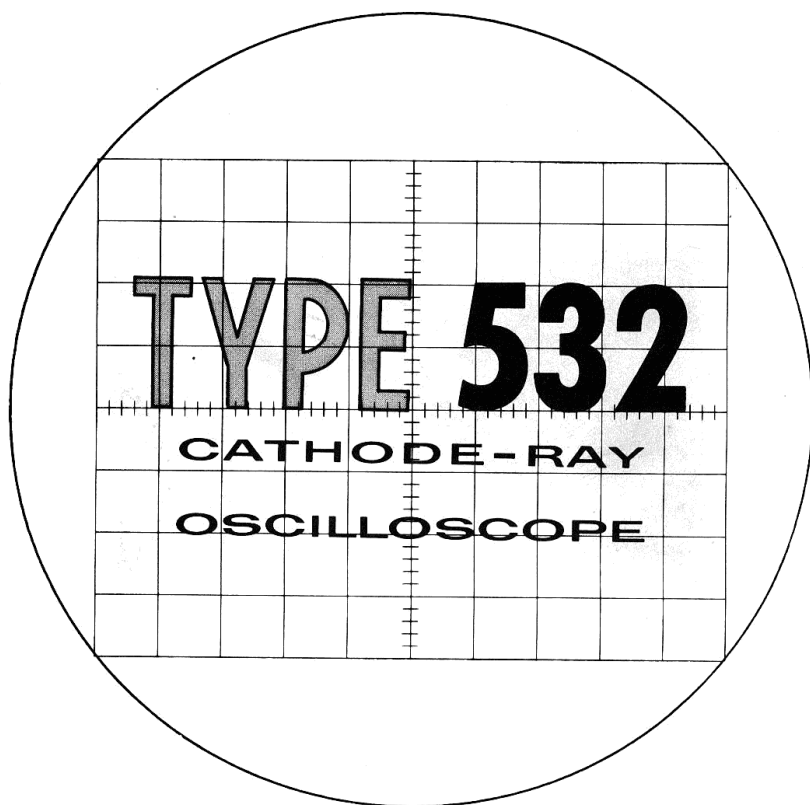
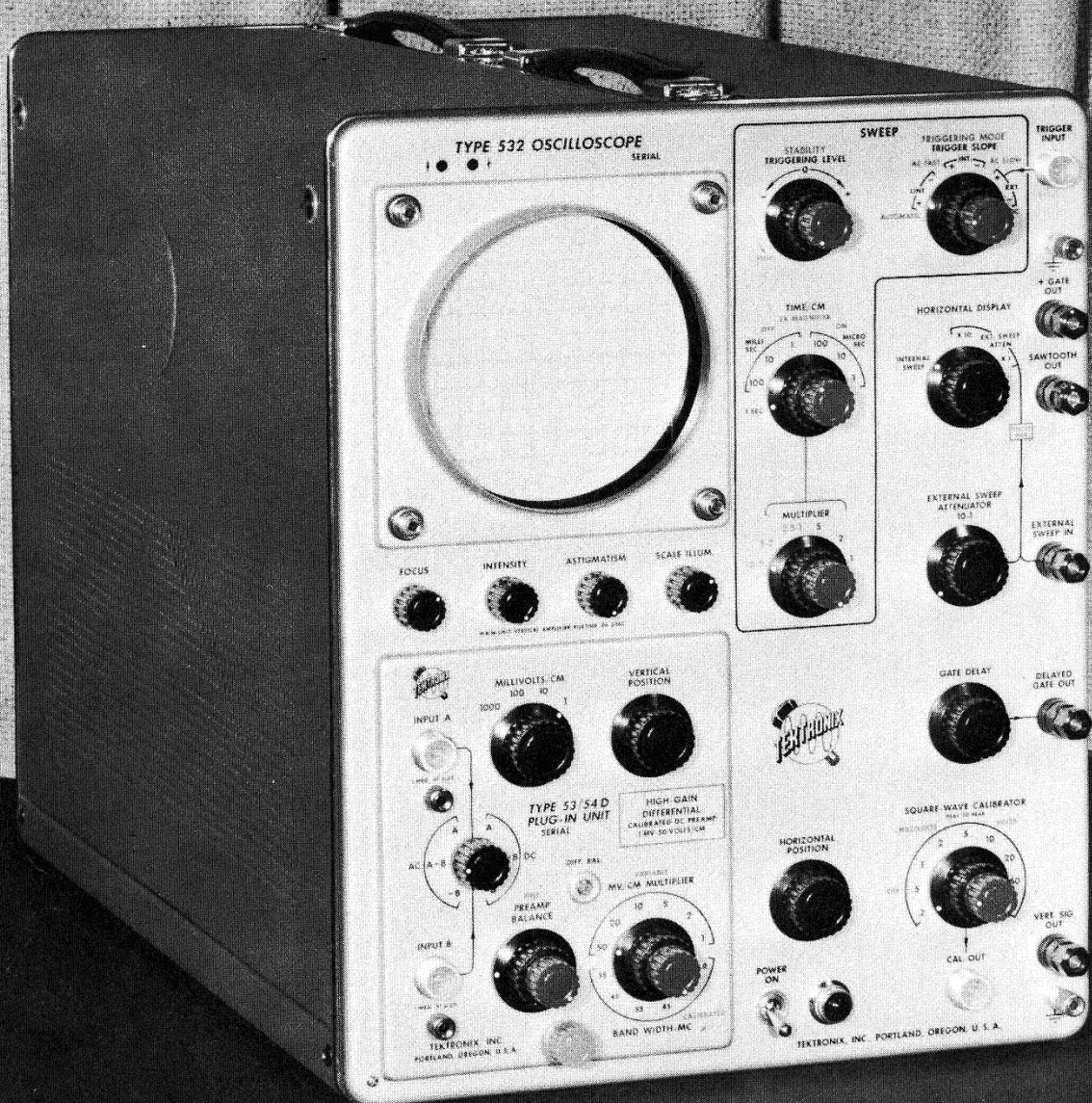
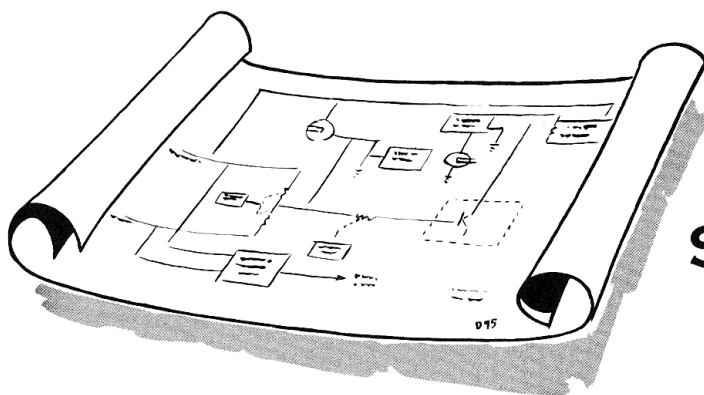


INSTRUCTION MANUAL



S.W. Millikan Way • P.O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cables: Tektronix
070-233





SECTION 1

SPECIFICATIONS

General

The Tektronix Type 532 Oscilloscope is a high-performance medium-speed, laboratory instrument with plug-in preamplifiers. It is specially engineered to get extra dependability through circuit simplicity and conservative tube loading. While achieving the extra dependability obtainable with fewer tubes more conservatively loaded, the Type 532 has retained the same precision and stability expected of Tektronix oscilloscopes, combined with performance characteristics that will take care of most of the demands of a laboratory.

Letter Series plug-in units fit the Type 532. All the versatility of these plug-in units is thus available, limited only by the 5-megacycle pass band of the Type 532.

Vertical Deflection System

Output Amplifier

Frequency Response - dc to 5 mc.
Risetime - .06 microseconds.

Linear Deflection - 8 cm.

Horizontal Deflection System

Sweep Range

Twenty-one calibrated speeds from 1 μ sec/cm to 5 sec/cm.

Accuracy - 3 per cent.

Continuously variable, uncalibrated, between ranges and to 12 sec/cm.

Magnifier

Expands sweep 5 times to right and left

of screen center. Extends fastest sweep speed to .2 μ sec/cm.

Accuracy - 5 per cent.

Unblanking - DC coupled.

Trigger Requirements

Internal - 2 mm of deflection.
External - .2 volts to 40 volts.
Frequency range - dc to 5 mc.

Horizontal Input

Deflection Factor

Continuously variable, .2 v/cm to 20 v/cm.

Frequency Response - dc to 300 kc.

Other Characteristics

Cathode-Ray Tube

Type T52P2

P1, P7 and P11 phosphors optional.

Accelerating Potential - 4,000 volts.

Deflection Factor at Plates

Vertical - 9 v/cm.
Horizontal - 22 v/cm.

Voltage Calibrator

Eighteen fixed voltages from .2 milli-volts to 100 volts, peak-to-peak.

Accuracy - 3 per cent.

Waveform - square wave at about 1 kc.

Output Waveforms Available

Positive gate of same duration as sweep, 20 volts.

Sweep Sawtooth waveform, 150 volts.

Delayed gate with delay adjustable throughout the period of the sweep and lasting for the duration of the sweep, 20 volts.

A sample of the vertical signal, pass-band dc to 2.5 mc with a 50 μmf capacitive load. Output: .9 volts per cm of deflection.

Vertical Beam-Position Indicators

Indicator lights show direction of beam when it is positioned off the screen vertically.

Power Supply

Electronic Regulation

Power Requirements - 105 to 125, or 210 to 250 V, 50-60 cycles, 475 watts with the Type D Plug-In Unit.

Mechanical Specifications

Ventilation - filtered forced-air ventilation.

Finish - photo-etched, anodized panel, blue wrinkle enameled cabinet.

Dimensions - 25" long, 13" wide, 16 3/4" high.

Weight - 52 pounds.

Functions of Controls and Connectors

TRIGGERING
MODE (red knob)

Four-position switch arranges trigger circuits for four kinds of triggering: AUTOMATIC, AC FAST, AC SLOW and DC.

TRIGGER
SLOPE

Six-position switch selects source of trigger signal and converts to negative-going output, either negative-going or positive going input.

TRIGGER
INPUT

Coaxial connector to triggering circuits through EXT. positions of TRIGGER SLOPE switch.

STABILITY

Control for adjusting the stability of the sweep circuits for a stable supply. The control has a PRESET position suitable for most triggering applications.

TIME/CM

Eight-position switch selects timing capacitors to determine sweep speeds, and determine duration of trigger-holdoff period.

MULTIPLIER

Six-position switch. Three positions place precision charging resistors in series with timing capacitors to determine sweep speeds in conjunction with selected timing capacitor. Three positions, marked in red, place adjustable charging voltages in series with timing capacitors for continuous control of sweep speeds.

5X MAGNIFIER
(red knob)

Two-position switch removes or inserts attenuator in sweep amplifier to change sweep speeds by a factor of five.

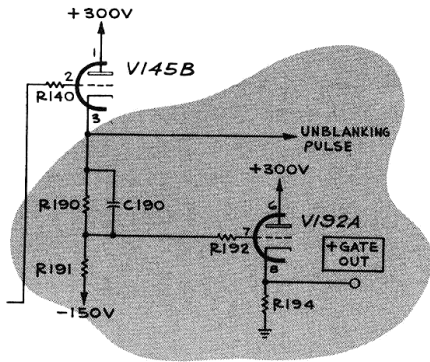
HORIZONTAL
DISPLAY

Three-position switch connects sweep amplifier to internal sweep generator in one position, or to front panel connector directly or through 10-1 fixed attenuator in second and third positions.

EXTERNAL SWEEP ATTENUATOR, 10-1	Continuously adjustable gain control on horizontal amplifier. Switched out of circuit for internal sweeps.
EXTERNAL SWEEP IN	Front-panel connector to horizontal amplifier through HORIZONTAL DISPLAY switch. Magnifier must be switched to ON for undistorted 10-cm deflection.
HORIZONTAL POSITION	Positions trace along horizontal axis.
SQUARE-WAVE CALIBRATOR (black knob)	Nine-position switch selects nine taps on precision voltage divider in calibrator circuit. Provides accurate voltages of .2, .5, 1, 2, 5, 10, 20, 50, and 100 volts in VOLTS position, or millivolts in the MILLIVOLTS position of the red concentric control knob.
MILLIVOLTS- VOLTS	1000-to-1 voltage divider to give either volts or millivolts output.
CAL OUT	UHF coax front-panel connector from the calibrator.
VERT SIG OUT	Front-panel binding post supplies a sample of the vertical signal for operation of auxiliary equipment.
+GATE OUT	Front-panel binding post supplies positive 20-volt square pulse, dc coupled through cathode follower, synchronized with the internal sweep.
SAWTOOTH OUT	Front-panel binding post supplies 150-volt positive-going sawtooth dc coupled through cathode follower, synchronized with the internal sweep.
GATE DELAY	Front-panel control adjusts delay time of delayed gate. Delay is adjustable by any percentage of the sweep-sawtooth time.
DELAYED GATE	Front-panel connector dc connected to cathode-follower output delivers 20-volt positive-going gate delayed according to the setting of the GATE DELAY control.
POWER	On-off switch primary of power transformer and ventilating-fan lead.
FOCUS	Adjustable voltage for the cathode-ray tube focusing grid.
INTENSITY	Bias adjustment to cathode-ray tube control grid.
ASTIGMATISM	Adjustable voltage for the astigmatism grid of the cathode-ray tube.
SCALE ILLUM	Adjustable series resistor controls the voltage across the graticule lights. Beam-position indicators, unlabeled, marked with arrows. The arrow nearest the illuminated indicator shows which way the beam is off the screen if it cannot be seen.

SECTION 3

CIRCUIT DESCRIPTION



Block Diagram

The Block Diagram shows interconnections of the functional parts of the oscilloscope, except the power supplies. Functions of the switches are shown instead of their actual connections.

Vertical Amplifier

Plug-In Preamplifiers

In the upper left of the Block Diagram is shown the vertical-deflection system. The block labeled "plug-ins" represents one of the several plug-in preamplifiers available. Units are available with a wide pass band, with reduced pass band and higher sensitivity, with differential input, with channel switching for alternate trace presentation, etc. These units have calibrated gain controls and vertical position controls. Connections for power in and signal out are made through a multiple-contact mating plug and socket. Output from these units is push-pull at low impedance.

Main Unit

The main unit contains all the power supplies, the sweep system, the high-level portions of the vertical amplifier and its associated circuits, the calibrator, and the cathode-ray tube.

The driver stage feeds the vertical-deflection signal to the trigger-pickoff circuits that supply an internally derived trigger signal to trip the sweep circuits with the observed signal.

Trigger Pickoff

The pickoff circuit supplies a sample of the vertical-deflection signal to the TRIGGER SLOPE switch for triggering purposes.

Vertical Output Amplifier

This amplifier raises the signal to the level needed for the vertical-deflection plates at low impedance.

Calibrator

The calibrator has no internal connection to the vertical-amplifier system. It consists of a symmetrical multivibrator with a cathode-follower output tube whose cathode resistor is a calibrated voltage divider.

Sweep

Trigger Mode and Trigger Slope Selectors

At the left of the diagram are shown the functions of the switches that select the source and slope of trigger signals and arrange the circuits to accommodate the trigger characteristics.

Trigger Phase Inverter

This stage provides either in-phase or inverted output so as to provide negative-going output for either negative-going or positive-going input trigger signals.

Trigger Shaper

The trigger-shaper amplifier makes a sharp pulse from the trigger signal at a time during the sloping part of the trigger signal determined by the setting of the triggering-level control. A sharpened negative-going pulse triggers the multivibrator.

Multivibrator

The multivibrator turns on the sweep generator and generates the crt-tube unblanking pulse when it is switched from its quiescent

state. The sharp negative-going trigger signal from the trigger-shaper circuit trips the multivibrator, which thereafter stays in the second state until the sweep generator reverts it to its quiescent state.

Sweep Generator

The sweep generator is a Miller integrator that produces a positive-going sawtooth about 150 volts peak-to-peak. The sweep generator turns itself off when it reaches a prescribed level determined by the sweep-length control, by transmitting a signal through the trigger-holdoff circuits to the multivibrator.

Trigger Holdoff

The trigger-holdoff circuit transmits the sweep turn-off signal to the multivibrator but briefly holds off subsequent trigger signals from starting the sweep again until all parts of the circuit have reached their quiescent states.

Sweep Amplifier

The sweep amplifier converts the sawtooth output of the sweep generator into push-pull output at low impedance at the level required to sweep the beam across the crt-tube screen. The amplifier gain can be increased by a factor of five for sweep magnification. The horizontal-positioning control operates on this stage.

Unblanking

The multivibrator generates the positive-going unblanking pulse at the same time it turns on the sweep generator. The positive pulse is transmitted by means of two cathode followers through a floating high-voltage negative supply to the control grid of the crt tube.

Delayed-Gate Circuit

The delayed-gate circuit is a bistable multivibrator which changes state when its input grid is raised above the triggering point by the sawtooth wave of the sweep generator.

An adjustable bias added to the sawtooth can move the triggering point to any position along the sawtooth. A positive pulse generated by the multivibrator is transmitted to a front-panel connector by means of a cathode-follower. The positive pulse is terminated when the sawtooth returns negative.

External-Sweep Amplifier

The external-sweep amplifier provides a means of using external sweep voltage. It includes a fixed attenuator and an adjustable attenuation control. Choice of internal or external sweep can be made by means of the HORIZONTAL DISPLAY switch. The sweep magnifier must be used with external sweeps.

Power Supply

Plate and Heater Power

The 60-cycle 117-234-volt transformer has four separate high-voltage windings. AC output from each winding is rectified by means of full-wave rectifiers. Rectified dc output is filtered with capacitors and regulated by means of series regulator tubes. Three positive voltages of 350, 225 and 100 volts are referred to -150 volts for their regulation. The negative 150-volt supply is referred to a 60-volt glow tube for its regulation.

Cathode-Ray Tube High-Voltage

A 60-kc vacuum-tube oscillator has the primary of a step-up transformer for its oscillator inductance. A sample of the rectified secondary voltage is compared to a stable dc source, and the difference is kept constant by an electronic circuit that adjusts the oscillator amplitude of oscillation in the direction to reduce any change.

Three vacuum diodes rectify stepped-up voltages at three secondary windings. Two rectifiers supply positive and negative accelerating potentials to the crt tube. The third supplies a nearly equal negative potential to the control grid of the crt tube. This supply floats on top of the unblanking pulse, which is connected in series with it to ground at its positive end.

Type 532 Plug-in Preamplifier Characteristics

Type N

The Type N Sampling Unit is designed for use with Tektronix plug-in type Oscilloscopes. The sampling system thus formed permits the display of repetitive signals with fractional nanosecond (10 second or nsec) risetime. By taking successive samples at a slightly later time at each resurgence of the pulse under observation, the Type N reconstructs the pulse on a relatively long time-base. Specifications of the Type N include a risetime of 0.6 nsec, corresponding to a maximum band-pass of approximately 600 mc; a sensitivity of 10 mv/cm with 2 mv or less noise; and a dynamic range of ± 120 mv minimum linear range before overloading results.

Accidental overload of ± 4 volts dc is permissible.

Type P

The Type P Plug-In Unit generates a fast rise step-function test signal of known waveform, simulating the output of an ideally compensated Type K Unit driven with a Tektronix Type 107 Square-Wave Generator. The Type P permits the standardization of the main-unit vertical amplifier transient response of a Tektronix convertible oscilloscope. Pulse repetition rate is 240 step-functions per second, with either positive or negative polarity. Step function amplitude is continuously adjustable between 0 and 3 major graticule divisions.

Type Q

The Type Q Plug-In Unit permits any Tektronix convertible oscilloscope such as the Type 532 to be operated with strain gages and other transducers. Excitation voltages for the strain gages and transducers are provided by the plug-in unit. The unit provides high gain, low noise, and extremely low drift. Frequency response of the Type Q Plug-In Unit is DC to 6 kc; risetime is approximately 60 microseconds.

Strain sensitivity is calibrated in 10 steps from 10 microstrain per major graticule division to 10,000 microstrain per division, and is continuously variable between steps.

Type R

The Type R Plug-In Unit is a combined power supply and pulse generator which is used to measure the high-frequency characteristics of junction transistors by the pulse-response method. When the Type R is used in an oscilloscope having a delay line; delay time, risetime, storage time, and falltime may be displayed simultaneously. A pushbutton switch connects a front-panel terminal directly to the input of the oscilloscope for observing externally derived waveforms.

Pulse risetime of the Type R Unit is less than 5 nanoseconds, so measurements depend on the risetime of the oscilloscope used. Pulse amplitudes are in 8 fixed, calibrated steps from .05 to 10 volts, adjustable between steps. Pulse recurrence frequency is 120 pulses per second.

Type S

The Type S Plug-In Unit is designed for use with Tektronix Wide-Band convertible oscilloscopes. Using the Type S, voltage across a test diode is displayed as a function of time.

Certain diode parameters, such as junction resistance, junction capacitance, and the stored charge at the junction, can be measured readily and reliably from the display. Performance of a diode in a particular circuit can be predicted by analyzing the recovery and the "turn-on" characteristics. Since it is essentially a means for plotting voltage across an element while passing constant current through it, the unit can be used for other applications as well. For example: observing the junction characteristics of transistors, or measuring the resistance, capacitance, or inductance of circuit components.

The Type S offers calibrated forward currents in five fixed steps from 1 to 20 milliamps, and reverse currents calibrated in six steps from 0 to 2 milliamps. Diode shunt capacitance is 9 picofarads, and deflection factors are 0.05 v/cm and 0.5 v/cm, calibrated.

PLUG-IN PREAMPLIFIER CHARACTERISTICS WITH TYPE 532 OSCILLOSCOPE

PLUG-IN TYPE	CALIBRATOR DEFLECTION FACTOR	PASSBAND	RISETIME	INPUT CAPACITANCE
TYPE A Wide-Band DC Coupled	0.05 v/cm to 20 v/cm	dc to 5 mc	70 nsec	47 pf
TYPE B Wide-Band High-Gain	5 mv/cm to 0.05 v/cm 0.05 v/cm to 20 v/cm	2 c to 5 mc dc to 5 mc	70 nsec	47 pf
TYPE CA Dual-Trace DC Coupled	0.05 v/cm to 20 v/cm	dc to 5 mc	70 nsec	20 pf
TYPE D High-Gain DC Coupled Differential	1 mv/cm to 50 v/cm	dc to 2 mc	0.18 μ sec	47 pf
TYPE E Low-Level AC Coupled Differential	50 μ v/cm to 10 mv/cm	0.06 cycles to 60 kc	6 μ sec	50 pf
TYPE G Wide-Band DC Coupled Differential	0.05 v/cm to 20 v/cm	dc to 5 mc	70 nsec	47 pf
TYPE H DC Coupled High-Gain Wide-Band	0.005 v/cm to 20 v/cm	dc to 5 mc	70 nsec	47 pf
TYPE K Fast-Rise DC Coupled	0.05 v/cm to 20 v/cm	dc to 5 mc	70 nsec	20 pf
TYPE L Fast-Rise High-Gain	5 mv/cm to 2 v/cm 0.05 v/cm to 20 v/cm	3 c to 5 mc dc to 5 mc	70 nsec	20 pf
TYPE N* Pulse Sampling	10 mv/cm	600 mc	0.6 nsec	Input Impedance 50 ohms
TYPE P* is a fast-rise step-function test signal unit.				
TYPE Q* Strain Gage	10 μ strain/div to 10,000 μ strain/div	dc to 6 kc	60 μ sec	Adjustable
TYPE R* Transistor Risetime	0.5 ma/cm to 100 ma/cm		70 nsec	
TYPE S* Semiconductor Diode Recovery	0.05 v/cm and 0.5 v/cm			
TYPE T*	Time-Base Generator			
TYPE Z* Differential Comparator	0.05 v/cm to 25 v/cm	dc to 5 mc	70 nsec	27 pf

*More data available on the special purpose plug-in units in the accompanying paragraphs.

Type T

The Type T Time-Base Generator provides sawtooth sweep voltages from 0.2 $\mu\text{sec}/\text{div}$ to 2 sec/div . The trigger source may be line frequency, external, ac or dc coupled, automatic of high-frequency sync. The triggering point can be on either rising or falling slope of the waveform, and triggering level is adjustable. A signal of 0.2 volts to 50 volts is required for triggering.

Type Z

The Type Z Plug-In Unit extends the accuracy of oscilloscope voltage measurements. It can be used in three modes of operation: (1) as a conventional preamplifier, (2) as a differential input preamplifier, or (3) as a calibrated differential comparator. With sensitivity of 50 mv/cm and insertion voltage range of

+or- 100 volts, the effective scale range is +or- 2000 cm. Maximum resolution of the Type Z Unit is .005%.

As a conventional preamplifier, the Type Z Unit offers a passband of dc to 5 mc with the Type 532 for signals that do not overscan the screen. The deflection factors are 0.05 volts/cm to 25 v/cm in 9 fixed, calibrated steps.

As a differential input preamplifier, the Type Z accepts a common-mode signal level +or- 100 volts with input attenuation X1, and offers a common-mode rejection ratio of 40,000 to 1. Maximum input signal is + 1 volt/7 nsec, or - 1 volt/5 nsec.

As a calibrated differential comparator, the Type Z makes available three comparison voltage ranges; from zero to +or- 1 volt, zero to +or- 10 volts, and zero to +or- 100 volts.

EXPORT POWER TRANSFORMER

Transformer Primary

The instrument for which this manual was prepared is equipped with a special transformer. The transformer has eight primary terminals making possible six different input connections. The six primary connections are shown in Fig. 1.

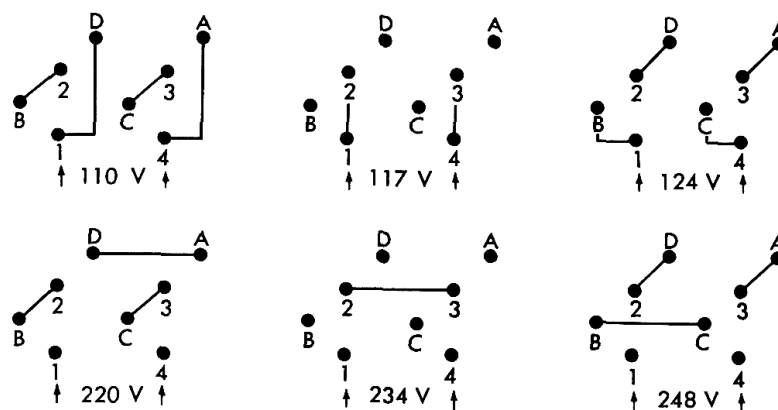


Fig.1. The power transformer has two extra windings permitting nominal primary voltages of 110, 117, 124, 220, 234, 248 volts, 50 or 60 cycle operation.

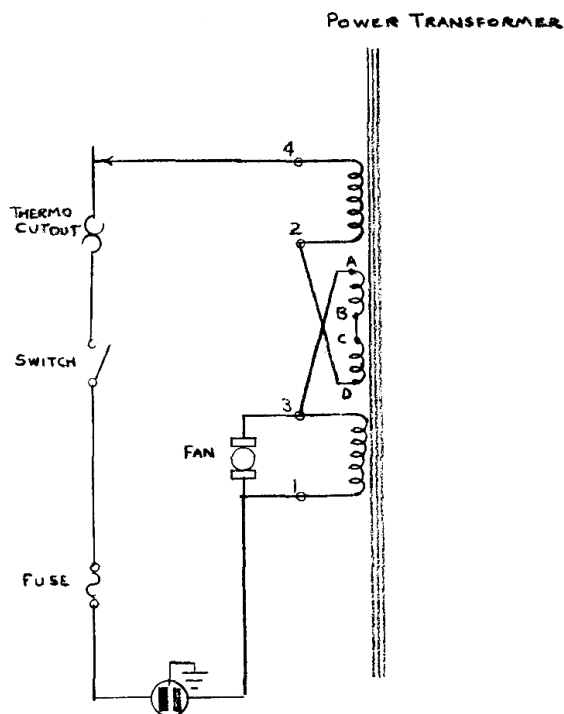


Fig. 2. When connecting the power transformer for operation with a supply voltage of 200 volts or more, be sure that the fan is connected between pins 1 and 3 of the primary. This is to insure that the fan is supplied with no more than 125 volts. Fig. 2 shows a typical high-voltage fan connection, using as an example the wiring for a 248 volt supply.

TYPE 532 Mod. 3377 Tentative s/n 6940
TYPE RM32 Mod. 3378 Tentative s/n 470

Add C813

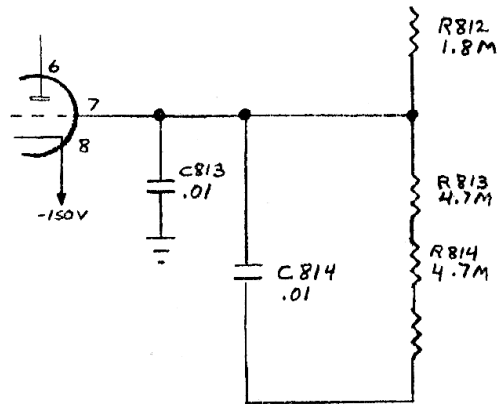
Cap.

Ceramic

.01 Discap

500V

283-002



TYPE 532 MOD. 3179 Eff. sn 6922
TYPE RM32 MOD. 3180 Eff. sn 450

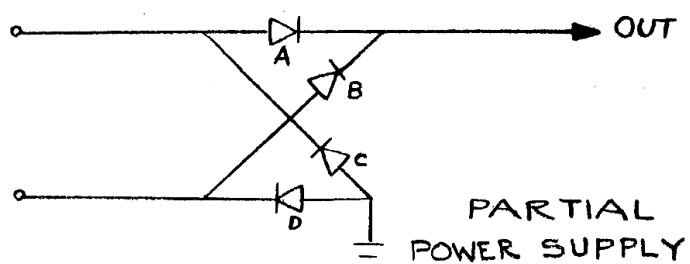
Remove: SR641

106-018

Add: D642 A,B,C,D

Transitron Diodes

152-023



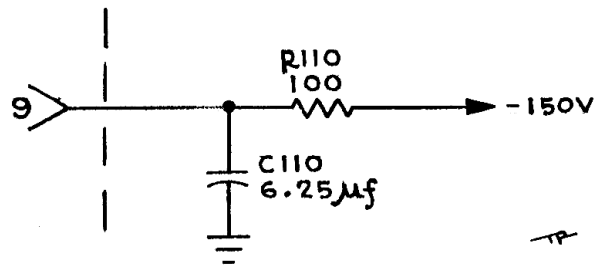
TYPE 532/RM32
Mod. 3417 eff. s/n 6950
Mod. 3418 eff. s/n 480

CAPACITORS

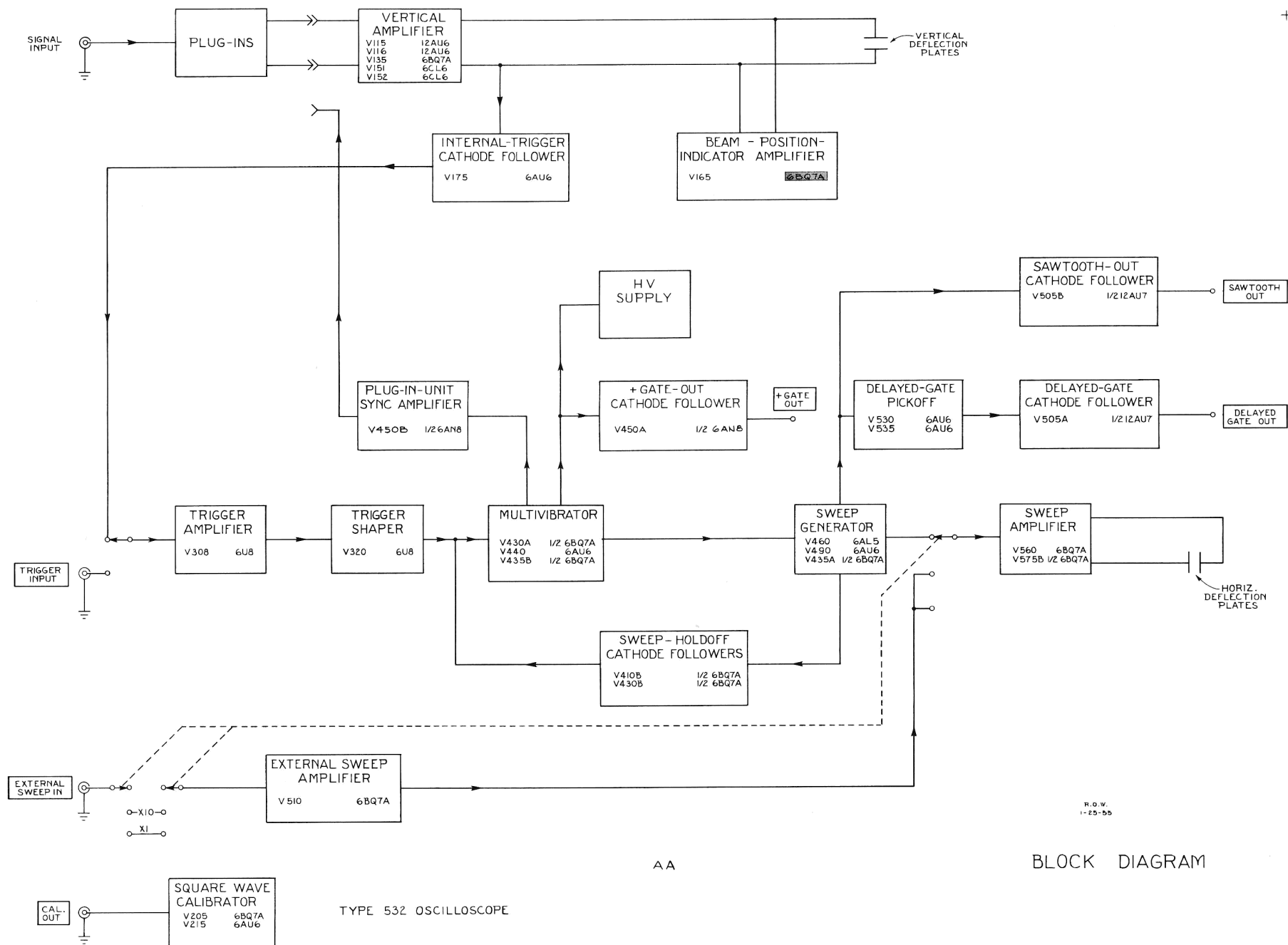
C110	6.25 μ f	Fixed	EMT	300 v	290-025
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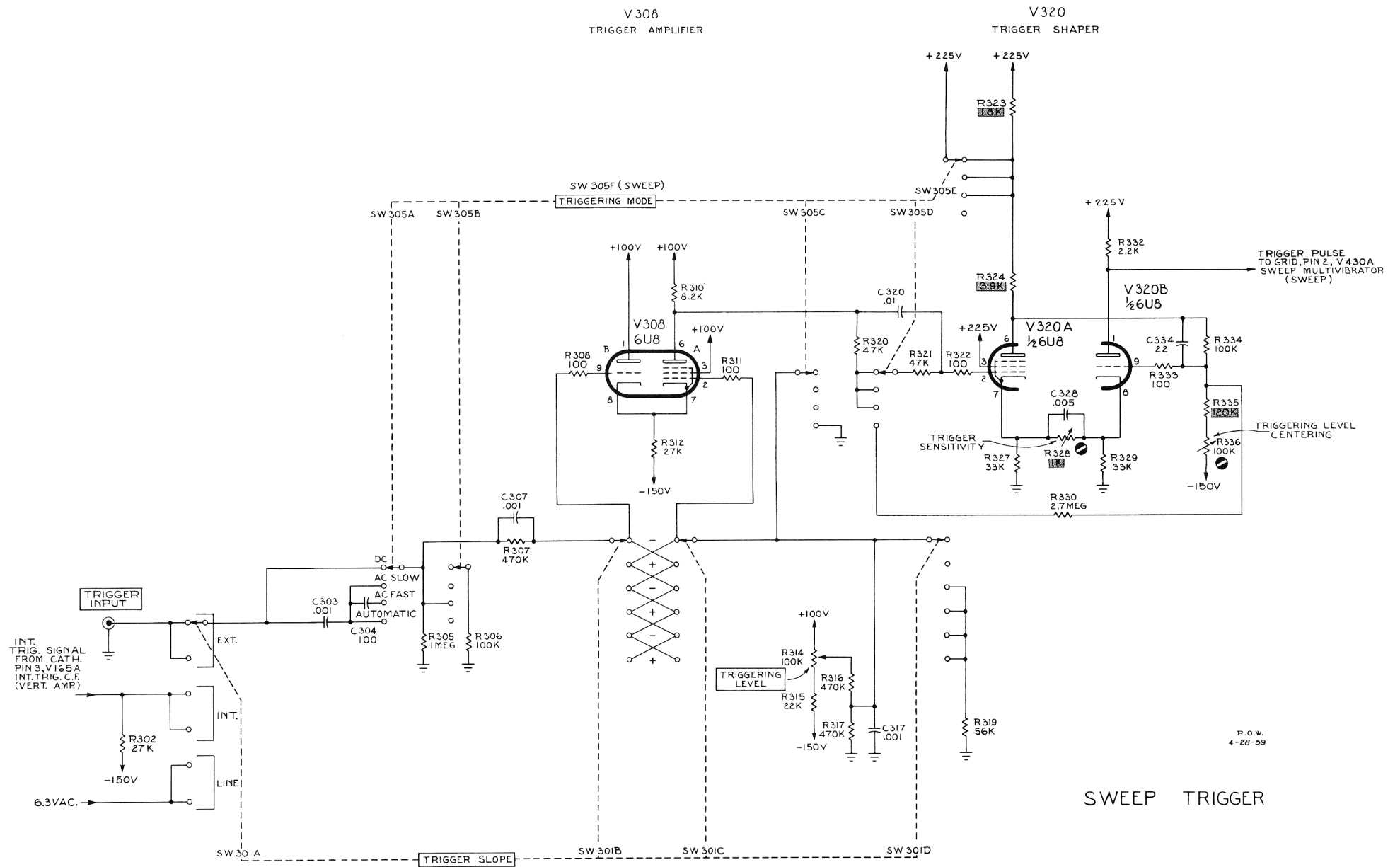
RESISTORS

R110	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
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PARTIAL DIAG.
VERT. AMP.



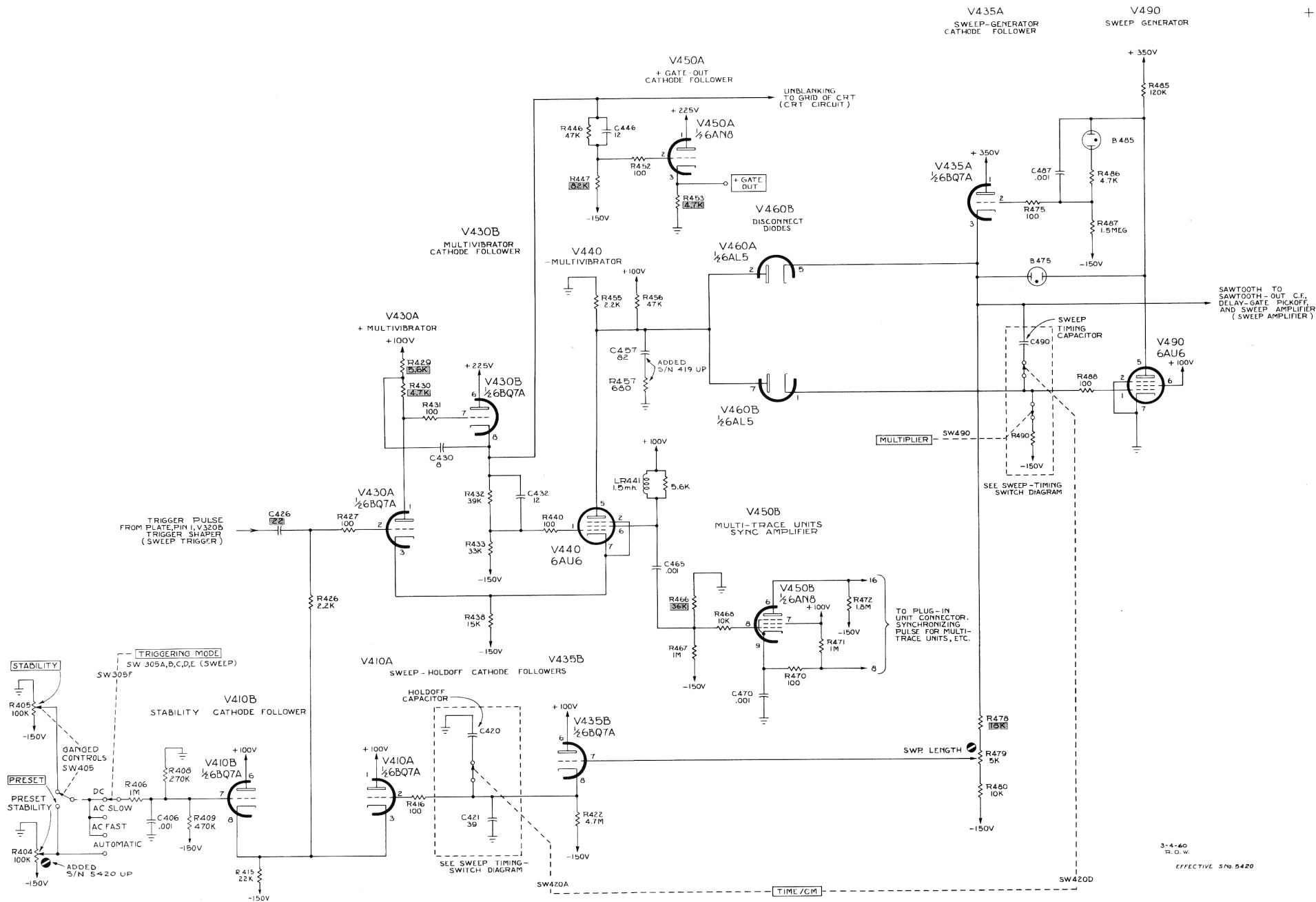


R.O.W.
4-28-59

SWEEP TRIGGER

TYPE 532 OSCILLOSCOPE

AA

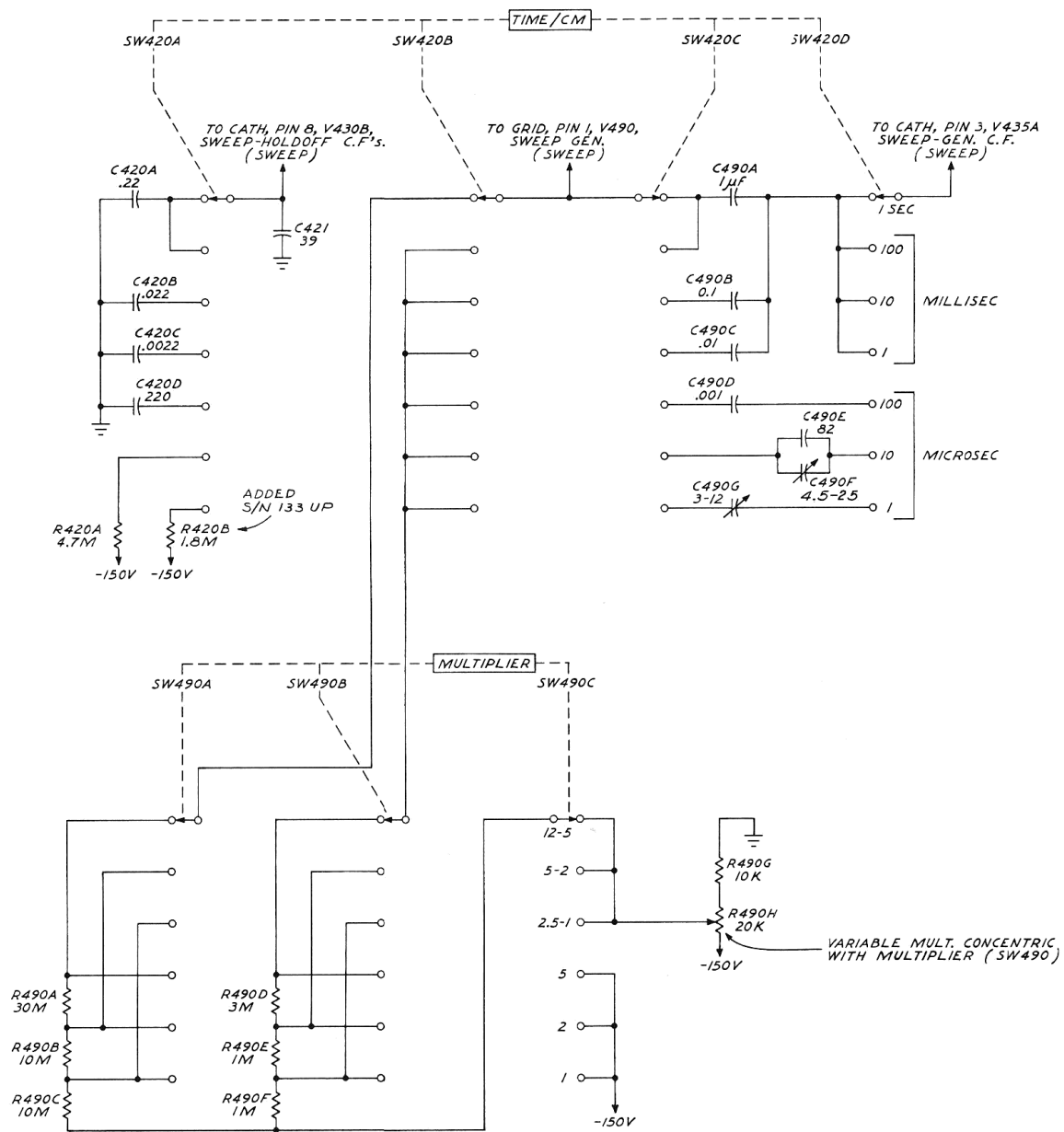


TYPE 532 CATHODE-RAY OSCILLOSCOPE

AA

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

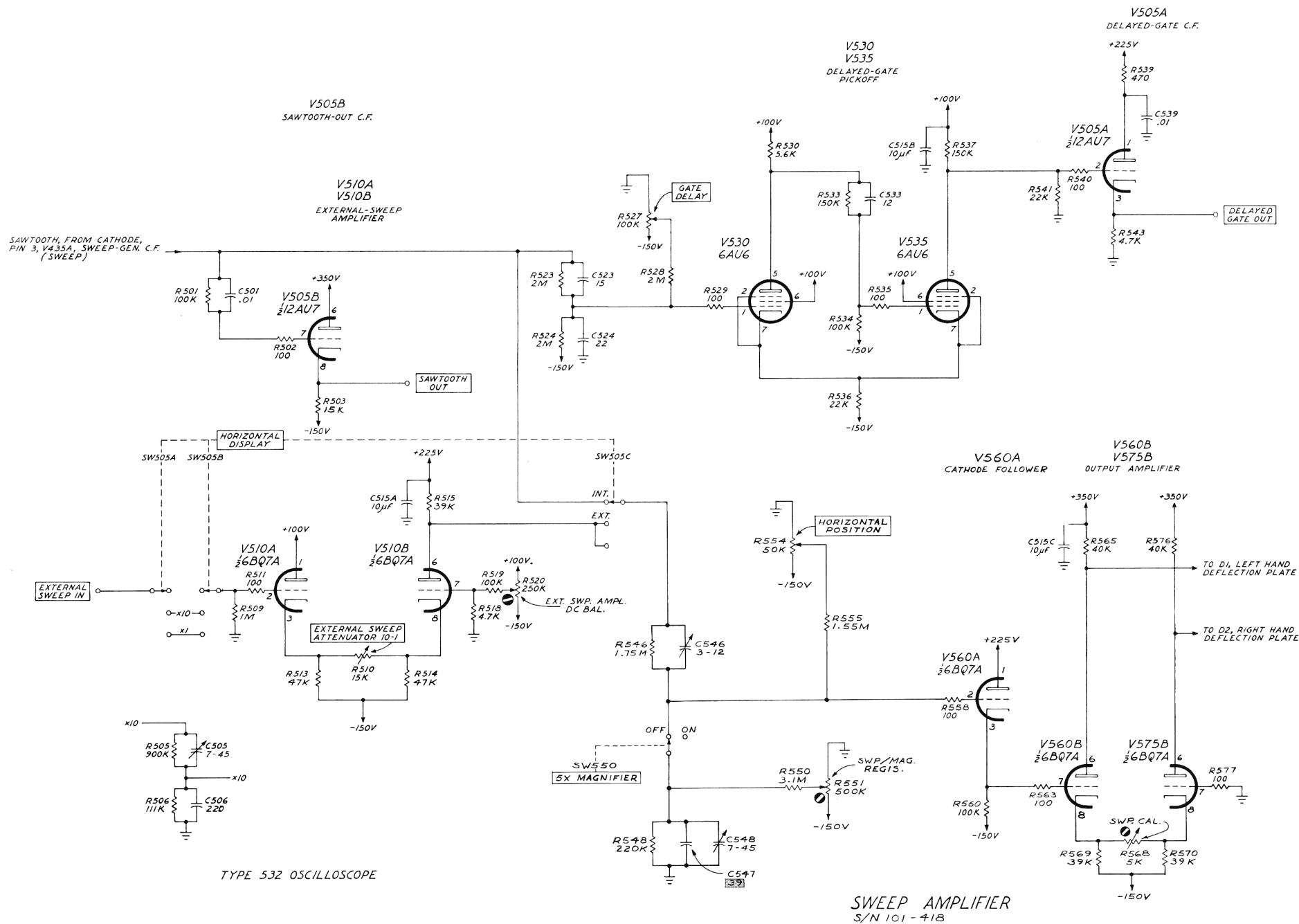
SWEEP



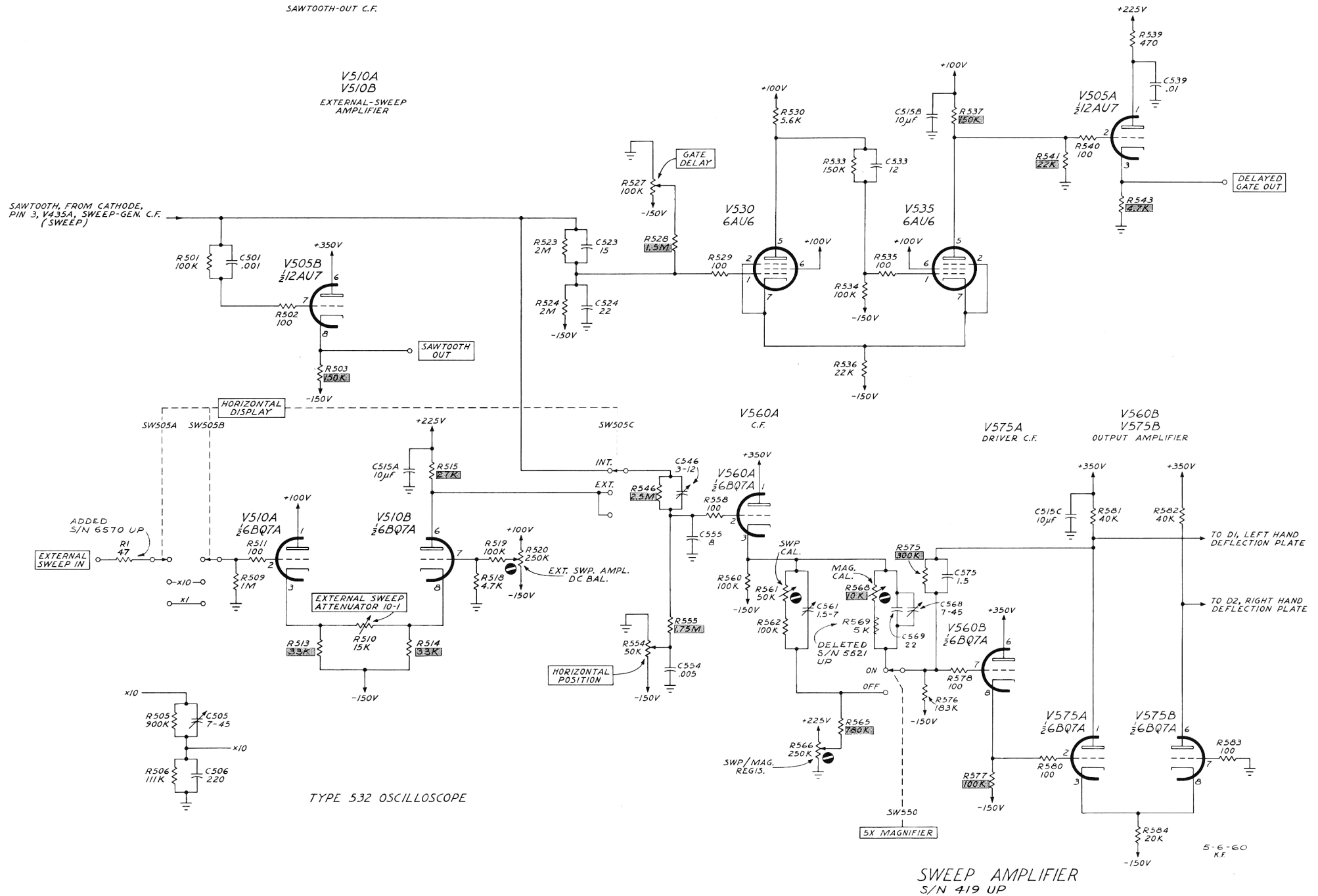
TYPE 532 OSCILLOSCOPE

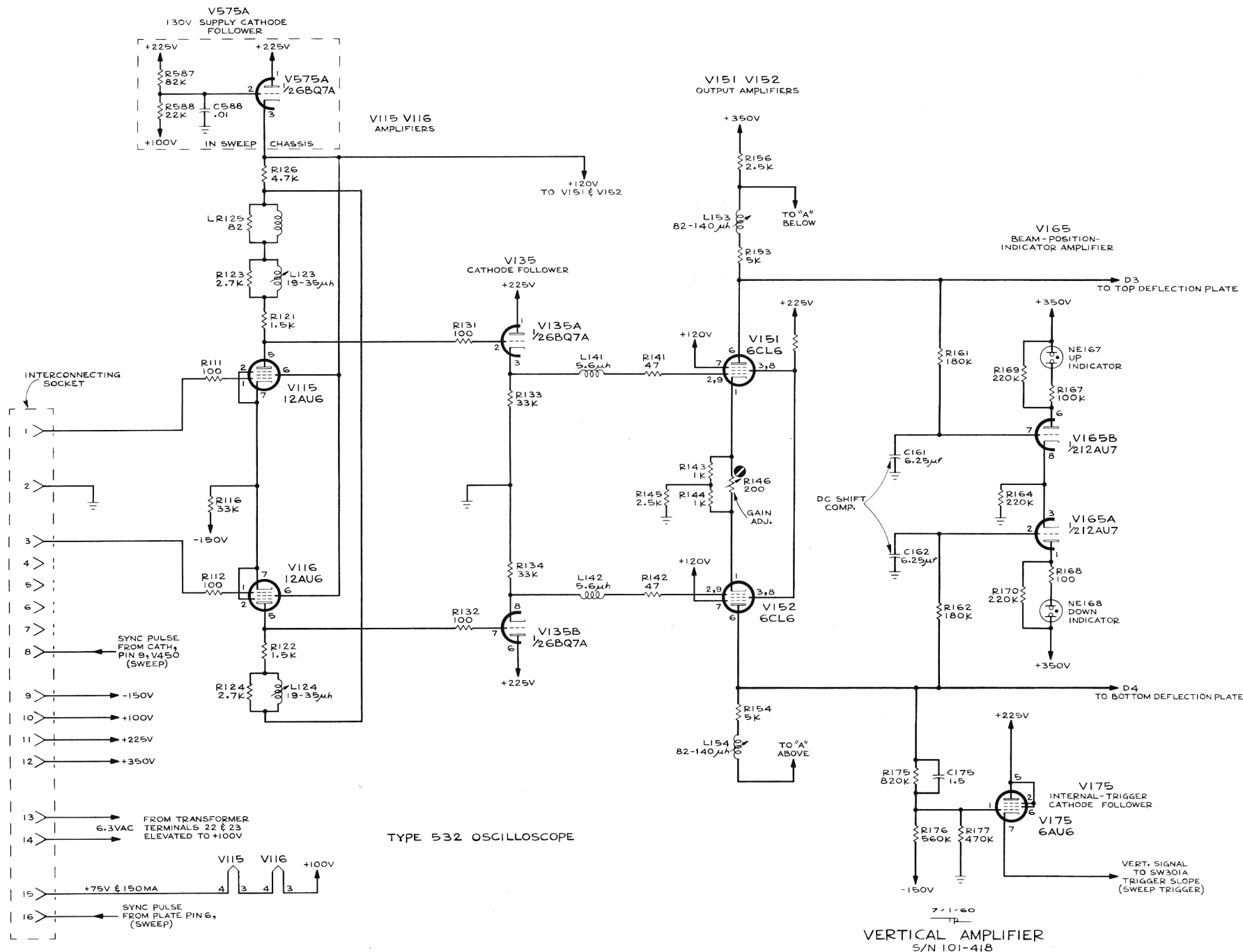
SWEEP GEN. TIMING SWITCH

8-1-55
KF

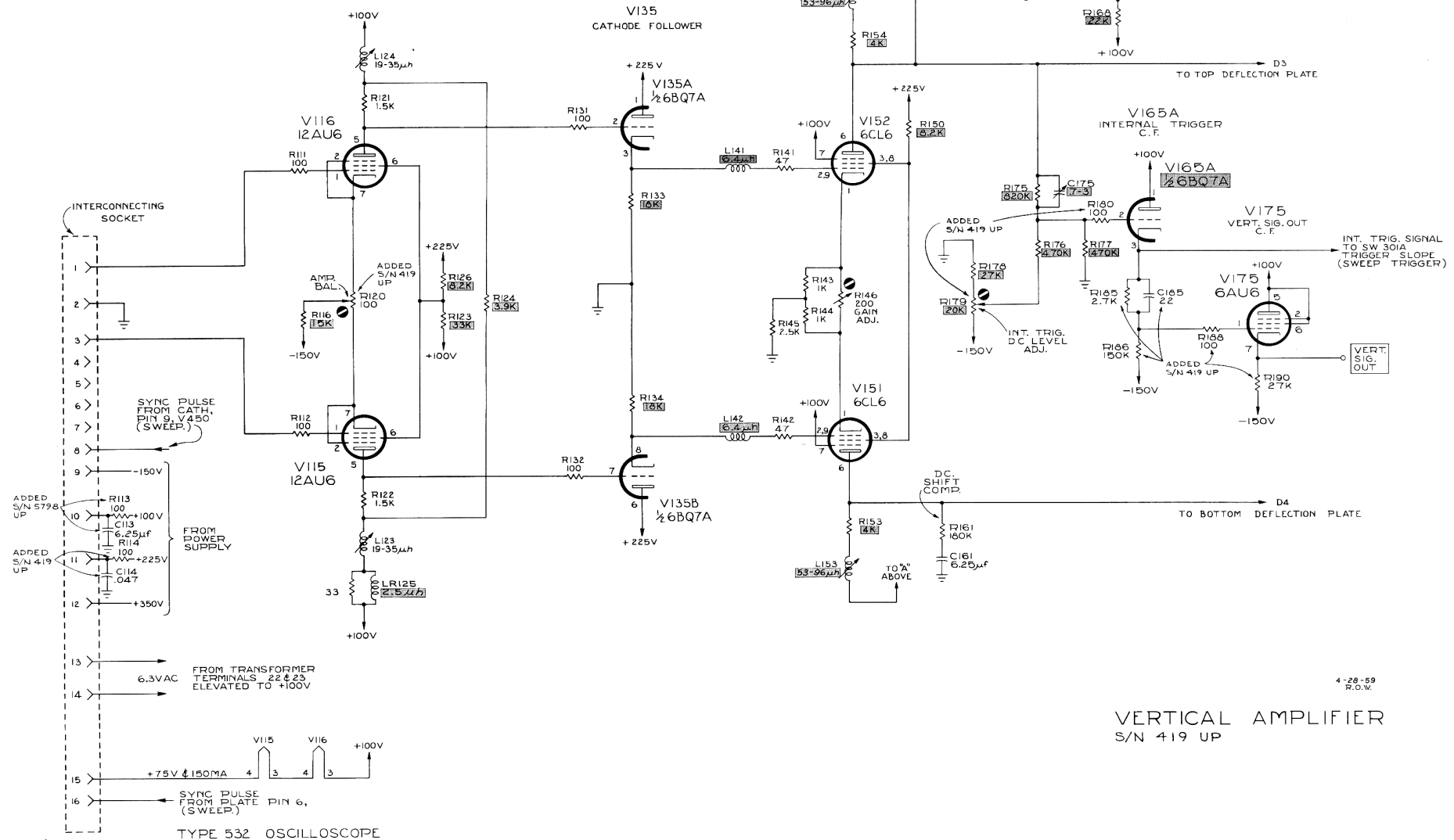


V510A
V510B
EXTERNAL-SWEEP
AMPLIFIER





VII5 VII6 AMPLIFIERS



4-28-59
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VERTICAL AMPLIFIER
S/N 419 UP

