alternate choice of 12 kv (+10 kv and −2 kv) which doubles the CRT horizontal and vertical sensitivity. The −4 kv supply is regulated to compensate for local changes and line voltage changes.

Low Voltage Supply

A separate power unit provides all dc voltages of 750 volts and less for the indicator unit. All heater voltages in the indicator unit are regulated by a saturable reactor to compensate for line voltage changes.

Power Requirements

1250 watts at 117 volts. Voltage range 105-125 or 210-250, 60 cycle single phase ac. Three primary circuit fuses are provided for protection against sustained overload conditions.

Cathode-Ray Tube

A metallized type T54P cathode-ray tube with P11 phosphor is furnished with the Type 517A (Type 5XP with Type 517) unless a P1 or P2 phosphor is specified as the optional choice.

Construction

Contained in two separate unts of convenient size, normally mounted on a Tektronix Scopemobile. Cabinets and chassis are made of electrically-welded aluminum alloy. Photo-etched panels are employed.

Dimensions

Indicator unit: 12½" wide, 18½" high, 25½" deep.
Power unit: 16" wide, 10" high, 18" deep.

Weight

Indicator unit	76 pounds
Power unit	72 pounds
Scopemobile	42 pounds

Accessories

1—P170CF Probe, 010-101,
1—B170A Attenuator, 011-017
1—P170 Output cable, 012-006
1—Interconnecting cable, 012-032
1—BE510 Bezel, 014-011
1—H510 Viewing hood assembly, 016-001
1—3 to 2 wire adapter, 103-013
1—3-conductor power cord, 161-010
1—3-conductor power cord, 20", 161-014
1—Blue filter, 378-515
2—Instruction manuals
1—500A Scopemobile, 016-018
1—Tektip, hook M5302, 206-107
2—Tektip, straight, M5302, 206-106

Functions of Controls and Connectors

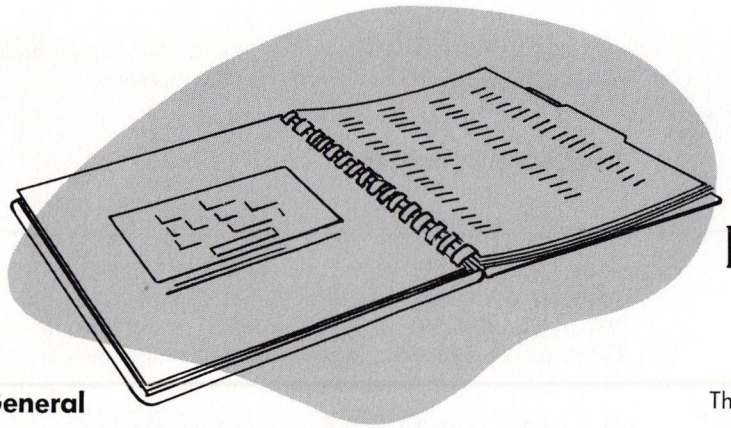
6.3 V 1A	Phone-tip jack connection from main heater bus. Useful for checking heater-bus voltage regulation. (Do not measure heater voltage on a rectifier type of voltmeter.)
SCALE ILLUM.	Variable resistor controlling brightness of lamps illuminating plastic graticule over face of crt.
VERT. AMPL. ATTEN.	Potentiometer varying grid bias on first and second vertical amplifier stages, permitting a two to one range of gain adjustment.
SIGNAL INPUT	UHF connector to grid line of first stage of distributed vertical amplifier.
VERT. POSITION	Twin differentially-connected potentiometer controlling average potential of cathode-ray tube vertical deflection plates and thereby adjusting vertical position of trace.
PROBE POWER	Connector providing heater and plate voltage for cathode-follower probe power.
HORIZONTAL POSITIONING, FULL RANGE	Twin differentially-connected potentiometer controlling average potential of crt horizontal deflection plates and thereby adjusting horizontal position of sweep.
HORIZONTAL POSITIONING 1 CENTIMETER	Twin differentially-connected potentiometer performing same function as above, but limited to one centimeter of positioning, and fitted with a dial calibrated in tenths of a centimeter.
FOCUS	Potentiometer controlling the voltage applied to the focusing anode (No. 1) of the crt for focusing the trace.
INTENSITY	Potentiometer controlling dc grid voltage of the crt and thereby the brightness of the trace.
ASTIGMATISM	Potentiometer controlling the grid bias of cathode-follower V134B to provide adjustable low-impedance source of voltage for anode (No. 2) of crt. Proper setting of the voltage of this anode with respect to the deflection plates permits the spot to be focused sharply in both dimensions simultaneously.
NORMAL SINGLE SWEEP	(S/N 1691 up only) Two-position switch to select either normal or single-sweep operation.
RESET	(S/N 1691 up only) Push button switch to arm the sweep circuit.
READY	(S/N 1691 up only) Neon light indicates when sweep circuit is armed.
+GATE	Binding post connected to positive multivibrator tube via cathode follower V124 to make available externally a positive pulse of the same duration as the sweep.
SENSITIVITY	Two-position switch to select either 24-kv or 12-kv accelerating voltage, and to select appropriate corresponding crt bias and unblanking voltages.
TRIGGER RATE GENERATOR (CYCLES/SEC)	Variable timing resistor for phantastron trigger-frequency generator.
CAL. RANGE	A six-position step attenuator constructed to give six full-scale amplitudes of the calibrating pulse, 0.15, 0.5, 1.5, 5, 15 and 50 volts.
CAL OUTPUT	UHF connector to arm of CAL. VOLTAGE potentiometer.
RATE GEN. OUTPUT A	UHF connector from cathode follower V130 providing 50-ohm output from trigger-rate generator.
RATE GEN. OUTPUT B	UHF connector from cathode follower V129 providing approximately 200-ohm output from trigger-rate generator.
TRIGGER RATE GEN. MULT.	Switch for selecting timing capacitors for phantastron trigger-frequency generator.
SWEEP TIME/CM	Gang switch controlling sweep duration and sweep rate.
TRIGGER SELECTOR	Switch selecting source and polarity of sweep-triggering voltage.
TRIGGER INPUT	UHF connector to —EXT. and +EXT. positions of TRIGGER SELECTOR switch, for connection to external trigger sources.
DC POWER	Neon pilot light across negative 250-volt supply in indicator unit.
SWEEP STABILITY	Potentiometer controlling grid bias of negative multivibrator tube. Determines optimum point of triggering.
TRIGGER AMPL.	Potentiometer controlling grid bias on trigger-amplifier second distributed amplifier stage and thereby determining amplitude of trigger signal applied to succeeding stage.

HEATERS	Pilot light on indicator unit connected to heater bus.
GND	Two binding posts electrically connected to the front panel.

External Power Supply

AC POWER	ON-OFF switch on power supply unit for controlling ac line voltage to unit, pilot light indicates switch ON position.
DC POWER	ON-OFF switch on power supply unit controlling ac line voltage to primary of plate-supply transformer, pilot light indicates switch ON position.
DC SUPPLIES	6 amp Fast-Blo fuse.
REGULATED HEATERS	5 amp Fast-Blo fuse.
POWER SUPPLY HEATERS	4 amp Fast-Blo fuse.

SECTION 2



OPERATING INSTRUCTIONS

General

The Type 517 or 517A Oscilloscope may be operated at any normal indoor location or in the open if it is protected from moisture. If the instrument has been exposed to dampness, it should be left in a warm room until it is throughly dry before it is placed in operation.

Ventilation

Both units require forced air cooling so that care must be exercised to avoid obstructing the air intakes to the circulating fans.

WARNING

The Type 517 or 517A should not be operated unless the fans are running. The interior will reach dangerous temperatures in five to ten minutes of such operation.

First-Time Operation

To place the oscilloscope in operation for the first time, the following procedure is suggested:

Set front-panel controls as follows:

POWER SUPPLY AC	OFF
POWER SUPPLY DC	OFF
VERT. POSITION	center
HORIZONTAL POSITIONING, FULL RANGE	center
FOCUS	center
INTENSITY	full ccw
NORMAL-SINGLE SWEEP (S/N 1691 up only)	NORMAL
TRIGGER RATE GENERATOR	50
TRIGGER RATE GEN. MULT.	100
SWEEP TIME/CM	500 MILLIμSEC PER CM
TRIGGER SELECTOR	RATE GEN.
SWEEP STABILITY	full ccw
TRIGGER AMPL.	full ccw

Install the interunit power cable and the line-voltage cable. The source of power must be capable of supplying 12 amperes 105 to 125 volts at 60 cycles.

The AC POWER switch may now be turned ON.

Allow about 30 seconds for the tube heaters to come up to operating temperature, then the DC switch may be turned on.

Advance the INTENSITY control almost fully clockwise until a spot appears near left center of the screen, then return counterclockwise until the spot just disappears.

CAUTION

Do not allow this spot to be excessively bright or allow it to remain long in one position as the screen will be damaged in a few seconds.

Advance the SWEEP STABILITY control clockwise until a horizontal sweep appears across the screen, then return counterclockwise until the sweep just disappears.

Advance the TRIGGER AMPL. control until the sweep just reappears. The sweep is now being triggered by the TRIGGER RATE GENERATOR at a repetition rate of 5000 cycles.

Return the INTENSITY control counterclockwise to reduce the beam intensity.

Observe a sample signal. RATE GEN. OUTPUT A, after about 50 db of attenuation, will provide a satisfactory signal of the correct amplitude. Turn the TRIGGER SELECTOR switch to +SIG.

Adjust the INTENSITY, FOCUS, and ASTIGMATISM controls until a sharp trace with adequate intensity is obtained. These controls are somewhat interdependent and will require slight repeated readjustment to obtain the best trace.

Readjust the SWEEP STABILITY and TRIGGER AMPL. controls to obtain a stable trace.

NOTE

If the SWEEP STABILITY control is advanced too far causing the sweep to run in the self-excited mode the sweep length will be shortened. Check this by turning the TRIGGER AMPL. control full counterclockwise. The trace should disapear.

Adjust the signal amplitude by means of the VERT. AMP. ATTEN. control, or with external attenuators until the vertical deflection amplitude does not exceed 1 centimeter above or below center corresponding to an input of about 0.1 volts, and adjust the VERT. POSITION and HORIZONTAL POSITION control for a satisfactory position of the trace.

The instrument should now be ready for application of external signals.

170 Ohm Attenuator

This attenuator can be used externally when it is desired to observe signal voltages higher than about 0.2 volts, peak to peak. Both input and output impedances are 170 ohms to match the scope input, and the attenuation calibration is accurate only at this impedance level. Attenuation values up to 64 db in one-db steps can be selected. selected.

Cathode Follower Probe

The probe power plug must be plugged into the PROBE POWER receptacle near the SIGNAL INPUT connector, and the male UHF coaxial fitting must be plugged into the SIGNAL INPUT panel coaxial connector. Three screw-on attenuators are provided.

The screw-on attenuators, used with the cathode follower probe, provide attenuation at high impedance.

Signal Amplitude Calibration

Calibrating voltage is supplied by means of a 25-kilocycle 10% duty-cycle square-wave generator to the CAL. OUTPUT panel connector. The generator impedance for each CAL. RANGE setting is shown on the front panel. The calibration is accurate on open circuit at the generator and will be affected by the external load to which it is connected. The frequency of the calibrator circuit is not intended to be synchronized with that of the observed wave. Instead, the sweep should be tripped by the TRIGGER RATE GENERATOR and the CAL. OUTPUT should be substituted for the source of the signal being measured. The indication is a pair of horizontal lines displayed across the face of the CRT. The output voltage is capacitor coupled to the deflection plates so that the positions of both the base and the top of the wave vary as the amplitude controls are adjusted. Calibrations are in peak-to-peak volts, and the calibrating wave must therefore be positioned properly when a measurement is made.

Time Calibration

Calibrations for the sweep circuit are in time/cm of horizontal deflections, which, with the one-centimeter horizontal graduations of the graticule and the calibrated 1-CENTIMETER HORIZONTAL POSITIONING control, permits measurement of the time dimensions of the displayed pulse to be made to a fraction of a centimeter by interpolation.

Trigger Rate Generator

Calibrations of the trigger rate generator are in cycles/second times a multiplier. To select a desired trigger rate, set the CYCLES/SEC dial to the significant figures, and the TRIGGER RATE GEN. MULT. dial to multiply by 1, 10 or 100 times. Any frequency between 15 cycles and 15 kilocycles can be selected accurately within about 5 percent.

Use of Type 517/517A as a Synchroscope

Two output connectors from the trigger rate generator are available on the front panel. To use the oscilloscope as a synchroscope output from one of these output connectors can trigger the function to be observed, and the other output can be delayed and applied to the TRIGGER INPUT connector throught an external delay circuit to start the horizontal sweep. No variable delay is incorporated in the trigger circuit.

+ Gate

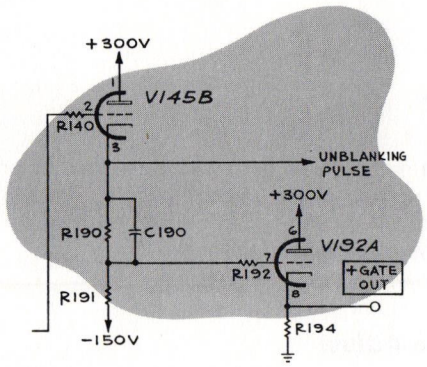
This output is approximately 40 volts at 270 ohms.

Direct Connection to Vertical Deflection Plates

An access hole on the left side of the indicator unit case near the top permits direct connection to the vertical deflection plates. First, remove the clip leads running from the vertical amplifier output stage and replace them with a pair of small wire leads. The leads can be held in place by grooves in the supporting plexiglass plate so as to have low capacitance to each other and to the case. The nominal deflection plate sentitivities are 14-17 volts/cm vertical and 65-75 volts/cm horizontal.

Scale Illumination

The intensity of the graticule illumination can be adjusted by means of a variable resistor in series with the graticule light to suit the conditions of the room lighting and trace intensity, and to permit the graticule lines to be photographed.



SECTION 3

CIRCUIT DESCRIPTION

INDICATOR UNIT

Horizontal Deflection System

A linear, triggered sweep is available with eleven fixed, accurately timed sweeps ranging from 0.01 microseconds/cm to 20 microseconds/cm when a 24-kilovolt accelerating potential is used. When the 12-kilovolt accelerating potential is used, each of those Sweep Time/CM figures is halved.

The basic waveform is generated by a pentode clamp with a cathode-follower bootstrap linearity corrector. Push-pull deflection is accomplished at output level by addition of a plate-output unit-gain phase-inverter stage.

Trigger Phase Changer

A trigger selector switch selects the source of trigger signal and V101 reverses the phase, if necessary, to provide the trigger amplitude with the required negative signal.

Distributed Trigger Amplifier

A broad-band trigger amplifier, capable of passing a steep wave-front pulse, is used in order to reduce to a minmum the delay betwen the start of the trigger pulse and the start of the sweep. This amplifier consists of two distributed stages of three pentodes each, V102 to V107. The grids of the second stage, V105 to V107, are driven in the positive direction and the negative-pulse output amplitude of this stage is adjustable by means of the TRIGGER AMPL. control which sets the grid bias level.

Trigger Limiter

The trigger limiter stage operates with zero bias. The negative pulse from the trigger amplifier drives this tube to plate-current cutoff. Choice of the proper value of quiescent plate-current and use of shunt-compensated plate-load resistance of low value results in a very steep positive pulse limited in amplitude to about 10 volts. Thus limited, this pulse does not drive the grid of V109 into the grid-current conducting region.

Trigger Switch Tube

The resulting negative pulse at the plate of V109, coupled through coupling diode V110 to the plate of minus multivibrator tube V111, triggers the sweep.

Trigger Coupling Diode

The trigger-coupling diode serves to disconnect the plate of trigger switch tube, V109, from the plate of negative multivibrator tube, V111, when the plate voltage of V111 drops below that of V109.

Sweep Lockout Circuit (S/N 1691 and up only)

With the NORMAL-SINGLE SWEEP switch, SW90, in the SINGLE SWEEP position, the thyratron, V90, is initially in a nonconducting state. The operating voltages on V255 and V109 are normal and the READY light, B90, is ignited through the control tube, V83A. Under these conditions, the oscilloscope sweep circuits will accept a triggering pulse and initiate a sweep.

At the completion of the sweep initiated by the triggering signal, a positive pulse is delivered to the grid of V90. The positive pulse ignites V90, dropping the plate voltage and extinguishing B90. The drop in plate voltage is used to render the sweep circuits inoperative through V255 and to drive the screen voltage on V109 negative through V83B. The negative screen voltage effectively blocks any further trigger pulses from reaching V110. By pressing the RESET button or switching SW90 to NORMAL, V90 is returned to the non-conducting stage.

Multivibrator

V111 and V119 operate as a plate-to-grid coupled monostable multivibrator for the purpose of converting a triggering pulse into a pulse of controllable duration, suitable for operating the sweep generator and unblanking circuits. The SWEEP STABILITY control, by varying the bias on the grid of V111, determines the optimum point of triggering. On Type 517 instruments below S/N 926, if there is insufficient bias, the multivibrator will begin to operate self-excited at a duty cycle such that the allowable dissipation of the 6J6 cathode followers may be exceeded. Care should be taken, therefore, not to leave this control at a setting which results in self-excited operation for extended periods.

Duty Cycle Limiter (S/N 926 up only)

A portion of the +GATE output is used to charge C258 through R258. When C258 has charged to a sufficiently high voltage the current in the triode section of V255 is switched to the pentode section. This pulls the grid of V111 down and holds the multivibrator in the quiescent state. The portion of the +GATE signal used to charge C258 is of about 20 volts amplitude but the discharge voltage is only a fraction of a volt so the discharge time is many times longer than the charge time. This ratio of charge to discharge time determines the duty cycle of the sweep. At slow sweep speeds the switching action of V255 will revert the multivibrator and thus determine the duration of the sweep. At fast sweep speeds several cycles of the +GATE are required to charge C258 sufficiently therefore the sweep will occur in bursts of several cycles and then remain quiescent during the discharge time of C258.

Sweep Generator Clamp Circuit

In the quiescent state, the parallel clamp tubes, V112 and V113, conduct heavily. The negative pulse from the plate of V111 to their grids interrupts the flow of plate current very rapidly, and the plate voltage then begins to rise at a rate determined by the values of capacitance and resistance in the charging circuits, both of which are selected by the SWEEP TIME/CM selector switch, SW103, for the various sweep times. The series inductor in the grid circuit of the clamp tubes provides a 10 nanosecond delay to enable the unblanking circuit to reach full voltage before the sweep voltage starts.

Bootstrap Cathode Follower

The voltage rise across the charging capacitor in the foregoing circuit would be exponential if no provisions were made to keep the charging current from varying during the sweep. The charging current is kept more nearly constant by the bootstrap action of V115 and V116, and sweep cathode follower V117, which tends to keep the voltage constant across the charging resistor for the duration of the sweep.

Decoupling Diode

A decoupling diode, V114, a 6X4 in series with the plus 475-volt supply to the clamp tubes, offers low resistance to the passage of the quiescent-state current to the clamp tubes, but disconnects the positive end of the charging resistor from the 475-volt supply when bootstrap action raises the cathode of V114 above 475 volts.

Plus-Sweep Cathode Follower

V117, a cathode follower, provides the positive sweep voltage to the cathode-ray tube, as well as to the grids of the bootstrap tubes and to the sweep-inverter stage.

Sweep Inverter

A unit-gain amplifier is used as a phase inverter to provide the negative portion of the sweep voltage. This stage consists of V118, a 6AG7, with gain maintained near unity by use of frequency-compensated feedback.

Bias and Screen Adjust

V137 (designated V118.1 S/N 101-495) a 12AU7, provides a low-impedance bias voltage and screen voltage for the sweep inverter stage V118.

DC Restorer

V133, a 6AL5 dual diode, removes the accumulated charge from the sweep-coupling capacitors, permitting the sweep to start at the same position on the cathode-ray tube regardless of the repetition rate of the sweep.

Unblanking Amplifier

During the waiting periods between sweeps, the bias on the cathode-ray tubes is such that the beam current is completely cut off. As soon os a trigger pulse appears and the sweep starts, a positive pulse of approximately 100 volts is required on the cathode-ray tube grid to turn the beam back on. This pulse must have a very fast rise time and a very flat top to insure fast unblanking and uniform image brightness. Both conditions are accomplished by means of the unblanking amplifier, V120 and V121, two 6AG7's in parallel, and associated output cathode follower V123. For the 10 MILLIμSEC/CM setting, an inductance ringing circuit is inserted at the grid of the unblanking tube to provide a sufficiently sharp unblanking pulse. This circuit consists of a 300-microhenry inductance from the grids of the unblanking amplifier tubes to ground through a 100-ohm resistor. The negative pulse of the multivibrator starts the circuit ringing in the negative direction. One-half cycle of the oscillation is a satisfactory period of unblanking. Grid current damps out further oscillation during the positive half cycle since the unblanking amplifier tubes operate at zero bias.

Unblanking Cathode Follower Output

V123 provides low-impedance output for the unblanking amplifier.

Plus Gate Cathode Follower

V124 is a 6J6 cathode follower whose grid is coupled to the plate of the positive multivibrator tube V110. The output of the cathode follower connected to a front-panel binding post provides a positive 50 v gating pulse of the same duration as the sweep.

Unblanking Amplifier Screen Supply

V122 is a cathode follower supplying the screen voltage to the unblanking amplifiers. The use of this circuit permits the unblanking voltage to be reduced to half when the crt is operated at a 12-kv accelerating potential. The grid voltage of V122 is controlled by the SENSITIVITY switch.

Trigger Rate Generator

An internal trigger generator provides positive pulses to two front-panel connectors labeled RATE GEN. OUTPUT A, and RATE GEN. OUTPUT B. OUTPUT A provides 20 volts at 50 ohms and OUTPUT B provides 60 volts at 200 ohms. The purpose of these circuits is to make available, externally trigger pulses of accurate repetition rate to permit use of the Type 517/517A as a synchroscope.

The frequency of the trigger circuit is determined by a self-excited screen-coupled phantastron, V126, a 6BH6. A cathode follower, V127A, one-half of a 12AU7, provides a low-impedance path for recharging the phantastron charging capacitors. The other half of this tube, V127B, provides a means of coupling from the phantastron to the blocking oscillator, V128, a 12AU7. One half of V125, a 12AU7, is a cathode follower providing a low-impedance bias source for the other half which serves as a plate-catching diode for phantastron V126. The output pulse is formed by the blocking oscillator, V128, and is coupled to the RATE GEN. OUTPUT A and the TRIGGER SELECTOR switch via cathode follower V130, a 12AU7, and to RATE GEN. OUTPUT B via cathode follower V129, a 12AU7.

VERTICAL DEFLECTION SYSTEM

The vertcial deflection system consists of five stages of distributed amplification in cascade with a phase inverter preceding the fourth stage. The first three single-ended stages, found in the pre-amplifier section, provide drive to a coaxial signal-delay cable and to the output trigger amplifier. The three pre-amplifier stages include, respectively, four, four, and five sections of distributed amplification. Following the signal-delay cable, the phase inverter provides push-pull drive for the remaining two push-pull distributed stages, which include 4 sections of distributed amplification in each side of the fourth stage, and 10 sections of each side of the fifth stage. The first two pre-amplifier stages employ 6AK5 tubes with bias voltage adjustable to provide a gain control of two to one. The remaining three amplifier stages employ type 6CB6 tubes. As shown in the simplified schematic, a parallel R-C network is inserted between the second-stage plate line and the third-stage grid line. This network deemphosizes the low frequencies to compensate for high-frequency losses in the amplifier system. An R-L network with a time constant of about 0.05 microseconds in the reverse termination of the second-stage plate line compensates for a time variation of the electrolytic bypass capacitors in the amplifier system. The later network may have either capacitive or inductive reactive elements depending upon the need.

Vertical Amplifier DC Supply Distribution

The plate and screen supply distribution is a simplified diagram showing dc distribution to the plates and screens of the various stages of the vertical amplifier and current consumption and normal ripple voltage at each of the four voltage levels.

EXTERNAL POWER SUPPLY

All voltages of 750 and less are provided by an external power supply. Distribution of the voltages, and the nominal load current at each voltage are as follows:

Negative 250 volts, regulated (50 ma)

a. bias voltages

b. negative positioning voltage

c. voltage reference supply for other voltage regulators

Positive 150 volts, regulated (550 ma)

a. plate voltage for distributed trigger amplifier

b. plate and screen voltage for all vertical amplifiers except plates of output stage.

Positive 180 volts, unregulated (250 ma)

a. plate voltage only for vertical output amplifier

Positive 225 volts, regulated (450 ma)

a. trigger phase changer

b. trigger limiter and switch tube

c. unblanking amplifier

d. positive multivibrator

e. negative multivibrator and clamp tube, screens only

f. calibrator circuit voltages

g. trigger rate generator voltage

h. filament oscillator tube for CRT high-voltage supply

i. positive vertical positioning voltage

j. probe voltage supply via a cathode follower

k. plate voltages for plus gate tube

Positive 365 volts, unregulated (111 ma)

plate and screen supply for CRT high voltage supply oscillator

Positive 475 volts, regulated (150 ma)

a. plate voltage for minus multivibrator

b. plate voltage for clamp tubes via 6X4 decoupling diode

c. plate voltage for unblanking cathode follower

d. screen voltage for sweep inverter via cathode follower

e. positive vertical positioning voltage

Positive 750 volts, regulated (50 ma)

a. plate voltage for positive sweep output cathode follower

b. plate voltage for bootstrap cathode follower

c. plate voltage for sweep inverter tube

Filament Voltage Regulator

Heater voltages of all tubes located in the indicator unit are regulated by automatically controlling the primary voltage of the filament transformer, T901, located in the indicator unit. The transformer primary voltage is controlled at a nominal 80 volts by a variable-reactance saturable reactor, located in the external power supply unit, connected in series with the line-voltage source and the transformer primary. Reactance of the saturable reactor is controlled by varying the direct current through an auxiliary winding in accordance with line-voltage variatons of direct current by means of an emission-sensitive diode whose filament is supplied from the regulated transformer, T901. In the schematic, V419, a Sorenson Type 2AS-15, is the emission-sensitive diode. The plate resistance of this tube varies rapidly with filament voltage, and in the opposite sense, so that the directly-connected grid of V420, a 6AU5, drops in voltage when, for example, the filament voltage increases. This results in a reduction of current through the auxiliary winding of the saturable reactor, which is a part of the plate load of V420. The resulting increase in reactance of the saturable reactor reduces the ac voltage available to the transformer primary and tends to maintain the diode filament voltage at a constant level. Capacitor C417 and resistor R477 (added S/N 994) connected between grid and plate of V420, form a feedback network which compensates for the 120-cycle modulation of filament temperature of V419. It should be noted that filament-winding terminals 5 and 6 on T901 are at minus 250 volts dc. This is necessary because the dc coupled plate of V419 is at approximately ground potential and its directly-heated filament is therefore depressed to provide the required cathode-to-plate potential difference.

Negative 250-volt Regulated Supply

This supply voltage is regulated by comparing the voltage of V418, a type 5651 gas diode, to that of a voltage divider connected across the regulated output, through comparator tube V417, a 6AU6. The difference voltage is amplified in V417, and applied to the grid of V416, a 6AU5 series regulator tube in the positive lead. V415 is a type 6X4 connected as a full-wave rectifier.

Positive 150-volt Regulated Supply

This supply voltage is regulated by comparing to ground, the voltage of a point near ground potential on a voltage divider connected between the positive 150-volt bus and regulated negative 250 volts, through comparator tube V422, a 12AX7. The difference voltage is further amplified in V414, a 6AU6, and applied to the grids of series regulator tubes V412, V413 and V421, three 6AS7's in parallel. The additional gain provided by V422 is necessary to reduce the output ripple voltage to a satisfactorily low level. Four ten-plate selenium rectifiers are used in a bridge circuit. A tap, taken off ahead of the series regulator tubes, supplies a nominal 180 volts at 250 ma, unregulated, from the same rectifier.

Positive 225-Volt Regulated Supply

This supply voltage is regulated by comparing to ground potential a point near ground potential on a voltage divider connected between the positive 225-volt bus and regulated negative 250 volts, through comparator tube V411, a 6AU6. The difference voltage is amplified in this tube, whose plate is directly connected to the grids of V409 and V410, two 6AS7 series regulator tubes in parallel. Four ten-plate selenium rectifiers are used in a bridge circuit. An unregulated tap at plus 330 volts is taken off ahead of the regulator to supply dc saturation current for the saturable reactor in the filament voltage regulator.

Positive 365-Volt Unregulated Supply

This unregulated supply uses V407 and V408, two 6X4's in parallel, in a full-wave rectifier circuit with capacitor input. The ac voltage for this supply is obtained from taps on the transformer that supplies ac for the positive 475-volt regulated supply.

Positive 475-Volt Regulated Supply

This supply is regulated by comparing to ground potential a point near ground potential on a voltage divider connected between the 475-volt bus and regulated negative 250 volts through comparator tube V406, a 6AU6. The difference voltage is amplified in V406, whose plate is directly connected to the grids of 405, two halves of a 6AS7 series regulator tube in parallel. V404, a 5R4GY rectifier, is connected in a full-wave circuit, the ac voltage for this supply is obtained from the outside taps of the same tranformer that supplies the 365-volt unregulated supply. At S/N 496 and up, R476, 7.5 k shunting the regulator tube increases the available current.

Positive 750-volt Regulated Supply

This supply is regulated by comparing to the previously-described 475-volt supply, the voltage near 475 volts of a divider connected between the 750-volt bus and ground, through comparator tube V403, a 6AU6. The difference voltage is amplified in V403, and applied to the grid of V402, a triode-connected 6AU5 series-regulator tube. V401, a 6X4 rectifier, is connected in a full-wave circuit. The unregulated output of this portion of the circuit is approximately 425 volts, which, added to the unregulated 580-volt portion of the 475-volt supply, results in a potential of approximately 900 volts to ground at the plate of V402.

NOTE

The capacitance between the regulated bus and the grid of the reference tube in each of these supplies is for the purpose of increasing the ac gain of the regulator circuit loop.

Cathode-Ray Tube Circuit

The NE2 neon glow lamps across the INTENSITY control potentiometer and Max. Intensity Adj. variable resistor maintain the INTENSITY potentiometer terminal voltage constant regardless of cathode-ray tube cathode current, thereby stabilizing the intensity adjustment. Two of the four neon glow lamps are shorted out by the SENSITIVITY switch when it is turned to the 12-kv position. This reduces the maximum cathode-ray tube bias available by a factor of two at the lower accelerating voltage. The purpose of the Max. Intensity Adj. variable resistor is to adjust the minimum grid bias setting available by the INTENSITY control to a safe value thus preventing damage to the cathode-ray tube screen in case the INTENSITY control is advanced too far. The ASTIGMATISM control potentiometer controls the grid bias of cathode follower V135B to provide an adjustable low-impedance source of voltage for anode No. 2 of the cathode-ray tube.

Type 420/420A High Voltage Power Supply

All the accelerating potentials for the cathode-ray tube are provided by a high-voltage supply employing an audio oscillator operating at a frequency of approximately 1.8 kilocycles. Four type 1X2 high-voltage rectifier tubes in a voltage quadrupling circuit provide positive 20 kilovolts. In type 420 High Voltage Power Supplies, with Type 517 oscilloscopes S/N 101 through 993, voltage divider resistors provide 13.3 kilovolts and 6.6 kilovolts positive. This feature is not found in Type 420A High Voltage Power Supplies with Type 517A Oscilloscopes, S/N 994 and up. The high-voltage rectifiers, capacitors, resistors and transformers are all oil-immersed.

High-Voltage Oscillator and Regulator

The high-voltage oscillator plate voltage is regulated to maintain a constant negative 4 kilovolts of rectified output so that deflection sensitivity of the cathode-ray tube will not be affected by line-voltage or load changes.

A tap on the negative 4-kilovolt portion of the power supply is referred to a regulated negative 250-volt source through V302A, one section of a 12AU7. The other section of this tube, V302B, amplifies the difference voltage and applies it to the grids of the series regulator tubes, V301 and V307 in parallel, which control the plate voltage of oscillator V303, a 6AU5.

In Type 517 Oscilloscopes, serial numbers 187 and higher, V305, a 6C4, provided with an R-C network in its grid circuit, depresses the grids of the series regulator tubes, V301 and V306 when power is first applied, and then slowly allows the grids to assume their normal regulating voltage depending on the time constant of the R-C network. This circuit delays application of full accelerating voltage to the cathode-ray tube, thus preventing "flare" when the instrument is turned on with the INTENSITY control at normal setting. In eariler Type 517 Oscilloscopes, serial numbers 186 and lower, flare protection is incorporated in the filament-voltage oscillator supplying filament voltage to the 1X2 high-voltage rectifiers.

Filament-Voltage Oscillator

Filament voltage for the five 1X2 high-voltage rectifiers is supplied by means of a separate oscillator circuit with V304, a 6AQ5. In Type 517 Oscilloscopes, serial numbers 186 and lower, a 6C4 cathode follower, V305, supplies the screen voltage of oscillator tube V304. An R-C network in the grid circuit of V305 causes the screen voltage of V304 to rise slowly when power is first applied, thus prolonging the filament-heating time of the 1X2 high-voltage rectifiers. The corresponding gradual rise of voltage of the high-voltage supply prevents flare on the cathode-ray tube when the instrument is turned on with the INTENSITY control at normal setting.

Calibrator

The signal-amplitude calibrating unit consists of a self-excited unsymmetrical multivibrator operating at a frequency of about 25 kilocycles. The positive pulse, about 3 μseconds long, is clipped in diode V135A at a level determined by the setting of the grid voltage of cathode follower V135B on the Cal. Adjust potentiomenter. The negative portion of the pulse is clamped at ground potential by a crystal diode. A potentiometer labeled CAL. VOLTAGE in the cathode circuit of cathode follower V132 provides a continuously-variable pulse amplitude to cathode follower V131. A six-position step attenuator in the cathode circuit of V131, labeled CAL. RANGE provides six voltage range steps.

170-Ohm Attenuator (Type B170-V)

This device consists of a series of resistor pi pads which can be selected by means of frequency-compensated toggle switches. The nominal impedance of the box is 170 Ω to match the impedance of the scope input and of the probe cable.

The inductors between switches compensate for switch capacitance to approximately 150 mc. Additional rise time, contributed by the use of the attenuator to the overall step response of the Type 517/517A, is of the order of 3 nsec.

Input and output connectors are chassis-mounted female UHF coaxial fittings.

Cathode Follower Probe

The Type P-170-CF Probe provides high-impedance input to the Type 517/517A. The probe consists of a type 5718 minature triode enclosed in a brass housing, connected to the oscilloscope by means of a 40-inch flexible cable. Cathode output from the cathode follower is fed through 170 Ω

coaxial cable to the 170 Ω input of the oscilloscope. The cathode resistor for the cathode follower consists of the 170 Ω grid line termination of the distributed preamplifier. The cable is also provided with a four-prong power plug which plugs into a socket near the 170 Ω coaxial input of the oscilloscope to provide 110 volts dc at 9.5 milliamps and 6.5 volts ac at 150 milliamps, for plate and heater power for the Type 5718 tube.

Three screw-on capacitive attenuators, I, II, and III, each adjustable over a ten-to-one range in conjunction with the probe and instruments' two-to-one variable attenuator make available the following voltage sensitivities and attenuation ranges:

Type 517 S/N 101 through 925

	Voltage Sensitivity	Attenuation
170 Ω input	.1 to .2 volts/cm	0
Probe alone	.2 to .4 volts/cm	2:1
Attenuator I	.4 to 8.0 volts/cm	2:1 to 20:1
Attenuator II	4.0 to 80 volts/cm	20:1 to 200:1
Attenuator III	40.0 to 800 volts/cm	200:1 to 2000:1

Type 517A S/N 926 up

	Voltage Sensitivity	Attenuation
Direct Input	0.05 to 0.1 v/cm	0 to 2:1
Probe alone	0.1 to 0.2 v/cm	2:1 to 4:1
Attenuator I	0.2 to 4 v + cm	4:1 to 80:1
Attenuator II	2 to 40 v/cm	40:1 to 800:1
Attenuator III	20 to 400 v/cm	400:1 to 8000:1

The input admittance of the probe alone consists of a capacitance of 5 $\mu\mu$f shunted by a 12 megohm, ½ watt Allen Bradley resistor. The minimum input capacitance of the attenuators is of the order of 1 $\mu\mu$f.

Input capacitance of the capacitive attenuators when attached to the probe are shown in the following table. The sensitivities listed are for a full-right setting of the VERT. AMPL. ATTEN. control of the Type 517/517A. The capacitance values were measured using actual production attenuators, but capacitance of individual attenuators may depart somewhat from the values listed.

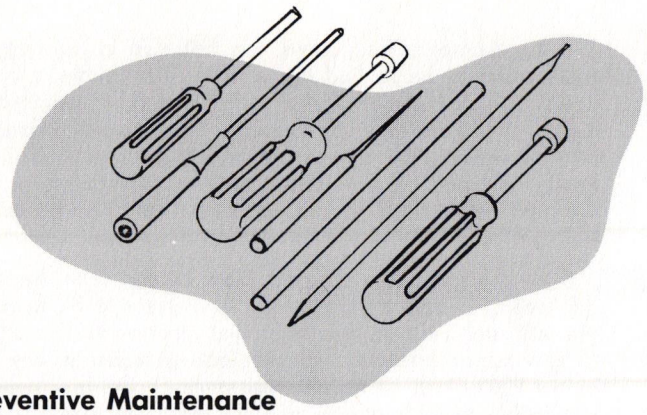
Type 517 S/N 101 through 925

Attenuator Number	Attenuator Sensitivity Setting	Input Capacitance
I	0.4 v/cm 4.1	5.0 $\mu\mu$f 1.2
II	4.0 40	5.0 1.2
III	40 400	3.0 1.1

Type 517A S/N 926 up

Attenuator Number	Attenuator Sensitivity Setting	Input Capacitance
I	0.2 v/cm 2 v/cm	5.0 $\mu\mu$f 1.2 $\mu\mu$f
II	2 v/cm 20 v/cm	5.0 $\mu\mu$f 1.2 $\mu\mu$f
III	20 v/cm 200 v/cm	3.0 $\mu\mu$f 1.1 $\mu\mu$f

Intermediate setting of attenuators between the settings listed will result in intermediate values of input capacitance.



SECTION 4

MAINTENANCE

Preventive Maintenance

When the Type 517/517A is being operated, it is extremely important that adequate ventilation be provided for both the Indicator Unit and the Power Supply, since some of the components in both units are operated at dissipation levels such that excessive temperatures and consequent component damage might occur without adequate air circulation.

To assure free passage of air, the units should be placed so that the air intakes are not blocked by other apparatus or furniture, and the filters should be kept clean.

Washable Lumaloy Air Filters are used at the air intake ports of both units. The following filter cleaning instructions are given by the filter manufacturer:

"To Clean:

(1) If grease or dirt load is light, remove filter from installation and flush dirt or grease out of filter with a stream of hot water or steam.

(2) If load is too heavy for treatment in (1) above, prepare mild soap or detergent solution in pan or sink, deep enough to cover filter when laid flat. Agitate filter up and down in this solution until grease or dirt is loosened and carried off filter.

(3) Rinse filter and let dry.

(4) Dip or spray filter with fresh Filter Coat, or other approved adhesive. Filter Coat is available from the local representative of RESEARCH PRODUCTS CORP. in the one-pint Handi-Koter with spray attachment or one-gallon and five-gallon containers."

Unless they are specifically ordered otherwise, Type 517/517A Oscilloscopes are shipped connected for operation at 105 to 125 volts, 50 to 60 cycles ac. However, provisions are made for easy conversion to operation at 210 to 250 volts, 50 to 60 cycles. In instruments with serial numbers 280 and higher, three transformers, T401, T402 and T901, with one series reactor, L402, are provided with split input windings which are normally connected in parallel for 115-volt operation, but which can easily be connected in series for 230-volt operation. Each of these split windings terminates in a nest of four terminal lugs arranged in a square on a bakelite terminal board, and numbered 1, 2, 3 and 4 in clockwise rotation.

Terminals numbered 1 and 3 are connected to one winding and terminals numbered 2 and 4 are connected to the second winding. The ac input leads are connected to terminals 1 and 4 whether for 115-volt or for 230-volt operation, so that these leads do not need to be moved when conversion is made from one to the other operating input-voltage level.

When wired for 115-volt operation, terminals 1 and 2 are joined by a bare bus wire, and terminals 3 and 4 are similarly joined. To convert to 230-volt operation, remove the bare bus wires between these terminals and substitute a single connecting wire between terminals 2 and 3.

Transformer T901 terminal board is located on the underside of the indicator unit, readily accessible at the right rear when the indicator unit is turned upside down. The remaining three terminal boards are located on the underside of the external power-supply unit. When the power-supply unit is turned upside down L402 is on the right front of the chassis, T401 is located at the left rear and T402 at the right rear.

The three fuses mounted at the front of the power supply should be changed to accommodate the reduction in input current. Three tables are silkscreened on the back panel of the power supply. These tables give the correct ratings of fuses to be used for either 117-volt or 220-volt operation.

ANALYZING TROUBLE

Tube Replacement

A good percentage of the troubles that occur are likely to be found in the tubes and it is therefore advisable to check tubes before extensive tests are made on other components. Tube checks can be made by substitution in many cases. Tube failures may result in failure of other components so that it is advisable to examine all components associated with an offending tube.

Selected tubes are used in several positions in the Type 517/517A as follows:

6AK5—	V501 thru V512	preamplifier
	V102 thru V107	preamplifier
6CB6—	V501 thru V519	preamplifier
	V521 thru V523	preamplifier
	V520	trigger pickoff
6BH6	V126	trigger rate generator
6J6	V101	trigger selector
NE-2	Neon Glow Lamps	CRT Bias

6AK5: Selected for normal or better Gm and for low microphonics for all tube positions.

6CB6 Selected for low grid current and for normal plate current. Above-normal grid current loads the grid lines of the distributed amplifier and disturbs the line impedance. Tubes which exhibit plate current above or below normal are potentially unstable.

6BH6 The trigger rate generator phantastron, V126, must have suppressor grid characteristics within close limits. A good percentage of these tubes are satisfactory, however.

6J6 The trigger selector phase changer, V101, requires equal sections so that both positive and negative pulses will receive equal amplification within about 20 percent.

NE-2 The type NE-2 neon glow lamps determine the bias on the CRT. The bias must be reduced to half when the SENSITIVITY switch is turned from NORMAL (24 KV) to X2 (12 KV) position. For NORMAL (24 KV) operation, four lamps are used and for X2 (12 KV) operation, two are used so that each should have similar voltage-current characteristics.

CAUTION

Voltages high enough to be dangerous are present at several places in this instrument, and inasmuch as maintenance must be performed with the power circuits energized, the utmost caution should be observed. Both the 750-volt and 475-volt leads are potentially more dangerous than higher-voltage 4-KV and 20-KV leads. The 750-volt and 475-volt supplies have much lower internal impedancs. Use only insulated tools. Stand on dry floor and do not lean with bare arms on the framework of the instrument. if possible, keep one hand in your pocket.

Removal of the Case

To remove the case, place the oscilloscope face downward on a padded flat surface, remove the two screws in the bottom, and lift off the case. The power supply case may be removed in a similar manner.

Fuses

Three fuses, located on the front panel of the power supply, provide over-current protection. These are labeled as follows for protection as shown:

DC SUPPLIES, 6-amp, Fast-Blo, in primary of dc supply high voltage transformer, T401.

REGULATED HEATERS, 5-amp, Fast-Blo, in primary circuit of heater transformer, T901, supplying heaters of all tubes in indicator unit. Transformer is located on underside of indicator unit.

POWER SUPPLY HEATERS, 4-amp, Fast-Blo, in primary of filament Transformer. T402 supplying heater and filament voltage to all tubes located in power supply unit.

If the 6-ampere fuse blows, the first step in locating the trouble should be to find out whether the trouble is in the power unit or the indicator unit. This can be determined by disconnecting the inter-unit power cable. If a new 6-ampere fuse blows with the cable disconnected, the trouble is in the power unit, and the usual types of checks for capacitor failure and tube shorts should be made until the trouble is isolated.

If the 6-ampere fuse does not blow except when the inter-unit cable is connected, the trouble is likely to be found in the indicator unit. In this case, first measure the resistance to ground at each dc voltage jack to learn if any are below 9000 ohms. If no low resistance circuits are found, it is possible there is a type of tube short which occurs only when both heater and plate voltage are applied. Reconnect inter-unit cable and set controls as follows:

SENSITIVITY	NORMAL (24 KV)
SWEEP TIME/CM	10 or 20 MILLIμSEC
VERT. AMPL. ATTEN	FULL CLOCKWISE
TRIGGER AMPL	FULL CLOCKWISE
SWEEP STABILITY	FULL CCW

After these control settings have been made, voltage and currents to the various units can be determined at a panel on the underside of the indicator unit. 10-ohm resistors, either singly or in parallel, are in series with each of the supply voltages. The supply voltage and nominal current is silk-screened next to the proper resistor. The voltage of the minus 250-volt supply and the plus 225-volt supply should be within 1 percent. The other regulated supplies should be within 3 percent. Unregulated voltages will follow line voltage but should be within 10 percent at 117 volts line.

Find out the various currents by measuring the voltage drops across the series resistors. The currents stated are nominal and might vary as much as 10 percent between instruments. Also, the voltage measurement will be made across resistors of 10% tolerance. If you feel the need for more accurate measurement, break the circuit at the panel and insert a milliameter.

SUPPLY	CURRENT	VOLTAGE DROP
—250 v regulated	50 ma	0.5 v
+150 v regulated	550 ma	2.75 v
+180 v unregulated	250 ma	2.5 v
+225 v regulated	450 ma	2.25 v
+350 v unregulated	100 ma	1 v
+475 v regulated	150 ma	1.5 v
+750 v regulated	50 ma	0.5 v

If currents at the test panel are abnormal, determine what terminal boards are involved by reference to the Power Distribution Diagram. By lifting individual leads from the board, the offending circuit can be found.

When circuit trouble is found, look for charred or discolored resistors in associated circuits, particularly the distributed amplifier line terminations.

If voltages at the test panel are not within tolerances, look for troubles in the power supply.

If all voltages are off in value, check the negative 250-volt supply, which all other regulated supplies are compared to. If all voltages are low, V415 may be low in emission, or V418 may not be conducting and the minus 250-volt jack should indicate —250 volts or less. If all voltages are high, V418 may be shorted and the —250 volt jack should indicate about —350 volts.

If individual voltages are off, check the voltage at the plate of the series regulator tube involved for evidence of low cathode emission. Check resistance and voltage at the grid of the reference tube for evidence of failure in the voltage divider.

CAUTION

To measure heater voltage, use an rms voltmeter, not a rectifier type of meter.

Heater voltage low to about 5 volts as measured at the 6.3 v 1A pin jack on the indicator unit indicates filament failure of V419, loss of emission, open circuit at V420, or open circuit on +350-volt lead to saturable reactor.

Heater voltage above 6.3 v indicates a possible short in V420.

Sweep

If a spot can be made to appear at left center by following the procedure shown in Operating Instructions, but no sweep occurs, advance the SWEEP STABILITY control full clockwise. If a sweep occurs with this control adjustment, the difficulty may be in the trigger circuit. Turn the TRIGGER SELECTOR switch to RATE GEN. and advance the TRIGGER AMPL. control full clockwise. If no sweep occurs, observe the output at one of the RATE GEN. OUTPUT connectors on another oscilloscope. There should be approximately 20 volts peak to peak at RATE GEN. OUTPUT A or 60 volts at RATE GEN. OUTPUT B connectors. If enough output is available, look for low gain in the trigger amplifier.

The gain may be checked by coupling the RATE GEN. OUTPUT A or B, through a voltage divider to give about 0.1 volt peak to peak into the trigger amplifier circuit via the TRIGGER INPUT UHF connector. Place the trigger selector in the +EXT. position. Make sure the voltage at this point is about 0.1 volts and turn the TRIGGER AMPL. control full clockwise. Then with a suitable oscilloscope, such as Tektronix Type 530- or 540-Series, check the gain in the various trigger amplifier stages, which should be as follows: V101, the trigger phase changer, should be approximately 0.7; between 4 and 6 for the first distributed trigger amplifier stage consisting of V102 or V104; and between 4 and 6 for the second distributed trigger stage, V105 to V107. Output of this stage is negative and goes to the grid of V108, a 6AG7, which acts as a limiting amplifier. This tube should have a gain of about 4, making a total gain of trigger input to plate output at V108 of 80 to 100. Gain less than 80 indicates low Gm tubes, especially the 6AK5's. As in checking trouble in the trigger amplifier circuit, the following point-to-point voltages are listed. These are typical voltages, checked on a production model. Variations of 10 to 15% may be expected. Measurements were made with a 20,000 Ω/volt voltmeter and with the trigger amplitude control in the full clockwise position with no signal fed into the system. For a quick first test, check screen voltages of the 6AK5's, V102, V103 and V104. High screen voltage is an indication of low output. Normal screen voltage is around 80 volts.

NORMAL VOLTAGES

Tube	Check Point	Voltage Reading
V101	cathode plate	+1.6 v +150 v each
V102	plate screen	+100 v approx 90 v
V103	plate screen	+100 v approx 90 v
V104	plate screen	+100 v approx 90 v
V105	plate screen	95 v 145 v
V106	plate screen	95 v 145 v
V107	plate screen	95 v 145 v
V108	plate screen	approx 200 v* approx 100 v
V109	plate screen cathode	+205 v approx 200 v +8.5 v

*** Depending upon +225 v source. In any event, the drop across V108 plate load, R126, should be about 8 v at 30 ma.**

CRT Power Supply

In case of failure of the 20-kv power supply, find out first whether the oscillators supplying ac input voltage to the high-voltage supply and filament supply transformers are functioning satisfactorily. This can be determined by measuring the dc grid voltages of the two tubes using a 20,000 Ω/volt meter. The voltage at the grid, pin 1 of V303, a 6AU5, should be about 27 volts. The voltage at the grid, pin 7 of V304, a 6AQ5, should be about 19.5 volts. Or another oscilloscope such as a Tektronix 530- or 540-Series instrument can be used for reading the ac voltages.

If thse tests show that failure has occurred in the oscillator circuit, it is recommended that a new Type 420 power supply be ordered from the factory. The factory will ship a replacement power unit, shipping charges prepaid, by air if desired, immediately on receipt of notification of failure. Collect telegrams will be accepted at the factory for this purpose. Do not return the defective unit, unless asked to do so by the factory.

Vertical Amplifier

Overall gain of the Vertical Amplifier can be checked by using a calibrated pulse from the CAL. OUTPUT terminal. With the VERT. AMPL. ATTEN. turned full clockwise and the SENSITIVITY switch set to NORMAL (24 KV) 0.05 volts input should give about one centimeter of vertical deflection.

If gain is appreciably low, first check voltages and currents at the test panel on the underside of the indicator unit and check the power supply if indicated. Low gain of one or more 6AK5 is a possible cause of low gain, and it is suggested that the twelve 6AK5's, V501 to V512, be checked or replaced with tubes known to be good.

Individual stage gains can be checked by means of a test oscilloscope to observe the pulse amplitude at the input and output of each stage. The proper gain of each stage is indicated on the simplified schematic diagrams of the vertical amplifier system. Gain about twice normal may indicate an open line termination, either the direct termination or the reverse termination. Signal saturation at low signal levels may indicate leaky .005 μf grid-coupling capacitors or shorted 150 μf cathode bypass capacitors. By biasing off individual tubes or by measuring voltages, the offending capacitor can be isolated.

If, after preliminary tests have been made for amplifier gain and satisfactory operation of components, aberration of the pulse shape is suspected, recommended test procedure will require a pulse generator with a very short rise-time—at the most, 3 nanoseconds. The pulse duration should be 5 μseconds or more, and repetition rate should be above 60 cycles. Both positive and negative pulses are needed for the procedure, and the pulse must be produced across 170 Ω at a variable level up to about 0.2 volts, peak to peak. If an attenuator is required to adjust the pulse level to needed amplitude, do NOT use the 170 Ω step attenuator supplied with the oscilloscope.

Connect the pulses to the Type 517/517A SIGNAL INPUT connector and watch the displayed pulse at various levels of both polarities, and at different sweep times per centimeter. If the trace shows aberration of the pulse, or a difference in gain for positive and negative pulses, it is recommended that the following steps first be read and understood, and that the indicated tuning procedure then be followed:

Display on the CRT a positive pulse with 1 cm amplitude and repeat, using a negative pulse.

1. If aberration of the front corner of the pulse occurs within the first 50 nanoseconds of the rise, consisting of either rounding, or overshoot or spiking, correction can probably be made by tuning the trimmer capacitors on the plate line of the output distributed amplifiers C713A to L and C714A to L. An upward deflection of the trace results from positive grid drive on the half of the output amplifier nearest the front panel, V713 to V724. Tuning the trimmers of this half of the amplifier, C714A to L, therefore compensates for aberration occurring during upward deflection of the trace.

A downward deflection of the trace is the result of positive grid drive on the half of the amplifier farthest from the panel, V701 to V712. Tuning the trimmers of this half of the amplifier, C713A to L therefore compensates for aberration occurring during a downward deflection of the trace.

2. A much longer aberration having the shape of an RC charge or discharge curve of duration 100 to 500 nanoseconds results from the variation with voltage and time of the impedance characteristics of the 150 μf cathode bypass capacitors throughout the amplifier, and the 8 μf capacitors to ground at the plate-line terminations. Compensation for these sources of aberration is produced by means of two RL networks in the reverse-termination networks of the first two stages of the preamplifier, R503, L509 and R515B, L510. Sense of the compensation contributions can be determined by shorting out the inductance. Amplitude of the compensation depends on the value of R and the duration, or time constant, depends on the value of L. In a few instruments, it has been found necessary to replace one of the RL networks with a parallel RC network of 10 to 20 Ω and 0.01 to 0.02 μf.

3. A small sharp notch or spike occurring 30 to 35 nanoseconds following the rise may result from feedback between plate and grid line of the output stage near the reverse terminations, especially following retuning. These aberrations can be corrected by means of C735 and C736 located at the output-stage plate-line reverse terminations. With a positive pulse displayed, adjust C736 at the plate line nearest the front panel. With a negative pulse displayed, adjust C735 at the plate line farthest from the panel, and repeat the procedure once or twice for the best adjustment.

4. Under normal operating conditions, a small wrinkle of about 0.5 mm peak to peak amplitude occurs on the trace about 100 nanoseconds after the start of the sweep. Except for this wrinkle, a properly tuned amplifier will have no ringing or overshoot greater than 0.3 or 0.5 mm, peak to peak.

5. The tuning capacitors of the vertical amplifier are preset at the factory to the following approximate adjustment, in terms of the depth the inner concentric cyclinder is engaged into the outer cyclinder.

Stage	Depth
1st Stage	1/16 inch
2nd Stage	1/8 inch
3rd Stage	3/16 inch
Inverter	3/16 inch
Driver	3/32 inch
Output	adjusted by observation for best response charactistics

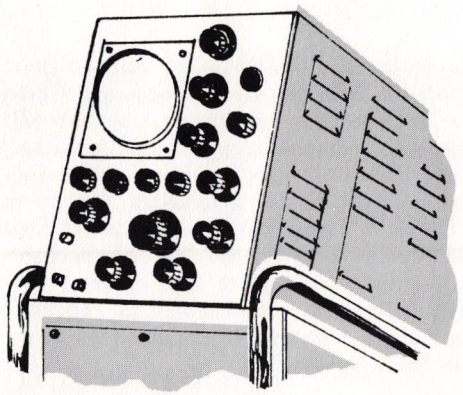
6. The following list of delay times may be useful in adjusting the amplifier and in determining the effects of unmatched terminations.

Stage	Delay Time
1st & 2nd preamplifier stages and driver, each 8 nsec, total	24 nsec
Inverter Stage	4 nsec
3rd Stage	11 nsec
Output	16 nsec
Delay Line	65 nsec
Total Overall Amplifier Delay	120 nsec
Sweep-starting time, INT. triggering	90 nsec
Sweep-starting time, EXT. triggering	60 nsec

Noise and hum occurring elsewhere than in the vertical amplifier or in the sweep circuits can be seen by shorting the deflection plates and determining whether the noise voltage still persists on the trace.

SECTION 5

CALIBRATION PROCEDURE



Equipment Required

The following equipment or its equivalent is necessary for a full recalibration of the Types 517 and 517A Oscilloscopes. Differences existing in requirements for test equipment between the 517 and 517A are noted.

1. DC voltmeter with at least 20,000 ohms per volt sensitivity. To satisfy the accuracy requirements, corrected readings must be known for the following voltages: 150, 180, 225, 250, 365, 475, 750, 1950, and 4,000 volts.

2. DC milliameter with ranges from 25 to 500 milliamperes. (Used on the 517 only.)

3. Oscilloscope with a minimum of a 10 mc bandpass such as the Tektronix Type 316 and a 10X probe.

4. AC voltmeter with a range of zero to 10 volts rms of the iron vane or dynamometer type.

5. Time-mark generator such as the Tektronix Type 180 or 180A. If neither of these instruments are available, it will be necessary to substitute a time-mark generator having 1, 5, 10, and 50 microsecond markers and sine-wave outputs of 5, 10, and 50 megacycles, with an accuracy of at least 1%.

6. Earphones with 4000 ohms or more impedance.

7. Variable autotransformer with a 1.5 KVA minimum rating.

8. Short rise time pulser such as the Tektronix Type 108. If Type 108 is not available, it will be necessary to substitute a pulser with a rise time of 1 millimicrosecond or less.

9. AC Ammeter with a current range up to 10 amperes.

10. AC Voltmeter with a range of at least 105 to 125 volts.

11. Miscellaneous cables, terminating resistors, attenuators, and pads as determined by the particular requirements of the test equipment used.

12. Adjustment tools.

Preliminary Procedure

Place the oscilloscope face downward on a padded flat surface, remove the two screws in the bottom, and lift off the case. Repeat this procedure for the power supply. Set power supply and oscilloscope front panel controls as follows:

AC POWER	OFF
DC POWER	OFF
INTENSITY	fully ccw
SWEEP STABILITY	fully ccw
HORIZONTAL POSITIONING	fully ccw
SENSITIVITY (24 KV)	NORMAL

Connect the power cord and an voltmeter to the output of the 1.5 KVA variable autotransformer. Adjust the autotransformer for a meter reading of 117 volts. Check this meter reading frequently during recalibration and maintain the autotransformer output at 117 volts unless instructed otherwise. If the power transformer in your instrument is connected for 234-volt operation, adjust the variable autotransformer for a meter reading of 234 volts.

1. Low Voltage Power Supply

Proper operation of your instrument is dependent upon correct power supply voltages. The negative 250-volt power supply is used as a reference voltage for regulation of the other dc power supplies and consequently must be set accurately. Any error in the output of the negative 250-volt power supply will cause corresponding errors in the outputs of all other regulated power supplies and resulting improper operation of the entire instrument. Occasionally when the

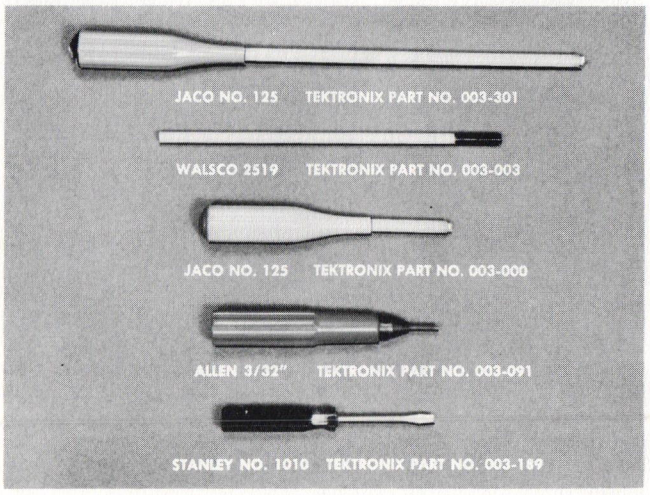


Fig. 5-1. Suggested alignment tools

negative 250-volt power supply is set at exactly 250-volts, outputs of one or more of the other regulated supplies are not within tolerances. In such a case it may be possible to bring all voltages within tolerances by readjusting the negative 250-volt supply slightly within its voltage tolerances. If it is impossible to bring all power supplies simultaneously within tolerances, this indicates trouble in the instrument and normal troubleshooting procedures should be used to locate the cause.

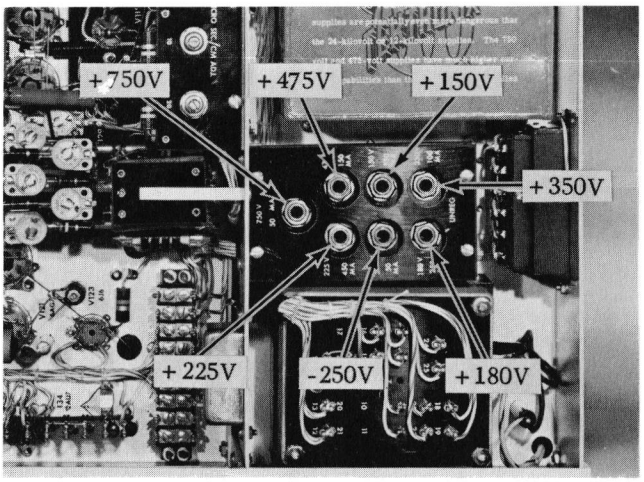


Fig. 5-2. Type 517 Oscilloscope power supply test points.

With the power off, check the resistance at the output of each power supply to ground. Resistance readings obtained should be checked against the values given in Table 1. If any of these readings are lower than the values given in Table 1, the power must not be turned on until the cause of the abnormal resistance reading has been determined and corrected.

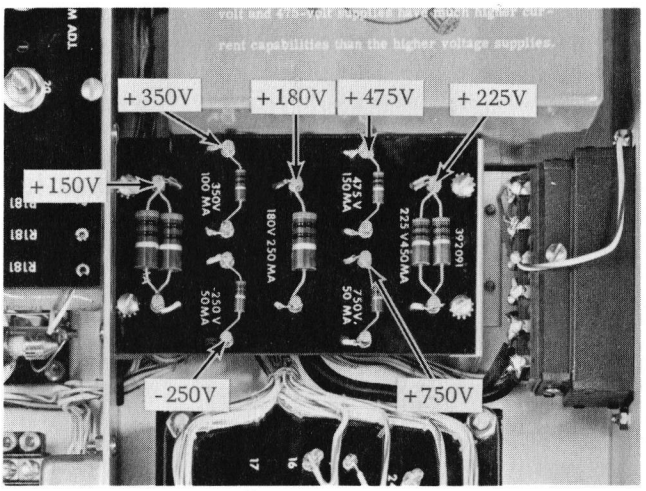


Fig. 5-3. Type 517A Power supply test points.

Place AC POWER and DC POWER switches at ON and allow several minutes for instrument warm-up. Connect the dc voltmeter between the appropriate —250 volt test point (shown in Figures 5-2 for Type 517 Oscilloscopes and Figure 5-3 for Type 517A Oscilloscopes) and ground. Set the ADJ TO —250 V control on the power supply chassis for a corrected meter reading of —250 volts. Measure output voltages of other low voltage power supplies at test points shown in Figure 5-2 or 5-3 and compare voltage readings with the tolerances listed in Table 1. Using the variable autotransformer, vary the input voltage to the instrument between 105 and 125 volts while checking that all regulated low voltage power supply output voltages remain within the tolerances listed in Table 1.

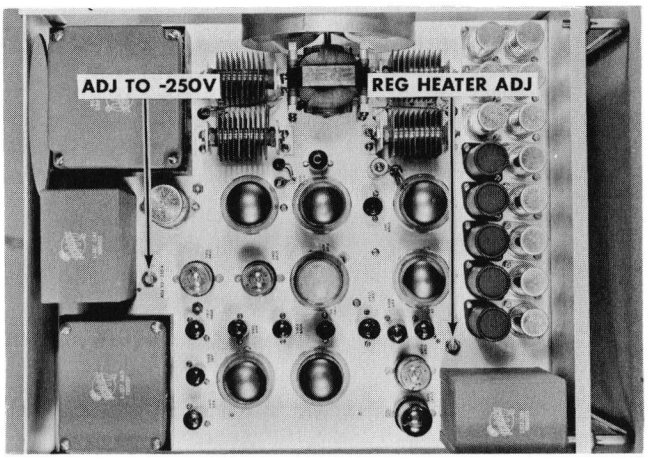


Fig. 5-4. Top view of the power supply unit showing the location of adjustments.

On the test oscilloscope, place the TIME/DIV control at 5 MILLISEC and the TRIGGER SELECTOR controls at + LINE and AUTO. Measure the ripple voltage at the output of each power supply. Approximate ripple voltages for each power supply are given in Table 1.

TABLE 1

Power Supply Characteristics

Supply	Ripple Voltage	Output Voltage	Minimum R to Ground With load
—250	50 mv	—248 to —252	18 kilohms
+150	40 mv	+147 to +153	8 kilohms
+180*	4 volts	+179 to +189	40 kilohms
+225	50 mv	+220 to +229	15 kilohms
+350*	6 volts	+347 to +385	150 kilohms
+475	100 mv	+465 to +485	40 kilohms
+750	150 mv	+735 to +765	40 kilohms

For Type 517 power supply current measurements, connect the test leads of a milliameter to a phone plug. Place the milliameter in series with each power supply output by connecting the phone plug to appropriate phone jacks provided on the botom of the indicator unit. (See Fig. 5-2). Current readings should be approximately equal to those listed in Table 2.

***Unregulated +180 and +350 output voltages are nominal values only.**

For Type 517A power supply current measurements, connect a dc voltmeter across the current measuring resistors located on the bottom of the indicator unit. (See Fig. 5-5). Voltage readings should be approximately equal to those listed in Table 2.

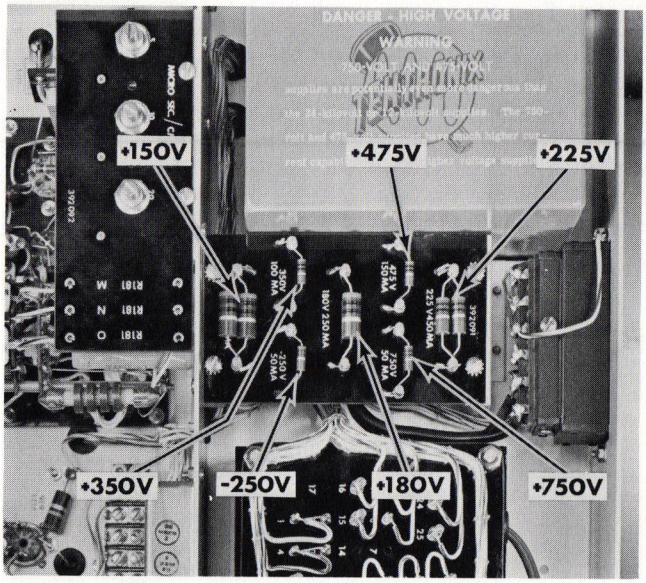


Fig. 5-5. Location of Type 517A current measuring resistors. The voltage drops across the resistors are used to measure the load currents drawn from the power supplies.

TABLE 2

Power Supply Current Requirements

Supply	Current (Type 517)	Voltage (Type 517A)
—250	30 ma	0.3 volt
+150	500 ma	2.8 to 3 volts
+180	250 ma	2.5 volts
+225	200 to 400 ma	1 to 2.25 volts
+350	80 ma	0.8 volt
+475	50 ma	0.5 volt
+750	20 ma	0.2 volt

2. Reg Heater Adj.

Connect a rms reading ac voltmeter between the 6.3 V 1A jack on the indicator front panel and ground. Rotate the REG HEATER ADJ control (See Fig 5-4) on the power supply chassis for a reading of 6.2 volts. Using the variable autotransformer, vary the voltage applied to the instrument between 105 and 125 volts while observing the regulated heater voltage. The voltage should remain at 6.2 volts.

Connect a 10 amp ac ammeter in parallel with the REGULATED HEATERS fuse at the fuseholder on the rear of the power supply front panel. Remove the REGULATED HEATERS fuse. Regulated heaters current indicated by the ammeter should then be approximately 3 amperes. Replace the REGULATED HEATERS fuse.

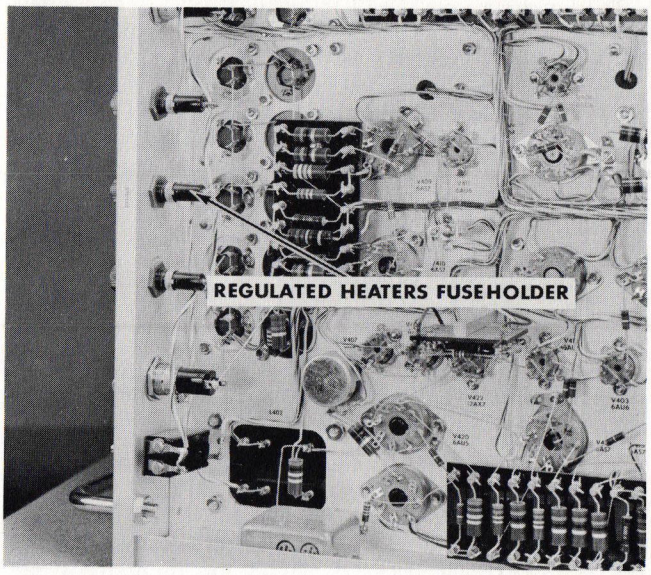


Fig. 5-6. Location of the Regulated Heaters fuseholder. An ammeter connected across the fuseholder is used to measure the Regulated Heaters current.

3. Trigger Rate Generator

Trigger rate generator frequency adjustments require the use of a test oscilloscope with accurately calibrated sweep speeds. Be sure that your oscilloscope is accurate.

Adjustments and checks made on the trigger rate generator in this section all produce identical indications on the test oscilloscope. The proper indication for each of these checks and adjustments is a series of four trigger pulses displayed on the screen of the test oscilloscope behind the 10 divisions of the graticule. The first trigger pulse should be under the first vertical line of the graticule, and the fourth trigger pulse should be under the last vertical line of the graticule (See Fig. 5-7). It will be necessary to adjust the HORIZONTAL POSITIONING control on the test oscilloscope as well as the indicated adjustment in order to obtain the correct indication.

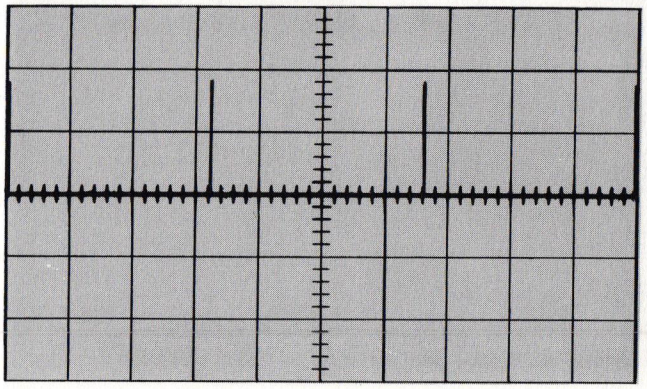


Fig. 5-7. Typical waveform obtained while adjusting and checking the Trigger Rate Generator.

Place a cable from the RATE GEN OUTPUT A to the test oscilloscope input. On the test oscilloscope, set the VOLTS/DIV control to 20 and the TIME/DIV control to .2 MILLISEC. On the instrument under test, set the TRIGGER RATE GENERATOR control at 150 and the TRIGGER RATE GEN MULT control at X10. Adjust the HF TRIG RATE control for the indication described previously. (It may be necessary for you to turn up the intensity in order to see the positive spikes.)

Set the TRIGGER RATE GENERATOR control at 15 and the test oscilloscope TIME/DIV control at 2 MILLISEC. Adjust the LF TRIG RATE control for the indication described previously. Set the TRIGGER RATE GEN MULT control at 150 and the TRIGGER RATE GEN MULT control at X1. The indication obtained should be the same as for the previous adjustments.

Set the TRIGGER RATE GENERATOR control at 150 and the TRIGGER RATE GEN MULT switch at X100. Place the test oscilloscope TIME/DIV control at 20 μSEC. Adjust C801A for the indication described previously. Set the TRIGGER RATE GENERATOR control at 15 and the test oscilloscope TIME/DIV controls at .2 MILLISEC. The test oscilloscope indication should be the same as those obtained previously.

Using the test oscilloscope, check that the trigger pulses at the RATE GEN OUTPUT A receptacle have a peak amplitude of at least 20 volts. Connect the test oscilloscope input to RATE GEN OUTPUT B and check that the observed trigger pulses have a peak amplitude of at least 60 volts.

4. Trigger Amplifier

Check tubes V105, V106, and V107 for gas by measuring the voltage drop across their respective grid resistors, R116A, R116B, and R116C. If the voltage across any of the grid resistors is other than zero volts, the corresponding tube is probably gassy and should be replaced.

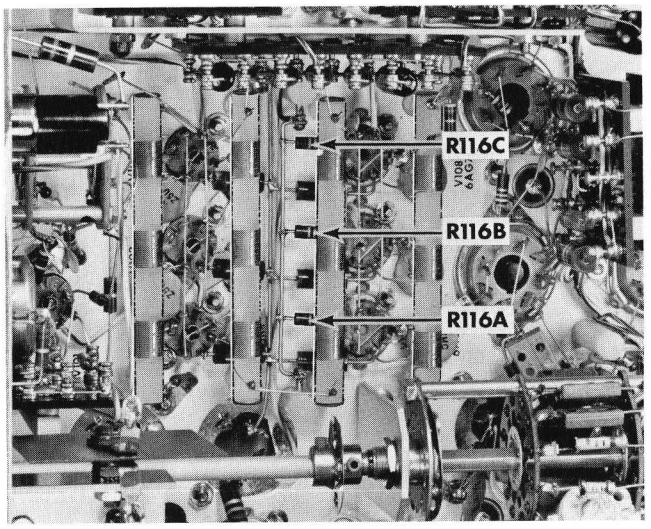


Fig. 5-8. Location of grid resistors R116A, R116B, and R116C for tubes V105, V106 and V107 respectively.

The gain of the Trigger Amplifier circuit can be checked by dividing down the RATE GEN OUTPUT A output spike and applying a portion of the spike to the TRIGGER INPUT receptacle. The circuit shown in Figure 5-9 may be used for this purpose. To check the gain of the Trigger Amplifier circuit place the TRIGGER SELECTOR switch in the +EXT position and, using the test oscilloscope, adjust the potentiometer of the circuit shown in Fig. 5-9 for .1 volt spikes at the TRIGGER INPUT receptacle. Then connect the input of the test oscilloscope to pin 4 of V109 through a 10X probe. With the TRIGGER AMPL. control fullly cw, if the amplifier gain is correct, the spike at pin 4 of V109 should be at least 10 volts in amplitude indicating that the amplifier has a gain of at least 100. If the gain of the amplifier is less than 100, replace the tubes V101 through V108 as necessary to obtain the correct gain.

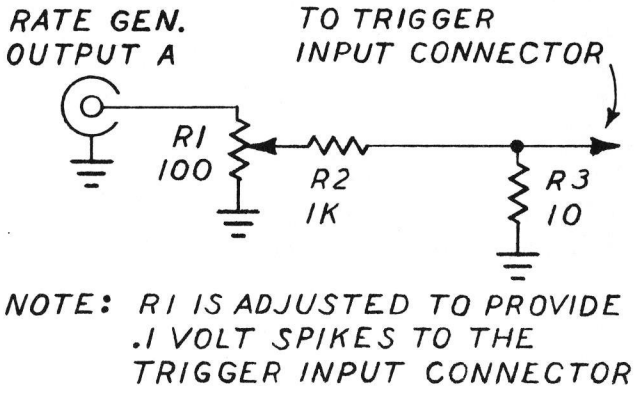


Fig. 5-9. Circuit used to check the gain of the Trigger Amplifier.

5. Check +GATE Waveform

Set the TRIGGER RATE GENERATOR for 1 kc, place the TRIGGER SELECTOR switch in the RATE GEN position, and set the SWEEP TIME/CM switch in the 20 μSEC/CM position. Adjust the SWEEP STABILITY and TRIGGER AMPL. controls until the sweep triggers. Using the test oscilloscope and a 10X probe, check the waveform at the +GATE connector. The +GATE waveform should have a peak amplitude of more than 40 volts and a duration of from 250 to 300 μseconds (See Fig. 5-10). As the SWEEP TIME/CM switch is rotated position by position from the 20 μSEC/CM position to the 50 MμSEC/CM position, the duration of the +GATE waveform in each position should be approximately halved from the previous position.

With the SWEEP TIME/CM switch in the 50 MμSEC/CM position, set the TRIGGER RATE GENERATOR for 10 kc. Adjust the test oscilloscope so that the +GATE covers 10 divisions horizontally (See Fig. 5-11A). Then place the SWEEP TIME/CM switch in the 20 MμSEC/CM position and adjust C128J so that the +GATE waveform covers 9 divisions horizontally (See Fig. 5-11B). Place the SWEEP TIME/CM switch in the 10 MμSEC/CM position and adjust C128K so that the +GATE waveform covers 8 divisions horizontally (See Fig. 5-11C).

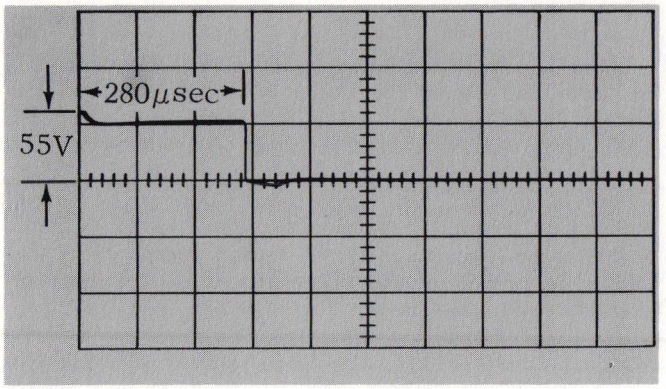


Fig. 5-10. Typical + Gate waveform obtained when the SWEEP TIME/CM switch is in the 20 μSEC/CM position.

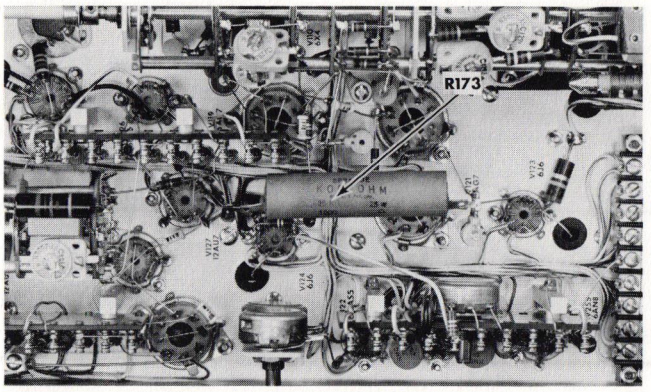


Fig. 5-12. Bottom view of the indicator unit showing the location of R173. The UNBLANK control is adjusted to provide 100 volts drop across R173.

6. UNBLANK

Set the SENSITIVITY switch at NORMAL (24 KV), the SWEEP TIME/CM switch at 200 MμSEC/CM, and the SWEEP STABILITY and TRIGGER AMPL controls fully counterclockwise. Adjust the UNBLANK control for a 100-volt drop across R173, the plate load resistor for tubes V120 and V121. (See Fig. 5-12.)

7. Check Probe Power

To check the probe power, it is necessary to place a load at the PROBE POWER receptacle. A suitable load can be obtained by using the circuit shown in Fig. 5-13. With this load applied, the lamp should be at normal brilliance and the voltage at pin 3 of the PROBE POWER receptacle should measure 120 ±3 volts.

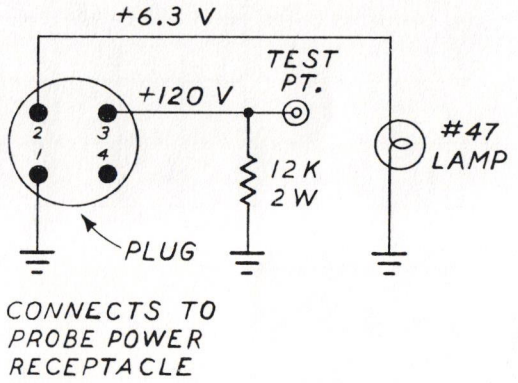


Fig. 5-13. Circuit used to check Probe Power.

8. Check the Calibrator Waveform

After making sure that the test oscilloscope attenuator and probe are properly compensated, connect the input of the test oscilloscope to the CAL OUTPUT connector through a 10X probe. Adjust the calibrator voltage to about 40 volts with the CAL VOLTAGE control and check the Calibrator waveform for distortion and for peaks or overshoot on the baseline of the waveform. The normal Calibrator waveform is shown in Fig. 5-14. If the waveform has more overshoot on the baseline than is shown in the illustration, check the 1N34 diode in the grid circuit of V132.

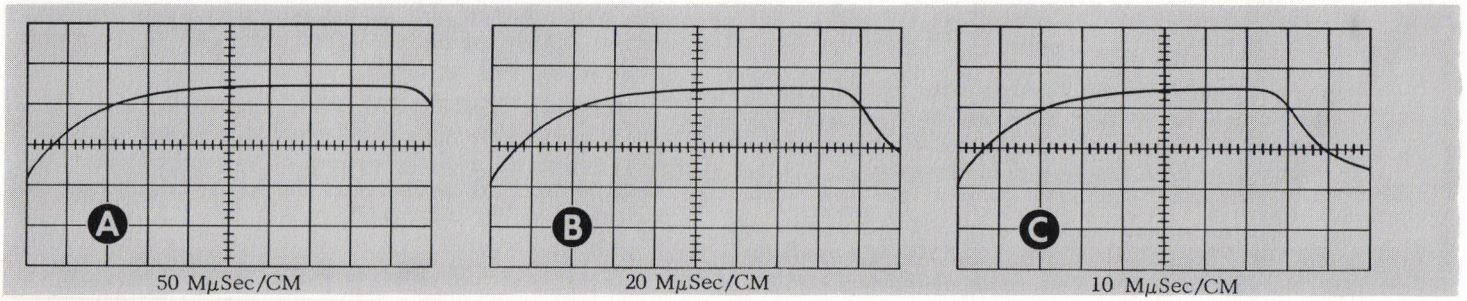


Fig. 5-11. Waveforms obtained when the + GATE is adjusted properly for the respective sweep rates.

9. CAL VOLTAGE Dial

Set the test oscilloscope for automatic triggering and place the VOLTS/DIV control in the .01 position. Connect the test oscilloscope to the CAL OUTPUT connector and place the CAL RANGE switch in the 50 position. The setting of the CAL VOLTAGE dial can be checked by observing the test oscilloscope when the dial is set at zero. With the dial set at zero, no output from the calibrator should be displayed on the test scope. However the calibrator voltage should increase rapidly as the dial is moved off zero. If the dial is incorrectly set, loosen the knob and rotate the dial to the proper settings.

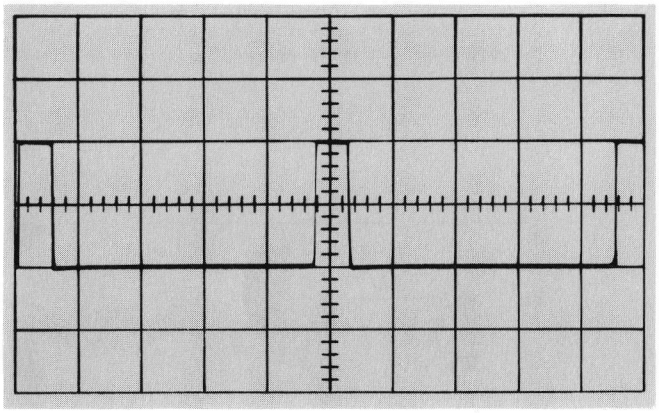


Fig. 5-14. Normal Calibrator waveform.

10. CAL ADJ.

Set the test oscilloscope for 10 volts per division and connect the test oscilloscope input to the CAL OUTPUT connector. Set the CAL VOLTAGE control for 40 volts of calibrator signal and adjust the CAL ADJ control for 4 divisions of vertical deflection on the test oscilloscope. Then spot check the calibration voltage displayed on the test oscilloscope against the setting of the CAL VOLTAGE dial from various settings on each of the ranges of the CAL RANGE switch.

11. CRT Alignment

NOTE

The first portion of the instructions for this adjustment pertain only to the Type 517A and modified Type 517 instruments. The remainder of the instructions apply to both Type 517A and Type 517 instruments.

For Type 517A and modified Type 517 instruments only, preset the VERT SCAN ADJ and GEOM ADJ controls so that the voltage at the center arms of the two controls is —30 volts. For all instruments, trigger the sweep with the Trigger Rate Generator and loosen the crt clamp. Press the crt forward against the graticule and align the crt so that the trace is parallel to the graticule lines. Retighten the crt clamp.

12. L.F. COMP.

Connect a 50 mc sine wave signal to the SIGNAL INPUT connector and trigger the sweep at a 1 kc rate with the Trigger Rate Generator. Adjust the signal amplitude and VERT AMPL. ATTEN control to obtain 4 centimeters (2 cm for 5XP CRT) of vertical deflection. Adjust the L.F. COMP. control to eliminate any wedge-shaped appearance of the brightened portion of the screen. When the L.F. COMP. control is adjusted properly, the vertical amplitude of the brightened portion of the screen should be the same at each point across the screen.

13. DUTY CYCLE LIMITER ADJ. (Types 517A and Modified 517 only).

Place the SWEEP TIME/CM switch in the 20 μSEC/CM position, set the TRIGGER RATE GENERATOR control for 1.25 kc, and place the TRIGGER SELECTOR switch in the RATE GEN position. Rotate the TRIGGER AMPL control fully counterclockwise and adjust the SWEEP STABILITY control to a setting just below the point where the sweep free-runs. Then rotate the TRIGGER AMPL and DUTY CYCLE LIMITER ADJ controls fully clockwise. Under these conditions, there should be no sweep.

Turn up the intensity slightly and rotate the DUTY CYCLE LIMITER ADJ control until the sweep is 7.5 centimeters long and is unstable at the right end. As an additional check on the control setting, increase and decrease the triggering rate. The sweep length should decrease as you increase the triggering rate and increase as you decrease the triggering rate. Check that the sweep will free-run in all sweep speeds when the SWEEP STABILITY control is fully clockwise and the TRIGGER AMPL control is fully counterclockwise.

14. VERT SCAN ADJ and GEOM ADJ. (Types 517A and Modified 517 only.)

Rotate the ASTIGMATISM, SWEEP STABILITY, and TRIGGER AMPL controls fully countercockwise and FOCUS control fully clockwise. Connect a 5 mc sine wave signal to the SIGNAL INPUT connector and rotate the INTENSITY control clockwise until a vertical trace appears. Adjust the signal amplitude and the VERT AMPL ATTEN control to obtain 3 centimeters of vertical deflection. Using the HORIZONTAL POSITIONING controls, move the display under the center vertical line of the graticule. Adjust the VERT SCAN ADJ to obtain a vertical retangular trace of constant width. (See Fig. 5-15).

Using the HORIZONTAL POSITIONING controls, move the display to the left side of the screen. Adjust the GEOM ADJ control for minimum bowing of the vertical trace. Position the trace to the center of the screen and recheck the setting of the VERT SCAN ADJ. control.

WARNING

Because of the high voltages involved, the DC POWER switch should be placed in the OFF position when the leads of the dc voltmeter are connected or disconnected during the high voltage adjustments of steps 15 and 16.

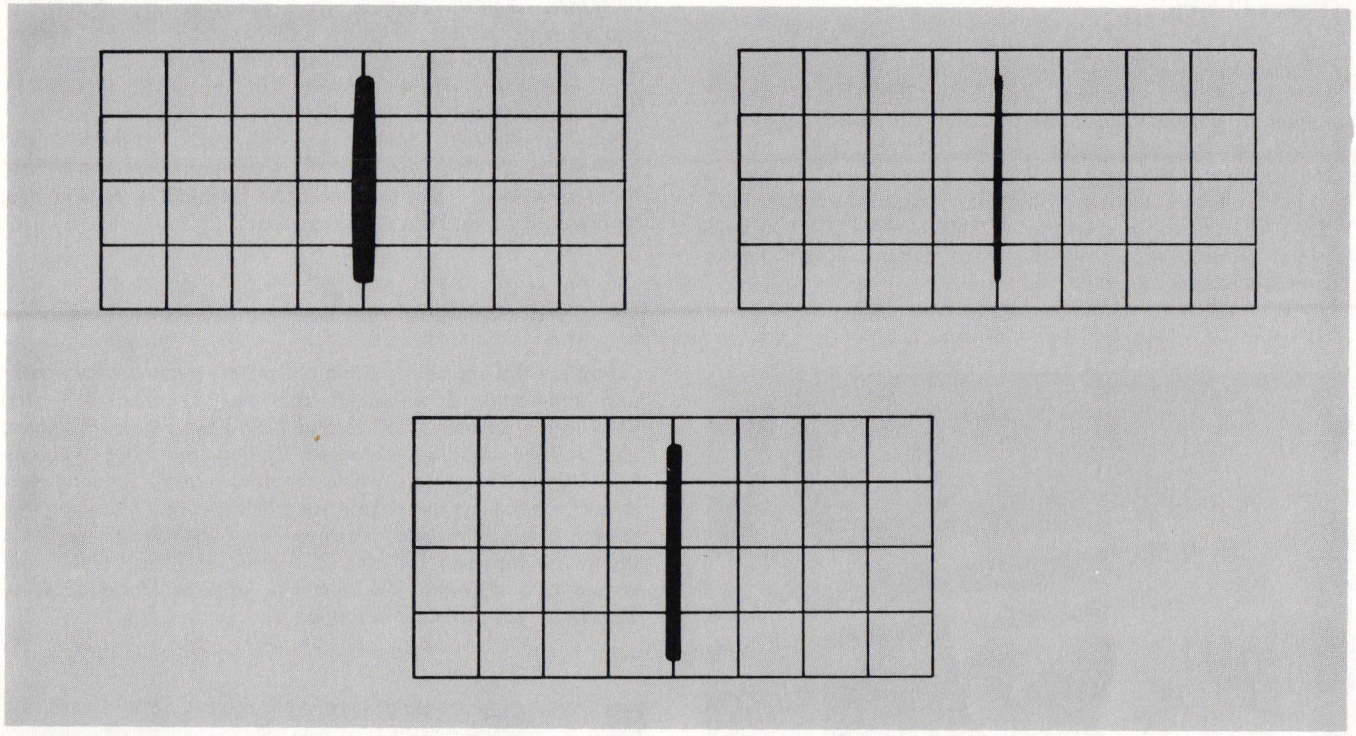


Fig. 5-15. Typical displays obtained with different settings of the VERT SCAN ADJ control. The VERT SCAN ADJ control should be set to obtain the display shown in the bottom illustration.

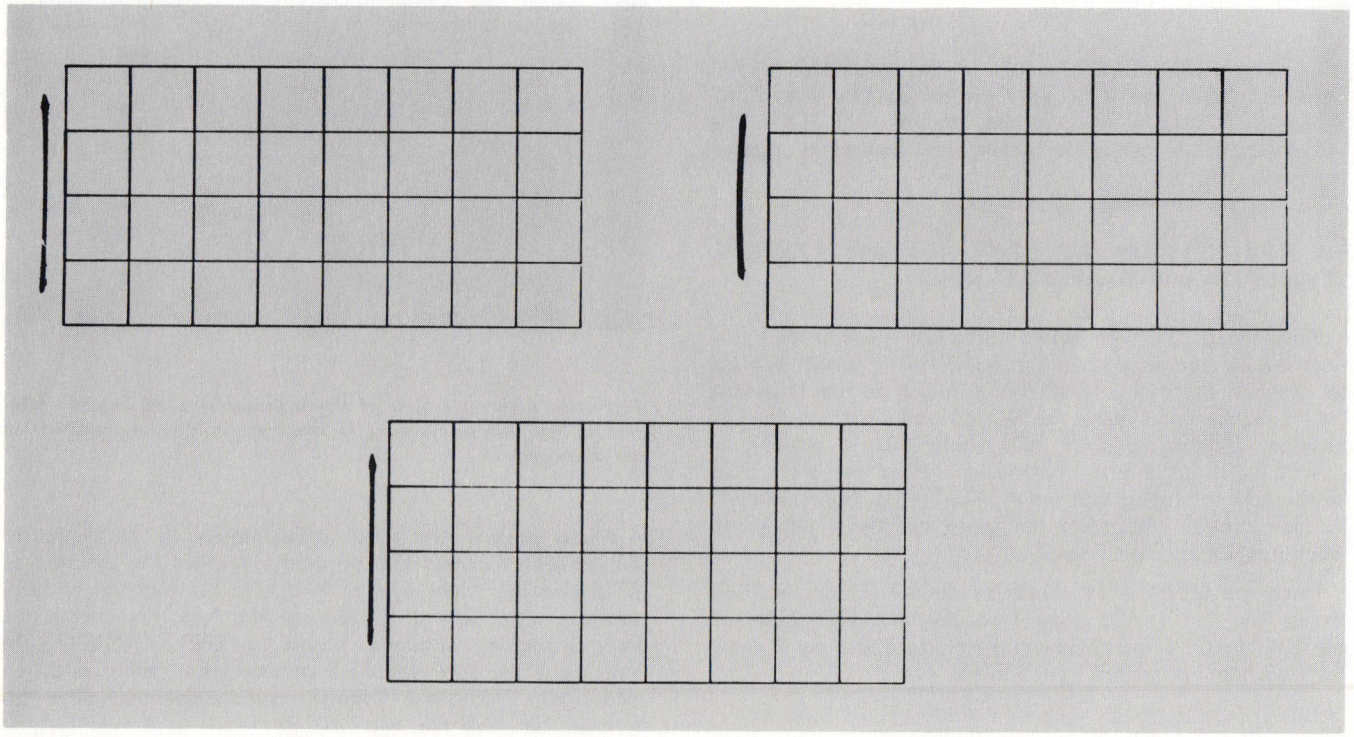


Fig. 5-16. Typical displays obtained with different settings of the GEOM ADJ control. The GEOM ADJ control should be set to obtain the display shown in the bottom illustration.

15. HOR POS VERN ADJ, 2 KV ADJ, and 4 KV ADJ. (Type 517 only).

Place the DC POWER switch in the OFF position and connect the dc voltmeter from the SENSITIVITY switch bracket to ground. Place the SENSITIVITY switch in the X2 (12 KV) position and return the DC POWER switch to the ON position. Adjust the 2 KV ADJ control for a reading of —1950 volts on the dc voltmeter. Adjust the HOR POS VERN ADJ control so that the HORIZONTAL POSITIONING Vernier control will move the trace exactly 2 centimeters when it is turned from 0 to 1.0.

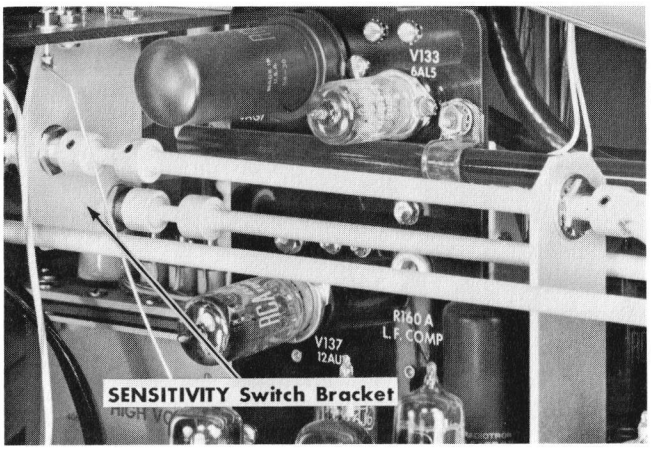


Fig. 5-17. Left side view of the indicator unit showing the location of the SENSITIVITY switch bracket.

Place the SENSITIVITY switch in the NORMAL (24 KV) position. Adjust the 4 KV ADJ control so that the HORIZONTAL POSITIONING Vernier control will move the trace exactly 1 centimeter when the control is rotated from 0 to 1.0.

16. HOR POS VERN ADJ, 2 KV ADJ, and 4 KV ADJ. (Types 517A and Modified 517 only.)

Place the DC POWER switch in the OFF position and connect the dc voltmeter from the SENSITIVITY switch bracket to ground. Place the SENSITIVITY switch in the NORMAL (24 kv) position and return the DC POWER switch to the ON position. Adjust the 4 KV ADJ control for a reading of —4000 volts on the dc voltmeter. Adjust the HOR POS VERN ADJ control so that the HORIZONTAL POSITIONING Vernier control will move the trace exactly 1 centimeter when it is rotated from 0 to 1.0.

Place the SENSITIVITY switch in the X2 (12 KV) position. Adjust the 2 KV ADJ control so that the HORIZONTAL POSITIONING Vernier will move the trace exactly 2 centimeters when it is rotated from 0 to 1.0.

17. MAX INTENSITY ADJ.

With the SWEEP STABILITY and TRIGGER AMPL controls fully counterclockwise and the SENSITIVITY switch in the NORMAL (24 KV) position, slowly rotate the INTENSITY control until a low intensity spot appears on the screen. Use the FOCUS and ASTIGMATISM controls to bring the spot into sharp focus. Rotate first the MAX INTENSITY ADJ control then the INTENSITY CONTROL to their fully clockwise positions. Slowly turn the MAX INTENSITY ADJ control counterclockwise until the spot reappears and a halo forms around it. Then turn the MAX INTENSITY ADJ control clockwise until the halo just disappears.

18. Check Horizontal and Vertical Deflection Sensitivity.

Position the spot approximately at the center of the screen and connect the dc voltmeter from the junction of R182 and R184 to the junction of R185 and R186. (See Fig. 5-18) Record the voltage reading obtained. Using the HORIZONTAL POSITIONING controls, move the spot exactly 2 centimeters in either direction and again record the voltage reading obtained. The difference between the two voltage readings should be between 184 and 204 volts for Type 517 Oscilloscopes and between 100 and 140 volts for Type 517A or Modified Type 517 Oscilloscopes.

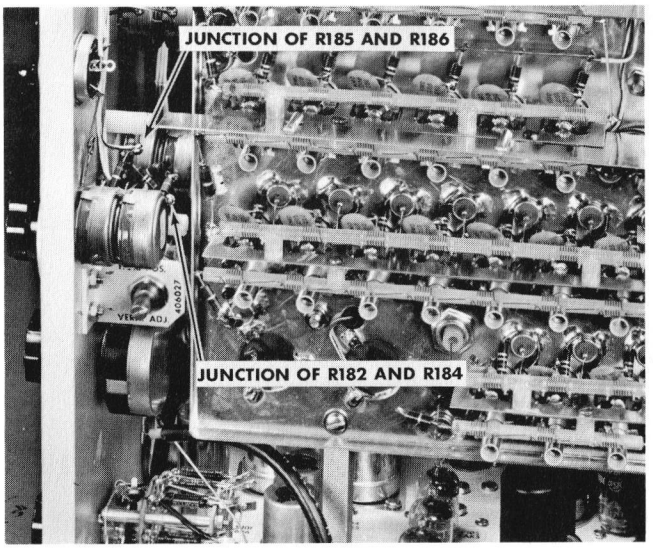


Fig. 5-18. Right side view of the indicator unit showing the location of the test points used to check the horizontal sensitivity of the instrument.

Again position the spot approximately to the center of the screen. Connect the dc voltmeter from the junction of R706 and the wiper arm of R716A to the junction of R713 and the wiper arm of R716B (See Fig. 5-19) and record the voltage reading obtained. Using the VERT POSITION control, move the spot exactly 2 centimeters in either direction and again record the voltage reading obtained. The difference between the two voltage readings should be between 62 and 72 volts for Type 517 Oscilloscopes and between 26 and 36 volts for Type 517A and Modified Type 517 Oscilloscopes.

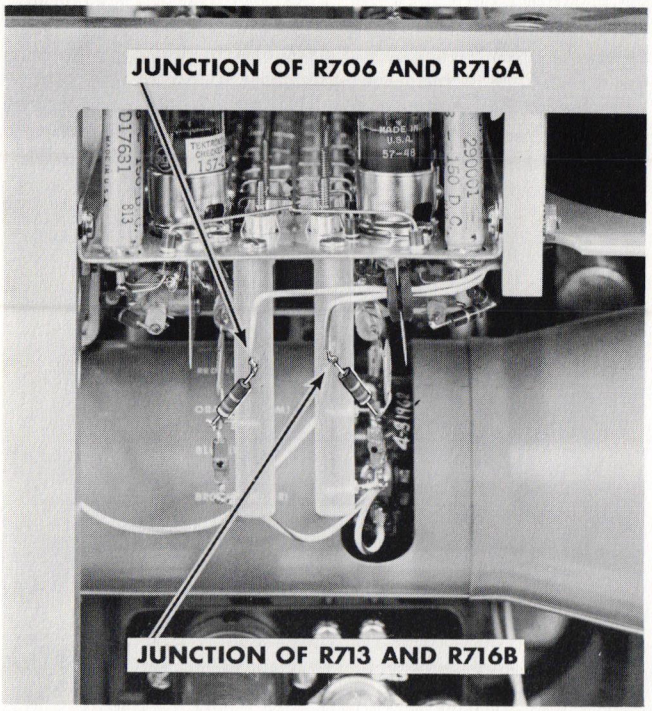


Fig. 5-19. Left side view of the indicator unit showing the location of the test points used to check the vertical sensitivity of the instrument.

WARNING

In checking the crt cutoff voltage, the meter leads are connected to points where the potential is approximately —4000 volts. The entire meter is consequently also at approximately —4000 volts. Therefore it is essential that you shut off the high voltage when connecting or disconnecting the meter leads and that you refrain from touching the meter when the high voltage is on.

19. Check CRT Cutoff Voltage.

Using the HV SW, turn off the high voltage. Rotate the INTENSITY control fully countercockwise and connect the dc voltmeter between the grid and cathode of the crt at the test points shown in Fig. 20. Return the HV SW to the ON position and slowly advance the INTENSITY control until a spot is visible on the screen. Then turn the INTENSITY control counterclockwise until the spot just disappears. The meter reading is the cutoff voltage of the crt. This voltage should be between 93 and 115 volts for Type 517 Oscilloscopes and between 120 and 135 volts for Type 517A and Modified Type 517 Oscilloscopes.

Turn off the HV SW and allow the high voltage power supply to discharge before removing the meter leads.

20. Check Vertical and Horizontal Positioning Limits

Place the SENSITIVITY switch in the NORMAL (24 KV) position and turn on the high voltage. Position the spot to

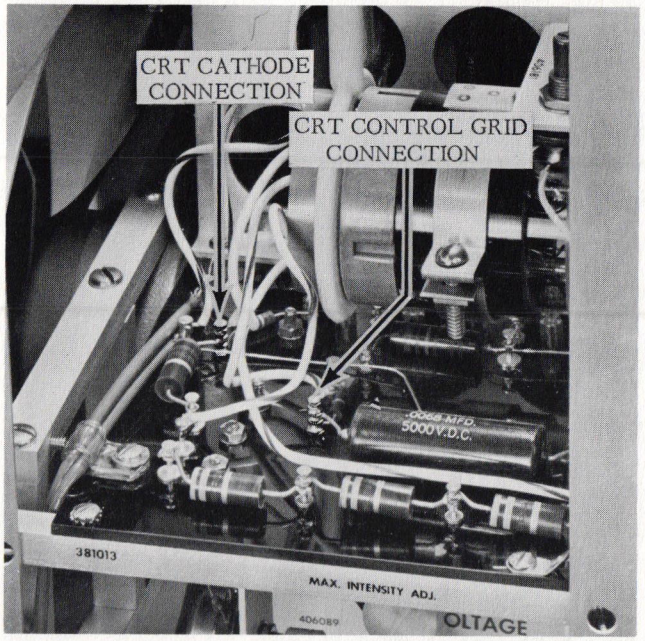


Fig. 5-20. Location of test points used to check the CRT cutoff voltage.

the center of the screen and then check the movement of the spot while rotating the POSITIONING controls between their limits. From the center of the screen, the minimum spot movement should be the amounts and directions listed in Table 3. Modified Type 517 Oscilloscopes should have the same positioning limits as the Type 517A Oscilloscopes.

TABLE 3

Positioning Limits

	517	517A
Left	4 centimeters	5 centimeters
Right	1 centimeter	1.5 centimeters
Up	1.5 centimeters	2.1 centimeters
Down	1.5 centimeters	2.1 centimeters

21. Adjust Unblanking Compensation.

Place the SWEEP TIME/CM switch in the 2 μSEC/CM position. Connect a 50 mc sine wave signal to the SIGNAL INPUT connector and trigger the sweep at a 1 kc rate using the Trigger Rate Generator. Adjust the signal amplitude and the VERT AMPL ATTEN control to obtain approximately 4 centimeters of vertical deflection. Rotate the SCALE ILLUM control fully counterclockwise and turn down the intensity until the trace is just visible. Adjust L110 until the intensity at the start of the trace is the same as the intensity of the remainder of the sweep.

22. Check the Sweep Inverter.

Rotate the SWEEP STABILITY and TRIGGER AMPL controls fully counterclockwise. Measure the voltage dropped

across R163. (See Fig. 5-21.) This voltage should be between 25 and 35 volts. If the voltage is incorrect, it will be necessary that you select tubes for use as V118 and V137 which will produce the proper voltage drop across R163.

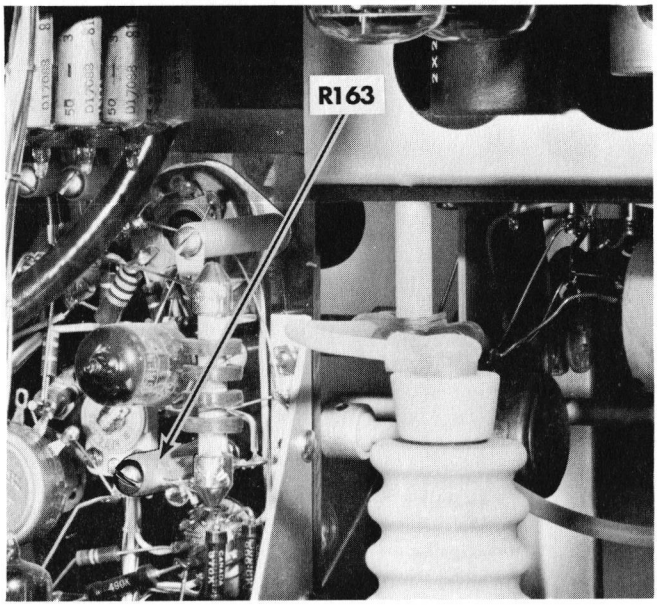


Fig. 5-21. Right side view of the indicator unit showing the location of R163.

23. Check the DC Restorer.

Slowly turn up the intensity until a spot appears on the screen. Remove tube V133 and note any change in the position of the spot. If the spot moves more than 1 millimeter, tube V133 is defective and must be replaced.

24. Check Clamp Tubes.

Place the SWEEP TIME/CM switch in the 20 μSEC/CM position and trigger the sweep at a 1 kc rate with the marker generator. Connect 10 μsecond markers to the SIGNAL INPUT connector and observe the spacing between markers on the display. Change the triggering rate to 100 cycles and again observe the spacing between markers. If the sweep timing is changed, as is evident if the spacing between markers is different, clamp tubes V112 and V113 should be replaced.

NOTE

In each sweep timing step place the second time marker or sine wave under the second vertical line of the graticule and time the sweep between the second and ninth vertical lines.

25. 2 μSEC/CM Sweep Timing.

Preset capacitor C136 up one-third from minimum capacitance and connect 1 μsecond markers from the time-mark generator to the SIGNAL INPUT connector. Place the SWEEP TIME/CM switch in the 2 μSEC/CM position. Trigger the sweep and adjust the L.F. COMP control and C129D for 2 markers per centimeter. Capacitor C129D is used to time the sweep while the L.F. COMP control is used to adjust the sweep for best linearity. It is necessary to adjust C129D and the L.F. COMP control simultaneously to obtain the proper settings for both adjustments. The L.F. COMP control was adjusted previously in step 12 to approximately the correct setting and should require only a slight additional adjustment at this point.

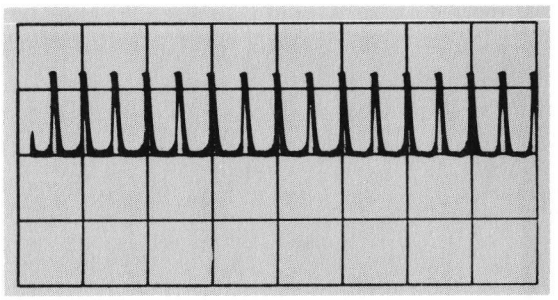


Fig. 5-22. Typical waveform obtained with correct 2 μSEC/CM sweep timing and linearity.

26. 10 MμSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 10 MμSEC/CM position. Connect a 50 mc sine wave signal from the time-mark generator to the SIGNAL INPUT connector and trigger the sweep at a 10 kc rate from the time-mark generator. Adjust C136 for one cycle per 2 centimeters.

NOTE

It may be necessary to repeat steps 25 and 26 several times to obtain the best sweep linearity due to the interaction between the L.F. COMP control and C136.

27. 20 MμSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 20 MμSEC/CM position. Leave the input and triggering signal connections as they were in step 26. Adjust C129J for 1 cycle per centimeter.

28. 50 MμSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 50 MμSEC/CM position. Leave the input and triggering signal connections as they were in step 27. Adjust C129I for 5 cycles per 2 centimeters

29. 100 MμSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 100 MμSEC/CM position. Connect a 10 mc sine wave signal from the time-mark generator to the SIGNAL INPUT connector and trigger the sweep at a 1 kc rate from the time-mark generator. Adjust C129H for 1 cycle per centimeter.

30. 200 MμSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 200 MμSEC/CM position. Connect a 5 mc sine wave signal from the time-mark generator to the SIGNAL INPUT connector and trigger the sweep at a 1 kc rate from the time-mark generator. Adjust C129G for 1 cycle per centimeter.

31. 500 MμSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 500 MμSEC/CM position. Leave the input and triggering signal connections as they were in step 30. Adjust C129F for 5 cycles per 2 centimeters.

32. 1 μSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 1 μSEC/CM position. Connect 1 μsecond markers to the SIGNAL INPUT connector and trigger the sweep at a 1 kc rate from the time-mark generator. Adjust C129E for 1 marker per centimeter.

33. Check 2 μSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 2 μSEC/CM position and check the setting of C129D. (C129D was set in step 25.) If the sweep timing is incorrect, reset C129D as necessary to obtain the proper sweep timing.

34. 5 μSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 5 μSEC/CM position. Connect 5 μsecond markers to the SIGNAL INPUT receptacle and trigger the sweep at a 1 kc rate from the time-mark generator. Adjust R181E for 1 marker per centimeter.

35. 10 μSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 10 μSEC/CM position. Connect 10 μsecond markers to the SIGNAL INPUT receptacle and trigger the sweep at a 1 kc rate from the time-mark generator. Adjust R181C for 1 marker per centimeter.

36. 20 μSEC/CM Sweep Timing.

Place the SWEEP TIME/CM switch in the 20 μSEC/CM position. Leave the marker and triggering signal connections as they were in step 35. Adjust R181A for 2 markers per centimeter.

37. Check Vertical Amplifier for Microphonic or Noisy Tubes.

Disconnect any input signals to the oscilloscope being checked. Place the VERT AMPL ATTEN control fully clockwise and connect high impedance earphones directly between the vertical deflection plates at the neck of the crt. Using the rubber tip of a pencil, tap the vertical preamplifier chassis and listen for excessive hum or noise. Either excessive hum or noise can indicate microphonic tubes. The defective tubes can be detected by tapping each tube individually.

38. Check Vertical Preamplifier Bias Voltage

Rotate the VERT AMPL ATTEN control fully clockwise. Measure the voltage at the wiper arm of the VERT AMPL ATTEN potentiometer to ground. This voltage should be between —1.9 and —2.1 volts.

39. Check Vertical Deflection Factor.

Rotate the VERT AMPL ATTEN control fully clockwise, and using the Calibrator voltage, check the vertical deflection factor of the oscilloscope. If the instrument is a Type 517, the deflection factor should be between 60 and 100 millivolts per centimeter. The vertical deflection factor for Type 517A and Modified Type 517 Oscilloscopes should be between 25 and 50 millivolts per centimeter.

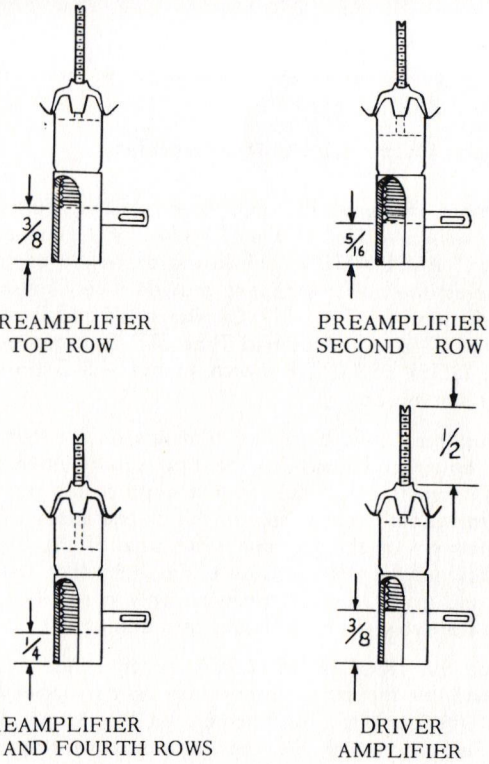


Fig. 5-23. Vertical amplifier trimmer settings.

40. Preset Trimmer Slugs.

Trimmer slugs in the vertical preampliifer and driver amplifier should be preset as follows and as shown in Fig. 5-24 if the vertical amplifier is to be tuned.

Top row on preamplifier chassis ..... slugs in 3/8"

Second row on preamplifier chassis ..... slugs in 5/16"

Third and Fourth rows on preamplifier chassis . slugs in 1/4"

Driver amplifier ..... adjustment shaft protruding 1/2"

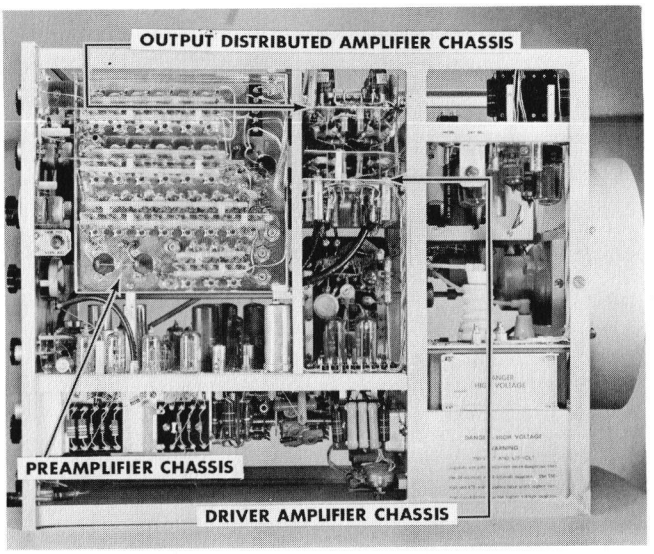


Fig. 5-24. Location of the various portions of the vertical amplifier.

41. Tune Output Distributed Amplifier

Connect the properly terminated positive output of the short rise-time pulser to the SIGNAL INPUT connector. Set the VERT AMPL ATTEN control approximately at mid range and adjust the pulser output to provide 1 centimeter of vertical deflection for Type 517 Oscilloscopes and 2 centimeters for Type 517A and Modified Type 517 Oscilloscopes. Place the TRIGGER SELECTOR switch in the +SIG position and trigger the sweep.

Adjust the forward row of trimmers on the output distributed amplifier chassis for the best square-wave response. These trimmers affect the leading edge of the pulser waveform for about 1 centimeter at this sweep speed. Start with the trimmers at the extreme right side of the chassis and work toward the left. Because of the interaction between the front and back rows of trimmers, only a rough adjustment of the front row trimmers should be made at first.

Place the TRIGGER SELECTOR switch in the —SIG position and set the pulser controls to obtain negative pulses. Adjust the back row of trimmers on the output distributed amplifier chassis for the best square-wave response. The same procedure in adjusting the back row of trimmers should be used as was used to adjust the front row. When the back row of trimmers has been adjusted approximately, apply positive pulses and repeat the adjustment of the front row. Continue to adjust the forward row of trimmers with positive pulses and the back row of trimmers with negative pulses until all trimmers are set at their best positions. While adjusting the trimmers, occasionally reduce the sweep speed momentarily so that you may obtain a better perspective of any tilt or slope of the waveform.

The neutralizing capacitors affect the portion of the pulse waveform just to the right of the portion adjusted by the last trimmer capacitors on the output distributed amplifier chassis. The neutralizing capacitors are located on the extreme right end of the driver amplifier chassis and are accessible from below. The front capacitor is adjusted using a positive going pulse and the back one is adjusted with a negative going pulse.

The leading edge of the pulses can be adjusted to a limited extent by L509 and L510 in the preamplifier circuit. If you shunt these coils one at a time, you can observe the portion of the waveform which is affected by each coil. It is possible that different shunt resistors across the coils will produce a better waveform and in such cases the resistors should be changed. In extreme cases, either or both coils may be shorted completely.

42. Check Delay Time.

Place the SWEEP TIME/CM switch in the 10 MμSEC/CM position. Connect appropriate properly terminated outputs from the short risetime pulses to the SIGNAL INPUT and TRIGGER INPUT connectors. When the sweep is triggered externally by the pulser, the applied pulses should appear approximately 2 centimeters from the start of the trace. When the sweep is triggered internally from the input signal, the applied pulse should appear approximately 1 centimeter from the start of the trace. If the delay observed is much shorter than indicated, tubes V108 and V109 should be replaced. If the delay time is not the same for both positive and negative pulses, change V101.

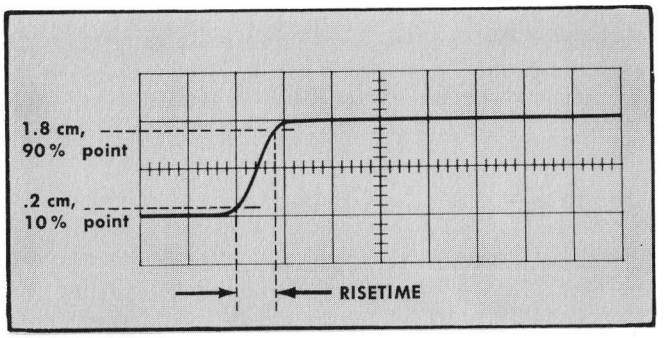


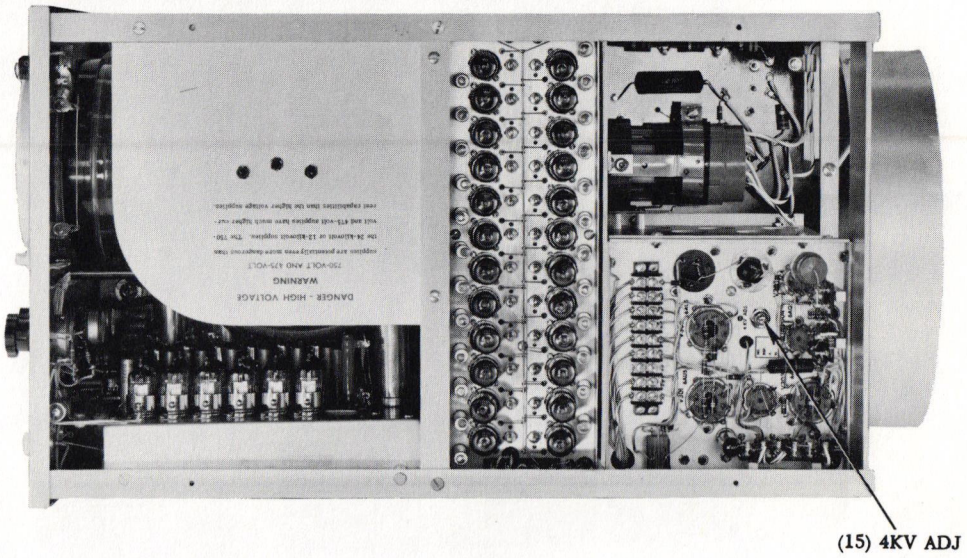
Fig. 5-25. Measurement of vertical risetime.

43. Check Risetime.

Connect the properly terminated outputs of the pulser to appropriate oscilloscope input connectors and adjust the pulser output for 2 centimeters of vertical deflection. Under these conditions the time required for the pulse to rise from .2 to 1.8 centimeters should be less than 7 Mμseconds. This can be checked using the HORIZONTAL POSITIONING Vernier control.

Set the HORIZONTAL POSITIONING Vernier control at zero and use the coarse HORIZONTAL POSITIONING control to position the display so that the center vertical line of

the graticule passes through the rising portion of the waveform .2 centimeters from the bottom of the rise. Use the HORIZONTAL POSITIONING Vernier control to position the display so that the vertical centerline of the graticule passes through the rising portion of the waveform 1.8 centimeters up from the bottom of the rise. The reading of the HORIZONTAL POSITIONING Vernier control multiplied by 10 is the rise-time in Mμseconds.



NOTE
Numbers in parenthesis refer to the particular step(s) where the control is adjusted.

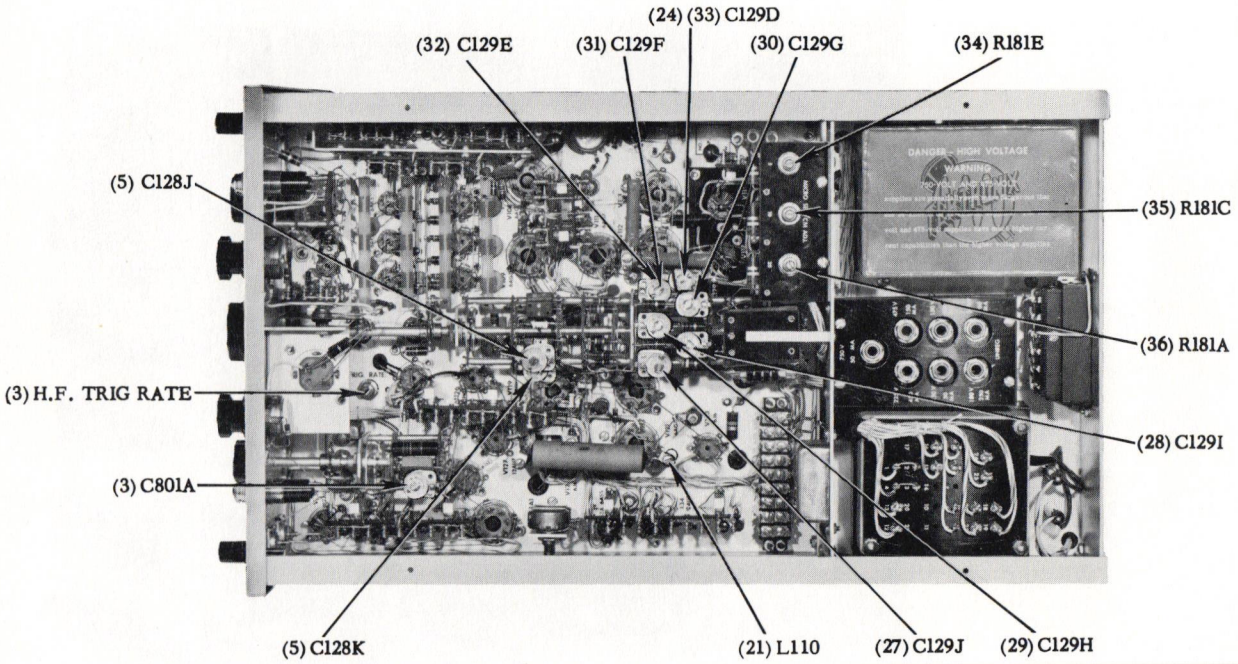
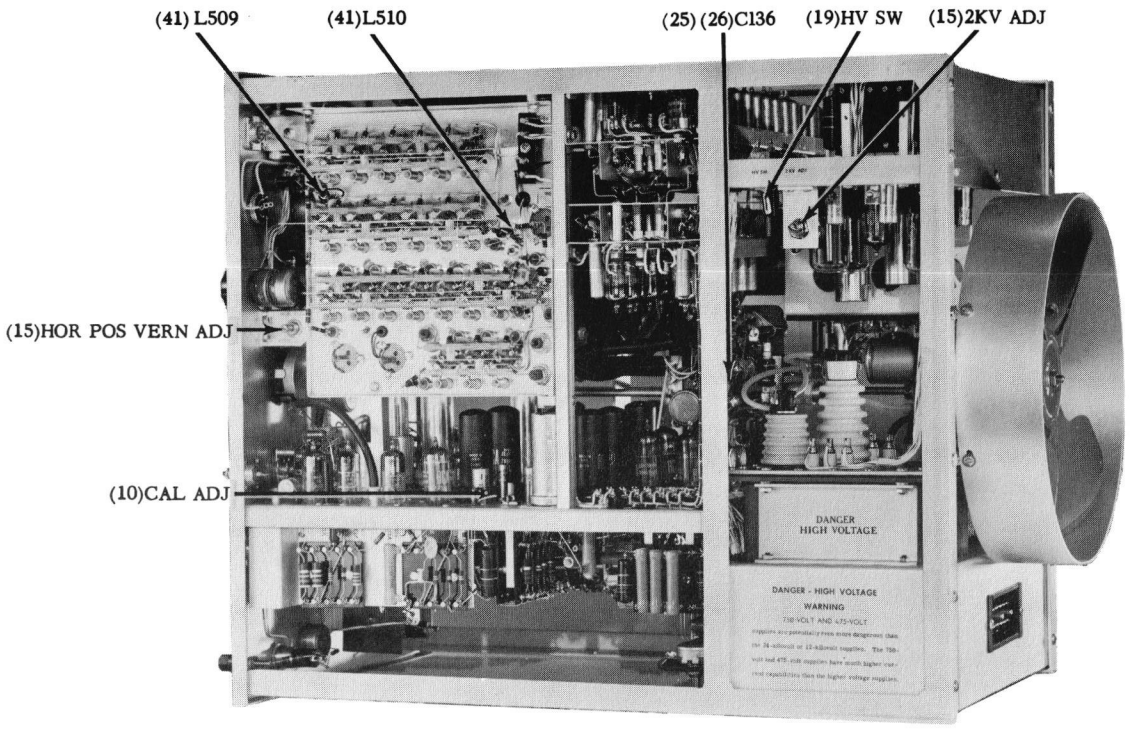


Fig. 5-26. Type 517 Oscilloscope top and bottom views showing the location of adjusting controls.



NOTE
Numbers in parenthesis refer to the particular step(s) where the control is adjusted.

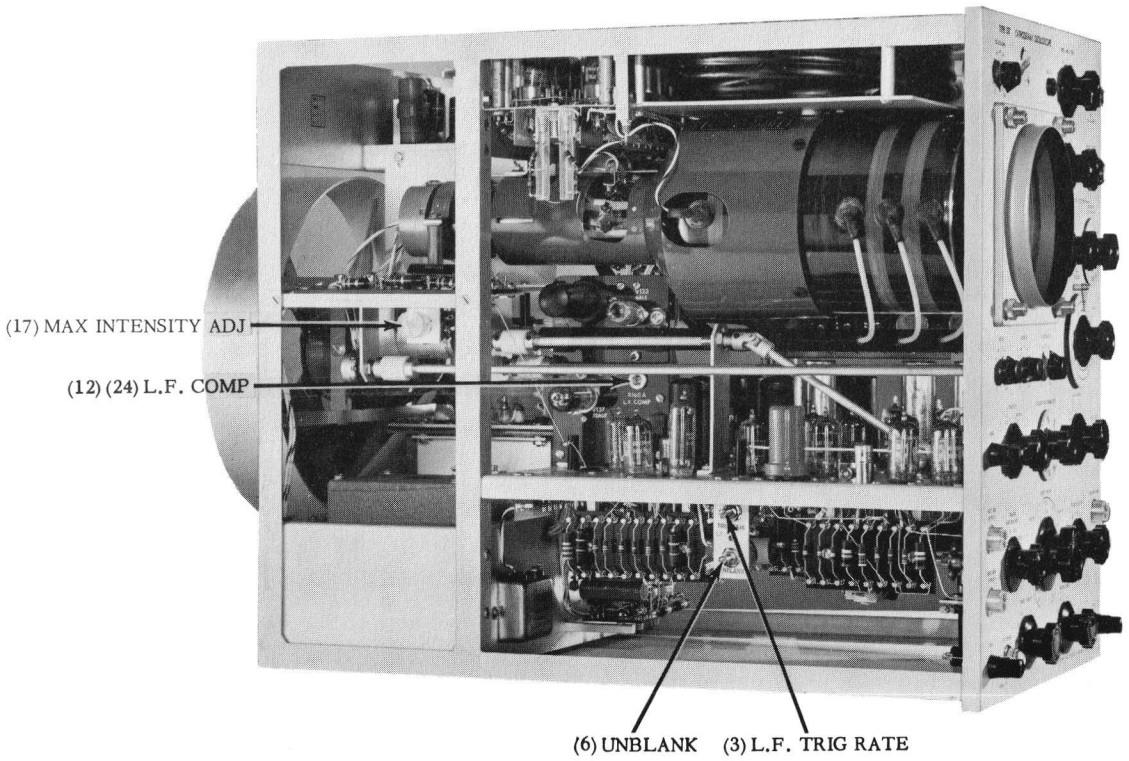
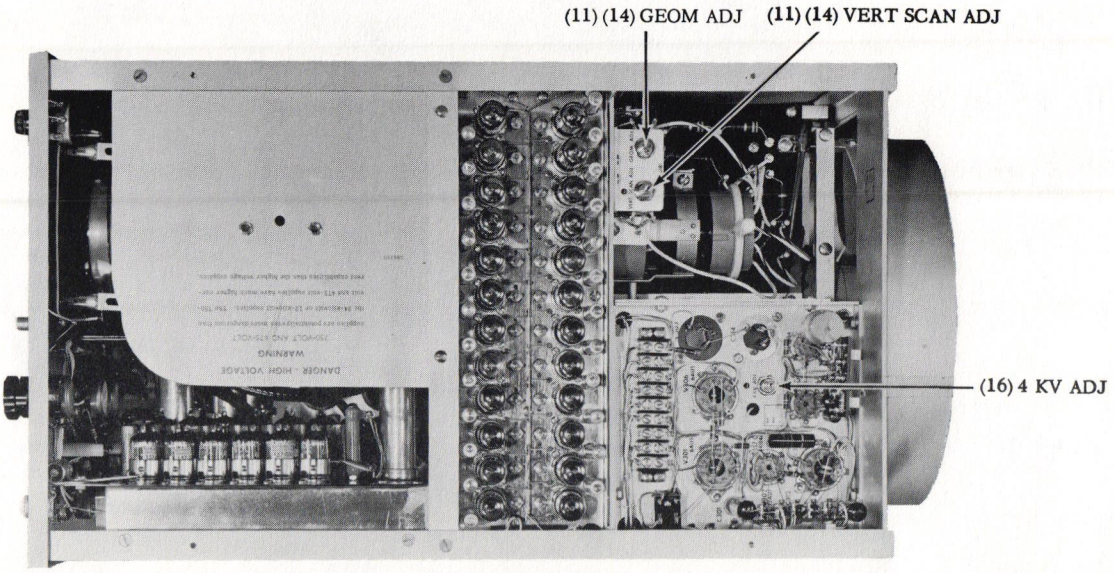


Fig. 5-27. Type 517 Oscilloscope left and right side views showing the location of adjustment controls.



NOTE
Numbers in parenthesis refer to the particular step(s) where the control is adjusted.

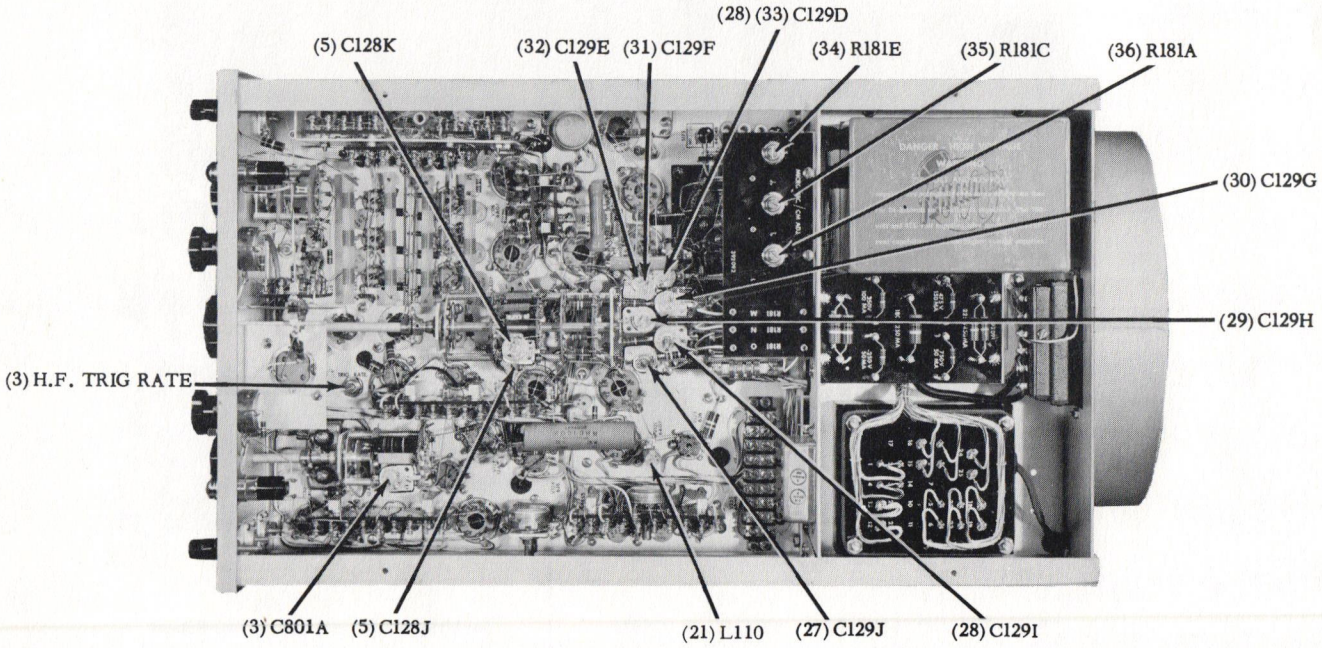
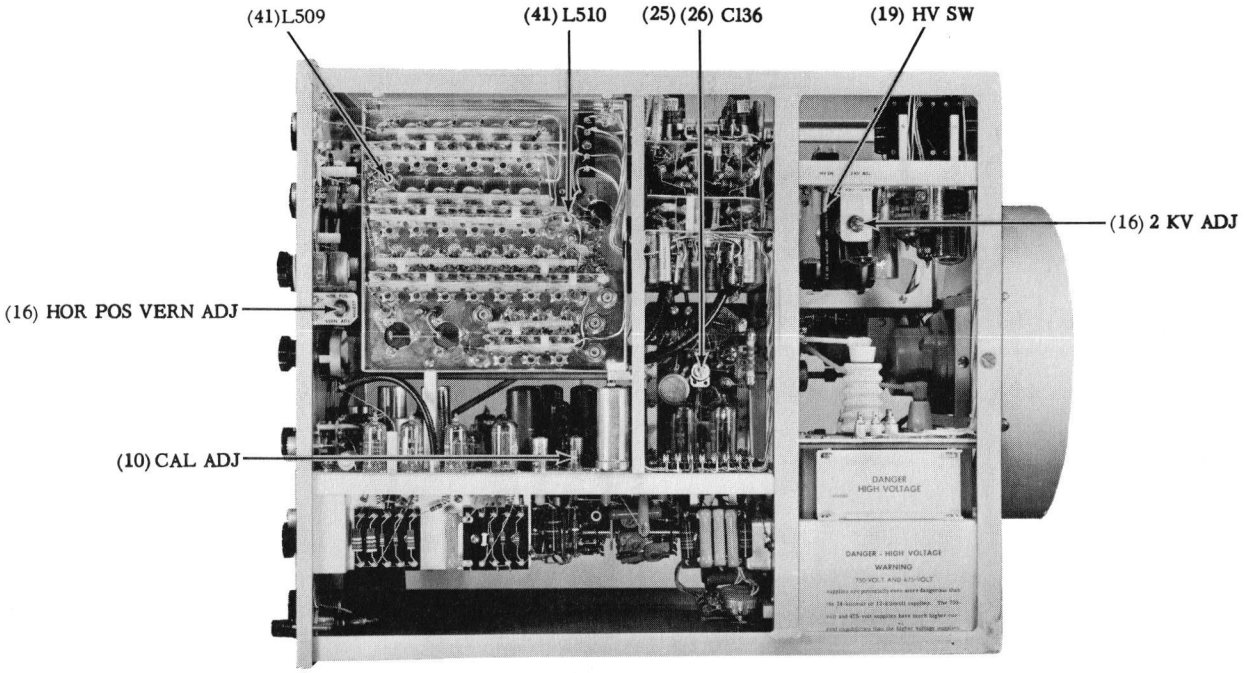


Fig. 5-28. Type 517A Oscilloscope top and bottom views showing the location of adjustment controls.



NOTE
Numbers in parenthesis refer to the particular step(s) where the control is adjusted.

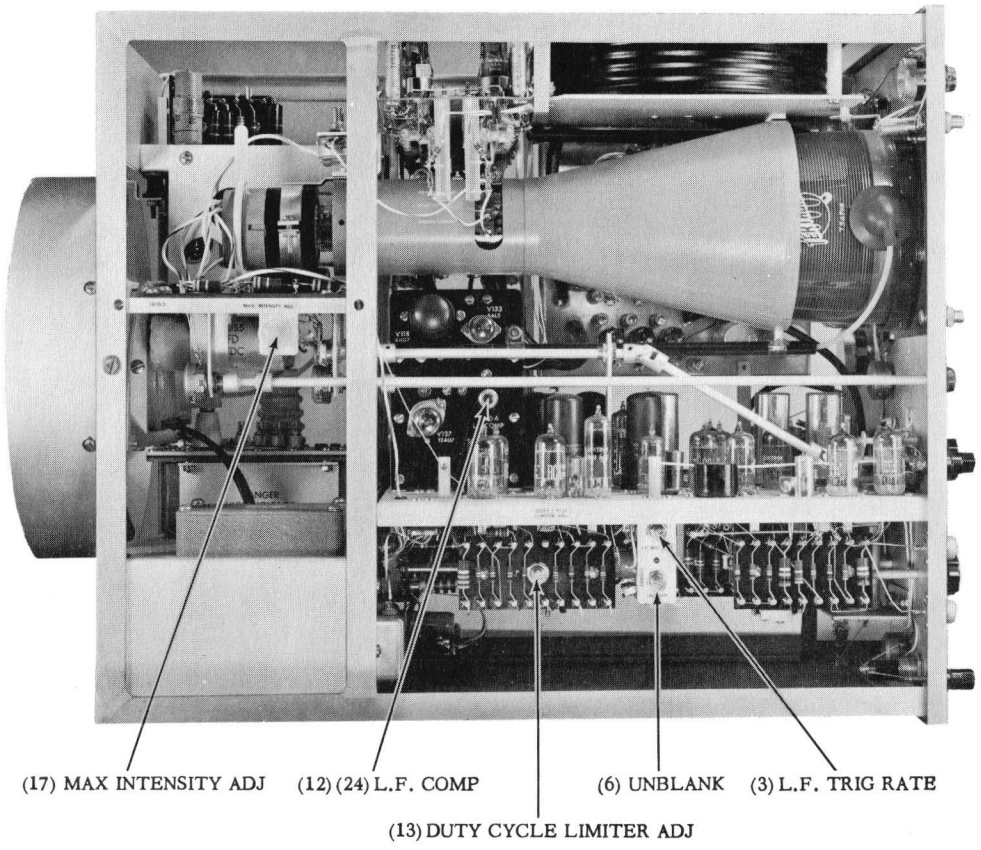
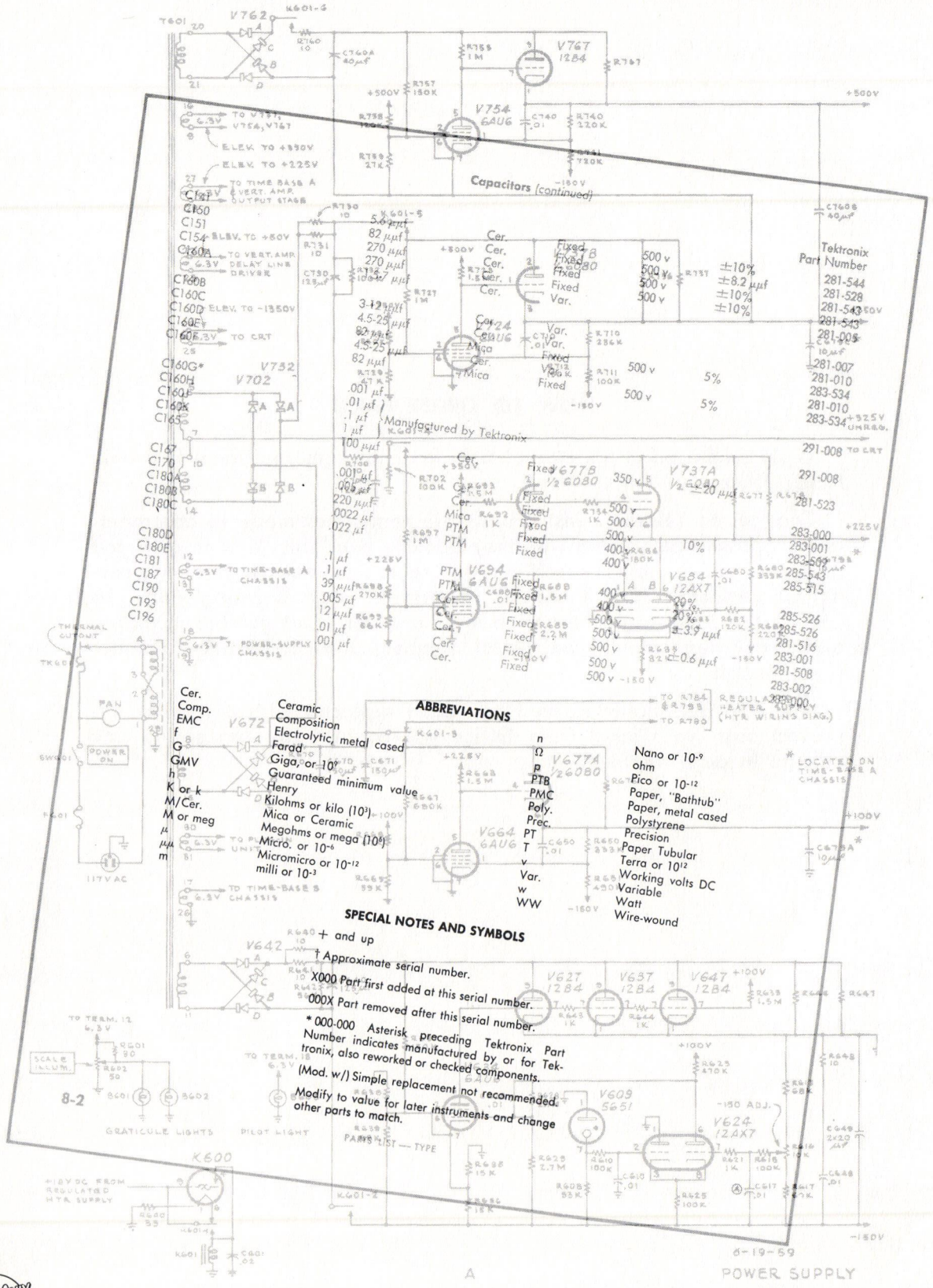


Fig. 5-29. Type 517A Oscilloscope left and right side views showing the location of adjustment controls.

PARTS LIST *and* DIAGRAMS



MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

HOW TO ORDER PARTS

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

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

If a part you have ordered has been replaced with a new or improved part, your local Field Office will contact you concerning any change in part number.

PART LIST

Bulbs

			Tektronix Part Number
B90	X1691 up	Neon, NE-2	150-002
B324		Neon, NE-51	150-003
B325		Incandescent, #47	150-001
B326		Incandescent, #47	150-001
B327		Incandescent, #47	150-001
B401		Incandescent, #47	150-001
B430		Neon, NE-51	150-003
B838-841	101-2126	Neon, NE-2 Aged and Checked	150-010
B838	2127-up	Neon, NE-2, Aged and Checked	150-011
B839	2127-up	Neon, NE-23	150-027
B840	2127-up	Neon, NE-23	150-027
B841	2127-up	Neon, NE-2, Aged and Checked	150-011

Capacitors

Values fixed unless marked Variable.

Tolerance ±20% unless otherwise indicated.

C95	X1691 up	100 μμf	Cer.	500 v		281-530
C96	X2041-up	100 μμf	Cer.	350 v		281-523
C98	X1691 up	.01 μf	Cer.	500 v		283-002
C101		.001 μf	Cer.	500 v	GMV	283-000
C102		½ 2 x 20 μf	EMC	450 v	(with C817)	Use 290-0010-00
C103		.001 μf	Cer.	500 v	GMV	283-000
C104		.005 μf	Cer.	500 v	GMV	283-001
C105		.01 μf	PT	400 v		285-510
C106A		.01 μf	Cer.	500 v	GMV	283-002
C106B		.01 μf	Cer.	500 v	GMV	283-002
C106C		.01 μf	Cer.	500 v	GMV	283-002
C107A		.001 μf	Cer.	500 v	GMV	283-000
C107B		.001 μf	Cer.	500 v	GMV	283-000
C107C		.001 μf	Cer.	500 v	GMV	283-000
C108A		.01 μf	Cer.	500 v	GMV	283-002
C108B		.01 μf	Cer.	500 v	GMV	283-002
C108C		.01 μf	Cer.	500 v	GMV	283-002
C109		.01 μf	Cer.	500 v	GMV	283-002
C110		.01 μf	PT	400 v		285-510
C111		½ 2 x 20 μf	EMC	450 v		Use 290-0010-00
C112		½ 2 x 20 μf	EMC	450 v		
C113		½ 2 x 20 μf	EMC	450 v	(with C124)	Use 290-0010-00
C114		.01 μf	Cer.	500 v	GMV	283-002
C115		6.25 μf	EMC	300 v		290-000
C116		.001 μf	Cer.	500 v	GMV	283-000
C117		220 μμf	Mica	500 v		283-536
C118	101-1690X	6.25 μf	EMC	300 v		290-000
C119		6.25 μf	EMC	300 v		290-000
C120		6.25 μf	EMC	300 v		290-000
C121		100 μμf	Mica	500 v	10%	283-505
C122		6.25 μf	EMC	300 v		290-000

Capacitors *(continued)*

							Tektronix Part Number
C123		47 μμf	Cer.		500 v		281-518
C124		½ 2 x 20 μf	EMC		450 v	(with C113)	Use 290-0010-00
C125		47 μμf	Cer.		500 v		281-518
C126		6.25 μf	EMC		300 v		290-000
C127		47 μμf	Cer.		500 v		281-518
C128A		3900 μμf	Mica		500 v	5%	283-531
C128B		2000 μμf	Mica		500 v	5%	283-529
C128C		1000 μμf	Mica		500 v	5%	283-527
C128D		500 μf	Mica		500 v	5%	283-523
C128E		250 μμf	Mica		500 v	5%	283-543
C128F		100 μμf	Mica		500 v	5%	283-506
C128G		47 μμf	Cer.		500 v	5%	283-501
C128H		27 μμf	Cer.		500 v	5%	281-515
C128I		12 μμf	Cer.		500 v	5%	281-508
C128J		4.5-25 μμf	Cer.	Var.	500 v		281-010
C128K		3-12 μμf	Cer.	Var.	500 v		281-007
C129A		750 μμf	Mica		500 v	5%	283-524
C129B		355 μμf	Mica		500 v	5% Selected	*295-011
C129C		170 μμf	Mica		500 v	5% Selected	*295-008
C129D-J		7-45 μμf	Cer.	Var.	500 v		281-012
C129K	X1491-up	12 μμf	Cer.		500 v	10%	281-505
C130		½ 2 x 15 μf	EMC		450 v	(with C906)	Use 290-0007-00
C131		1 μf	PBT		600 v		285-541
C132	101-349	.047 μf	PT		600 v		285-520
	350-up	.022 μf	PT		600 v		285-517
C133	101-349	.047 μf	PT		600 v		285-520
	350-up	.022 μf	PT		600 v		285-517
C134		.001 μf	PT		1000 v		285-502
C135		.01 μf	Cer.		500 v	GMV	283-002
C136		4.5-25 μμf	Cer.	Var.	500 v		281-010
C137		7 μμf	Cer.		500 v		281-502
C138		.01 μf	Cer.		500 v	GMV	283-002
C139		.01 μf	Cer.		500 v	GMV	283-002
C140		.01 μf	Cer.		500 v	GMV	283-002
C141A		.01 μf	Cer.		500 v	GMV	283-002
C141B		.01 μf	Cer.		500 v	GMV	283-002
C142		.001 μf	Cer.		500 v	GMV	283-000
C145		.01 μf	Cer.		500 v	GMV	283-002
C146		0.5 μf	PBT		1000 v		285-538
C250	X1691-up	12 μμf	Cer.		500 v		281-506
C258	X926 up	.01 μf	Cer.		500 v	GMV	283-002
C301		6.25 μf	EMC		300 v		290-000
C302		.1 μf	PT		400 v		285-526
C303		2 x 20 μf	EMC		450 v		Use 290-0010-00
C304		.022 μf	PT		400 v		285-515
C305		.01 μf	PT		400 v		285-510
C306		.01 μf	PT		400 v		285-510
C307		6.25 μf	EMC		300 v		290-000
C308		.022 μf	PT		600 v	5% Selected	*295-018
C309		.01 μf	PT		400 v		285-510

Capacitors *(continued)*

								Tektronix Part Number
C311		.047 μf	PT		600 v	5%	Selected	*295-019
C312		6.25 μf	EMC		300 v			290-000
C314		½ 2 x 15 μf	EMC		450 v			Use 290-0007-00
C315	101-517	.22 μf	PT		600 v			Use 285-534
	518-up	.27 μf	PTM		600 v			Use 285-0700-00
C401		2 x 20 μf	EMC		450 v			Use 290-0010-00
C402		.01 μf	PT		400 v			285-510
C403A		2 x 20 μf	EMC		450 v			Use 290-0010-00
C403B		2 x 20 μf	EMC		450 v			Use 290-0010-00
C403C		2 x 20 μf	EMC		450 v			Use 290-0010-00
C403D		2 x 20 μf	EMC		450 v			Use 290-0010-00
C403E		2 x 20 μf	EMC		450 v			Use 290-0010-00
C403F		2 x 20 μf	EMC		450 v			Use 290-0010-00
C404	101-679	.01 μf	PT		400 v			Use 285-511
	680 up	.01 μf	PT		600 v			285-511
C405A		2 x 20 μf	EMC		450 v			Use 290-0010-00
C405B		2 x 20 μf	EMC		450 v			Use 290-0010-00
C406A		2 x 20 μf	EMC		450 v			Use 290-0010-00
C406B		2 x 20 μf	EMC		450 v			Use 290-0010-00
C406C		2 x 20 μf	EMC		450 v			Use 290-0010-00
C406D		2 x 20 μf	EMC		450 v			Use 290-0010-00
C406E		2 x 20 μf	EMC		450 v			Use 290-0010-00
C407		.01 μf	PT		400 v			285-510
C408		2 x 40 μf	EMC		450 v			Use 290-0013-00
C409		2 x 20 μf	EMC		450 v			Use 290-0010-00
C410		.01 μf	PT		400 v			285-510
C411		.01 μf	PT		400 v			285-510
C412		.01 μf	PT		400 v			285-510
C413		½ 2 x 20 μf	EMC		450 v			Use 290-0010-00
C414		½ 2 x 20 μf	EMC		450 v			
C415		.01 μf	PT		400 v			285-510
C416		.01 μf	PT		400 v			285-510
C417		1 μf	PBT		600 v			285-541
C418		.001 μf	Cer.		500 v	GMV		283-000
C501A-F		.005 μf	Cer.			GMV	Note 1	*295-015
C502A-F		.5-5 μμf	Poly	Var.	500 v			281-002
C503A-F		.001 μf	Cer.		500 v	GMV		283-000
C505A-F		.005 μf	Cer.		500 v	GMV	Note 1	*295-015
C506A-F		1-8 μμf	Poly	Var.	500 v	GMV		281-004
C507A-F		.001 μf	Cer.		500 v	GMV		283-000
C508		8 μf	EMC		150 v		Note 2	*295-021
C509		150 μf	EMC		150 v			290-018
C510		150 μf	EMC		150 v			290-018
C511		150 μf	EMC		150 v			290-018
C512	101-179	22 μμf	Cer.		500 v			Use 281-516
	180-2068X	39 μμf	Cer.		500 v			281-516

Note 1: Pretested at 2600 V.

Note 2: Selected 0 to 5 Ω.

Capacitors *(continued)*

						Tektronix Part Number
C514A-G	.005 μf	Cer.		500 v	GMV Note 1	*295-015
C515A-G	47 μf	EMC		6 v	Use	*290-114
C516A-G	.001 μf	Cer.		500 v	GMV	283-000
C518	8 μf	EMC		150 v	Note 2	*295-021
C519	.005 μf	Cer.		500 v	GMV Note 1	*295-015
C520	47 μf	EMC		6 v	Use	*290-114
C521	.001 μf	Cer.		500 v	GMV	283-000
C522	.005 μf	Cer.		500 v	GMV Note 1	*295-015
C523A-C	.005 μf	Cer.		500 v	GMV Note 1	*295-015
C524A-C	47 μf	EMC		6 v	Use	*290-114
C525A-C	.001 μf	Cer.		500 v	GMV	283-000
C526A-G	.5-5 μμf	Poly	Var.	500 v		281-002
C527A-C	.5-5 μμf	Poly	Var.	500 v		281-002
C528	8 μf	EMC		150 v	Note 2	*295-021
C529	8 μf	EMC		150 v	Note 2	*295-021
C530	8 μf	EMC		150 v	Note 2	*295-021
C531	275 μf	EMC		6 v		290-020
C532	8 μf	EMC		150 v	Note 2	*295-021
C601A-F	.005 μf	Cer.		500 v	GMV Note 1	*295-015
C602A-F	47 μf	EMC		6 v	Use	*290-114
C603A-F	.001 μf	Cer.		500 v	GMV	283-000
C604	8 μf	EMC		150 v	Note 2	*295-021
C605	8 μf	EMC		150 v	Note 2	*295-021
C606A-F	.005 μf	Cer.		500 v	GMV Note 1	*295-015
C607A-F	47 μf	EMC		6 v	Use	*290-114
C608A-F	.001 μf	Cer.		500 v	GMV	283-000
C609	8 μf	EMC		150 v	Note 2	*295-021
C610	8 μf	EMC			Note 2	*295-021
C611A-E	.5-5 μμf	Poly	Var.	500 v		281-002
C612A-E	.5-5 μμf	Poly	Var.	500 v		281-002
C613, C614	Neutralizing Capacitors					(2) *281-020
C701A-L	.005 μf	Cer.		500 v	GMV Note 1	*295 015
C702A-L	47 μf	EMC		6 v	Use	*290-114
C703A-L	.001 μf	Cer.		500 v	GMV	283-000
C704	8 μf	EMC		150 v	Note 2	*295-021
C705	.01 μf	Cer.		500 v	GMV	283-002
C706	6.25 μf	EMC		300 v		290-000
C707A-L	.005 μf	Cer.		500 v	GMV Note 1	*295-015

Note 1: Pretested at 2600 V.

Note 2: Selected 0 to 5 Ω.

Capacitors *(continued)*

							Tektronix Part Number
C708A-L		47 μf	EMC		6 v		Use *290-114
C709A-L		.001 μf	Cer.		500 v	GMV	283-000
C710		8 μf	EMC		150 v	Note 2	*295-021
C711		.01 μf	Cer.		500 v	GMV	283-002
C712		6.25 μf	EMC		300 v		290-000
C713A-L		.5-5 μμf	Poly	Var.	500 v		281-002
C714A-L		.5-5 μμf	Poly	Var.	500 v		281-002
C735	101-925X	.5-5 μμf	Poly	Var.	500 v		281-002
C736	101-925X	.5-5 μμf	Poly	Var.	500 v		281-002
C801A		7-45 μμf	Cer.	Var.	500 v		281-012
C801B	101-678	200 μμf	Mica		500 v	10%	Use 283-510
	679-1472	200 μμf	Mica		500 v	5%	Use 283-510
	1473-up	180 μμf	Mica		500 v	5%	283-510
C802		.0022 μf	Mica		500 v	Selected ±2% of each	
C803		.022 μf	PT		400 v	other	*295-017
C804		1/3 3 x .1 μf	PBT		400 v	20%	285-531
C805		12 μμf	Cer.		500 v		281-505
C806	101-598	47 μμf	Cer.		500 v		Use 281-510
	599-up	22 μμf	Cer.		500 v		281-510
C807		22 μμf	Cer.		500 v		281-510
C808		1/3 3 x .1 μf	PMC		400 v		With C804
C809		6.25 μf	EMC		300 v		290-000
C810		1/3 3 x .1 μf	PMC		400 v		With C804
C815	101-925	.01 μf	PTM		400 v		285-510
	926-up	.01 μf	Cer.		500 v	GMV	283-002
C816	101-925	.01 μf	PTM		400 v		285-510
	926-up	.01 μf	Cer.		500 v	GMV	283-002
C817		½ 2 x 20 μf	EMC		450 v	(with C102)	Use 290-0010-00
C818		.0068 μf	PT		5000 v		285-509
C819	101-925	.001 μf	PT		600 v		285-501
	926-up	.001 μf	PT		1000 v		285-502
C820		.05 μf	PMC		6000 v		285-524
C825	X435-up	1000 μf	EMC		15 v		Use 290-0022-00
C826	X435-up	1000 μf	EMC		15 v		Use 290-0022-00
C901		47 μμf	Cer.		500 v		281-518
C902		100 μμf	Mica		500 v	10%	283-505
C903		.01 μf	Cer.		500 v	GMV	283-002
C904		.1 μf	PT		400 v		285-526
C905		.01 μf	PT		400 v		285-510
C906		½ 2 x 15 μf	EMC		450 v	(with C130)	Use 290-0007-00
C907	101-547	8 μf	EMT		150 v		Use 290-000
	548-up	6.25 μf	EMT		300 v		290-000

Note 2: Selected 0 to 5 Ω.

Diodes

D96	X2041-up	Germanium T12G	152-008
D100		1N34A or T12G	152-008
D478	X1901-up	Silicon Diode	Use 152-047
D479	X1901-up	Silicon Diode	Use 152-047
D480	X1901-up	Silicon Diode	Use 152-047
D481	X1901-up	Silicon Diode	Use 152-047

Diodes *(continued)*

			Tektronix Part Number
D482	X1901-up	Silicon Diode	Use 152-047
D483	X1901-up	Silicon Diode	Use 152-047
D484	X1901-up	Silicon Diode	Use 152-047
D485	X1901-up	Silicon Diode	Use 152-047
D486	X1901-up	Silicon Diode	Use 152-047
D487	X1901-up	Silicon Diode	Use 152-047
D488	X1901-up	Silicon Diode	Use 152-047
D489	X1901-up	Silicon Diode	Use 152-047
D490	X1901-up	Silicon Diode	Use 152-047
D491	X1901-up	Silicon Diode	Use 152-047
D492	X1901-up	Silicon Diode	Use 152-047
D493	X1901-up	Silicon Diode	Use 152-047
D801	X1901-up	Silicon Diode	Use 152-047

Fuses

							Tektronix Part Number
F1		6 Amp	3 AG	Fast-Blo			159-013
F2	101-1739	4 Amp	3 AG	Fast-Blo			159-017
	1740-up	15 Amp	3 AG	Fast-Blo			159-038
F3		5 Amp	3 AG	Fast-Blo			159-014

Inductors

					Tektronix Part Number
L101		First distributed stage trigger amplifier, grid inductor			*108-040
L102		First distributed stage trigger amplifier, plate inductor			*108-084
L103		Second distributed stage trigger amplifier, grid inductor			*108-085
L104		Second distributed stage trigger amplifier, plate inductor			*108-086
L105		12 μh			*108-005
L106		7.1 μh			*108-020
L107	101-547	20-30 μh	Var.	core 276-503	*114-005
	548-up	22 μh			*108-014
L108		2.5 mh			*108-055
L109		255 μh			*108-015
L110		6.5-13 μh	Var.	core 276-503	*114-023
L181P		2.5 mh			*108-055
L181R	X1962-up	2.5 mh			*108-055
L401		1.6 h			*108-052
L402		Saturable reactor			*108-053
L501		First stage vertical amplifier, grid inductor			*108-046
L502		First stage vertical amplifier, plate inductor			*108-046
L503		Second stage vertical amplifier, grid inductor			*108-046
L504		Second stage vertical amplifier, plate inductor			*108-043
L505		Third stage vertical amplifier, grid inductor			*108-047
L506		Third stage vertical amplifier, plate inductor			*108-045
L507		Inverter stage vertical amplifier, grid inductor			*108-044
L508		Inverter stage vertical amplifier, plate inductor			*108-044
L509		0.79-1.5 μh	Var.	core not replaceable	*114-025
L510		2.9-6.6 μh	Var.	core not replaceable	*114-012
L601		Fourth stage vertical amplifier, D3 chain, grid inductor			*108-043

				Tektronix Part Number
L602		Fourth stage vertical amplifier, D3 chain, plate inductor		*108-043
L603		Fourth stage vertical amplifier, D4 chains, grid inductor		*108-043
L604		Fourth stage vertical amplifier, D4 chain, plate inductor		*108-043
L701		Output stage vertical amplifier, D3 chain, grid inductor		*108-042
L702		Output stage vertical amplifier, D3 chain, plate inductor		*108-041
L703		Output stage vertical amplifier, D4 chain, grid inductor		*108-042
L704		Output stage vertical amplifier, D4 chain, plate inductor		*108-041
L705	101-925	.13 μh		*108-006
	926-1096	.15 μh	Mod w/L707	
	1097-2068	.15 μh		*108-113
	2069-up	.2 μh		*108-115
L706	101-1919	.18 μh		*108-009
L706	1920-up	.15 μh		108-206
L707	101-925	.13 μh		*108-006
	926-1096	.15 μh	Mod w/L705	
	1097-2068	.15 μh		*108-113
	2069-up	.2 μh		*108-115
L708	101-1919	.18 μh		*108-009
L708	1920-up	.15 μh		108-206

Rectifiers

			Tektronix Part Number
SR401A,B	101-1900X	10-250 ma plates per leg	106-009
SR402A,B	101-1900X	10-250 ma plates per leg	106-009
SR801	101-1900X	1-500 ma plate per leg	106-010

Resistors

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

				Tektronix Part Number
R81	X1691-up	220 k	1 w	304-224
R83	X1691-up	22 k	2 w	306-223
R84	X1691-up	100 k	½ w	302-104
R85	X1691-up	820 k	½ w	302-824
R90	X1691-up	270 k	½ w	302-274
R92	X1691-up	10 meg	½ w	302-106
R93	X1691-up	5.6 k	½ w	302-562
R94	X1691-up	10 k	½ w	302-103
R95	X1691-up	100 k	½ w	302-104
R96	X1691-up	3.3 meg	½ w	302-335
R98	X1691-up	18 k	½ w	302-183
R99	X1691-up	1 meg	½ w	302-105
R101		100 Ω	½ w	302-101
R102		470 k	½ w	302-474
R103		47 Ω	½ w	302-470
R104		220 Ω	½ w	302-221
R105		3.9 k	2 w	306-392
R106		270 Ω	½ w	302-271
R107		100 Ω	½ w	302-101
R108		470 k	½ w	302-474
R109		10 Ω	½ w	302-100
R110		10 Ω	½ w	302-100
R111A		27 k	1 w	304-273
R111B		27 k	1 w	304-273
R111C		27 k	1 w	304-273

							Tektronix Part Number
R112		560 Ω	½ w				302-561
R113		560 Ω	1 w				304-561
R114		10 Ω	½ w				302-100
R115A		15 k	1 w				304-153
R115B		15 k	1 w				304-153
R115C		15 k	1 w				304-153
R116A		820 k	½ w				302-824
R116B		820 k	½ w				302-824
R116C		820 k	½ w				302-824
R117		560 Ω	1 w				304-561
R118		10 Ω	½ w				302-100
R119		560 Ω	1 w				304-561
R120		10 Ω	½ w				302-100
R121		220 Ω	1 w				304-221
R122		470 Ω	1 w				304-471
R123		470 Ω	2 w				306-471
R124		47 Ω	½ w				302-470
R125		470 Ω	½ w				302-474
R126		270 Ω	2 w				306-271
R127		15 k	2 w				306-153
R128		390 k	½ w				302-394
R129		2.7 k	½ w				302-272
R130		10 k	2 w				306-103
R131		220 Ω	2 w				306-221
R132A		6.8 k	½ w				302-682
R132B		100 k	2 w	Var.		TRIGGER AMPL.	311-026
R132C		820 k	½ w				302-824
R133		27 Ω	½ w				302-270
R134		150 k	½ w				302-154
R135A		180 k	½ w				302-184
R135B		100 k	2 w	Var.		SWEEP STABILITY	311-026
R135C		120 k	½ w				302-124
R136		5.6 k	2 w				306-562
R137		120 k	1 w				304-124
R138		15 k	10 w	Fixed	WW	5%	308-024
R139		15 k	10 w	Fixed	WW	5%	308-024
R140		100 k	1 w				304-104
R141		47 Ω	½ w				302-470
R142		1.5 k	5 w	Fixed	WW	5%	308-002
R143		6.8 k	2 w				306-682
R144		470 k	½ w				302-474
R145		820 k	½ w				302-824
R146		10 k	2 w				306-103
R147		150 Ω	1 w				304-151
R148A		1.5 k	25 w	Fixed	WW	5%	308-040
R148B		1.5 k	25 w	Fixed	WW	5%	308-040
R149		47 Ω	½ w				302-470
R150A	101-349X	10 k	2 w				306-103
R150B	101-349X	10 k	2 w				306-103
R150	X350-up	15 k	10 w	Fixed	WW	5%	308-024

							Tektronix Part Number
R151		47 Ω	½ w				302-470
R152	101-349	47 Ω	½ w				302-470
	350-up	22 Ω	½ w				302-220
R153A	101-349X	10 k	2 w				306-103
R153B	101-349X	10 k	2 w				306-103
R153	X350-up	15 k	10 w	Fixed	WW	5%	308-024
R154		47 Ω	½ w				302-470
R155		56 Ω	½ w				302-560
R156		47 Ω	½ w				302-470
R157	101-349	47 Ω	½ w				302-470
	350-up	56 Ω	½ w				302-560
R158	101-349	22 k	2 w				306-223
	350-up	15 k	10 w	Fixed	WW	5%	308-024
R159	101-349X	22 k	2 w				306-223
R160	101-495X	330 k	½ w				302-333
R160A	X496-up	500 k	2 w	Var.		L.F. Comp.	311-034
R160B	X496-up	100 k	½ w				302-104
R161	101-925	470 k	½ w	Fixed	Comp.	5%	301-474
	926-up	330 k	1 w				304-334
R162	101-925	470 Ω	½ w				302-471
	926-up	1 k	½ w				302-102
R163	101-495	18 k	2 w				306-183
	496-up	10 k	10 w	Fixed	WW	5%	308-023
R164	101-495	18 k	2 w				306-183
	496-up	490 k	½ w	Fixed	Prec.	1%	309-002
R165		3.3 meg	½ w				302-335
R166		3.3 meg	½ w				302-335
R167A	101-495X	22 k	½ w				302-223
R167B	101-495X	20 k	2 w	Var.		V118 Bias Adj.	311-018
R167C	101-495X	220 k	½ w				302-224
R167	X496-up	68 k	½ w	Fixed	Prec.	1%	309-042
R168	101-495X	1 k	½ w				302-102
R169		120 k	½ w				302-124
R170	101-495X	1 k	½ w				302-102
R171A	101-495X	68 k	½ w				302-683
R171B	101-495X	50 k	2 w	Var.		V118 Screen Adj.	311-023
R171C	101-495X	120 k	1 w				304-124
R171	X496-up	370 k	½ w	Fixed	Prec.	1%	309-055
R172	101-759	150 k	½ w				Use 302-184
	760-up	180 k	½ w				302-184
R173		1 k	25 w	Fixed	WW	5%	308-038
R174		47 Ω	½ w				302-470
R175A		2 meg	2 w	Var.		Unblank Adj.	311-042
R175B		3.3 meg	½ w				302-335
R176		22 k	½ w				302-223
R177		15 k	2 w				306-153
R179A	101-199	820 k	½ w				Use 302-125
	200-545	1 meg					Use 302-125
	546-up	1.2 meg	½ w				302-125
R179E		820 k	½ w				302-824
R179F	101-753	220 k	½ w				Use 302-274
	754-up	270 k	½ w				302-274

							Tektronix Part Number
R179G	101-1206	82 k	1 w				304-823
	1207-up	180 k	1 w				304-184
R179I		4.7 k	½ w				302-472
R179J		1.2 k	½ w				302-122
R179K		100 Ω	½ w				302-101
R180E	101-455	4.7 k	1 w				304-472
	456-1562	2.7 k	1 w				304-272
	1563-up	2.7 k	½ w				302-272
R180F	101-455	3.3 k	1 w				304-332
	456-1562	1.8 k	1 w				304-182
	1563-up	1.8 k	½ w				302-182
R180G	101-455	2.2 k	1 w				304-222
	456-1562	1.2 k	1 w				304-122
	1563-up	1.2 k	½ w				302-122
R180H	101-455	1.2 k	1 w				304-122
	456-1562	820 Ω	1 w				304-821
	1563-up	820 Ω	½ w				302-821
R180I	101-455	1 k	1 w				304-102
	456-1562	680 Ω	1 w				304-681
	1563-up	680 Ω	½ w				302-681
R180J	101-455	470 Ω	1 w				304-471
	456-1562	390 Ω	1 w				304-391
	1563-up	390 Ω	½ w				302-391
R181A		100 k	2 w	Var.		—20 μsec/cm Adj..	311-026
R181B	101-476	180 k	2 w				306-184
	477-971	220 k	2 w				306-224
	972-up	270 k	2 w				306-274
R181C		100 k	2 w	Var.		—10 μsec/cm Adj.	311-026
R181D	101-476	180 k	2 w				306-184
	477-971	220 k	2 w				306-224
	972-up	270 k	2 w				306-274
R181E		100 k	2 w	Var.		—5 μsec/cm Adj.	311-026
R181F	101-476	180 k	2 w				306-184
	477-971	220 k	2 w				306-224
	972-up	270 k	2 w				306-274
	X1382-up	2.7 meg	½ w				302-275
R181G		150 k	2 w				306-154
R181H		150 k	2 w				306-154
R181I		39 k	2 w				306-393
R181J		39 k	2 w				306-393
R181K		22 k	2 w				306-223
R181L		22 k	2 w				306-223
R181M		30 k	10 w	Fixed	WW	5%	308-027
R181N		7.5 k	10 w	Fixed	WW	5%	308-022
R181O		4.5 k	20 w	Fixed	WW	5%	308-033
R181P		2.5 mh				See Inductors	
R182		1.2 meg	½ w				302-125
R183A,D		2 x 220 k	2 w	Var.	HORIZ. POS. FULL RANGE		Use 311-031
R183B		150 k	½ w				302-154
R183C		150 k	½ w				302-154
R183D	See R183A						
R184		5.6 meg	½ w				302-565

							Tektronix Part Number
R185		5.6 meg	½ w				302-565
R186		1.2 meg	½ w				302-125
R187A,B		2 x 220 k	2 w	Var.		HORIZ. POS. 1 CENTIMETER	*312-101
R188		500 k	2 w	Var.		Horiz. Pos. Vern. Adj.	311-034
R190	101-1690X	27 k	1 w				304-273
R191		3 k	10 w	Fixed	WW	5%	308-020
R192		470 k	½ w				302-474
R193	X360-up	33 k	2 w				306-333
R194	X496-up	666.6 k	½ w	Fixed	Prec.	1%	309-007
R250	X926-1690	150 k	½ w				302-154
	1691-up	750 k	½ w	Fixed	Prec.	1%	309-010
R251	X926-1690	100 k	½ w				302-104
	1691-up	200 k	½ w	Fixed	Prec.	1%	309-051
R255	X926-up	47 k	1 w				304-473
R256	X926-up	10 k	½ w				302-103
R258	X926-up	2.2 meg	½ w				302-225
R260	X926-up	180 k	½ w				302-184
R261	X926-973	50 k					Use 311-026
	974-up	100 k	2 w	Var.		Duty Cycle Limiter Adj.	311-026
R262	X926-up	100 k	½ w				302-104
R301		180 k	½ w				302-184
R302		1 k	½ w				302-102
R303		1 k	½ w				302-102
R304		47 Ω	½ w				302-470
R305		47 Ω	½ w				302-470
R306		47 Ω	½ w				302-470
R307		330 k	1 w				304-334
R308		1 k	½ w				302-102
R309		1.5 k	½ w				302-152
R310A		2 meg	2 w	Var.		4 KV Adj.	311-042
R310B		3.3 meg	½ w				302-335
R311A	101-517	4 meg	2 w	Var.			Use 311-044
	518-up	5 meg	2 w	Var.		2 KV Adj.	311-044
R311B	101-1181	12 meg	½ w				302-126
	1182-up	10 meg	½ w				302-106
R312		10 k	2 w				306-103
R313		120 k	½ w				302-124
R314		1 k	½ w				302-102
R315		470 Ω	1 w				304-471
R316		82 k	½ w				302-823
R317		3.3 k	½ w				302-332
R318		33 k	½ w				302-333
R320		220 k	½ w				302-224
R321	101-186	680 k	½ w				302-684
	187-up	33 k	½ w				302-333
R322	101-186	1.2 meg	½ w				302-125
	187-up	6.8 meg	½ w				302-685
R324	X2127-up	560 k	½ w				302-564
R325		27 Ω	1 w				304-270
R326		50 Ω	2 w	Var.	WW	SCALE ILLUM.	311-055
R330	X926-up	10 Ω	2 w				306-100
R332	X926-up	10 Ω	½ w				302-100
R334	X926-up	10 Ω	½ w				302-100

							Tektronix Part Number
R336	X926-up	10 Ω	2 w				306-100
R337	X926-up	10 Ω	2 w				306-100
R338	X926-up	10 Ω	1 w				304-100
R339	X926-up	10 Ω	1 w				304-100
R340	X926-up	10 Ω	½ w				302-100
R342	X926-up	10 Ω	½ w				302-100
R400	X725-886	100 Ω	½ w				Use 304-101
	887-up	100 Ω	1 w				304-101
R401		330 k	1 w				304-334
R402		1 meg	½ w				302-105
R403		47 Ω	½ w				302-470
R404		600 k	½ w	Fixed	Prec.	1%	309-004
R405		1 meg	½ w	Fixed	Prec.	1%	309-014
R406		47 k	2 w				306-473
R407		18 k	1 w				304-183
R408		470 k	2 w				306-474
R409		1 meg	½ w				302-105
R410		1 k	½ w				302-102
R411		1 k	½ w				302-102
R412		56 Ω	2 w				306-560
R413		56 Ω	2 w				306-560
R414	101-185	990 k	½ w		Prec.	1%	Use 309-012
	186-up	970 k	½ w	Fixed	Prec.	1%	309-012
R415		500 k	½ w	Fixed	Prec.	1%	309-003
R416		100 k	2 w				306-104
R417		27 k	1 w				304-273
R418		330 k	1 w				304-334
R419		10/2 Ω	2 x 2 w	Two 10 Ω, 2 w resistors in parallel			306-100
R420		100 k	2 w				306-104
R421		1 meg	½ w				302-105
R422		1 k	½ w				302-102
R423		1 k	½ w				302-102
R424		56 Ω	2 w				306-560
R425		56 Ω	2 w				306-560
R426		1 k	½ w				302-102
R427		56 Ω	2 w				306-560
R428		1 k	½ w				302-102
R429		56 Ω	2 w				306-560
R430	101-440	600 k	½ w		Prec.	1%	Use 309-006
	441-up	610 k	½ w	Fixed	Prec.	1%	309-006
R431		666.6 k	½ w	Fixed	Prec.	1%	309-007
R432		39 k	2 w				306-393
R433		18 k	1 w				304-183
R434		100 k	1 w				304-104
R435		1 meg	½ w				302-105
R436		1 k	½ w				302-102
R437		1 k	½ w				302-102
R438		1 k	½ w				302-102
R439		56 Ω	2 w				306-560
R440		56 Ω	2 w				306-560

Resistors *(continued)*

								Tektronix Part Number
R441		1 k	½ w					302-102
R442		56 Ω	2 w					306-560
R443		56 Ω	2 w					306-560
R444		2 x 470 Ω	2 x ½ w	Two 470 Ω ½ w resistors in series				302-471
R445		1 k	½ w					302-102
R446		56 Ω	2 w					306-560
R447		56 Ω	2 w					306-560
R448		200 Ω	20 w	Fixed	WW		5%	308-028
R449		18 k	1 w					304-183
R450		18 k	1 w					304-183
R451		820 k	½ w					302-824
R452		270 k	½ w					302-274
R453		470 k	½ w					302-474
R454		470 k	½ w					302-474
R455		600 k	½ w	Fixed	Prec.		1%	309-004
R456		220 Ω	2 w					306-221
R457		390 k	1 w					304-394
R458		1 meg	½ w					302-105
R459		1 k	½ w					302-102
R460		47 Ω	½ w					302-470
R461		22 k	1 w					304-223
R462		470 k	½ w					302-474
R463A	101-195	150 k	½ w		Prec.		1%	Use 309-092
	196-up	143 k	½ w	Fixed	Prec.		1%	309-092
R463B		10 k	2 w	Var.	WW	Adj. to —250		311-015
R463C	101-195	78 k	½ w		Prec.		1%	Use 309-042
	196-up	68 k	½ w	Fixed	Prec.		1%	309-042
R464		33 k	1 w					304-333
R465		2.7 meg	½ w					302-275
R466		1.5 meg	½ w					302-155
R467		18 k	2 w					306-183
R468		1 k	½ w					302-102
R469		10 Ω	2 w					306-100
R470		10 Ω	2 w	Var.	WW	Reg. Heater Adj.		311-001
R471		100 k	2 w					306-104
R472	X725-886	100 Ω	½ w					Use 304-101
	887-up	100 Ω	1 w					304-101
R473A	X2041-2056X	3 k	10 w		WW		5%	308-020
R473B	X2041-2056X	3 k	10 w		WW		5%	308-020
R473	X2127-up	470 k	½ w					302-474
R474		1 k	½ w					302-102
R475	101-195	1 meg	½ w		Prec.		1%	Use 310-098
	196-up	990 k	1 w	Fixed	Prec.		1%	310-098
R476	X360-up	10 k	10 w	Fixed	WW		5%	Use 308-023
R477	X1280-up	470 k	½ w					302-474
R478	X1901-up	1 meg	½ w					302-105
R479	X1901-up	1 meg	½ w					302-105
R480	X1901-up	1 meg	½ w					302-105
R481	X1901-up	1 meg	½ w					302-105
R482	X1901-up	1 meg	½ w					302-105
R483	X1901-up	1 meg	½ w					302-105
R484	X1901-up	1 meg	½ w					302-105
R485	X1901-up	1 meg	½ w					302-105

Resistors *(continued)*

							Tektronix Part Number
R486	X1901-up	1 meg	½ w				302-105
R487	X1901-up	1 meg	½ w				302-105
R488	X1901-up	1 meg	½ w				302-105
R489	X1901-up	1 meg	½ w				302-105
R490	X1901-up	1 meg	½ w				302-105
R491	X1901-up	1 meg	½ w				302-105
R492	X1901-up	1 meg	½ w				302-105
R493	X1901-up	1 meg	½ w				302-105
R494	X1901-2040	100 Ω	10 w	Fixed	WW	5%	308-153
R494	2041-up	40 Ω	10 w	Fixed	WW	5%	308-012
R495	X1901-2040	100 Ω	10 w	Fixed	WW	5%	308-153
R495	2041-up	40 Ω	10 w	Fixed	WW	5%	308-012
R496	X2057-up	25 Ω	25 w		WW	5%	308-233
R501A-F		470 k	½ w				302-474
R502		170 Ω	½ w			1%	Use 309-404
R503		12 Ω	½ w			Selected Note 1	
R504		170 Ω	½ w			1%	Use 309-404
R505A-G		10 Ω	½ w				302-100
R506		10 Ω	½ w				302-100
R507A		5.6 k	½ w			5%	Use 301-562
R507B		5 k	2 w			VERT. AMPL. ATTEN.	311-011
R507C		15 k	½ w	Selected nominal value		5%	Use 301-153
R507D		680 k	½ w			5%	Use 301-684
R508A-F		470 k	½ w				302-474
R509		170 Ω	½ w			1%	Use 309-404
R510		10 Ω	½ w				302-100
R511		250 Ω	10 w	Fixed	WW	5%	308-014
R512		40 Ω	10 w	Fixed	WW	5%	308-012
R513A-F		10 Ω	½ w				302-100
R514	101-179	120 Ω	½ w				302-121
	180-up	82 Ω	½ w				302-820
R515A		116 Ω	½ w			1%	Use 309-402
R515B		5 Ω	½ w			Selected Note 1	
R517A-G		470 k	½ w				302-474
R518A-G		150 Ω	½ w				302-151
R519A-G		10 Ω	½ w				302-100
R520		121 Ω	½ w			1%	Use 309-403
R521		10 Ω	½ w				302-100
R522		470 k	½ w				302-474
R523		150 Ω	½ w				302-151
R524		5.6 k	1 w				304 562
R525		10 Ω	½ w				302-100
R526A-C		470 k	½ w				302-474
R527A-C		150 Ω	½ w				302-151
R528A-C		10 Ω	½ w				302-100
R529		116 Ω	½ w			1%	Use 309-402
R530		10 Ω	½ w				302-100
R531		121 Ω	½ w			1%	Use 309-403

Note 1: Selected for best amplifier performance.

						Tektronix Part Number
R532		10 Ω	½ w			302-100
R534		10 k	½ w			302-103
R535		10 k	½ w			302-103
R536	X369-up	10 k	½ w			302-103
R537	X369-up	10 k	½ w			302-103
R601A-F		470 k	½ w			302-474
R602A-F		150 Ω	½ w			302-151
R603A-F		10 Ω	½ w			302-100
R604		116 Ω			1%	Use 309-402
R605		10 Ω	½ w			302-100
R606		121 Ω			1%	Use 309-403
R607		10 Ω	½ w			302-100
R608A-F		470 k	½ w			302-474
R609A-F		150 Ω	½ w			302-151
R610A-F		10 Ω	½ w			302-100
R611		116 Ω			1%	Use 309-402
R612		10 Ω	½ w			302-100
R613		121 Ω			1%	Use 309-403
R614		10 Ω	½ w			302-100
R701A-L		470 k	½ w			302-474
R702A-L		150 Ω	½ w			302-151
R703A-L		10 Ω	½ w			302-100
R704		104 Ω	½ w		1%	Use 309-401
R705		10 Ω	½ w			302-100
R706		4.7 meg	½ w			302-475
R707	101-1919	205 Ω				Use *050-025
R707	1920-up	Checked		Selected	½%	*312-601
R708		10 Ω	½ w			302-100
R709A-L		470 k	½ w			302-474
R710A-L		150 Ω	½ w			302-151
R711		104 Ω	½ w		1%	Use 309-401
R712		10 Ω	½ w			302-100
R713		4.7 meg	½ w			302-475
R714	101-1919	205 Ω			Selected with R707	
R714	1920-up	Checked			½% Selected with R707	
R715		10 Ω	½ w			302-100
R716A		220 k	2 w	Var.	VERT. POSITION	Use 311-031
R716B		220 k	2 w	Var.	VERT. POSITION	Use 311-031
R717		330 k	½ w			302-334
R718		330 k	½ w			302-334
R719A-L		10 Ω	½ w			302-100
R720†	101-2068	47 Ω	½ w			
R720†	2069-up	10 Ω	½ w			
R721††	101-2068	470 Ω	½ w			
R721††	2069-up	10 Ω	½ w			
R801A		100 k	2 w	Var.	TRIG. RATE GEN. (CYCLES/SEC)	*312-102
R801B		20 k	2 w	Var.	L.F. Trigger Rate	311-018
R802	101-1376	680 k	½ w			302-684
	1377-up	820 k	½ w		5%	301-824
R803		82 Ω	½ w			302-820
R804		100 Ω	½ w			302-101

†Sub-Part of L705

††Sub-Part of L707

						Tektronix Part Number
R805		47 k	1 w			304-473
R806A		100 k	½ w			302-104
R806B		500 k	2 w	Var.	H.F. Trigger Rate	311-034
R806C		220 k	½ w			302-224
R807		47 k	1 w			304-473
R808		180 k	1 w			304-184
R809		27 k	1 w			304-273
R810		470 k	½ w		—10+0%	*312-584
R811		1.5 meg	½ w	Nominal Value		Use 302-155
R812		22 k	2 w			306-223
R813		10 k	½ w			302-103
R814		100 k	½ w			302-104
R815		100 k	½ w			302-104
R816		10 k	2 w			306-103
R817		4.7 k	1 w			304-472
R818		33 k	½ w			302-333
R819		220 k	½ w			302-224
R820		68 Ω	½ w			302-680
R821		470 Ω	½ w			302-471
R822		10 Ω	½ w			302-100
R823		10 k	2 w			306-103
R825		150 k	½ w			302-154
R826		180 k	½ w			302-184
R827	101-925X	220 k	½ w			302-224
R828		220 k	½ w			302-224
R829		.5 meg	2 w	Var.	ASTIGMATISM	Use 311-034
R830		330 k	½ w			302-334
R831		1 k	½ w			302-102
R832		100 k	½ w			302-104
R833		3.3 meg	2 w			306-335
R834	101-925	2.7 meg	2 w			306-275
	926-up	3.3 meg	2 w			306-335
R835		3.3 meg	2 w			306-335
R836		2 meg	2 w	Var.	FOCUS	Use 311-042
R837	101-925	3.3 meg	2 w			306-335
	926-up	1.5 meg	2 w			306-155
R838		2 meg	2 w	Var.	Max. Intensity Adj.	Use 311-042
R839		1 meg	2 w	Var.	INTENSITY	Use 311-039
R840		2.2 meg	½ w			302-225
R841		22 k	½ w			302-223
R842	X926-up	2 meg	2 w	Var.	Geom. Adj.	311-042
R845	101-1900	10 Ω	1 w			304-100
R845	1901-1962	12 Ω	½ w			302-120
R845	1963-up	22 Ω	½ w	Selected nominal value		302-220
R846	X435-1900	10 Ω	1 w			304-100
R846	1901-up	15 Ω	½ w			302-150
R851	X926-up	2 meg	2 w	Var.	Vert. Scan. Adj.	311-042
R901		10 k	½ w			302-103
R902	101-997	150 k	½ w			302-154
	998-up	220 k	½ w			302-224
R903	101-997	150 k	½ w			302-154
	998-up	220 k	½ w			302-224

Resistors *(continued)*

							Tektronix Part Number
R904		10 k	10 w	Fixed	WW	5%	308-023
R905		10 k	½ w				302-103
R906		27 k	½ w				302-273
R907A		100 k	2 w	Var.		Cal. Adj.	311-026
R907B		390 k	½ w				302-394
R907C		82 k	½ w				302-823
R908		470 k	½ w				302-474
R909		47 Ω	½ w				302-470
R910		5 k	3 w	Var.	WW	CAL. VOLTAGE	311-013
R911		47 Ω	½ w				302-470
R912		180 Ω	1 w				304-181
R913		470 k	½ w				302-474
R914		100 k	½ w				302-104
R915		47 k	1 w				304-473
R916		47 Ω	½ w				302-470
R917A		700 Ω	½ w	Fixed	Prec.	1%	309-083
R917B		200 Ω	½ w	Fixed	Prec.	1%	309-073
R917C		70 Ω	½ w	Fixed	Prec.	1%	309-069
R917D		20 Ω	½ w	Fixed	Prec.	1%	309-064
R917E		7 Ω	½ w	Fixed	Prec.	1%	309-061
R917F		3 Ω	½ w	Fixed	Prec.	1%	Use 309-059
R918		47 k/2	2 x 2 w				(2) 306-473
R919	101-299	47 k	1 w				304-473
	300-up	47 k	½ w				302-473

Switches

			Wired	Unwired
SW90	X1691-up	Toggle NORMAL-SINGLE SWEEP		260-134
SW91	X1691-up	Pushbutton RESET		260-016
SW101		Rotary TRIGGER SELECTOR		*260-001
SW102		Rotary SENSITIVITY, 12 KV		*260-085
SW103	101-1961	Rotary SWEEP TIME/CM	050-051	*260-055
SW103	1962-up	Rotary SWEEP TIME/CM	*262-437	*260-055
SW302		Toggle H.V. Oscillator		260-014
SW401		Toggle DC POWER		260-199
SW402		Toggle AC POWER		260-199
SW801		Rotary TRIG. RATE GEN. MULT.	*262-043	*260-037
SW802		Rotary SENSITIVITY, 24 KV		*260-018
SW901		Rotary CAL. RANGE	*262-044	*260-021
TK401	X1740-up	Thermal Cutout 137°F. ±5°		260-120
TK402	X1740-up	Thermal Cutout 137°F. ±5°		260-120

Transformers

T401	Ext. Power Supply, plate	*120-028
T402	Ext. Power Supply, filaments and heaters	*120-027
T801	Blocking Oscillator	*120-035
T901	Indicator Unit Heaters	Use *120-029

					Tektronix Part Number
V83	X1691-up	12BH7			154-046
V90	X1691-up	2D21			154-171
V101		6J6			154-032
V102		6AK5	Selected		157-002
V103		6AK5	Selected		157-002
V104		6AK5	Selected		157-002
V105		6AK5			154-014
V106		6AK5			154-014
V107		6AK5			154-014
V108		6AG7			154-012
V109		6AG7			154-012
V110	101-691	6J6			Use 154-035
	692-up	6X4			154-035
V111		6AG7			154-012
V112		6AG7			154-012
V113		6AG7			154-012
V114		6X4			154-035
V115	101-560	6J6 or 12A4		Modification Kit	*040-053
V116		6J6 or 12A4			
V117		6J6 or 12A4			
V115	561-up	12BH7			154-046
V116	561-up	12BH7			154-046
V117	561-up	12BH7			154-046
V118		6AG7			154-012
V118.1	101-495X	12AU7			154-041
V119		6AG7			154-012
V120		6AG7			154-012
V121		6AG7			154-012
V122		6AS5			154-018
V123		6J6			154-032
V124		6J6			154-032
V125		12AU7			154-041
V126		6BH6			154-026
V127		12AU7			154-041
V128		12AU7			154-041
V129		12AU7			154-041
V130		12AU7			154-041
V131		6J6			154-032
V132		6J6			154-032
V133		6AL5			154-016
V134		12AU7			154-041
V135		6J6			154-032
V136		12AU7			154-041
V137	X496-up	12AU7			154-041
V138	101-495	1N34A			Use 152-008
	496-up	6AL5			154-016
V255	X926-up	6AN8			154-078
V301		6AU5			154-021
V302		12AU7			154-041
V303		6AU5			154-021
V304		6AQ5			154-017

			Tektronix Part Number
V305		6C4	154-029
V306		6AU5	154-021
V401		6X4	154-035
V402		6AU5	154-021
V403		6AU5	154-022
V404		5R4GY	154-007
V405		6AS7	154-020
V406		6AU6	154-022
V407		6X4	154-035
V408		6X4	154-035
V409		6AS7	154-020
V410		6AS7	154-020
V411		6AU6	154-022
V412		6AS7	154-020
V413		6AS7	154-020
V414		6AU6	154-022
V415		6X4	154-035
V416		6AU5	154-021
V417		6AU6	154-022
V418		5651	154-052
V419		2AS-15	154-006
V420		6AU5	154-021
V421		6AS7	154-020
V422		12AX7	154-043
V501-6		6AK5 Selected	157-002
V507-12		6AK5 Selected	157-002
V513-19		6CB6 Selected	157-005
V520		6CB6 Selected	157-005
V521-23		6CB6 Selected	157-005
V601-V612		6CB6 Selected	157-005
V701-724		6CB6 Selected	157-005
V859†	101-925	5XP11M CRT	*154-0105-00
	926-up	T0541-11 CRT	*154-105

†SN's 101-925 add *040-0296-00. This kit does not include the CRT. Please indicate the type of CRT phosphor when ordering.

420 and 420A Power Supplies

Capacitors

C201		.0047 μf	PT	6000 v	285-507
C202		.0047 μf	PT	6000 v	285-507
C203		.0047 μf	PT	6000 v	285-507
C204		.0047 μf	PT	6000 v	285-507
C205		.0047 μf	PT	6000 v	285-507
C206		.0047 μf	PT	6000 v	285-507
C207		.0047 μf	PT	6000 v	285-507
C208	101-925X	.0047 μf	PT	6000 v	285-507
	X994-up	.0047 μf	PT	6000 v	285-507
C209	101-925X	.0047 μf	PT	6000 v	285-507
	X994-up	.0047 μf	PT	6000 v	285-507

Capacitors *(continued)*

					Tektronix Part Number
C210	101-925X	.0047 μf	PT	6000 v	285-507
	X994-up	.0047 μf	PT	6000 v	285-507
C211	101-925X	.0047 μf	PT	6000 v	285-507
	X994-up	.0047 μf	PT	6000 v	285-507
C212	101-925X	.015 μf	PT	3000 v	285-513
C213	101-925X	.0047 μf	PT	6000 v	285-507
C214		.0068 μf	PT	5000 v	285-509
C215		.0068 μf	PT	5000 v	285-509
C216		.0068 μf	PT	5000 v	285-509
C217	X926-up	.0068 μf	PT	5000 v	285-509

Resistors

R201		100 meg	2 w	314-005
R202		100 meg	2 w	314-005
R203	101-925	30 meg	2 w	314-003
	926-up	50 meg	2 w	314-004
R204	101-925	10 meg	½ w	302-106
	926-up	50 meg	2 w	314-004
R205	101-925	10 meg	1 w	314-001
	926-up	50 meg	2 w	314-004
R206	101-925	20 meg	2 w	314-002
	926-up	50 meg	2 w	314-004
R207	101-925	10 meg	½ w	302-106
	926-up	1 meg	½ w	302-105
R208	101-925X	20 meg	2 w	314-002
	X994-up	3.3 meg	½ w	302-335
R209	101-925X	10 meg	1 w	314-001
	X994-up	3.3 meg	½ w	302-335
R210	101-925X	10 meg	½ w	302-106
	X994-up	3.3 meg	½ w	302-335
R211	101-925X	30 meg	2 w	314-003
R212		22 meg	½ w	302-226
R213		50 meg	2 w	*312-543
R214		220 k	½ w	302-224
R215	101-925X	1 meg	½ w	302-105

Transformers

T205	CRT Supply	*120-034
T206	CRT voltage rectifier filaments	*120-033

Vacuum Tubes

V201	1X2B	Use *157-079
V202	1X2B	Use *157-079
V203	1X2B	Use *157-079
V204	1X2B	Use *157-079
V205	1X2B	Use *157-079

P170CF Probe and B170V-B170A Attenuators

Capacitors

						Tektronix Part Number
C951	.001 μf	Cer.		500 v	GMV	283-000
C952	.01 μf	Cer.		250 v	GMV	283-005
C953	.01 μf	Cer.		250 v	GMV	283-005
C954	2 x .01 μf	Cer.		250 v	GMV	(2) 283-005
C955-A	.5-5 μμf	Special	Var.			
C956-D	Special*					283-500

*Silvered Mica Disk. Capacitance depends on desired time constant and voltage division ratio. Limits between 2 μμf and 500 μμf, approximately.

Inductors

L995	Special					*108-100
L996	Special					*108-101

Resistors

R951	100 Ω	1/10 w	Fixed	Comp.	20%	307-008
R952	12 meg	½ w	Fixed			307-003
R953	10 Ω	½ w				302-100
R995A	2960 Ω	½ w	Fixed	Prec.	2%	309-031
R995B	1480 Ω	½ w	Fixed	Prec.	2%	309-028
R995C	995 Ω	½ w	Fixed	Prec.	2%	309-085
R995D	513 Ω	½ w	Fixed	Prec.	2%	309-080
R995E	285 Ω	½ w	Fixed	Prec.	2%	309-075
R995F	208 Ω	½ w	Fixed	Prec.	2%	309-074
R995G	208 Ω	½ w	Fixed	Prec.	2%	309-074
R996A	19.6 Ω	½ w	Fixed	Prec.	2%	309-063
R996B	39.5 Ω	½ w	Fixed	Prec.	2%	309-065
R996C	60 Ω	½ w	Fixed	Prec.	2%	309-068
R996D	127 Ω	½ w	Fixed	Prec.	2%	309-070
R996E	317 Ω	½ w	Fixed	Prec.	2%	309-077
R996F	840 Ω	½ w	Fixed	Prec.	2%	309-084
R996G	840 Ω	½ w	Fixed	Prec.	2%	309-084
R997A	2960 Ω	½ w	Fixed	Prec.	2%	309-031
R997B	1480 Ω	½ w	Fixed	Prec.	2%	309-028
R997C	995 Ω	½ w	Fixed	Prec.	2%	309-085
R997D	513 Ω	½ w	Fixed	Prec.	2%	309-080
R997E	285 Ω	½ w	Fixed	Prec.	2%	309-075
R997F	208 Ω	½ w	Fixed	Prec.	2%	309-074
R997G	208 Ω	½ w	Fixed	Prec.	2%	309-074

Switches

					Tektronix Part Number	
					Wired	Unwired
SW995A-G	B170-V	DPDT	toggle	ATTEN.		260-068
SW995A-G	B170-A	DPDT	toggle	ATTEN.		260-014

Electron Tubes

V951	5718	Selected				*157-019

Type 517/517A
Mechanical Parts List

	Tektronix Part Number
ADAPTOR, 3 WIRE TO 2 WIRE SN 1554-up	103-013
ANGLE, BRACE 14 13/16	122-002
ANGLE, BRACE 11 3/4	122-003
BAR, 3/8 x 1/2 x 3 1/2	381-004
BAR, 3/8 x 1/2 x 2 1/4	381-006
BAR, 3/8 x 1/2 x 3 1/2	381-007
BAR, 3/8 x 3/8 x 4	381-008
BAR, 3/8 x 3/8 x 2 3/4	381-009
BAR, 3/8 x 1/2 x 3 17/32	381-010
BAR, 3/8 x 1/2 x 10 9/16	381-011
BAR, 3/8 x 3/8 x 6 1/2	381-013
BAR, 3/8 x 1/2 x 11 15/16	381-018
BAR, 1/4 x 1/4 x 2 1/8	381-021
BAR, 1/4 x 1/4 x 2 3/8 TAPPED 6-32 1 1/4" FROM END	381-022
BAR, 1/4 x 1/4 x 2 3/8 TAPPED 6-32 1" FROM END	381-023
BAR, 1/4 x 1/4 x 4 W/ONE TAPPED HOLE 8-32 TAPPED 6-32 ONE END	381-028
BAR, 1/4 x 1/4 x 4 W/ONE #18 HOLE TAPPED 6-32 ONE END	381-029
BAR, 3/8 x 1/2 x 10 9/16	381-036
BAR, 1/4 x 1/4 x 9/16	381-041
BAR, 1/4 x 1/4 x 11/16	381-042
BASE, 3/4 x 1/4 PLATED	432-004
BLOCK, WOOD DC	391-003
BLOCK, WOOD SP32-16	391-004
BOARD, TERMINAL 5/8 x 2	392-011
BOARD, TERMINAL 1 15/16 x 2 1/32	392-012
BOARD, TERMINAL 31/32 x 4 1/16	392-015
BOARD, TERMINAL 3 x 5 3/8 (BOOTSTRAP)	392-039
BOARD, TERMINAL 3 5/8 x 5 3/8	392-040
BOARD, TERMINAL 5 5/8 x 5 5/8	392-041
BOARD, TERMINAL 1 5/8 x 1 5/16	392-053
BOARD, TERMINAL 13/16 x 31/32	392-054
BOARD, TERMINAL 1 15/16 x 2 1/32	392-055

	Tektronix Part Number
BOARD, TERMINAL 1 7/8 x 2 7/8	392-056
BOARD, TERMINAL 1 5/16 x 3 7/32 W/16 TERMINALS	392-058
BOARD, TERMINAL 1 7/8 x 4 1/16 SN 1691-up	392-061
BOARD, TERMINAL 1 7/8 x 5 3/4	392-064
BOARD, TERMINAL 1 5/16 x 7 5/16	392-066
BOARD, TERMINAL 1 5/16 x 3 5/8 W/18 TERMINALS	392-085
BOARD, TERMINAL 2 3/4 x 4 5/8	392-091
BOARD, TERMINAL 2 1/4 x 4 3/8	392-092
BOLT, SPADE 6-32 x 7/8	214-013
BRACKET, BS8B SWITCH	406-006
BRACKET, BS9 SWITCH W/2 CLIPPED CORNERS	406-007
BRACKET, 2 POT	406-015
BRACKET, 1 x 1 5/16 x 1/2	406-020
BRACKET, POT 1 x 1 21/32 x 1/2	406-023
BRACKET, POT 1 x 1 13/32 x 1/2	406-027
BRACKET, INTENSITY	406-073
BRACKET, FOCUS	406-074
BRACKET, SWEEP	406-075
BRACKET, SWEEP OUTPUT "G"	406-077
BRACKET, SWEEP OUTPUT "H"	406-078
BRACKET, SHOCKMOUNT	406-081
BRACKET, GROUND STRAP PLATED	406-086
BRACKET, MOUNTING 2 1/8 x 4 1/2 x 7/16	406-089
BRACKET, F & I MOUNTING	406-094
BRACKET, "J" 2 1/4 x 2 3/4 x 7/16	406-095
BRACKET, RIGHT ANGLE GEOM. & V. SEAM ADJ. POT	406-181
BRACKET, CRT SN 1509-up	406-363
BRACKET, RECTIFIER MOUNTING 1 x 3 x 5/8 SN 101-1900	406-079
BRACKET, RECTIFIER MOUNTING 2 1/8 x 2 3/4 x 1 SN 101-1900	406-080
BRACKET, RECTIFIER MOUNTING SILICON 3 x 3 SN 1901-up	406-507
BRACKET, RECTIFIER MOUNTING 3 x 2 1/8 x 3/4 SN 1901-up	406-612
BUSHING, CERAMIC #10.31	358-001
BUSHING, ALUM. 3/8-32 x 9/16	358-010
BUSHING, BRASS HEX 3/8-32 x 13/32 PLATED	358-029

	Tektronix Part Number
BUSHING, NYLON FOR 5-WAY BINDING POST	358-036
CABINET, INDICATOR SN 101-1894	437-014
CABINET, INDICATOR, BLUE VINYL SN 1895-up	437-055
CABINET,POWER SN 101-1739	437-015
CABINET, POWER SN 1740-1894	437-047
CABINET, POWER, BLUE VINYL SN 1895-up	437-056
CABLE, HARNESS VERT. AMP. #2 PRE-AMP	179-018
CABLE, HARNESS VERT. AMP. #1	179-019
CABLE, HARNESS SWEEP OUTPUT	179-021
CABLE, HARNESS F & I (CRT FILAMENT) 101-1316X	179-022
CABLE, HARNESS H.V. OSC. #1	179-023
CABLE, HARNESS H.V. OSC. #2	179-024
CABLE, HARNESS POT BOARD	179-025
CABLE, HARNESS POWER SN 101-1429	179-017
CABLE, HARNESS POWER SN 1430-1739	179-212
CABLE, HARNESS POWER SN 1740-up	179-358
CABLE, HARNESS SWEEP SN 101-1690	179-020
CABLE, HARNESS SWEEP SN 1691-up	179-339
CABLE, HARNESS INTERCHASSIS SN 101-1739	179-026
CABLE, HARNESS INTERCHASSIS SN 1740-up	179-357
CAP, FUSE	Use 200-582
CHASSIS, DA 2 PLATED	441-042
CHASSIS, DA 3 PLATED	441-044
CHASSIS, DA 1 PLATED	441-043
CHASSIS, H.V.P.	441-045
CHASSIS, O	441-046
CHASSIS, P	441-047
CHASSIS, S	441-048
CLAMP, CABLE $3/16$ PLASTIC	343-002
CLAMP, CABLE $1/4$ PLASTIC	343-003
CLAMP, CABLE $1/2$ PLASTIC	343-006
CLAMP, CABLE $3/4$ PLASTIC	343-008
CLAMP, TUBE BASE $1\,3/8$, $13/32 \times 1\,3/8$ W/1 MOUNTING STRAP	343-012
CLAMP, CABLE $3/8$	343-013

	Part Number Tektronix
CLAMP, STAINLESS STEEL 1/2 MOUNTING RIGHT ANGLE TO CIRCLE SN 101-1657	343-015
CLAMP, 17/32 CRT SOCKET 2 3/16 DIA. W/2 MOUNTING STRAPS	343-022
CLAMP, PLASTIC CABLE 3/8	343-023
CONNECTOR, CABLE TRANSFORMER	131-003
CONNECTOR, CHAS. MOUNT 4 CONT. FEMALE	131-009
CONNECTOR, CHAS. MOUNT 2 CONT. MALE	131-010
CONNECTOR, CHAS. MOUNT 1 CONT. FEMALE	131-012
CONNECTOR,TERMINAL FEED THRU 1 PT.	131-025
CONNECTOR, CABLE END CO5 PLATED	131-028
CONNECTOR, CHAS. MOUNT 16 CONT. MALE PLUG SN 1740-up	131-077
CONNECTOR, CHAS. MOUNT 16 CONT. FEMALE SOCKET SN 1740-up	131-078
CONNECTOR, CHAS. MOUNT 3 COND. MALE W/3 SE6 LUGS SN 101-1844	131-094
CONNECTOR, CABLE ASS'Y	131-111
CONNECTOR, CHAS. MOUNT 3 WIRE MOTOR BASE ASS'Y SN 1885-up	131-150
COUPLING, FIBER	Use 376-003
COUPLING, ALUM. 9/32 "UNIVERSAL"	376-005
COUPLING, INSULATING MOLDED NYLON ASS'Y	376-011
COVER, GRATICULE	Use 200-382
EYELET, TAPERED BARREL	210-601
FAN, 5 1/2" BLADE	369-001
FAN, 10" BLADS, TORRINGTON	Use 369-005
FILTER, LIGHT PLEXI 5" BLUE SN 101-956	378-504
FILTER, LIGHT PLEXI 5" BLUE W/CAM HOLE SN 957-up	378-515
FRAME, LO B 33	426-010
FRAME,LP B 37	426-011
FRAME, RO B 32	426-012
FRAME, RP B 36	426-013
GRATICULE, 5" SN 101-925	331-008
GRATICULE, 5" W/O CAM SN 926-956	331-030
GRATICULE, 5" W/CAM SN 957-up	331-033
GROMMET, RUBBER 1/4	348-002
GROMMET, RUBBER 5/16	348-003
GROMMET, RUBBER 3/8	348-004

	Tektronix Part Number
GROMMET, RUBBER 1/2	348-005
GROMMET, RUBBER 3/4	348-006
HANDLE, PLATED	367-003
HOLDER, NEON BULB SINGLE MOLDED	352-008
HOLDER, FUSE	352-010
KNOB, RAW 1400	366-004
KNOB, RAW 4104	366-007
KNOB, RAW 4108	366-009
KNOB, SMALL REXOLITE .750 x .625 x .250 HOLE	366-025
KNOB, DIAL ASS'Y KN. 380A1 W/S.S. & 88CL.	366-507
LOCKWASHER, INT. #4	210-004
LOCKWASHER, EXT. #6	210-005
LOCKWASHER, INT. #6	210-006
LOCKWASHER, INT. #8	210-008
LOCKWASHER, EXT. #10	210-009
LOCKWASHER, INT. #10	210-010
LOCKWASHER, POT INT. 3/8 x 1/2	210-012
LOCKWASHER, INT. 3/8 x 11/16	210-013
LOCKWASHER, 1/4 x 1/4 SPLIT SPRING	210-016
LOCKWASHER, SHAKEPROOF .472 ID	210-021
LUG, SOLDER SE4	210-201
LUG, SOLDER SE6 W/2 WIRE HOLES	210-202
LUG, SOLDER SE6 LONG	210-203
LUG, SOLDER DE6	210-204
LUG, SOLDER SE10, LONG	210-206
LUG, SOLDER POT PLAIN	210-207
MOTOR, 34 W, 1500 RPM, 115 V	147-001
MOTOR, PAINTED, DRILLED, TAPPED	147-004
NUT, HEX 4-40 x 3/16	210-406
NUT, HEX 6-32 x 1/4	210-407
NUT, HEX 8-32 x 5/16	210-409
NUT, HEX 1/4-20 x 7/16	210-411
NUT, HEX 3/8-32 x 1/2	210-413
NUT, HEX 15/32-32 x 9/16	210-414

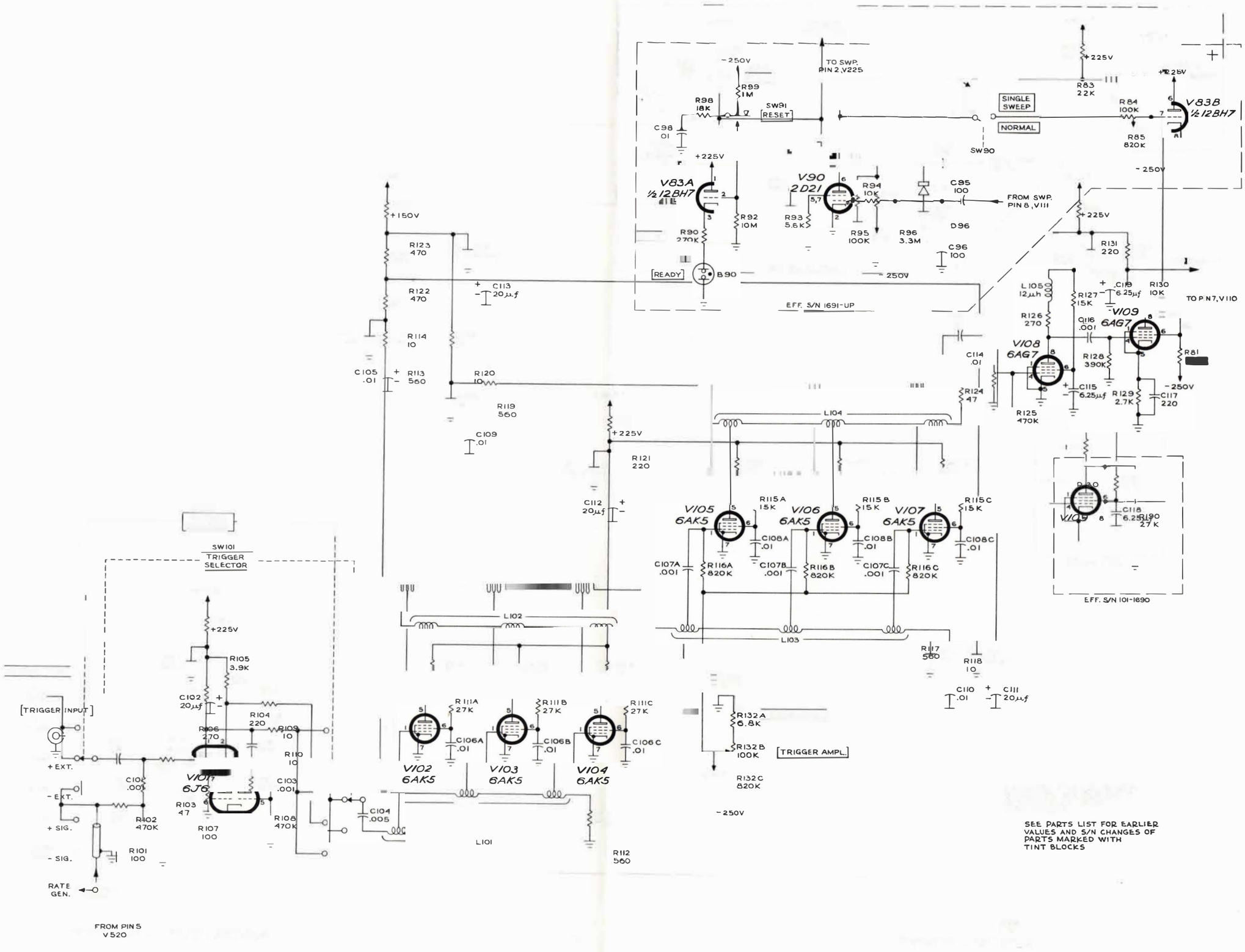
	Tektronix Part Number
NUT, HEX 5/16-24 x 9/16	210-417
NUT, KNURLED GRATICULE	210-424
NUT, HEX 10-32 x 3/8 x 1/8	210-445
NUT, KEPS 6-32 x 5/16	210-457
NUT, KEPS 8-32 x 11/16	210-458
NUT, SWITCH, 12 SIDED	210-473
NUT, HEX ALUM 8-32 x 1/2 x 23/64	210-462
NUT, HEX 6-32 x 5/16 x .194 5-10 W. RESISTOR MOUNTING	210-478
NUT, HEX 3/8-32 x 1/2 x 11/16	210-494
NUT, SQUARE 10-32 x 3/8	210-501
NUT, ROUND 7/16 x 1/8 BNC ADAPTER TYPE	210-507
NUT, HEX 10-32 x 3/8 x 1/8	210-564
NUT, KEPS STEEL 10-32 x 3/8	220-410
PANEL, FRONT FELIX SN 101-564	333-081
PANEL, FRONT, REVISED SN 565-925	333-082
PANEL, FRONT SCOPE "A" SN 926-1690	333-164
PANEL, FRONT W/SWEEP LOCK OUT CIRCUIT SN 1691-up	333-484
PANEL, FRONT POWER SN 101-925	333-174
PANEL, FRONT POWER "A" SN 926-1739	333-165
PANEL, FRONT POWER "A" SN 1740-up	333-548
PLATE, SUB-PANEL POWER	386-305
PLATE, ACCESS COVER PLEXI	386-310
PLATE, SPACING W/1 ROUND CORNER	386-320
PLATE, 517C	386-321
PLATE, SPACING 3/8 x 1 1/2	386-439
PLATE, SUB-PANEL INDICATOR	386-449
PLATE, CRT SUPPORT FLANGE	386-453
PLATE, CAP. MOUNTING S.S. FOR 517A	386-825
PLATE, PLUG ADAPTER SN 1740-up	386-923
PLATE, THERMO CUT-OUT MOUNTING SN 1740-up	386-936
PLATE, FP 8 1/2 x 14 7/8	387-509
PLATE, CENTER 1 x 11 3/4	387-510
PLATE, TOP 3 3/16 x 11 3/4	387-511
PLUG, 12 PIN CHASSIS MALE SN 101-1739	134-017
POINTER, 5/16 OD x 17/32 LG.	331-018
POINTER, MOLDED	331-021
POST, CONNECTING INSULATED	129-006

	Tektronix Part Number
POST, BINDING 5-WAY STEM & CAP ASS'Y (FLUTED)	129-036
RING, FAN SHIELD	354-007
RING, FAN	354-008
RING, LOCKING SWITCH	354-055
RING, ROTATING NYLON W/HANDLE	354-066
RING, SECURING SN 1658-up	354-068
ROD, EXT. ALUM. 1/4 x 4 13/16	384-008
ROD, EXT. ALUM. 1/4 x 5 1/16	384-009
ROD, EXT. ALUM. 1/4 x 2 1/4	384-014
ROD, EXT. ALUM. 1/4 x 6 3/4	384-018
ROD, EXT. ALUM. 1/4 x 14 7/8	384-036
ROD, EXT. ALUM. 1/4 x 18 1/16	384-037
ROD, POLY 1/4 x 9/32 TAPPED 4-40 THRU	385-001
ROD, POLY 1/4 x 5/16 TAPPED 4-40 THRU	385-002
ROD, POLY 1/4 x 11/32 TAPPED 4-40 THRU	385-003
ROD, DELRIN 3/8 x 2 1/2 TAPPED 6-32 ONE END	385-005
ROD, NYLON 5/16 x 3/4 TAPPED 6-32 THRU	385-013
ROD, NYLON 5/16 x 1 TAPPED 6-32 THRU	385-016
ROD, BAKELITE 7/16 x 1 3/4 SN 101-1508	385-021
ROD, ALUM. 3/8 x 1 11/16 TAPPED 8-32 BOTH ENDS	385-030
ROD, NYLON 5/16 x 5/8 TAPPED 6-32 THRU W/#18 HOLE	385-033
ROD, NYLON 5/16 x 3/4 TAPPED 6-32 ONE END W/PIN	385-034
ROD, 5/16 x 1 TAPPED 6-32 ONE END W/PIN, NYLON	385-038
ROD, NYLON 5/16 x 1 1/4 TAPPED 6-32 ONE END W/PIN	385-040
ROD, NYLON 5/16 x 1 1/4 TAPPED 6-32 ONE END W/2 PINS	385-041
ROD, NYLON 5/16 x 1 3/4 TAPPED 6-32 BOTH ENDS W/PIN	385-046
ROD, NYLON 5/16 x 1 3/4 TAPPED 6-32 BOTH ENDS	385-060
ROD, ALUM. 1/4 x 1 5/8 TAPPED 6-32 BOTH ENDS	358-091
SCREW, 4-40 x 1/8 BHS	211-005
SCREW, 4-40 x 3/16 BHS	211-007
SCREW, 4-40 x 1/4 BHS	211-008
SCREW, 4-40 x 5/16 BHS	211-011
SCREW, 4-40 x 3/8 RHS	211-013
SCREW, 4-40 x 7/8 RHS	211-018

	Tektronix Part Number
SCREW, 4-40 x 1⅛ RHS	211-020
SCREW, 2-56 x 3/16 RHS	211-022
SCREW, 4-40 x 5/16 PAN HS, W/LOCKWASHER	211-033
SCREW, 2-56 x ½ RHS	211-034
SCREW, 6-32 x ⅛ BHS	211-501
SCREW, 6-32 x 3/16 FHS, 100°	211-502
SCREW, 6-32 x 3/16 BHS	211-503
SCREW, 6-32 x ¼ BHS	211-504
SCREW, 6-32 x 5/16 BHS	211-507
SCREW, 6-32 x ⅜ BHS	211-510
SCREW, 6-32 x ½ BHS	211-511
SCREW, 6-32 x ⅝ BHS	211-513
SCREW, 6-32 x ¾ BHS	211-514
SCREW, 6-32 x ⅞ BHS	211-516
SCREW, 6-32 x 1 BHS	211-517
SCREW, 6-32 x 1¼ RHS	211-520
SCREW, 6-32 x ⅝ FHS, 100°, PHILLIPS	211-522
SCREW, 6-32 x 5/16 PHS, W/LOCKWASHER	211-534
SCREW, 6-32 x 5/16 FHS, 100°, CSK, PHILLIPS	211-538
SCREW, 6-32 x 1½ RHS, PHILLIPS	211-553
SCREW, 6-32 x ⅜ FHS, 100°, CSK, PHILLIPS	211-559
SCREW, 8-32 x ¼ BHS	212-001
SCREW, 8-32 x ¼ FHS, 100°	212-002
SCREW, 8-32 x ¼ THS	212-003
SCREW, 8-32 x 5/16 BHS	212-004
SCREW, 8-32 x ½ BHS	212-008
SCREW, 8-32 x ¾ FHS, 100°	212-011
SCREW, 8-32 x 1¼ FHS, 100°	212-012
SCREW, 8-32 x 2 RHS	212-013
SCREW, 8-32 x 2¼ RHS	212-014
SCREW, 8-32 x 2½ RHS	212-015
SCREW, 8-32 x ⅜ BHS	212-023
SCREW, 8-32 x 1¾ FHS	212-037

	Tektronix Part Number
SCREW, 8-32 x 3/8 FHS, 100°, PHILLIPS	212-040
SCREW, 8-32 x 1/2 FHS, 100°, PHILLIPS	212-043
SCREW, 10-32 x 3/8 BHS	212-507
SCREW, 10-32 x 5/8 BHS	212--509
SCREW, 1/4-20 x 1 1/4 FHS	212-521
SCREW 10-32 x 5 HHS	212-542
SCREW, 10-32 x 3 FHS, 100°, PHILLIPS	212-544
SCREW 10-32 x 4 1/2 HHS	212-546
SCREW, 10-32 x 7/8 RHS	212-548
SCREW, SET 8-32 x 1/8 HSS	213-005
SCREW, SET 8-32 x 3/16 HSS	213-006
SCREW, THREAD CUTTING 4-40 x 3/8 FHS	213-012
SCREW, THREAD CUTTING 8-32 x 1/2 FHS	213-016
SCREW, THREAD CUTTING 6-32 x 3/8 TRUSS HS, PHILLIPS	213-041
SCREW, THREAD CUTTING 5-32 x 3/16 PHS, PHILLIPS	213-044
SCREW, THREAD CUTTING 6-32 x 5/16 FHS, 100°, CSK, PHILLIPS	213-068
SCREW, THREAD FORMING #4 x 1/4 PHS, PHILLIPS	213-088
SHIELD, TUBE 7/8 W/SPRING 1 3/8 HI	337-006
SHIELD, TUBE 7/8 W/SPRING 1 3/4 HI	337-007
SHIELD, CAL. VERT.	337-044
SHIELD, DA1 PRE-AMP PLATED W/RODS	337-045
SHIELD, DRIVER	337-063
SHIELD, CRT	337-110
SHIELD, TUBE 7 PIN 2 1/4 HI	337-128
SHIELD, 5" GRATICULE LIGHT SN 1376-up	337-187
SHOCKMOUNT, RUBBER SOLID SQUARE 1/2 x 9/16 HI	348-016
SOCKET, GRATICULE LAMP	136-001
SOCKET, STM7	136-007
SOCKET, STM7G	136-008
SOCKET, STM7 SHIELDED	136-009
SOCKET, STM8G	136-011
SOCKET, STM8 MOLDED	136-013
SOCKET, STM9	136-014
SOCKET, STM9G	136-015
SOCKET, UP BRACKET 12 (RECT.) CHASSIS FEMALE	136-018
SOCKET, STM14	136-019

	Tektronix Part Number
SOCKET, LIGHT W/GREEN JEWEL	136-027
SOCKET, LIGHT W/CLEAR JEWEL	136-028
SOCKET, TIP JACK BLACK NYLON	136-037
SPACER, NYLON 5/32 FOR CERAMIC STRIP SN 1901-up	361-007
SPACER, NYLON 3/8 FOR CERAMIC STRIP	361-009
STRAP, MOUNTING 1 x 4 5/16 W/214-012	346-002
STRIP, BAKELITE 8 PT.	124-006
STRIP, BAKELITE 9 PT.	124-007
STRIP, FELT 1/16 x 13/16 x 16 7/8 LIGHT BLUE SN 101-1375	124-055
STRIP, CERAMIC 3/4 x 3 NOTCHES CLIP MOUNTED SN 1901-up	124-087
STRIP, CERAMIC 3/4 x 1 NOTCHES CLIP MOUNTED	124-100
TAG, VOLTAGE RATING	334-649
TUBE, CONDUIT BAKELITE 1/4 x 3/8 x 9 3/4 LG.	166-002
TUBE, SPACER ALUM. .196 x 5/16 x 5/16 LG.	166-005
TUBE, SPACER ALUM. .441 x 1/2 x 2 3/8 LG.	166-013
TUBE, SPACER ALUM. .125 x 3/16 x 3/4 LG.	166-026
TUBE, SPACER ALUM. .180 x 1/4 x 1/8 LG.	166-029
TUBE, SPACER ALUM. .180 x 1/4 x 3/16 LG.	166-030
TUBE, SPACER ALUM. .180 x 1/4 x 1/4 LG.	166-031
TUBE, SPACER ALUM. .180 x 1/4 x 7/16 LG.	166-034
TUBE, SPACER, ALUM. .180 x 1/4 x 3/4 LG.	166-038
TUBE, SPACER ALUM. .180 x 1/4 x 1 LG.	166-039
TUBE, SPACER NYLON .144 x 5/16 x 1/2 W/#27 HOLE LENGTHWISE	166-051
TUBE, SPACER ALUM. .245 x 3/8 x 3/4 LG.	166-053
TUBE, SPRING PIN 1/8 x 9/16	166-058
WASHER, STEEL 6S x 5/16	210-802
WASHER, STEEL 6L x 3/8	210-803
WASHER, STEEL 8S x 3/8	210-804
WASHER, STEEL 5/16 x 5/8	210-807
WASHER, BRASS CENTERING RES. 20 W	210-808
WASHER, BRASS CENTERING RES. 25 W	210-809
WASHER, RUBBER WAN 13-20	210-816
WASHER, RUBBER WAN 16-24	210-818
WASHER, ALUM. 1/4 x 1/8	210-829
WASHER, STEEL .390 x 9/16	210-840
WASHER, RUBBER FOR FUSE HOLDER	210-873
WASHER, STEEL FLAT .470 x 21/32	210-902
WASHER, BRASS 1/4 x 7/16 x .050	210-905
WASHER, STEEL, 1/4 x 3/6 x .020	210-940



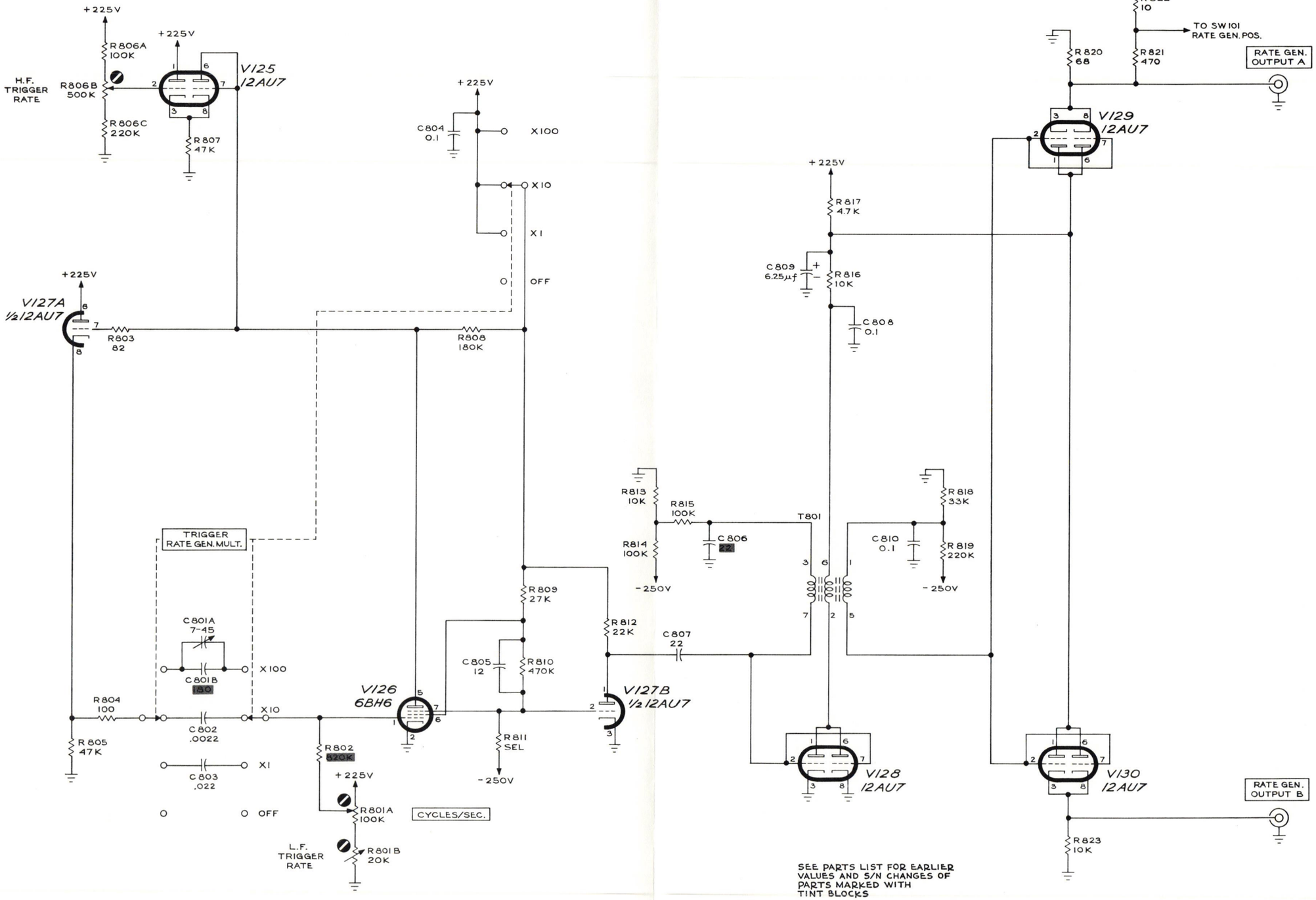
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH TINT BLOCKS

+ TYPE 517A OSCILLOSCOPE

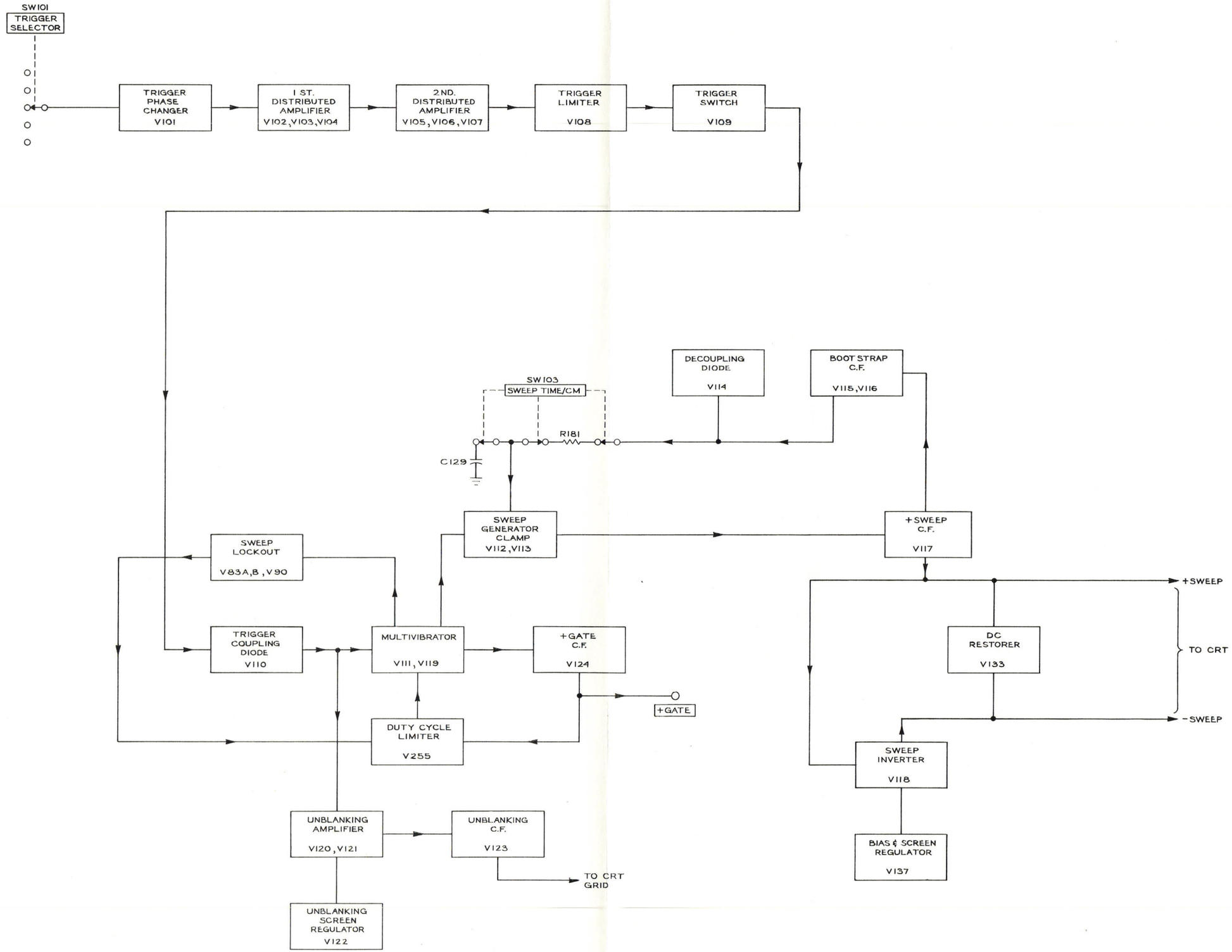
AB1

CMD 363

TRIGGER AMPLIFIER

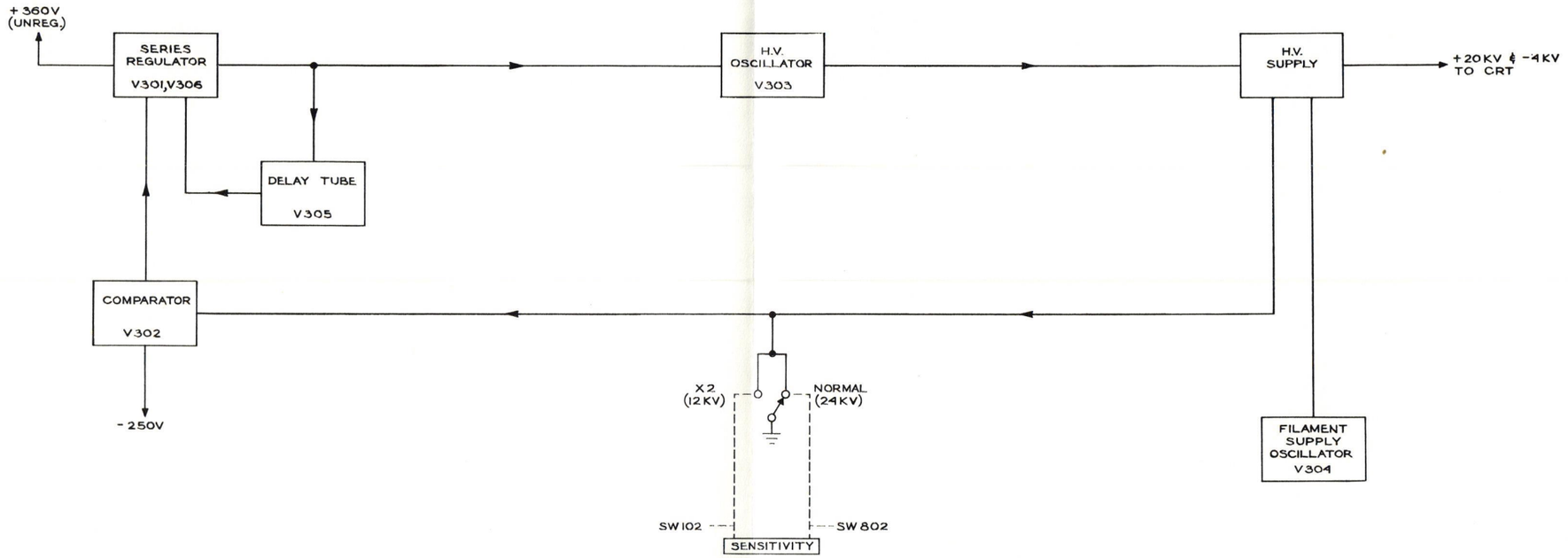


SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH TINT BLOCKS

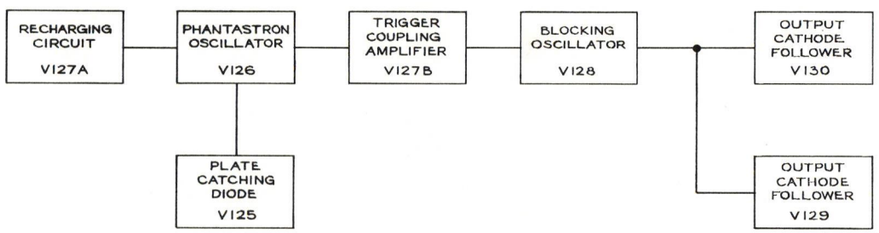


CMD 263

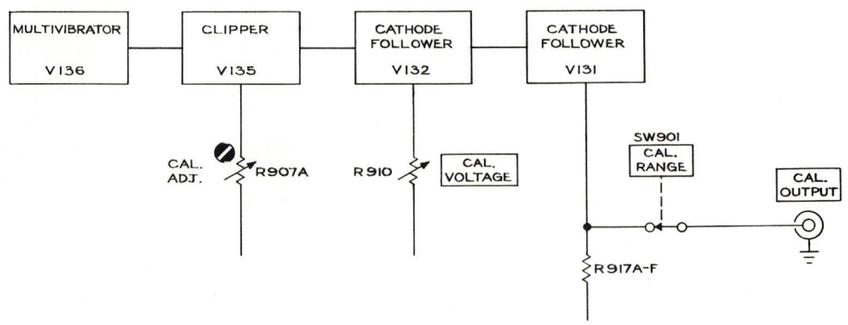
TRIGGER & SWEEP AMPLIFIER BLOCK DIAGRAM



H.V. SUPPLY BLOCK



TRIGGER RATE GENERATOR BLOCK

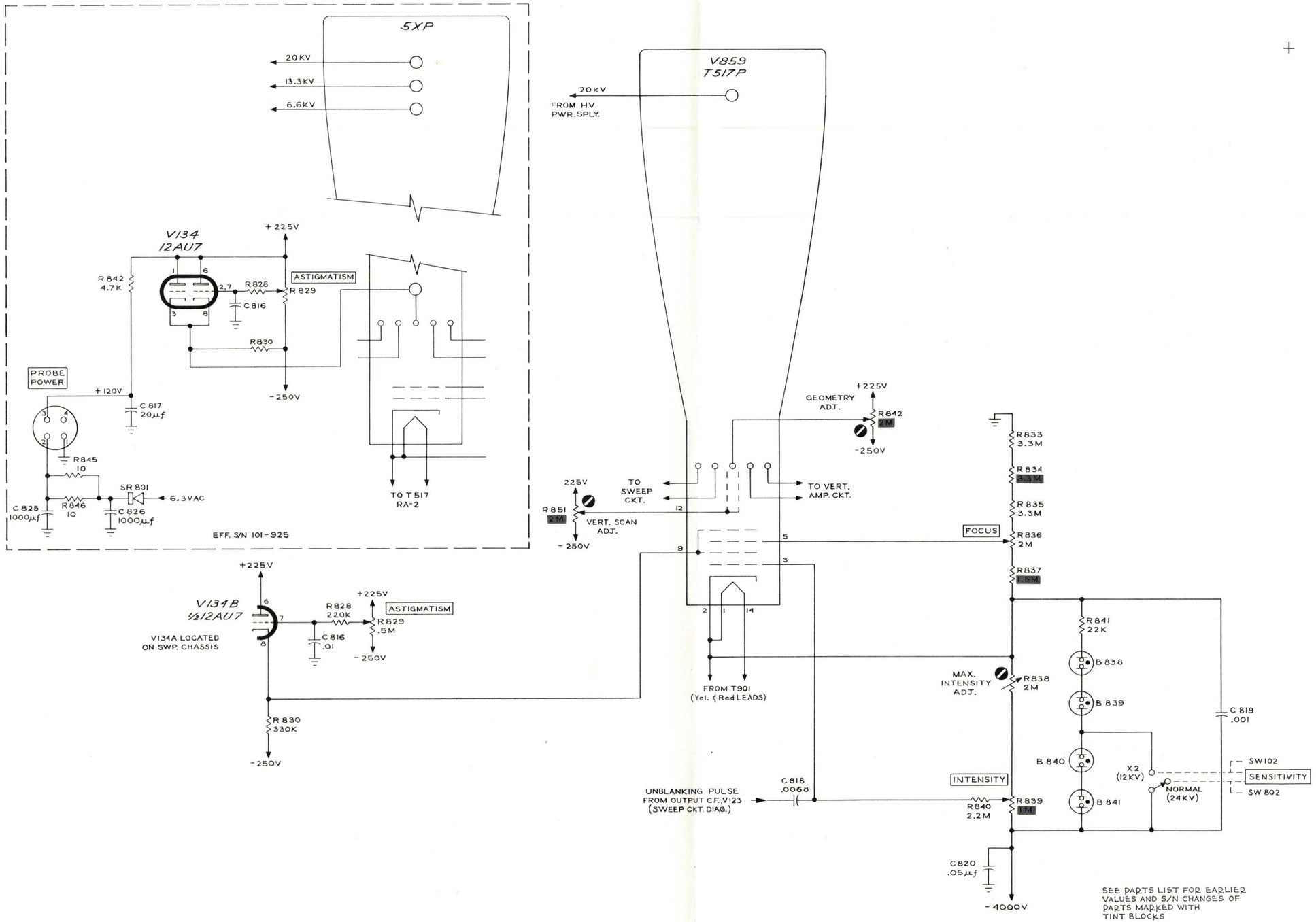


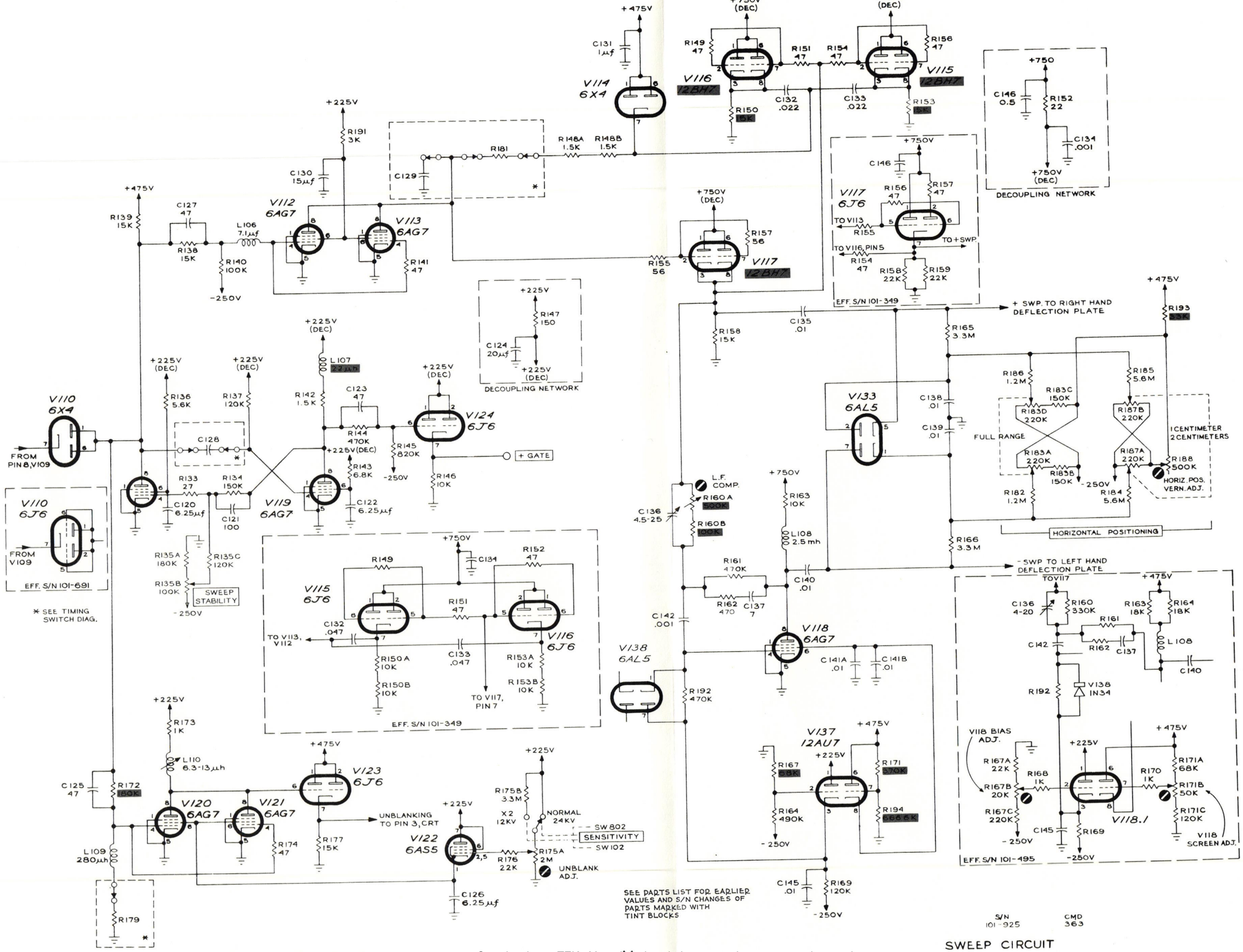
CALIBRATOR BLOCK

CMD
263

CALIBRATOR BLOCK DIAGRAM

H.V. TRIG. GEN.

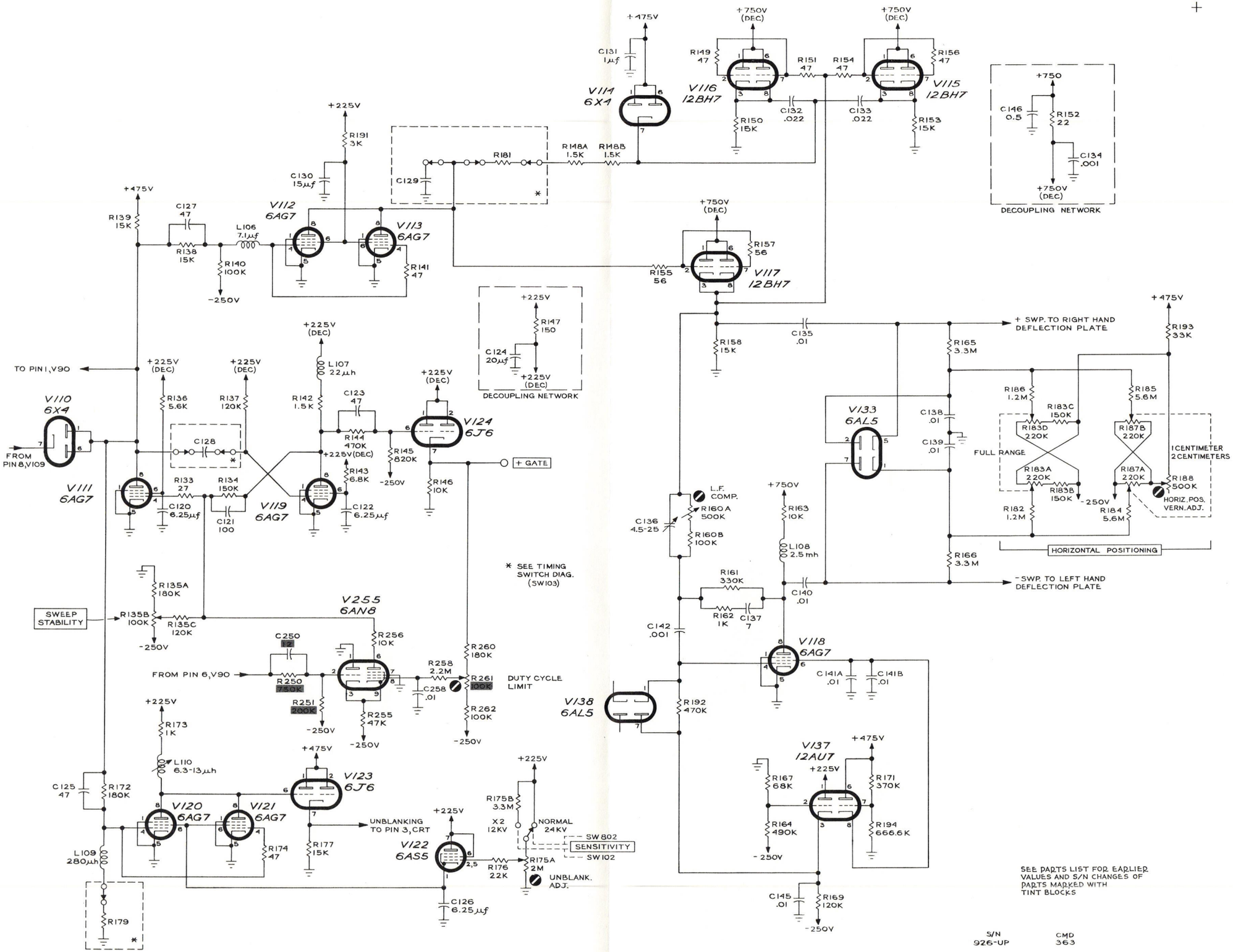




TYPE 517A OSCILLOSCOPE

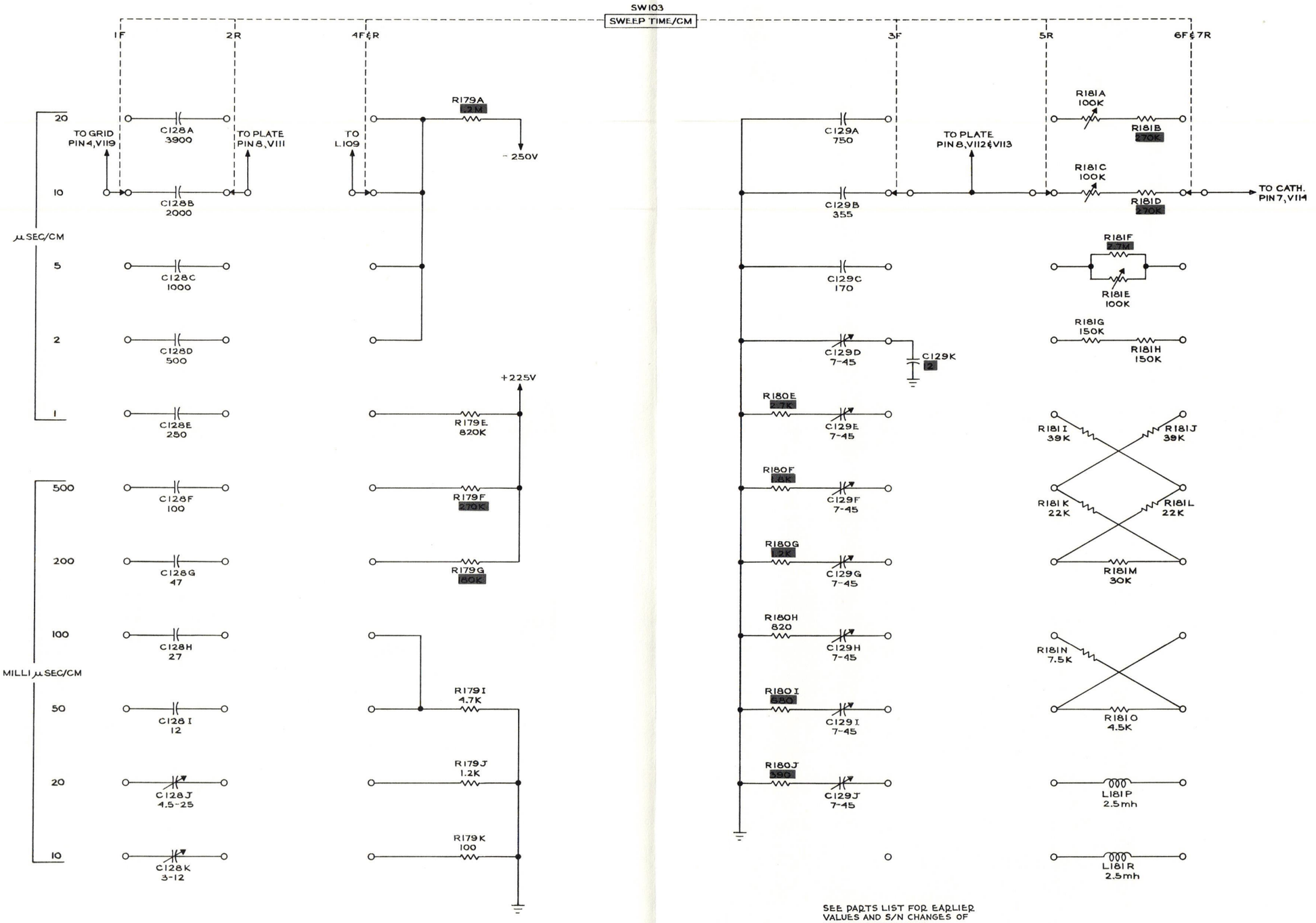
S/N 101-925 CMD 363

SWEEP CIRCUIT

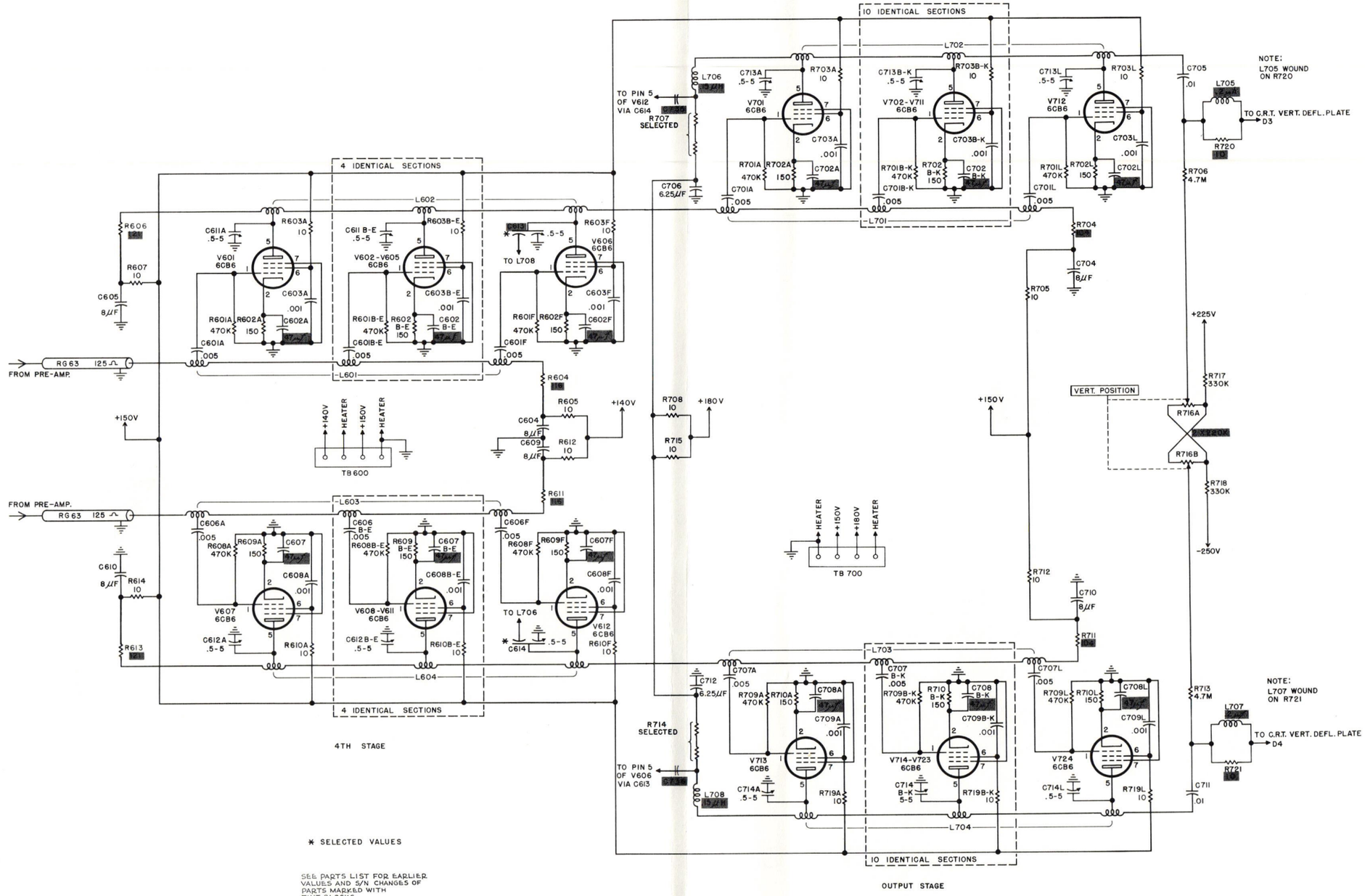


TYPE 517A OSCILLOSCOPE

SWEEP CIRCUIT



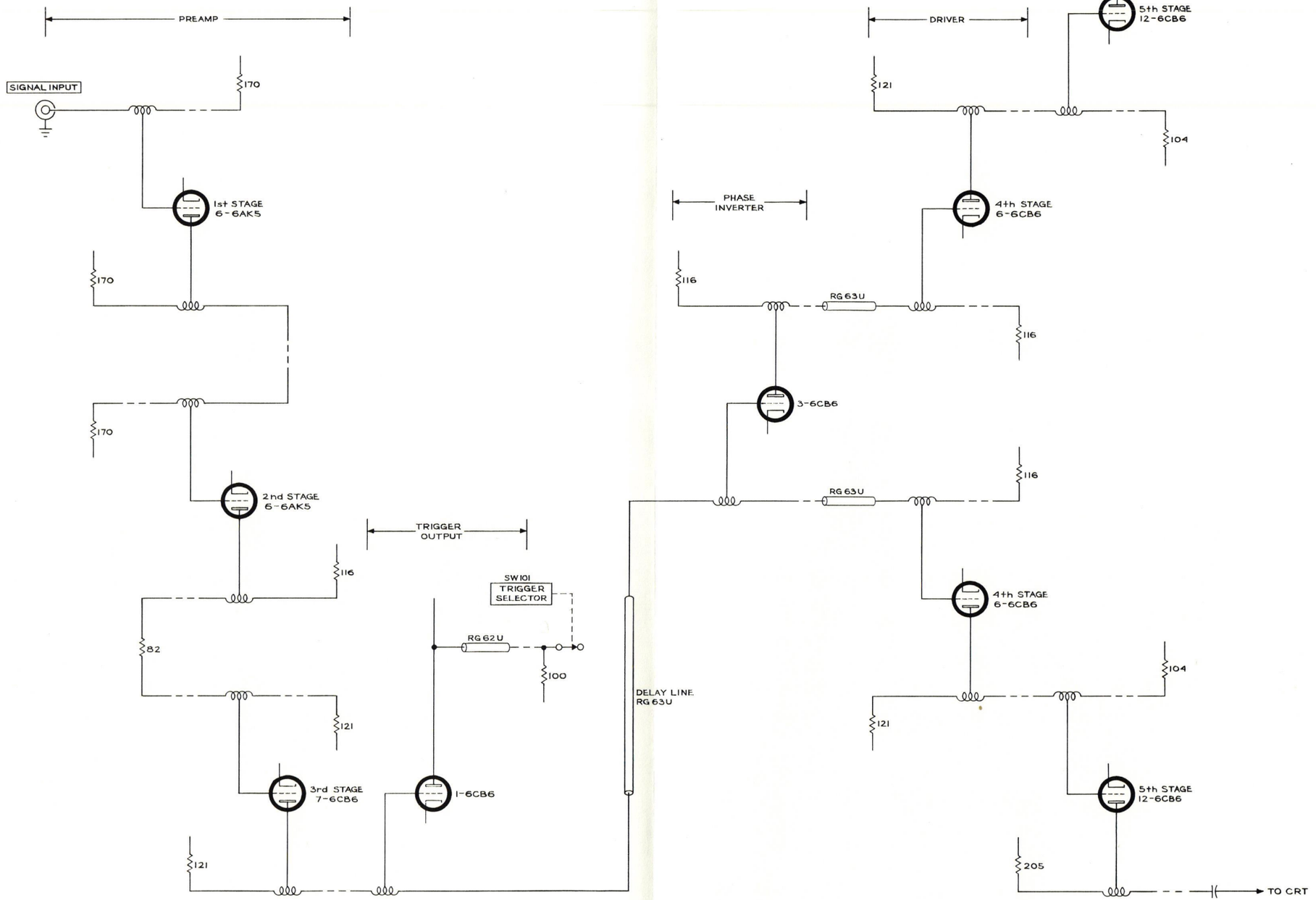
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH TINT BLOCKS



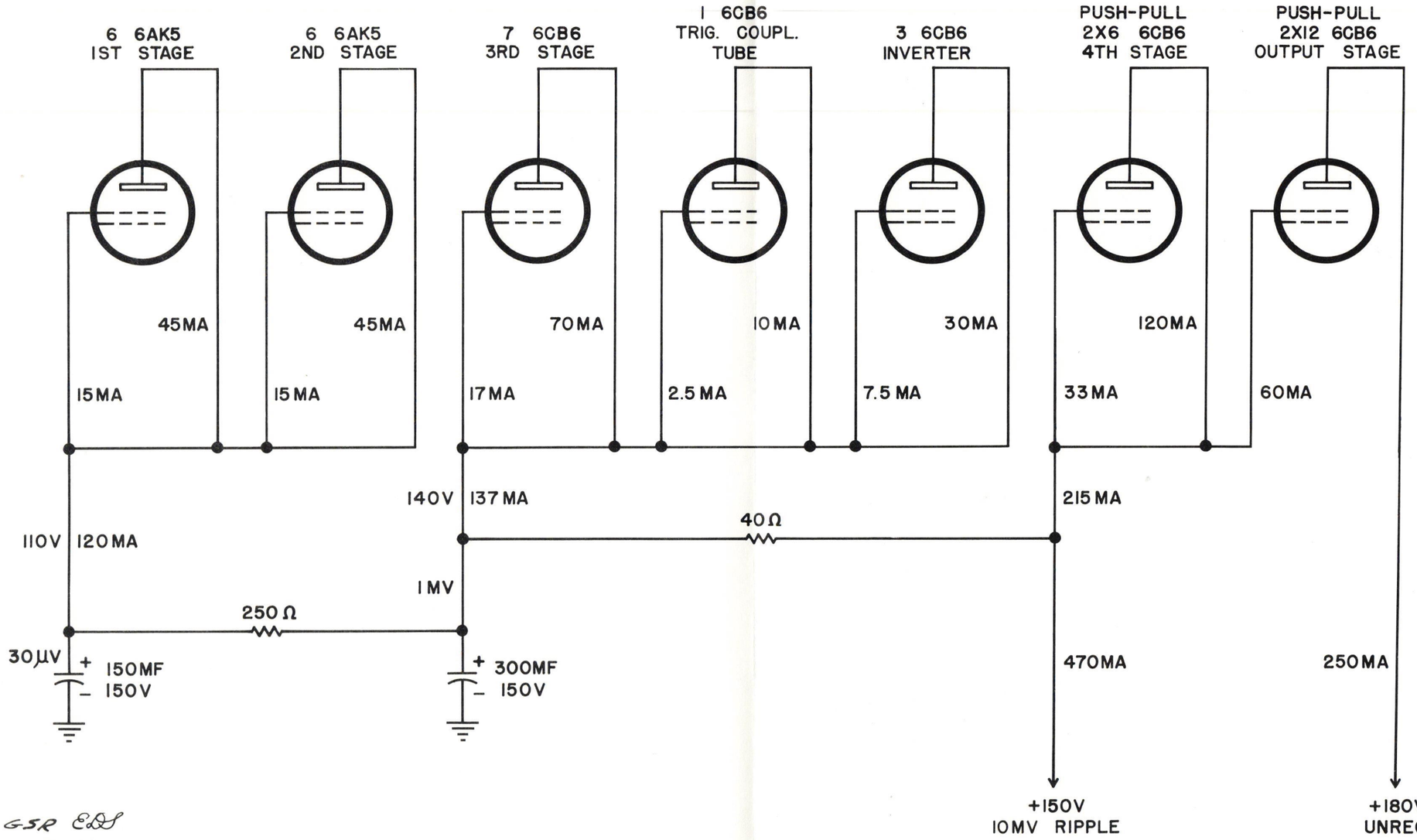
* SELECTED VALUES

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

L.A.P. 1-26-63



CMD
263



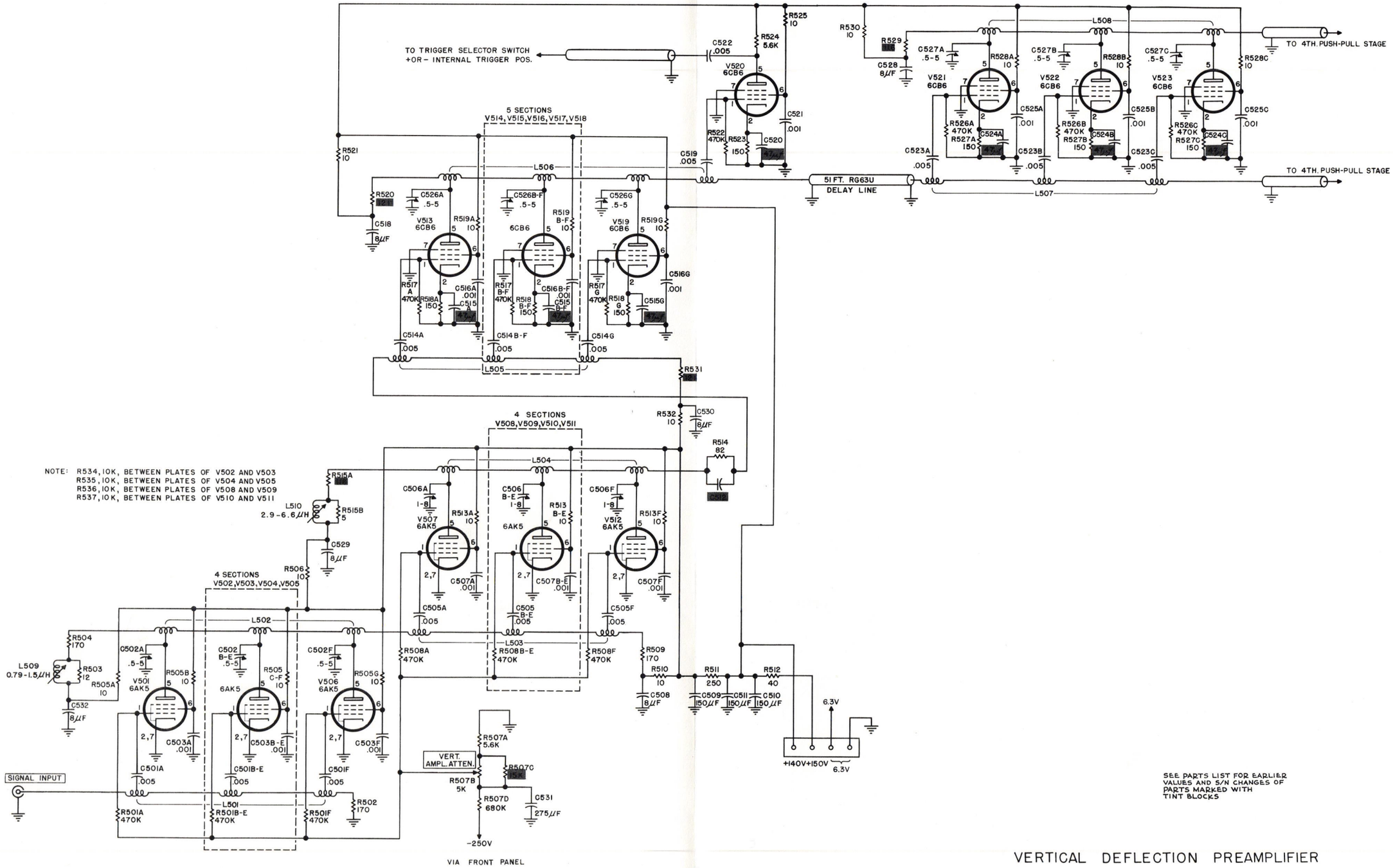
G.S.R. E.D.S.
1-3-63

TYPE 517A CATHODE-RAY OSCILLOSCOPE

AA1

VERTICAL AMPLIFIER, PLATE & SCREEN SUPPLY DISTRIBUTION

VERT. AMPL. PLATE & SCREEN SUPPLY



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

VERTICAL DEFLECTION PREAMPLIFIER

1-26-63

L.I.P. ~ EDS

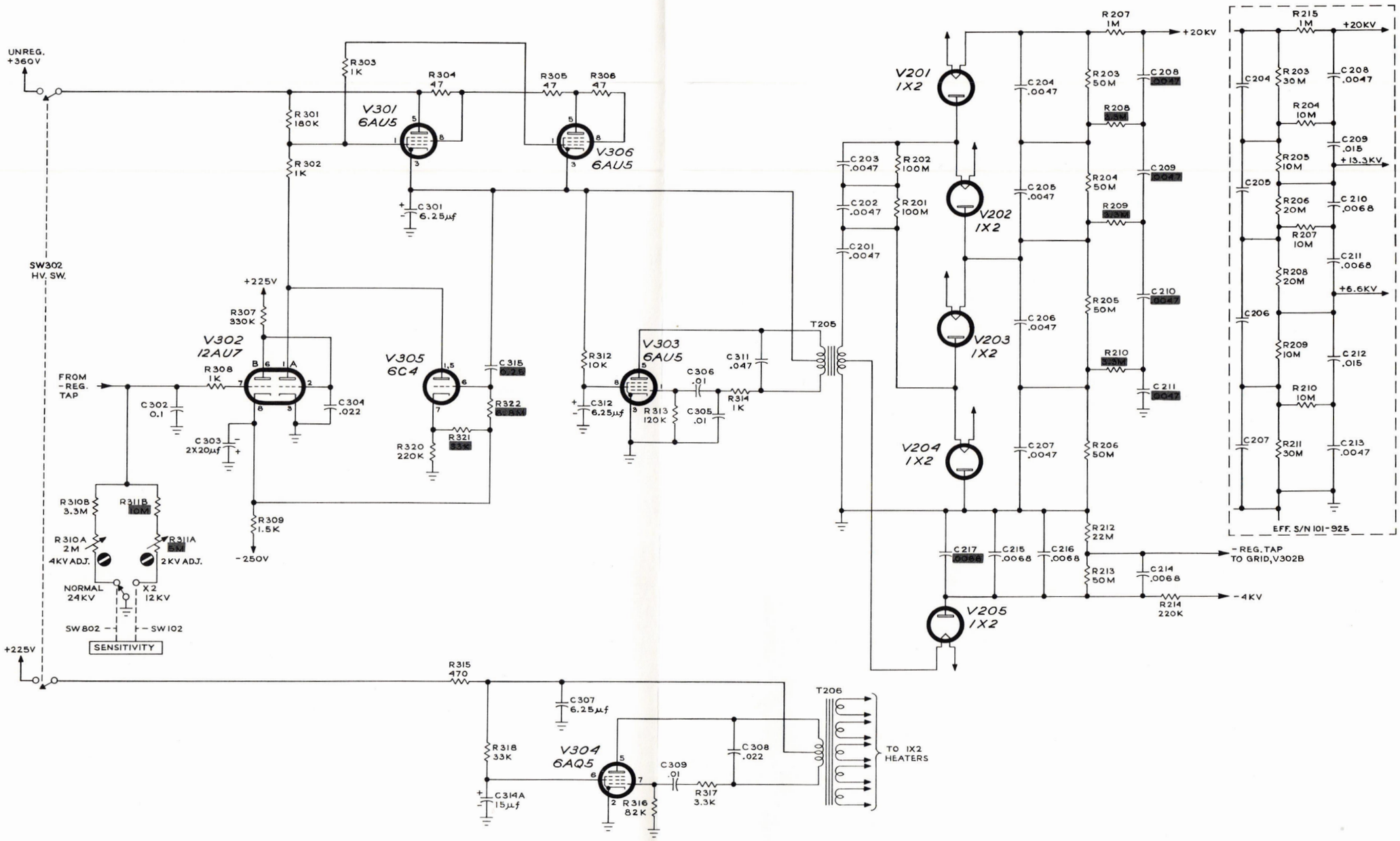
TYPE 517A CATHODE-RAY OSCILLOSCOPE

AD,

VERTICAL DEFLECTION PREAMPLIFIER

FILAMENT SUPPLY & HV OSCILLATORS

420A POWER SUPPLY



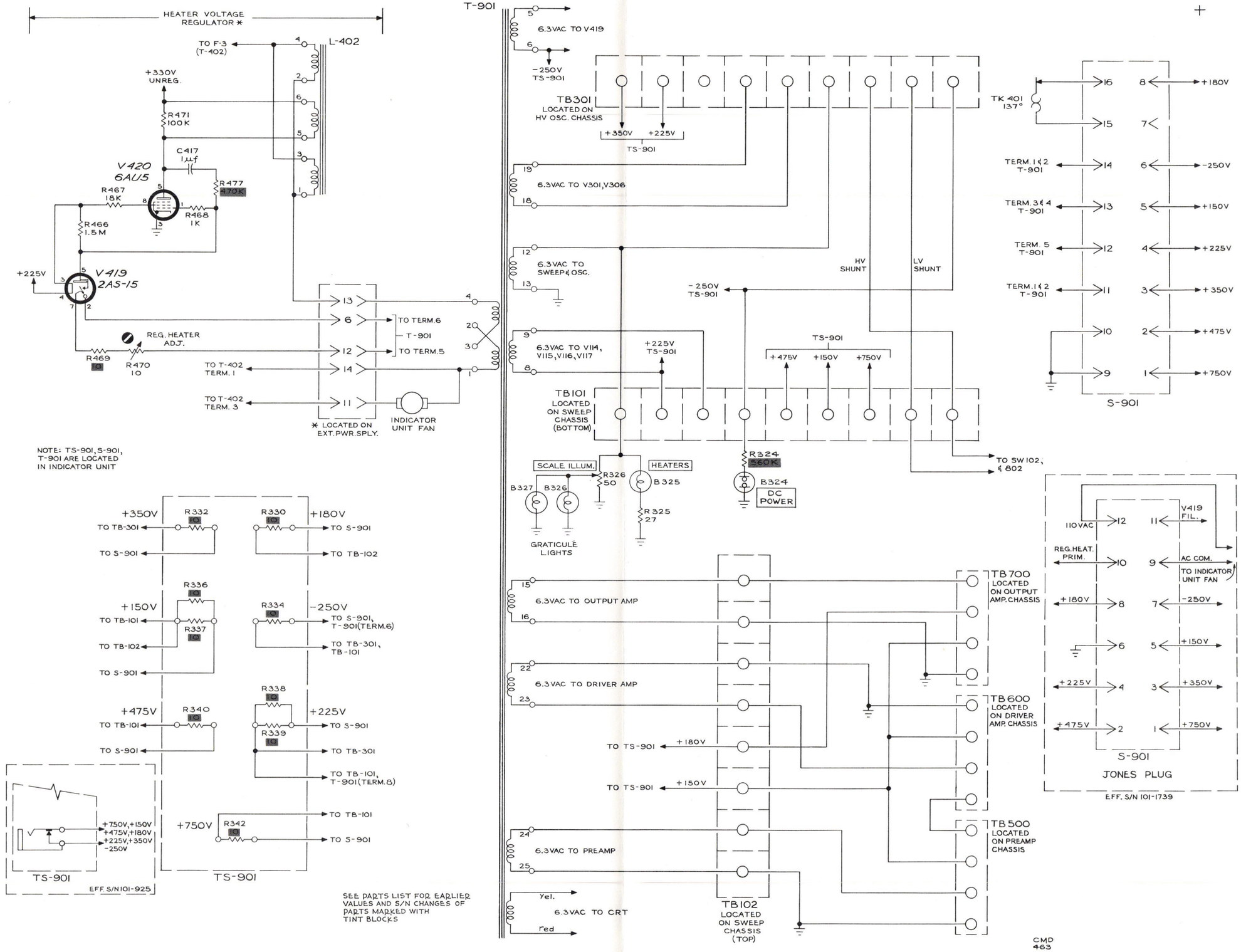
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH TINT BLOCKS

CMD 363

TYPE 517A OSCILLOSCOPE

AA,

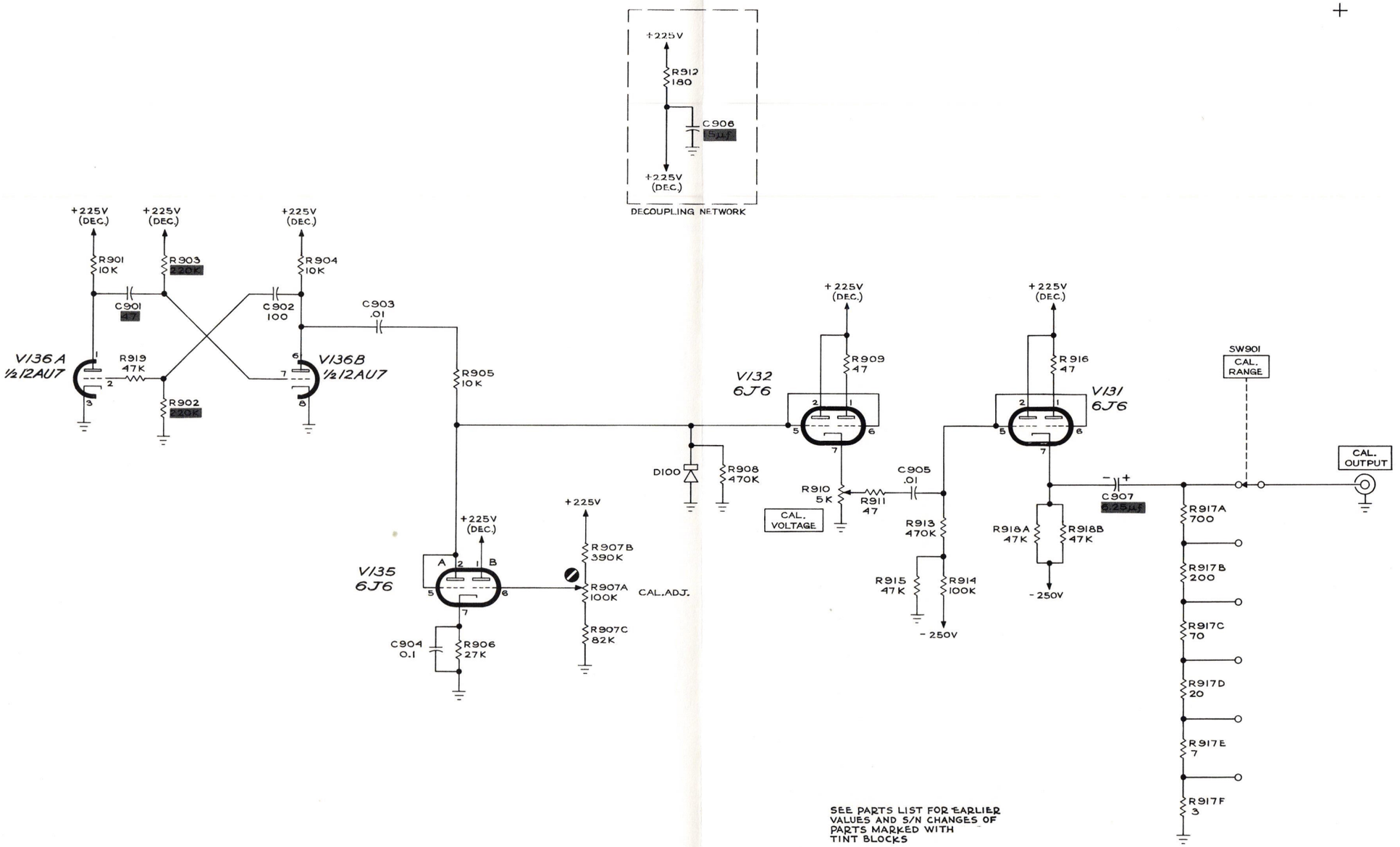
H.V. SUPPLY



TYPE 517A OSCILLOSCOPE

POWER DISTRIBUTION DIAGRAM

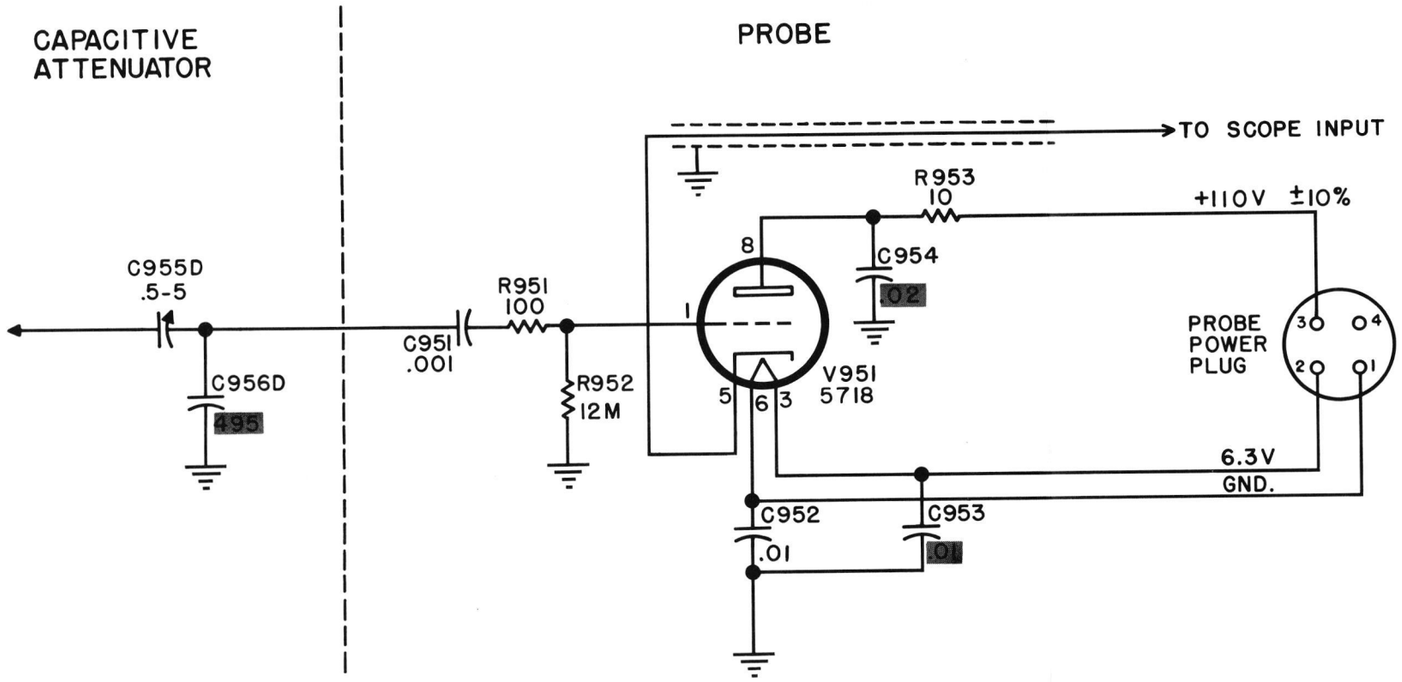
AB

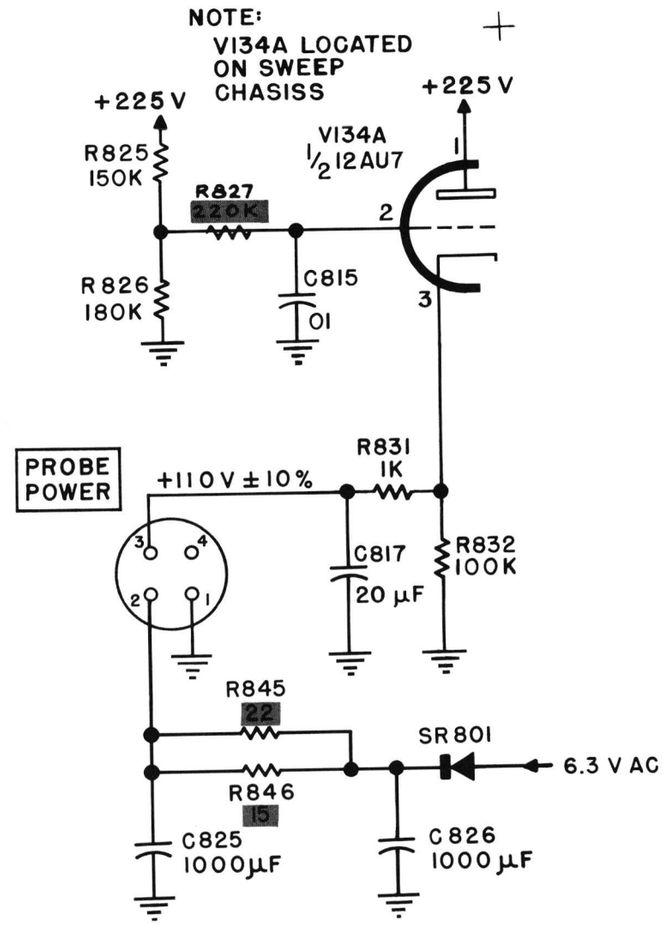


SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH TINT BLOCKS

CMD 263

CALIBRATOR CIRCUIT

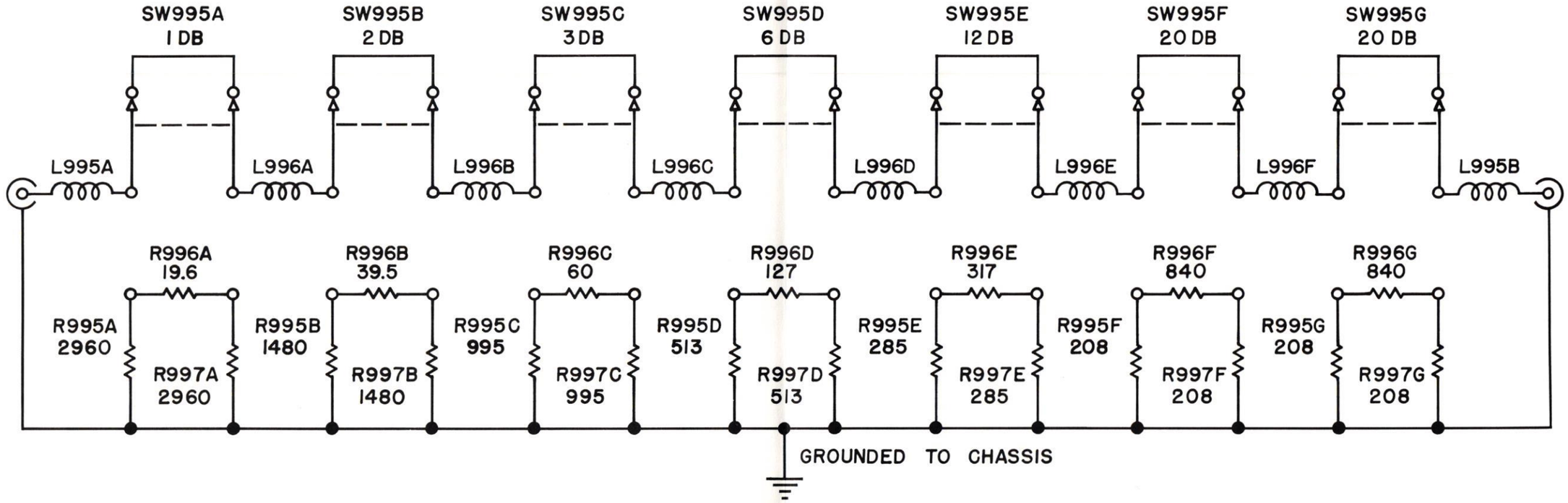




SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH TINT BLOCKS

1-29-63 L.A.P.

PROBE & PROBE POWER



L995: 22 TURNS # 28 BARE COPPER 3/32" FORM, 9/16" LONG.
L996: 17 TURNS # 28 BARE COPPER 3/32" FORM, 7/16" LONG.

G.S.E. EDS
1-10-63

TYPE 517A CATHODE-RAY OSCILLOSCOPE

AA$_1$

TYPE B170-A 170 OHM ATTENUATOR

MANUAL CHANGE INFORMATION

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

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

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ±5 V dc Offset. Has ±5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ±10 V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - ±5 V output	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ±5 V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μs, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

REV. A, OCT 1975

TYPE 517A -- TENT S/N 2184

PARTS LIST CORRECTIONS

CHANGE TO:

C315	285-0700-00	.27 µf	PTM	600V

M9243/1065