T E L E Q U I P M E N T

OSCILLOSCOPE TYPE S54 AND S54R

All TelequipmenT instruments are subject to continuous development and improvement, consequently this instrument may incorporate minor changes in detail from the information contained herein.

TelequipmenT is a registered trade mark of
TELEQUIPMENT LIMITED*
313 Chase Road
Southgate
London, N.14
England.

Telephone: 01-882 1166
Cables : TELEQUIPT LONDON N 14

* Member of the Tektronix group

Issue 3
August 1968

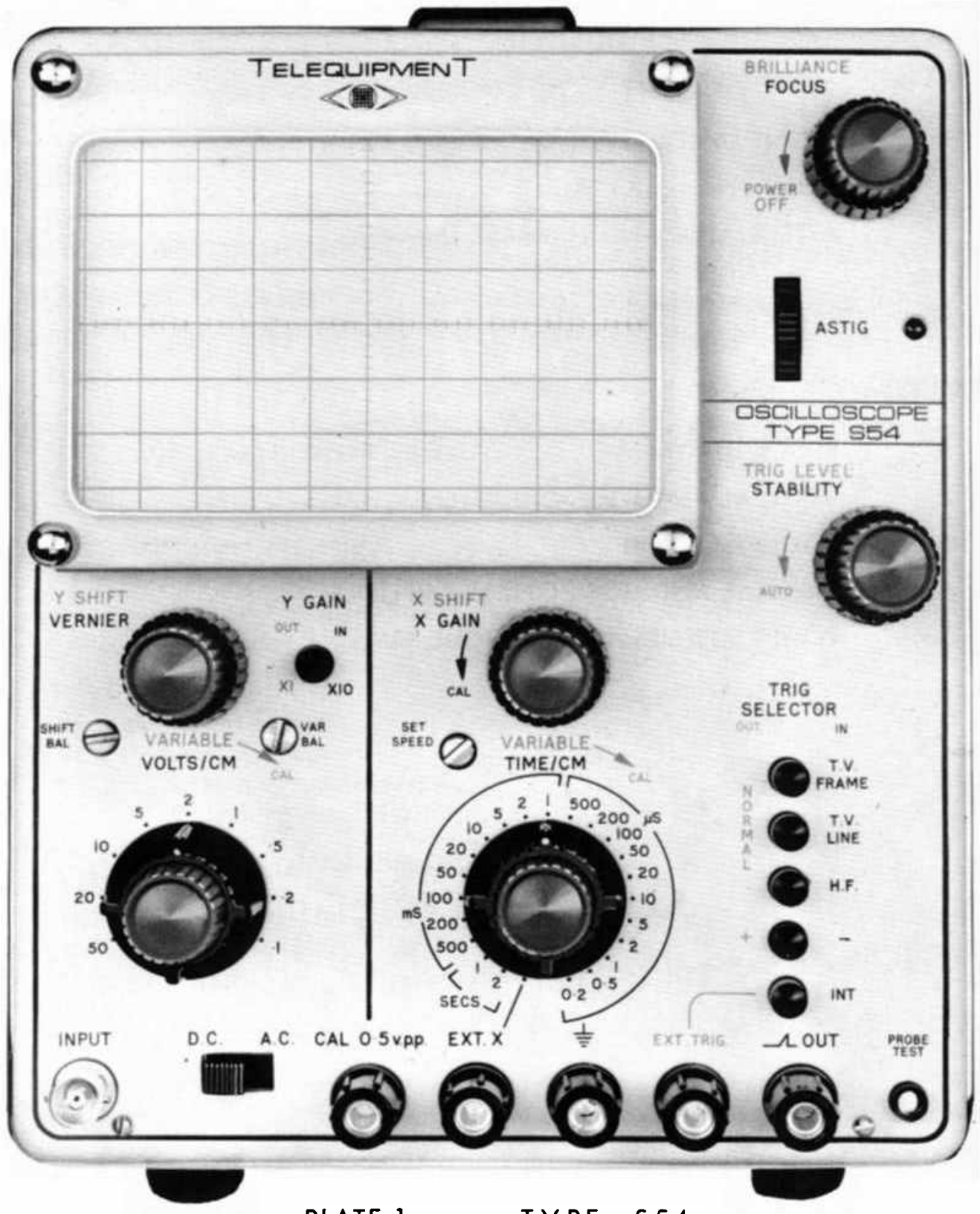


PLATE 1. TYPE S54.

TECHNICAL DATA

VERTICAL AMPLIFIER AND ATTENUATOR

	GAIN X1	GAIN X10
3dB bandwidth - d.c. coupled	d.c.-10MHz	d.c.-4MHz
a.c. coupled	2Hz -10MHz	2Hz -4MHz
10 to 90% risetime	35ns	90ns
Calibrated deflection sensitivity ± 5%	0.1-50V/cm	0.01-5V/cm
Minimum sensitivity approx.	125V/cm	12.5V/cm
Maximum input (via 400V capacitor a.c. coupled)	400Vp	
Maximum display amplitude	6cm d.c.-5MHz	
reducing to approx.	3cm at 10MHz	
Input impedance approx.	1 megohm & 47pF	

HORIZONTAL DEFLECTION SYSTEM

Trigger

Internal - minimum deflection	2mm
External - a.c. coupled via 400V d.c. wkg. capacitor	1.5Vp-p to ± 15V
input impedance approx.	100 kilohms & 10pF
Useful bandwidth approx.	
Automatic	50Hz-1MHz
Trigger level	10Hz-3MHz
HF	1MHz-25MHz

Sweep generator

Calibrated sweep speeds ± 5%	200ns-2s/cm
Maximum speed range approx.	40ns-5s/cm

Horizontal amplifier

3dB bandwidth	d.c.-750kHz
10 to 90% risetime	475ns
Deflection sensitivity approx.	600mV-3V/cm
Input impedance approx.	1 megohm & 30pF
Maximum input	400Vp

CATHODE RAY TUBE

Standard phosphor	GH (P31)
Display area	6 x 10cm
Overall post deflection acceleration	4kV
External intensity modulation	
Coupling	a.c. to first grid
Sensitivity for cut-off at average brilliance	-20Vp approx.
Time constant approx.	10ms via 0.01μF

FRONT PANEL OUTPUTS

Calibrator	0.5Vp-p ± 2% at supply frequency
Sawtooth approx.	1-35V d.c. coupled at sweep frequency
Minimum load	30 kilohms
Probe test approx.	5Vp a.c. coupled at sweep frequency

POWER REQUIREMENTS

Voltage	100-125 in 5V steps 200-250 in 10V steps
Frequency	48-440Hz
Consumption	30VA

PHYSICAL DATA

Approximate overall dimensions and weight

	High	Wide	Deep	Weight
S54	$9\frac{1}{4}$	$6\frac{3}{4}$	$16\frac{1}{4}$ in	17 lb
	23.5	17	41.5 cm	8 kg
S54R	$5\frac{1}{4}$	19	$17\frac{1}{2}$ in	22 lb
	13.5	48	44.5 cm	10 kg

Cooling - convection

Ambient temperature limits approx.

Operating	-15 to +40°C	+5 to +104°F
Non-operating	-25 to +70°C	-13 to +158°F

OPERATING INSTRUCTIONS

FIRST-TIME OPERATION

Before connection to the mains supply check that the voltage selector plug is inserted with the pointer indicating the local supply voltage and that the fuse is of the correct rating.

Set the front panel controls as follows:

BRILLIANCE	Fully anti-clockwise - POWER OFF
FOCUS	Mid-range
ASTIG	Mid-range
TRIG LEVEL	Fully anti-clockwise - AUTO
STABILITY	Fully clockwise
TRIG SELECTOR	NORMAL, +, INT (all buttons except lowest out)
X SHIFT	Mid-range
X GAIN	Fully anti-clockwise
TIME/CM	5mS
VARIABLE	Fully clockwise
Y GAIN	x1 (out)
Y SHIFT	Mid-range
VERNIER	Mid-range
VOLTS/CM	0.1
VARIABLE	Fully clockwise
DC AC	AC

Link INPUT and CAL 0.5V p-p.
Plug in to the mains and switch on by the POWER OFF/BRILLIANCE control.
Allow half a minute for the instrument to warm up then rotate BRILLIANCE clockwise until a display of convenient intensity is obtained.
Centre the trace by Y SHIFT and X SHIFT.
Adjust FOCUS and ASTIG for best definition.

Rotate STABILITY anti-clockwise until a stable trace is obtained.

2.5 cycles of the calibration waveform, 5 cm in amplitude, should now be observed. This is a suitable arrangement to become familiar with the use of the controls.

On removal of the INPUT link the instrument is in a condition to display most simple waveforms with appropriate adjustment of the switched and variable VOLTS/CM and TIME/CM controls.

ADDITIONAL INFORMATION AND FACILITIES

TRIG LEVEL In the AUTO position, the sweep is automatically triggered at the mean level of the waveform. When switched from AUTO, the TRIG LEVEL control enables the starting point of the sweep to be selected from any point on the displayed waveform. With control settings as for first-time operation and with the calibrator signal applied, rotation of TRIG LEVEL will cause the sweep to start at various points on the positive going slope of the calibration waveform. If the negative TRIG SELECTOR button is pressed the above will be seen to apply to the negative going slope.

TRIG SELECTOR

TV FRAME (FIELD) AND TV LINE Switch TRIG LEVEL to AUTO and adjust STABILITY for sweep to trigger from back edge of line or first frame pulse. With large trigger inputs it may be necessary to switch from AUTO and adjust TRIG LEVEL to obtain correct triggering. Trigger polarity relates to the polarity of video modulation.

HF Synchronisation of signals up to approximately 25MHz is obtained in this condition by adjustment of TRIG LEVEL.

+ AND - These positions determine whether triggering occurs on the positive or negative going slope of a waveform.

EXT TRIG AND INT When EXT TRIG is selected, an external signal over 1.5Vp-p in amplitude may be applied between this terminal and ground to trigger the sweep. For internal triggering a display of over 2mm is required.

TIME/CM The indicated sweep rates are only attained when VARIABLE is fully clockwise and X GAIN fully anti-clockwise. Turning VARIABLE anti-clockwise reduces the sweep speed by a factor of approximately 2.5, whereas clockwise rotation of X GAIN expands the sweep and increases the speed by up to about 5 times.

EXT X When set to this position external horizontal deflection signals may be applied via the EXT X terminal to the horizontal amplifier. Depending on the X GAIN setting the sensitivity varies approximately from 3V/cm at CAL to 600mV/cm. The bandwidth is from 0-750kHz.

SAWTOOTH OUT A directly coupled positive going sawtooth, rising from 1 to 35V approximately, is available when the timebase is running. To avoid over-loading the sweep generator the input resistance of an applied load should exceed 30 kilohms.

PROBE TEST A positive going fast-rise pulse is provided for probe adjustment as detailed in step 13 of the calibration procedure.

Y SHIFT AND VERNIER

Y GAIN X1 The Y SHIFT control produces a range of adjustment of over 2 screen amplitudes with VOLTS/CM VARIABLE at CAL, while VERNIER can be used as a fine adjustment.

Y GAIN X10 All volts/cm indications are divided by 10 giving sensitivities from 10mV/cm to 5V/cm.

DC AC While normally operated in the AC position to block the d.c. component of signals, the DC position should be used for d.c. voltage measurement and for the display of very low frequency signals due to the a.c. coupled lower 3dB point of approximately 2Hz. Where d.c. blocking at very low frequencies is desired the signal should be fed through an external capacitor, larger than 0.1μF, with the input switch at DC.

Z MOD A signal may be applied to intensity modulate the trace via this rear socket. Approximately 20Vp-p is required for full modulation at normal brilliance.

SCALE ILLUM At rear on S54. This control varies the illumination of the graticule divisions.

TRACE ROTATION At rear on S54. This control varies the alignment of the trace with the horizontal graticule lines.

SHIFT BAL, VAR BAL and SET SPEED The adjustment of these preset controls is described in the maintenance and calibration section page 13.

CIRCUIT DESCRIPTION

BLOCK DIAGRAM DESCRIPTION

This section describes briefly the principles of operation of the oscilloscope. Reference should be made to the block diagram, Fig. 1.

INPUT ATTENUATOR AND VERTICAL AMPLIFIER

The signal to be observed is applied via the BNC INPUT socket to the attenuator, which is used to vary the amplitude of the displayed signal, and thence to the three stage vertical amplifier which drives the Y plates of the c.r.t. A fraction of the amplifier output is fed by way of the TRIGGER SELECTOR in the INT position to the trigger circuit.

CALIBRATOR

A 0.5V p.-p. squarewave at power line frequency is provided to act as a reference for the adjustment of the vertical amplifier gain and the timebase speed.

TRIGGER

This circuit provides pulses of suitable amplitude and polarity to fire the sweep generator in synchronism with the internally or externally derived triggering waveforms.

SWEEP GENERATOR

When appropriately triggered the sweep generator produces a positive going sawtooth waveform which is fed to the horizontal amplifier and to a front panel terminal. A negative pulse is fed to the unblanking amplifier. When the TIME/CM switch is set to EXT X, the sweep generator is cut off, the trace unblanked and an external signal can be applied to the c.r.t. X plates via the horizontal amplifier.

HORIZONTAL AMPLIFIER

The sawtooth output from the sweep generator is amplified and applied to the X plates of the c.r.t. to give lateral deflection of the electron beam.

UNBLANKING AMPLIFIER

The unblanking pulse from the sweep generator is inverted and applied to a c.r.t. electrode to deflect the electron beam onto the tube phosphor for the duration of the sweep. A fast rising pulse is obtained which is provided to adjust the capacitance of a high impedance probe. The Z MOD socket at the rear of the instrument enables the trace brilliance to be modulated by an external signal.

CATHODE RAY TUBE

Controls governing the appearance of the trace on the c.r.t. screen are incorporated in this circuit. Graticule illumination is controlled from the rear of the instrument on S54, as is trace rotation.

POWER SUPPLIES

All voltages are derived from a double-wound transformer with two primary and two secondary windings.

DETAILED ANALYSIS

VERTICAL DEFLECTION SYSTEM - Figure Number 2

INPUT ATTENUATOR

Capacitor C1 is short-circuited by S1 in the DC position. The attenuator has four frequency compensated resistive dividers selected by S2, the VOLTS/CM switch, to give nine division ratios where used singly or in tandem. The first section has ratios of 1, 10 or 100:1 and the second 1, 2 or 5:1. C2, 5, 8, 10, 11 and 12 provide standardisation of the input time constant for all settings of S2. C3 and 6 affect compensation only when using a high impedance probe.

VERTICAL AMPLIFIER

The signal from the attenuator is fed to the grid of V21. Nuvistors V21 and 22 form a long-tailed paraphase amplifier whose gain is adjusted by RV26, the front panel VARIABLE. Balancing adjustment RV25 is set for no trace shift when RV26 is rotated. C22 compensates for variation of input capacity of V21 with change of gain. MR21 serves to make the amplifier gain proportional to the supply voltage. As the c.r.t. deflection sensitivity is inversely proportional to supply voltage, constancy of calibration over a wide range of mains voltages is ensured. Shift voltage is applied to the grid of V22 from RV39 and 40. Negative and positive stabilised supplies for the shift circuit are derived from the nuvistor heater stabiliser zener MR409 shown on the power supply circuit and the calibrator zener MR22 respectively.

The push-pull output from V21 and 22 anodes is directly coupled to the bases of TR23 and 21 which form a long-tailed pair. Gain selection and calibration is carried out in this stage, S21 switching in additional collector load resistors in the X10 position. Presets RV46 and 49, mounted at the rear of the instrument on the S54 set the gain in the X1 and X10 conditions respectively, RV49 is inoperative in X1.

The bases of the long-tailed pair output stage TR24 and 25 are directly fed from the collectors of TR23 and 21. C28 and RV61 provide compensation for optimum pulse response while C29 and 30 together with the short lengths of wire from the bases are neutralising components. The outputs at the collectors are taken to the c.r.t. Y plates, a part of this signal being tapped-off and fed to the EXT INT TRIG SELECTOR switch S101e.

AMPLITUDE CALIBRATOR

104V a.c. is applied from the mains transformer via R43 to zener MR22 which operates as a double clipper or limiter. The output, which is adjusted to 0.5V p.-p. by RV36, is obtained from potentiometer RV36, R37 and 38. The temperature coefficient of R37 is selected to compensate for that of the zener diode.

HORIZONTAL DEFLECTION SYSTEM

TRIGGER CIRCUIT - Figure Number 3

The bases of the trigger input amplifiers TR101 and 102 are fed with the triggering signal via switches S101e and d. S101e selects the source, either the vertical amplifier output stage for internal operation or the EXT TRIG terminal. S101d determines the polarity of slope on which triggering occurs.

When switched in by S102, RV115, the TRIG LEVEL control, varies the base potentials of TR101 and 102 in anti-phase. This alters the quiescent voltage on the base of TR103 and so varies the d.c. level of signal necessary to trip the Schmitt trigger formed by TR103 and 104.

With S102 switched to the automatic mode, feedback is applied from TR104 collector to TR102 base via R124 and 122 and from TR103 collector to TR101 base via R125 and 106. This causes TR101 and 102 to oscillate at a frequency in the order of 50Hz determined by C108, R124 and 125. The amplitude of the free-running output of TR102 is adjusted by the trigger sensitivity pre-set RV132. Set automatic pre-set RV114 is adjusted to take up component inequalities and provide symmetric operating of TR101 and 102.

The feedback networks R108, 109, C104, 105 and R118, 119, C106 and 107 serve to extend the frequency response of the amplifier and to enable a high input impedance to be presented to external trigger signals.

With TRIG SELECTOR buttons S101a, b and c in the NORMAL position, TR103 and 104 operate as a Schmitt trigger with coupling resistor R131 and speed-up capacitor C111. RV132, which is effectively in series with R127 in the emitter of TR104, adjust the hysteresis gap or degree of backlash. The fixed-amplitude

rectangular-wave output from the collector of TR104 is differentiated by C113 and R137 and the resulting bidirectional pulses applied to series clipper MR101 which provides the collector of TR105 in the timebase circuit with positive going trigger pulses.

In the TV positions of S101a and b TR103 is converted into a sync separator by R127 being switched out of circuit and C109 being switched across R128 to give a 2.2s time constant. TR104 changes into an inverter with decoupling capacitor C114 being switched across R133. In the TV FRAME position the differentiating time constant of C113 and R137 is increased to 24.4μs by the addition of R136.

With S101c in the HF position, R130 is placed in series with RV132 across C112, these components together with the TRIG LEVEL control determine the frequency at which TR103 and 104 oscillate. The frequency varies from approximately 250kHz to 1MHz.

SWEEP GENERATOR- Figure Number 4

The circuit comprises TR105 and 106 as a sweep-gating bistable with variable hold-off, Miller run-up stage TR107 and impedance matching cathode follower V101.

In the quiescent condition TR105 is off, TR106 on and diode gates MR104 and 105 are open holding the collector of TR107 and the grid of V101 at approximately the same potential across the timing capacitor, C282 to 288, which is thus held discharged. At this stage TR107 is conducting heavily.

A positive going trigger pulse from the trigger circuit is applied to the base of TR106 via R148 and C116 causing TR106 to cut-off and the bistable to switch over. The collector of TR105 goes positive thus biasing off the trigger coupling diode MR101 and inhibiting further trigger pulses. The collector of TR106 meanwhile goes negative assisted by MR111 which clamps the collector at earth potential. This reverse biases MR104 and 105.

With MR104 cut-off, the sweep commences with current flowing through the timing resistor, R276 to 281, and R282 to charge the timing capacitor.

The grid of V101 falls in potential and with it the base of TR107 due to cathode follower action of V101. This causes TR107 collector to rise and with it the grid of V101 by coupling through the timing capacitor. The tendency of V101 grid to go negative is thus limited, the grid remaining at an almost constant potential. A source of constant current to charge the timing capacitor is thus ensured. During this process the grid of V101 and with it the base of TR107 falls slightly but linearly. Due to the high gain of TR107 this results in a larger but still linear increase in potential at the collector, thus providing the positive going sweep.

With TR107 collector going positive MR103 is turned on allowing the hold-off capacitor, C276 to 281, to charge. The base of TR105 thus rises, causing TR105 and 106 to switch back into their initial condition with TR105 off and TR106 on. This time is determined by the relative base and collector potentials of TR105, set by RV147.

The rise in potential at the collector of TR106 turns on MR104. This initiates the fly-back period and permits the timing capacitor to discharge via TR107, MR104, TR106 and R149 causing the collector potential of TR107 to fall linearly due to a repetition of the Miller action which occurred during the sweep.

As the collector potential of TR107 falls, MR105 is turned on and MR103 off. With MR103 off, the hold-off capacitor discharges through R144 and 143, to a level set by RV141, driving the base of TR105 in a negative direction and turning on MR102 to clamp the base at a potential dependent on the setting of RV138, the STABILITY control.

The circuit is once more in a condition to respond to the next trigger pulse.

The STABILITY control provides three zones of operation for TR105 and 106. With the control anti-clockwise, the base of TR105 is held sufficiently positive to prevent the bistable responding to the constant amplitude trigger pulses. If advanced clockwise, the base potential of TR105 falls enabling the stage to be switched. When more fully advanced, the base potential of TR105 is sufficiently negative to cause the stage to oscillate and the sweep generator to produce a recurrent sweep in the absence of triggering signals.

The sawtooth waveform at the collector of TR107 is fed to the sawtooth out terminal and to the horizontal amplifier via RV161, the SET SPEED pre-set, which serves as an input gain control.

The collector of TR106 is connected to the base of TR111, the unblanking amplifier.

In the EXT X position of the TIME/CM switch, the base of TR105 is disconnected from MR102 turning TR105 on and TR106 and hence TR111 off, resulting in the beam being unblanked. The EXT X input is applied to the grid of V101 and thence via TR107 to the base of TR108.

HORIZONTAL AMPLIFIER - Figure Number 4

TR108 serves as a feedback amplifier followed by TR109 and 110 as a long-tailed pair.

The input from the timebase is fed to the base of TR108 whose d.c. level is controlled by RV167 the X SHIFT control. The feedback factor and hence gain

of this stage is varied by the X GAIN control, RV166. MR107 provides protection against base-emitter reverse voltage breakdown. The output at the collector of TR108 appears at the base of TR109 which with TR110 feeds the X plates in push-pull. MR108 protects TR109 from bottoming. RV178 sets the mean collector potential so that maximum collector voltage swing can occur. RV181 ensures symmetry of operation with variation of gain. C118 equalises input and feedback capacitance of TR108 on EXT X.

UNBLANKING AMPLIFIER - Figure Number 4

In the rest condition of the timebase, TR111 is held on by the positive potential at the collector of TR106. The unblanking grid (g2) of the c.r.t. is thus negative to the first anode which is maintained at a constant potential by potentiometer R186 and 187.

During the sweep and when switched to EXT X, TR106 and hence TR111 are off with their collector and base respectively at earth potential. When TR106 switches off, the collector of TR111 and unblanking grid rise rapidly towards HT potential until clamped by diode MR112 at the same voltage as the first anode. The beam is thus unblanked. TR112 is emitter coupled to TR111 forming a bistable which ensures that one of the pair is always conducting to maintain a constant load on the HT supply. The fast-edged pulse at the junction of R180 and 184 is fed to the PROBE TEST point for probe adjustment.

CATHODE RAY TUBE CIRCUIT - Figure Number 5

A 5 inch diagonal rectangular tube with helical post-deflection acceleration is used. Focus and push-pull deflection are electrostatic while trace rotation is magnetic, deflection unblanking is employed. Front panel controls RV301, 305 and 306 adjust for astigmatism, focus and brilliance respectively on the third and second anodes and the first grid.

The interplate shield potential is adjusted by RV302 for optimum geometry or freedom from bowing of the display.

RV405 & 410 adjust the current through the trace rotation coil to ensure alignment of a horizontal trace with the graticule, reversal of current and hence range of adjustment is effected by reversing a connecting plug.

The potentials on the blanking electrodes are provided by TR111 in the timebase circuit. During a sweep, or when TIME/CM is set to EXT X, the unblanking electrode (g2) and first anode are at the same potential. The unblanked electron beam then passes through the electron gun to activate the tube phosphor. In the absence of a sweep g2 is held negative to the anode and the beam is deflected off the screen.

Zener diode MR301 provides a low resistance path for the tube current.

External intensity modulation signals are fed to the first grid via C305.

POWER SUPPLIES - Figure Number 5

All voltages are derived from transformer T401 whose two primaries are connected in parallel for 100 to 125V operation and in series for 200 to 250V.

The L.T., H.T. and E.H.T. supplies, with the exception of the c.r.t. heater, are provided by a single tapped secondary. The c.r.t. heater is fed from a separate winding at -1kV d.c. to chassis.

L.T. The main -12V supply is obtained from half-wave rectifier MR404 which also supplies the nuvistor heaters via series stabiliser TR401 and current-sharing resistor R412. In addition, MR404 acts with MR405, C409 and 413 in a voltage-doubling circuit to provide the reference voltage across MR409 for TR401 and to provide a negative stabilised voltage for the vertical amplifier shift circuit. C409 is protected from over-voltage by R407 while R408 acts as a surge-limiter to protect MR405 from the charging current of C413.

The 14V transformer tapping is also used for the power-on lamp and for graticule illumination via RV406.

H.T. MR403 acts as a half-wave rectifier to provide the +105V supply via the trace rotation coil which forms part of the filter circuit. 104V a.c. is fed to the amplitude calibrator on the vertical amplifier circuit.

E.H.T. The negative tube supply of -1kV is obtained from MR406, 407 and 408 in series.

MR401 and 402 with C401, 402 and 403 form a voltage-doubling circuit to supply the P.D.A. anode with +3kV.

MAINTENANCE AND CALIBRATION PROCEDURES

GENERAL

It is desirable to check occasionally vertical amplifier balance and gain and timebase sweep speed. This should be done after the instrument has been operating for about 30 minutes, the internally generated calibration waveform may conveniently be used.

CHECK BALANCE

Set Y GAIN at X1, VOLTS/CM to .1, VARIABLE fully clockwise, DC AC to AC and other controls to give a convenient display.

Centre trace with Y SHIFT, switch Y GAIN to X10 and recentre trace with SHIFT BAL. Repeat until switching between X1 and X10 causes no trace shift.

With Y GAIN at X10 and trace centred, rotate VARIABLE fully anti-clockwise and recentre with VAR BAL. Rotate VARIABLE fully clockwise and recentre with SHIFT BAL. Repeat until rotation of VARIABLE causes no trace shift.

Recheck that operation of Y GAIN switch causes no trace shift.

CHECK GAIN

With Y GAIN at X1 and VARIABLE fully clockwise, link INPUT and CAL and adjust Y SET GAIN X1, at rear on S54, for 5 cm signal amplitude.

Switch VOLTS/CM to 1, Y GAIN to X10 and adjust Y SET GAIN X10 for 5 cm of display.

CHECK SWEEP SPEED

Set X GAIN fully anti-clockwise, TIME/CM to 10mS and VARIABLE fully clockwise. With INPUT and CAL linked adjust other controls for a locked display.

50Hz supply Adjust SET SPEED for 1 cycle in 2 cm.

60Hz supply Adjust SET SPEED for 3 cycles in 5 cm.

400Hz supply Switch TIME/CM to 1mS and adjust SET SPEED for 2 cycles in 5 cm.

Should a thorough recalibration of the various circuits of the instrument be required, details follow in the recalibration section.

MECHANICAL

Access to the interior of the instrument is gained in the S54 by loosening the screws attaching the carrying handle and sliding the tops of the side covers outwards. The covers can then be released from the locating slots at the bottom of the chassis. A removable plate at the bottom enables the TIME/CM switch presets to be adjusted. The rear cover is secured by four screws.

For tube removal the following procedure should be adopted, with suitable modifications for the S54R.

Ensure the instrument is disconnected from the mains.
Remove the left-hand side and rear covers.
Protect the eyes in case of tube implosion.
Unscrew the knurled nuts and remove bezel, graticule and light filter.
Disconnect the earth lead from the tube shield.
Unplug the trace rotation coil leads from the printed circuit board and remove the tube base socket.
Slacken the circular clamp at the rear of the shield.
Slide the tube assembly rearwards supporting the front end swinging this slightly outwards.
Unplug the P.D.A. anode connector.
Remove the rear clamp.
Rotate the assembly 90° clockwise and withdraw it forwards.
Slide off the shields and trace rotation coil.
Tube replacement is a reversal of the above procedure.

RECALIBRATION

Adoption of the procedure below will enable the performance of the various circuits to be optimised. When carrying out an individual step regard should be paid to relevant control settings in earlier steps.

TEST EQUIPMENT REQUIRED

Telequipment Type C1 Oscilloscope Calibrator
75Ω or appropriate termination
0-250V d.c. voltmeter, 20kΩ/V or better
Test oscilloscope with calibrated vertical sensitivity, any bandwidth

If Type C1 is not available, Tektronix Type 106 Squarewave Generator, with 50Ω termination, and Type 184 Time-mark Generator or suitable alternatives should be used.

VERTICAL DEFLECTION SYSTEM

VERTICAL AMPLIFIER	Steps 1 - 7
CALIBRATOR	8
INPUT ATTENUATOR	9 - 12
PROBE COMPENSATION	13 & 14

Omit step 8 unless an accurate amplitude calibrator has been used for step 3.
Omit steps 13 & 14 if a high impedance probe is not available.
A generator with approximately 5ns or better risetime is required for steps 5 to 7.

1. Y DC BALANCE

Set Y GAIN at X1, VOLTS/CM to .1, VARIABLE fully clockwise, DC AC to AC and other controls to give a convenient display.

Centre trace with Y SHIFT, switch Y GAIN to X10 and recentre trace with SHIFT BAL. Repeat until switching between X1 and X10 causes no trace shift.

With Y GAIN at X10 and trace centred, rotate VARIABLE fully anti-clockwise and recentre with VAR BAL. Rotate VARIABLE fully clockwise and recentre with SHIFT BAL. Repeat until rotation of VARIABLE causes no trace shift.

Recheck that operation of Y GAIN switch causes no trace shift.

2. Y PLATE POTENTIAL

Reset VARIABLE fully clockwise, set TIME/CM to 1ms. Feed a 500mV p.-p. 1kHz squarewave into INPUT. Adjust RV55 for square corner.

3. Y SET GAIN X1

Adjust RV46 for 5cm amplitude.

4. Y SET GAIN X10

Reduce input to 50mV and set Y GAIN to X10. Adjust RV49 for 5cm amplitude. Reset Y GAIN to X1.

5. HF COMPENSATION

Set TIME/CM to 0.2μS and feed in a 1MHz squarewave via appropriate termination, 75Ω for type C1. Adjust C28 and RV61 for best pulse response.

6. OUTPUT STAGE NEUTRALISING

Reduce amplitude of input and switch Y GAIN to X10. Adjust neutralising leads from bases of TR24 and 25 for best pulse response.

7. Switch Y GAIN to X1, increase input and repeat step 5.

8. SET CALIBRATION

Set TIME/CM to 10mS and feed CAL 0.5V p.p. into INPUT. Adjust RV36 for 5cm deflection.

9. ATTENUATOR COMPENSATION

Reset TIME/CM to 500μS, set VOLTS/CM to .2, turn VARIABLE fully anti-clockwise and apply a 1V 1kHz squarewave to INPUT. Adjust C10 for square corner. (C10, 12, 2, 8, 11, 5, 3 and 6 are accessible from underneath).

10. INPUT STAGE COMPENSATION

Turn VARIABLE fully clockwise. Adjust C22 for square corner.

11. Repeat 9 and 10 until adjustment of VARIABLE has no effect.

12. ATTENUATOR COMPENSATION

Return VARIABLE fully clockwise. Adjust appropriate trimmer for square corner with VOLTS/CM and input levels as undernoted:-

VOLTS/CM	Input V p.-p.	Adjust C
.5	2.5	12
1	5	2
2	10	8
5	25	11
10	50	5

13. PROBE COMPENSATION

Connect probe between INPUT and calibrator, set VOLTS/CM to .1 and set 1kHz squarewave amplitude for 5cm deflection, 5V for X10 probe. Adjust trimmer on probe for square corner.

14. ATTENUATOR COMPENSATION FOR PROBE

Switch VOLTS/CM to 1 and with 50V p.-p. squarewave, adjust C3 for square corner. Switch VOLTS/CM to 10 and with 100V p.-p. squarewave, adjust C6 for square corner.

HORIZONTAL DEFLECTION SYSTEM

HORIZONTAL AMPLIFIER	Steps 15 - 17
SWEEP GENERATOR	18 - 21
TRIGGER CIRCUIT	22 & 23

15. X PLATE POTENTIAL

Set TIME/CM to EXT X, VARIABLE fully clockwise, X GAIN fully anticlockwise and centre spot with X AND Y SHIFTS.

(1) Connect voltmeter between collectors of TR109 and 110 and adjust X SHIFT for 0V.
(2) Measure and note voltage of 105V line.

(3) Connect voltmeter, on same range as in (2), between either collector and chassis and adjust RV178 for half the voltage found in (2) plus 2.5V (nominally 105/2 + 2.5 = 55V).
(4) Repeat (1) and (3) until correct adjustment is obtained.

16. X DC BALANCE
Centre spot by X SHIFT and adjust RV181 so that rotation of X GAIN does not shift spot.

17. INPUT COMPENSATION
With no Y input, set X GAIN fully clockwise and feed a 2.5V 10kHz squarewave into EXT X. Adjust C118 for no under- or overshoot. (C118 and C286 in step 21 are accessible through trap under instrument). Reset X GAIN fully anti-clockwise.

18. HOLD-OFF TIME
Set TIME/CM to 500μS and STABILITY fully clockwise. Inspect waveform at SAWTOOTH OUT with test oscilloscope and adjust RV141 to make waiting time equal to flyback time.

19. SET SPEED
Check TIME/CM is set to 500μS, VARIABLE is fully clockwise and X GAIN fully anti-clockwise. Feed in 1ms time markers or an accurate 1kHz squarewave. Adjust RV161 SET SPEED for 1 marker or 1 cycle every 2cm.

20. TIME BASE LENGTH
Adjust RV147 for approximately 11cm sweep length.

21. SET 0.2μs/cm
Set TIME/CM to 0.2μS and feed in 1μs markers or an accurate 1MHz squarewave. Adjust C286 for 1 marker or 1 cycle in 5cm.

22. TRIGGER SENSITIVITY and SET AUTOMATIC
With no input, switch TRIG LEVEL to AUTO, turn STABILITY fully anti-clockwise, switch TRIG SELECTOR to EXT TRIG and short this terminal to earth. Inspect the waveform at the base of TR103 with the test oscilloscope set to 10ms/cm. Adjust RV132 to give a 100mV triangular waveform and adjust RV114 to make this waveform symmetrical. These settings are critical, so in the event of serious maladjustment or component change the procedure in step 23 should be followed.

23. With conditions for step 22, set RV132 fully anti-clockwise. Slowly rotate RV114 and adjust to the centre of the region of continuous HF oscillation. Gradually adjust RV132 to the point where the HF oscillation is replaced by a triangular waveform. If the HF oscillation is not replaced by the triangular waveform, RV114 should be readjusted. Adjust RV132 and 114 as in step 22.

CATHODE RAY TUBE CIRCUIT

24. TRACE ROTATION

Set TIME/CM to 500μS, STABILITY fully clockwise and RV405 TRACE ROTATION to mid-range. Centre trace with shift controls and adjust RV410 PRESET TRACE ROTATION for best alignment of trace with horizontal graticule line. Adjust RV405 TRACE ROTATION for final alignment of trace with line.

25. SET I.P.S.

Shifting trace to top and bottom of screen, adjust RV302 for minimum bowing with respect to top and bottom graticule lines.

COMPONENT LIST

The S54 and S54R have identical components except for those preceded by an asterisk.

All resistor and capacitor values are in ohms and microfarads unless otherwise stated; ratings in watts and volts respectively are at 70°C.

Carbon resistors are 10% and ¼W unless otherwise shown.

Whenever possible exact replacements for components should be used; these may be ordered from the company or its agents stating:

1. Instrument type
2. Instrument serial number
3. Component circuit reference
4. Component part number
5. Component value

Locally available alternatives may be satisfactorily for standard components.

ABBREVIATIONS

C	Carbon composition
CER	Ceramic
CP	Carbon preset
CT	Ceramic trimmer
CV	Carbon variable
E	Electrolytic
Ge	Germanium
HS	High-stability carbon
MF	Metal film
MO	Metal oxide
PE	Polyester
PS	Polystyrene
Se	Selenium
Si	Silicon
SM	Silver mica

TELEQUIPMENT LTD
313 Chase Road
Southgate
LONDON, N.14.

TELEPHONE: 01-882 1166
CABLES: TELEQUIPT LONDON N 14

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R1	319-0005-01	900k	HS	1	¼
R2	319-0096-00	111k	HS	1	¼
R3	319-0119-00	990k	HS	1	¼
R4	319-0120-00	10.1k	HS	1	¼
R5	319-0112-00	500k	HS	1	¼
R6	319-0031-01	1M	HS	1	¼
R7	319-0118-00	800k	HS	1	¼
R8	319-0103-00	250k	HS	1	¼
R9	319-0031-01	1M	HS	1	¼
R21	316-0104-01	100k	C		
R22	316-0101-01	100	C		
R23	315-0561-01	560	C	5	¼
R24	315-0242-01	2.4k	C	5	¼
RV25	311-0846-00	1k	CP	20	0.1
RV26	311-0847-00	1k	CV	20	¼
R27	315-0242-01	2.4k	C	5	¼
R28	316-0102-01	1k	C		
R29	315-0561-01	560	C	5	¼
R30	307-0186-00	22M	C	20	¼
R31	316-0101-01	100	C		
R32	316-0275-01	2.7M	C		
R33	316-0684-01	680k	C		
R34	316-0106-01	10M	C		
R35	316-0275-01	2.7M	C		
RV36	311-0798-00	2.2k	CP	20	¼
R37	319-0105-00	3.6k	HS	1	¼
R38	322-0670-00	100k	MF	5	¼
RV39)	311-0857-00	(25k	CV	20	2
RV40)		(500k	CV	20	2
R41	316-0333-01	33k	C		
R42	316-0154-01	150k	C		
R43	316-0154-01	150k	C		
R44	316-0221-01	220	C		
R45	316-0221-01	220	C		
RV46	311-0727-00	1k	CP	20	¼
* RV46R	311-0846-00	1k	CP	20	0.1
R47	316-0680-01	68	C		
R48	316-0121-01	120	C		
RV49	311-0848-00	5k	CP	20	¼
* RV49R	311-0872-00	5k	CP	20	¼
R50	316-0475-01	4.7M	C		
R51	316-0152-01	1.5k	C		
R52	316-0121-01	120	C		
R53	316-0103-01	10k	C		
R54	316-0103-01	10k	C		
RV55	311-0717-00	220	CP	20	¼
R56	316-0101-01	100	C		
R57	316-0680-01	68	C		

* S54R only

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R58	316-0222-01	2.2k	C		
R59	316-0222-01	2.2k	C		
RV60	311-0849-00	500k	CP	20	0.1
RV61	311-0712-00	100	CP	20	¼
R62	316-0121-01	120	C		
R63	303-0202-01	2k	C	5	1
R64	303-0202-01	2k	C	5	1
R65	316-0331-01	330	C		
R66	316-0331-01	330	C		
R67	303-0102-01	1k	C	5	1
R101	316-0104-01	100k	C		
R102	316-0183-01	18k	C		
R103	316-0183-01	18k	C		
R104	316-0182-01	1.8k	C		
R105	316-0333-01	33k	C		
R106	316-0273-01	27k	C		
R107	316-0223-01	22k	C		
R108	316-0823-01	82k	C		
R109	316-0184-01	180k	C		
R111	316-0272-01	2.7k	C		
R112	316-0183-01	18k	C		
R113	316-0272-01	2.7k	C		
RV114	311-0850-00	15k	CP	20	¼
RV115	311-0859-00	10k	CV (with RV138 & S102)	20	¼
R116	316-0183-01	18k	C		
R117	316-0272-01	2.7k	C		
R118	316-0184-01	180k	C		
R119	316-0823-01	82k	C		
R121	316-0333-01	33k	C		
R122	316-0273-01	27k	C		
R123	316-0223-01	22k	C		
R124	316-0224-01	220k	C		
R125	316-0154-01	150k	C		
R126	316-0393-01	39k	C		
R127	316-0272-01	2.7k	C		
R128	316-0223-01	22k	C		
R129	316-0331-01	330	C		
R130	316-0392-01	3.9k	C		
R131	316-0222-01	2.2k	C		
RV132	311-0717-00	220	CP	20	¼
R133	316-0682-01	6.8k	C		
R134	316-0471-01	470	C		
R135	316-0103-01	10k	C		
R136	316-0124-01	120k	C		
R137	316-0222-01	2.2k	C		
RV138	311-0859-00	25k	CV (with RV115 & S102)	20	¼
R139	316-0683-01	68k	C		
R140	316-0331-01	330	C		
RV141	311-0801-00	470k	CP	20	¼

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R142	316-0684-01	680k	C		
R143	316-0273-01	27k	C		
R144	316-0224-01	220k	C		
R145	316-0273-01	27k	C		
R146	316-0681-01	680	C		
RV147	311-0851-00	1k	CP	20	¼
R148	316-0103-01	10k	C		
R149	316-0223-01	22k	C		
R150	316-0100-01	10	C		
R151	316-0103-01	10k	C		
R152	316-0274-01	270k	C		
R153	316-0101-01	100	C		
R154	316-0180-01	18	C		
R155	316-0271-01	270	C		
R156	316-0472-01	4.7k	C		
R157	303-0153-01	15k	C	5	1
R158	316-0125-01	1.2M	C		
R159	316-0684-01	680k	C		
RV161	311-0852-00	10k	CP	20	0.1
R162	316-0183-01	18k	C		
R163	316-0105-01	1M	C		
R164	307-0186-00	22M	C	20	¼
R165	316-0564-01	560k	C		
RV166)	311-0858-00	(5k	CV	20	2
RV167)		(5k	CV	20	2
R168	316-0562-01	5.6k	C		
R169	316-0123-01	12k	C		
R171	316-0122-01	1.2k	C		
R172	302-0333-01	33k	C	10	½
R173	316-0222-01	2.2k	C		
R174	307-0143-00	5.6k	MO	5	1½
R175	307-0143-00	5.6k	MO	5	1½
R176	316-0121-01	120	C		
R177	316-0561-01	560	C		
RV178	311-0717-00	220	CP	20	¼
R179	316-0104-01	100k	C		
R180	316-0102-01	1k	C		
RV181	311-0851-00	1k	CP	20	¼
R182	316-0331-01	330	C		
R183	316-0180-01	18	C		
R184	301-0113-01	11k	C	5	½
R185	319-0091-00	1.5k	HS	1	¼
R186	316-0103-01	10k	C		
R187	316-0223-01	22k	C		
R188	307-0144-00	10k	MO	5	1½
R276	319-0097-00	750k	HS	1	¼
R277	319-0131-00	375k	HS	1	¼
R278	319-0132-00	225k	HS	1	¼
R279	319-0070-01	75k	HS	1	¼

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R281	319-0133-00	37.5k	HS	1	¼
R282	319-0133-00	37.5k	HS	1	¼
R283	315-0243-02	24k	C	5	¼
R284	315-0752-02	7.5k	C	5	¼
R285	316-0222-01	2.2k	C		
R286	316-0102-01	1k	C		
R287	315-0363-01	36k	C	5	¼
RV288	311-0853-00	50k	CV	20	¼
R289	316-0823-01	82k	C		
RV301	311-0854-00	100k	CV	20	0.1
* RV301R	311-0878-00	100k	CV (with RV406R)	20	2
RV302	311-0765-00	100k	CP	20	¼
R303	316-0155-01	1.5M	C		
R304	316-0334-01	330k	C		
RV305)	311-0855-00	(1M	CV) (with S401)	(20	¼
RV306)		(1M	CV)	(20	¼
* RV305R)	311-0824-00	(1M	CV) (with S401R)	(20	¼
* RV306R)		(1M	CV)	(20	¼
R307	316-0334-01	330k	C		
R308	316-0105-01	1M	C		
R309	316-0106-01	10M	C		
R401	316-0684-01	680k	C		
R402	302-0121-01	120	C	10	½
R403	316-0270-01	27	C		
R404	316-0221-01	220	C		
RV405	311-0856-00	100	CP	20	1
RV406	311-0856-00	100	CP	20	1
* RV406R	311-0878-00	100	CV (with RV301R)	20	2
R407	316-0151-01	150	C		
R408	316-0471-01	470	C		
RV410	311-0712-00	100	CP	20	¼
R411	316-0154-01	150k	C		
R412	302-0270-01	27	C	10	½
R413	316-0220-01	22	C		
R414	316-0270-01	27	C		
R415	316-0270-01	27	C		
C1	285-0772-00	0.1	PE	10	400
C2	281-0137-00	6-30p	CT		350
C3	281-0137-00	6-30p	CT		350
C4	285-0854-00	100p	PS	2p	350
C5	281-0137-00	6-30p	CT		350
C6	281-0137-00	6-30p	CT		350
C7	285-0850-00	1,000p	PS	5	125
C8	281-0137-00	6-30p	CT		350
C9	283-0653-00	5p	SM	10	350
C10	281-0137-00	6-30p	CT		350
C11	281-0137-00	6-30p	CT		350

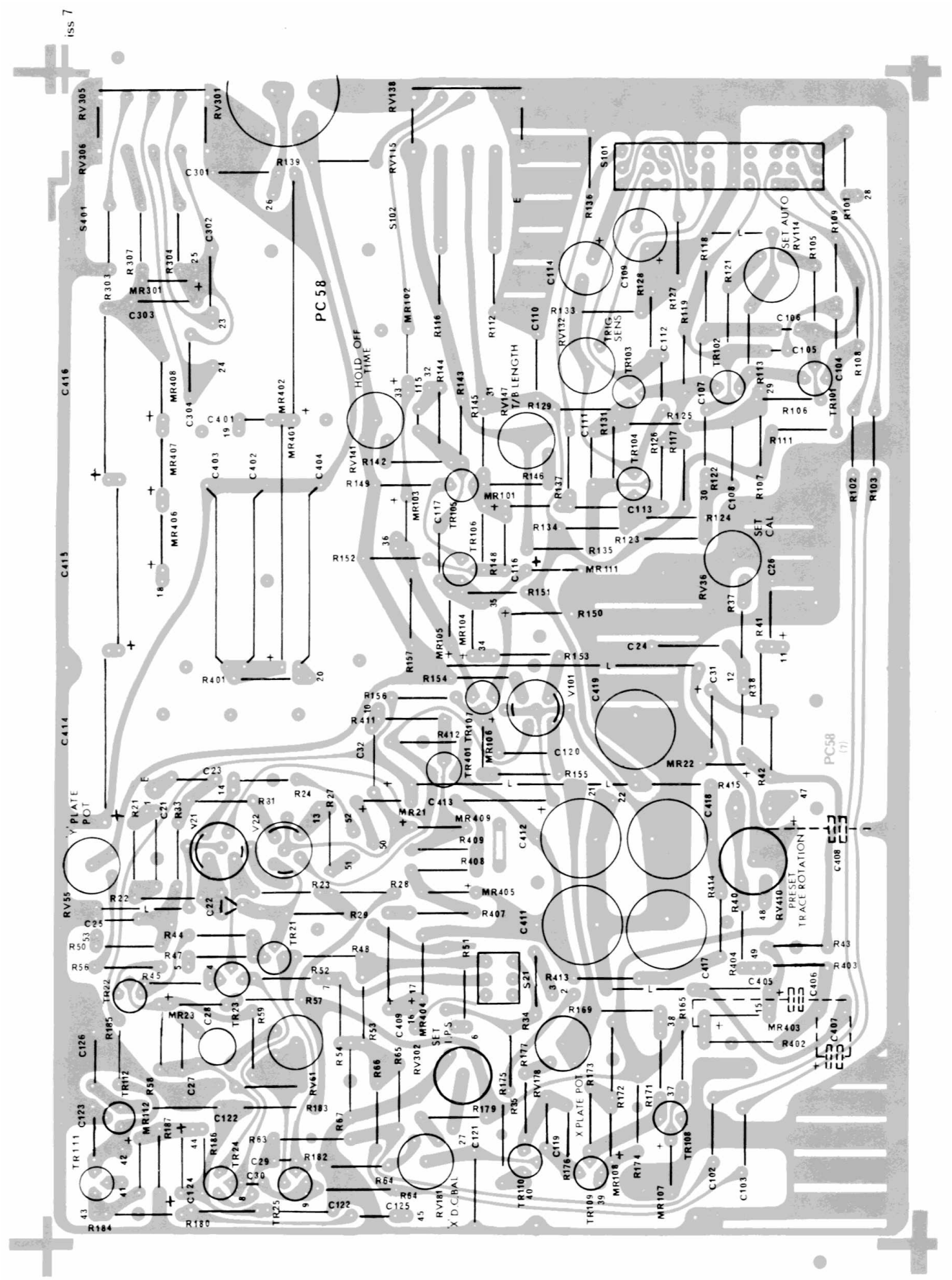
* S54R only

Cct. ref.	Part number	Value	Description	Tol. %	Rating
C12	281-0137-00	6-30p	CT		350
C13	285-0842-00	15p	PS	1p	350
C21	285-0769-00	0.01	PE	20	400
C22	281-0133-00	1-6p	CT		500
C23	285-0799-00	0.033	PE	20	250
C24	285-0783-00	2,200p	PE	20	400
C25	285-0836-00	0.047	PE	20	250
C26	290-0355-00	5	E		64
C27	285-0760-00	330p	PS	5	125
C28	281-0134-00	10-60p	CT		500
C29	281-0676-00	2.2p	CER	0.1p	500
C30	281-0676-00	2.2p	CER	0.1p	500
C31	290-0355-00	5	E		64
C32	290-0355-00	5	E		64
C101	285-0772-00	0.1	PE	10	400
C102	285-0779-00	0.47	PE	20	100
C103	285-0779-00	0.47	PE	20	100
C104	285-0761-00	0.015	PE	20	400
C105	281-0678-00	3p	CER	0.1p	500
C106	281-0678-00	3p	CER	0.1p	500
C107	285-0761-00	0.015	PE	20	400
C108	285-0779-00	0.47	PE	20	100
C109	290-0354-00	100	E		12
C110	285-0796-00	0.1	PE	20	250
C111	285-0854-00	100p	PS	2p	350
C112	285-0850-00	1,000p	PS	5	125
C113	285-0873-00	200p	PS	5	350
C114	290-0354-00	100	E		12
C115	281-0676-00	2.2p	CER	0.1p	500
C116	285-0867-00	20p	PS	1p	500
C117	285-0867-00	20p	PS	1p	500
C118	281-0137-00	6-30p	CT		350
C119	285-0873-00	200p	PS	5	350
C120	285-0867-00	20p	PS	1p	500
C121	285-0783-00	2,200p	PE	20	400
C122	285-0796-00	0.1	PE	20	250
C123	285-0850-00	1,000p	PS	5	125
C124	290-0355-00	5	E		64
C125	285-0761-00	0.015	PE	20	400
C126	285-0874-00	470p	PS	5	125
C276	285-0874-00	470p	PS	5	125
C277	285-0792-00	4,700p	PE	20	125
C278	285-0836-00	0.047	PE	20	250
C279	285-0791-00	0.47	PE	10	125
C281	285-0869-00	47p	PS	2p	350
C282	285-0762-00	450p	PS	1	125
C283	285-0770-00	4,700p	PS	1	125
C284	285-0771-00	0.047	PE	2	63
C285	285-0774-00	0.47	PE	2	63

Cct. ref.	Part number	Value	Description	Tol. %	Rating
C286	281-0137-00	6-30p	CT		350
C287	285-0775-00	4.7	PE	2	63
C288	285-0776-00	27p	PS	1p	500
C289	285-0769-00	0.01	PE	20	400
C291	285-0769-00	0.01	PE	20	400
C301	285-0796-00	0.1	PE	20	250
C302	285-0796-00	0.1	PE	20	250
C303	285-0796-00	0.1	PE	20	250
C304	285-0773-00	0.1	PE	20	400
C305	281-0677-00	0.01	CER		1.5k
C306	285-0843-00	30p	PS	2p	350
C401	281-0682-00	0.02	CER		2k
C402	281-0681-00	0.01	CER		4k
C403	281-0681-00	0.01	CER		4k
C404	281-0681-00	0.01	CER		4k
C405	285-0796-00	0.1	PE	20	250
C406	290-0400-00	280	E		150
C407	290-0400-00	280	E		150
C408	290-0400-00	280	E		150
C409	290-0401-00	25	E		30
C411	290-0402-00	1,000	E		18
C412	290-0402-00	1,000	E		18
C413	290-0401-00	25	E		30
C414	290-0364-00	16	E		450
C415	290-0364-00	16	E		450
C416	290-0364-00	16	E		450
C417	290-0402-00	1,000	E		18
C418	290-0402-00	1,000	E		18
C419	290-0402-00	1,000	E		18
F401	159-0077-00	0.25A	1¼ in delay 200 - 250V		
	159-0079-00	0.5A	1¼ in delay 100 - 125V		
L401	108-0494-00	100 ohm	Trace rotation coil (580 turns)		
LP401	150-0080-00	14V	L.E.S.		0.56W
LP402	150-0081-00	14V	Capless		0.75W
LP403	150-0081-00	14V	Capless		0.75W
MR21	152-0348-00	6.2V	Si zener	5	0.33W
MR22	152-0346-00	11V	Si zener	5	0.33W
MR23	152-0062-01		1N914 Si		
MR101	152-0062-01		1N914 Si		
MR102	152-0062-01		1N914 Si		
MR103	152-0062-01		1N914 Si		
MR104	152-0343-00		1N914T Si		
MR105	152-0370-00		AAY30 Ge		
MR106	152-0062-01		1N914 Si		
MR107	152-0062-01		1N914 Si		
MR108	152-0062-01		1N914 Si		

Cct. ref.	Part number	Value	Description	Tol. %	Rating
MR111	152-0062-01		1N914 Si		
MR112	152-0062-01		1N914 Si		
MR301	152-0344-00	100V	Si zener	5	0.33W
MR401	152-0374-00	3.4kV	Se rectifier		0.6mA
MR402	152-0374-00	3.4kV	Se rectifier		0.6mA
MR403	152-0341-00	450V	Si rectifier		0.5A
MR404	152-0339-00	50V	Si rectifier		0.5A
MR405	152-0062-01		1N914 Si		
MR406	152-0352-00	800V	Si rectifier		0.2A
MR407	152-0352-00	800V	Si rectifier		0.2A
MR408	152-0352-00	800V	Si rectifier		0.2A
MR409	152-0372-00	13V	Si zener	5	0.33W
S1	260-0926-00		Slide (2-position)		
S2	260-0934-00		Rotary (9-position)		
S21	260-0973-00		Push (1-button)		
S101	260-0994-00		Push (5-button)		
S102	311-0859-00		Rotary (with RV115 & 138)		
S276	260-0995-00		Rotary (23-position)		
S401	311-0855-00		Rotary (with RV305 & 306)		
* S401R	311-0824-00		Rotary (with RV305R & 306R)		
T401	120-0565-00		Transformer		
TR21	151-0255-00		TO/00103 Motorola Si PNP		
TR22	151-0255-00		TO/00103 Motorola Si PNP		
TR23	151-0255-00		TO/00103 Motorola Si PNP		
TR24	151-0255-00		TO/00103 Motorola Si PNP		
TR25	151-0255-00		TO/00103 Motorola Si PNP		
TR101	151-0255-00		TO/00103 Motorola Si PNP		
TR102	151-0255-00		TO/00103 Motorola Si PNP		
TR103	151-0255-00		TO/00103 Motorola Si PNP		
TR104	151-0255-00		TO/00103 Motorola Si PNP		
TR105	151-0255-00		TO/00103 Motorola Si PNP		
TR106	151-0255-00		TO/00103 Motorola Si PNP		
TR107	151-0242-00		SPS2506 Motorola Si NPN		
TR108	151-0242-00		SPS2506 Motorola Si NPN		
TR109	151-0257-00		U15581/1 SGS-Fairchild Si NPN		
TR110	151-0257-00		U15581/1 SGS-Fairchild Si NPN		
TR111	151-0257-00		U15581/1 SGS-Fairchild Si NPN		
TR112	151-0257-00		U15581/1 SGS-Fairchild Si NPN		
TR401	151-0243-00		ACY22 Mullard Ge PNP		
V21	154-0533-00		13CW4 RCA		
V22	154-0533-00		13CW4 RCA		
V101	154-0533-00		13CW4 RCA		
CRT	154-0542-00		D13-47GH P31 (standard)		
	154-0560-00		D13-47GM P7		
	154-0561-00		D13-47BE P11		

* S54R only


PC58
Iss 7
HOLD OFF TIME
T/B LENGTH
TRIG SENS
SET AUTO
SET CAL
PRESET TRACE ROTATION
Y PLATE POT
X PLATE POT
X D.C.BAL
SET I.P.S

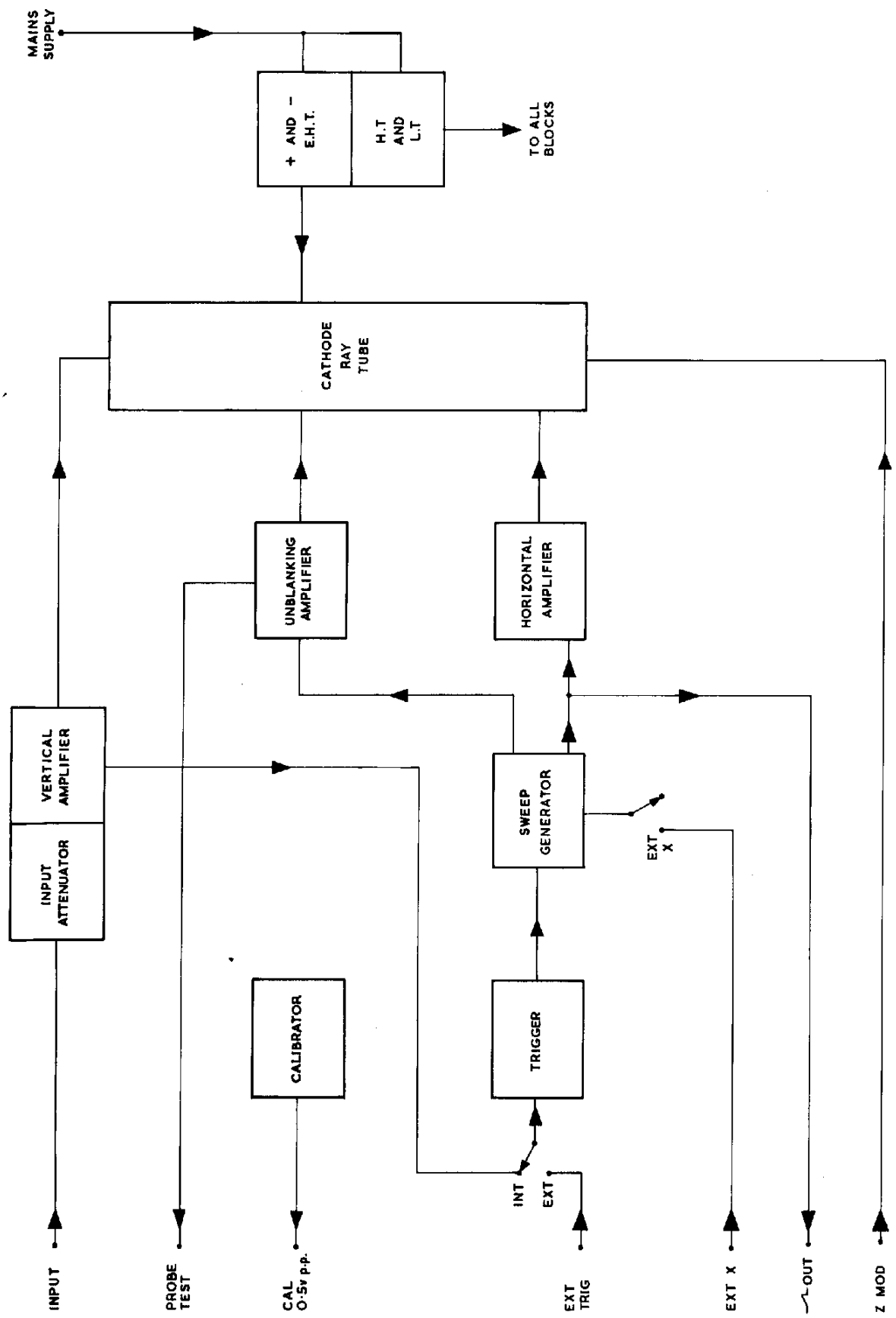
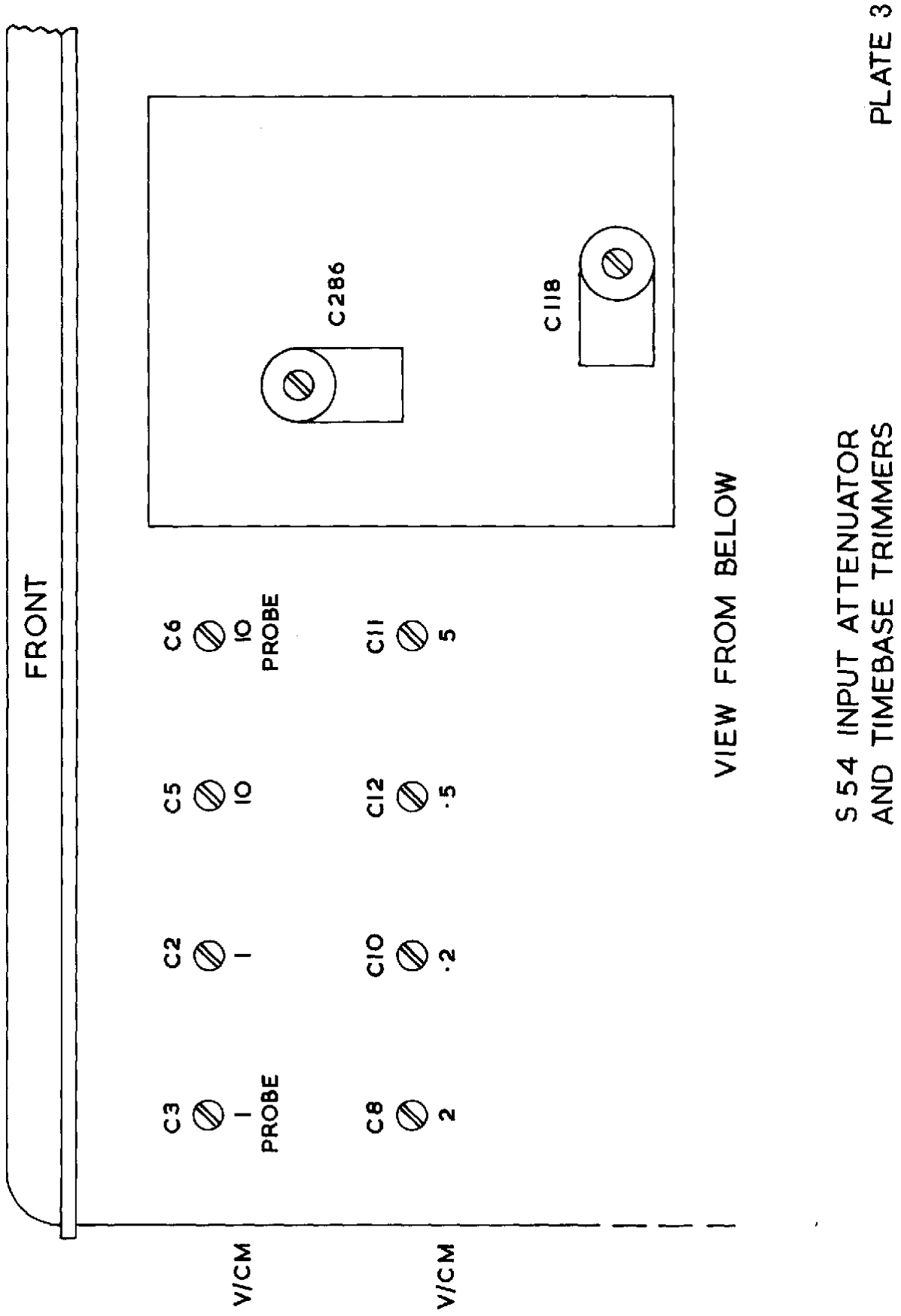
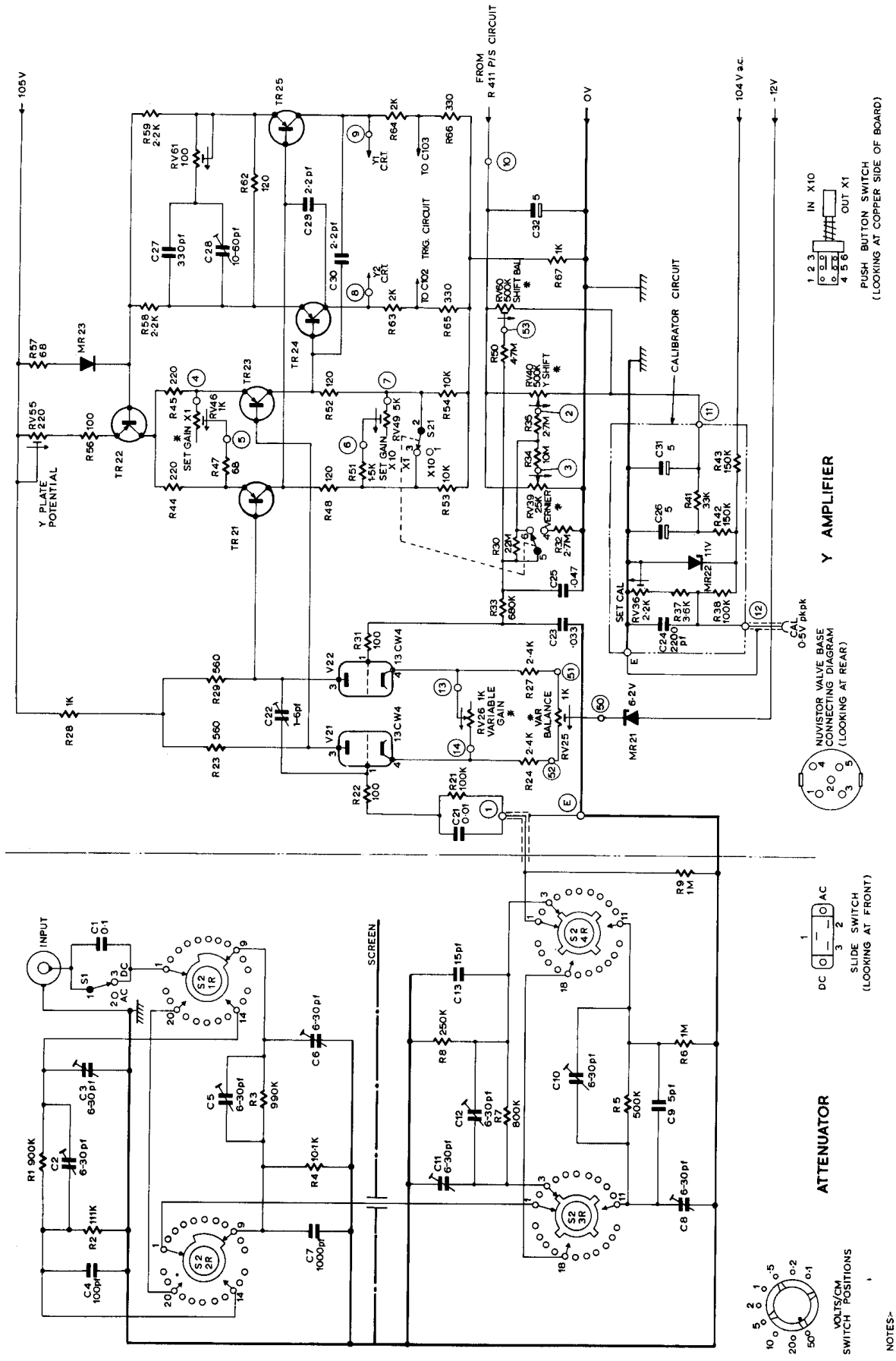


FIGURE 1

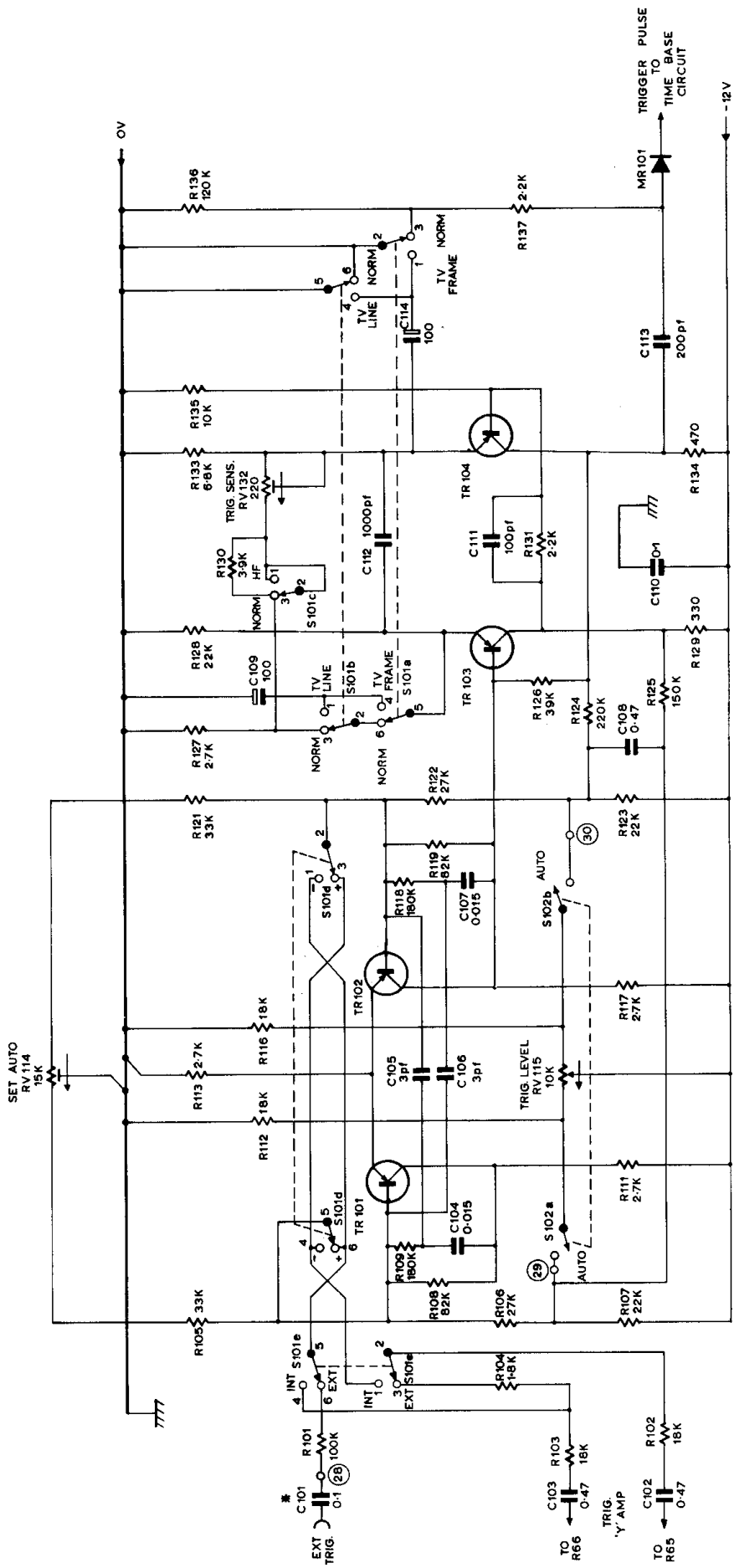
S54 S54R BLOCK DIAGRAM





Y AMPLIFIER & ATTENUATOR CIRCUIT. FIG. 2.

NOTES:-
1. AMPLIFIER COMPONENTS DESIGNATED THUS * AND ATTENUATOR COMPONENTS NOT MOUNTED ON PRINTED CIRCUIT BOARD P.C. 58
2. (No) DENOTES TAG NUMBERS ON PRINTED CIRCUIT BOARD P.C. 58
3. a) S1 SHOWN IN D.C. POSITION
   b) S2 SHOWN IN FULLY ANTICLOCKWISE POSITION i.e. 50V/CM
   c) S21 SHOWN IN X1 POSITION
4. ARROWS ⟶ ON POTENTIOMETERS INDICATE CLOCKWISE SENSE OF DIRECTION



NOTES:-

1. ✱ DENOTES COMPONENTS NOT MOUNTED ON PRINTED CIRCUIT BOARD P.C.58
2. (N) DENOTES TAG NUMBERS ON PRINTED CIRCUIT BOARD P.C.58
3. S101 a-e SHOWN IN THE OUT POSITION
4. ARROWS ⟶ ON POTENTIOMETERS INDICATES CLOCKWISE SENSE OF CONTROL

TRIG SELECTOR OUT / IN

NORMAL: TV FRAME / TV LINE / HF / - / INT

EXT

S101 a	1 2 3 / 4 5 6
S101 b	PUSH BUTTON SWITCH (LOOKING AT COPPER SIDE OF BOARD)
S101 c	
S101 d	
S101 e	

TRIGGER CIRCUIT

FIG. 3

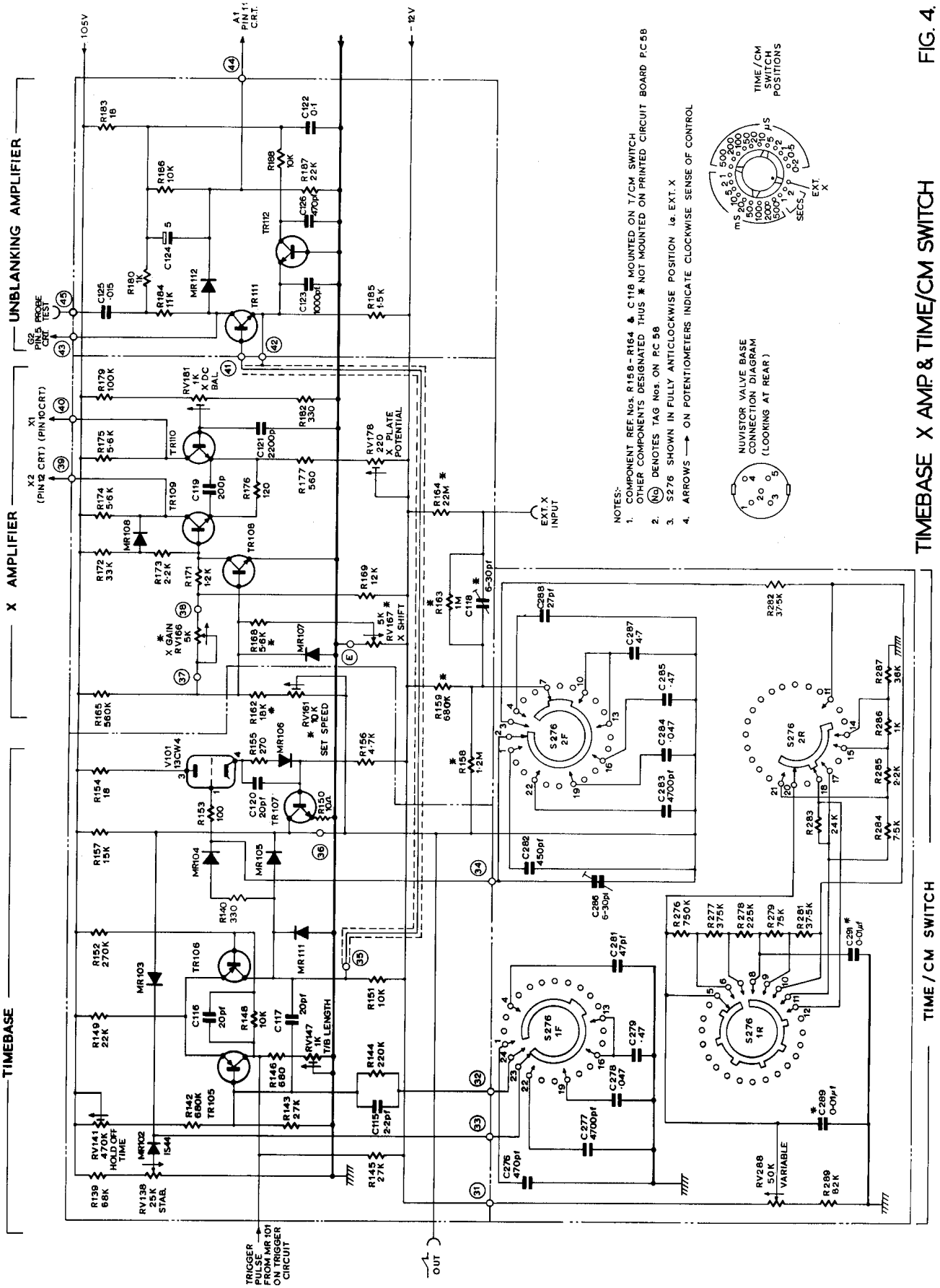


FIG. 4.