O S C I L L O S C O P E

T Y P E D 5 5 A

GENERAL DESCRIPTION

OPERATING AND MAINTENANCE

MANUAL

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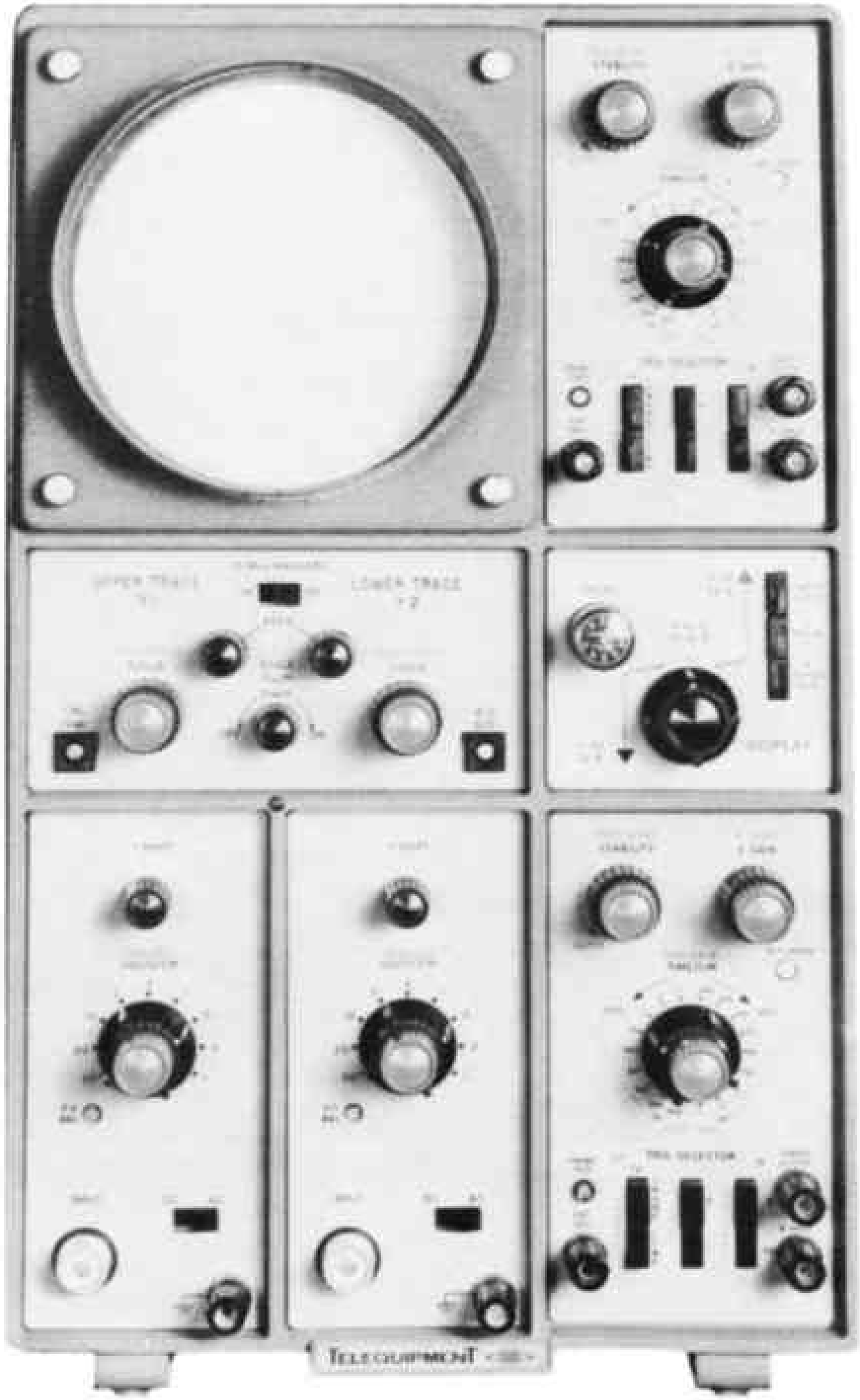


OSCILLOSCOPE TYPE D55A PLATE .I.

CHAPTER 1.

GENERAL DESCRIPTION, SPECIFICATION, FIRST TIME OPERATION

1. GENERAL DESCRIPTION

The D55A is a double-beam instrument, with two identical time-bases, "A" and "B". A versatile switching arrangement enables either timebase to be coupled to either beam, or alternatively enables both beams to be coupled to one timebase. Alternatively, timebase "B" can be switched to trigger timebase "A". The point at which timebase "A" is triggered can be varied by a delay pick-off control, calibrated from 0-100.

Thus the instrument has a unique facility whereby a signal displayed on the lower beam has a bright-up marker superimposed on it. This marker may be moved over the entire length of the trace by the delaying sweep control; the portion of the signal covered by the marker is determined by the setting of the main sweep and is simultaneously displayed across the entire length of the upper trace.

A special 5" Spiral PDA C.R. tube, with a double-gun assembly, ensures that both traces are completely independent. This enables both a completed waveform and a selected and magnified part of it to be displayed simultaneously. The double-gun assembly also eliminates the need for "chopper circuits", which are normally used when the phase relationship between waveforms is being examined.

In addition, the instrument is ideally suitable for use as a general purpose oscilloscope where a large display is required.

Twin High Gain D.C. Coupled Amplifiers

Each has a total of eight stages, including interstage and output cathode-followers. The amplifiers are free from drift, have equal D.C. and A.C. gain and are compensated for optimum pulse response.

Accurate Calibrated Input Attenuators

Give direct reading of input voltages A.C. and D.C. from 100 mV/cm to 50 V/cm. All D.C. to 15 Mc/s.

A 10 Mc/s triggered marker is provided for accurate measurement of rise times to 1/10th of a microsecond. This is available when using the upper beam, and the trace is displayed by Timebase "A".

High Quality Components

"C" core mains transformer and latest high efficiency valves ensure complete reliability and long periods of service between maintenance.

Unique System of Construction

Ensures adequate cooling under continuous operating conditions in addition to ensuring maximum accessibility for easy maintenance.

2. SPECIFICATION

2.1. Timebases

Two identical Timebases, "A" and "B" are provided, each with:

18 Pre-set calibrated Sweep Speeds.

500, 200, 100, 50, 20, 10, 5, 2 and 1 milliseconds per cm.	at minimum "X" expansion.
500, 200, 100, 50, 20, 10, 5, 2 and 1 microseconds per cm.	

Variable control covering intermediate speeds.

Slower speeds can be obtained by internal adjustment.

Time measurement accuracy $\pm$ 10%.

Timebase "A" may be switched to both traces or to the upper one only. In the latter case, the lower trace is coupled to Timebase "B".

Similarly, Timebase "B" may be switched to both traces, or to the lower one only.

2.2 "X" Expansion

Continuously variable up to 10 screen diameters (100 cms.) approx. Trace expands symmetrically about centre of screen. "X" - Shift - Control positions any portion of expanded trace on screen. Both these facilities are available for Timebases "A" and "B".

2.3 D.C. Coupled Trace Bright Up

Ensures uniform trace brightness at slow sweep speeds.

2.4 Triggering

Two modes of triggering are provided:

(1) Auto. On this setting the sweep free runs at a slow speed in the absence of an input signal, but is triggered automatically as soon as an input signal is applied.

(2) Trigger Level Selection. With the AUTO switch off, the TRIG LEVEL control allows the sweep to be triggered from any part of the slope of the input waveform.

2.5 Trigger Selection

Selector switches enable the timebases to be triggered from the output of either Vertical Deflection Amplifier, positive or negative; or from an EXTERNAL input, positive or negative.

2.5.1 H.F. Triggering

A special H.F. switch position gives good synchronization from high frequency input signals between 1 Mc/s and 15 Mc/s.

2.5.2 TV Sync. Separator

The built-in TV Sync. Separator enables the sweep to be triggered from the LINE or FRAME pulses of a composite TV waveform.

2.5.3 Delay

The DISPLAY switch, when set to

Y1 by "A"
Y2 by "B"

with the push button set to "A" delayed by "B", allows timebase "B" to be triggered by timebase "A". Under these conditions, the "A" timebase produces a brightening pulse which is added to the "B" timebase trace, so that the position of the delayed sweep can be seen.

2.6 Trigger Level Control

Allows any point on the synchronizing waveform, (repetitive, random or single shot) to be selected for triggering the timebase. A similar control is available for either timebase "A" or "B".

2.7 Cathode Ray Tube

5" flat-faced, double-gun, tube, operated at 6 KV overall. Screen phosphor P1 fitted as standard, removable filters are fitted to improve contrast at high ambient illumination.

10 x 6 cms "X" and "Y" deflection with 4 cms of overlap.

2.8 Illuminated Graticule

Edge-lit Illuminated Graticule facilitates accurate measurements. A front panel control varies illumination intensity.

2.9 Y Amplifiers

Frequency Response	D.C. to 15 Mc/s (approx. - 3dB) adjusted for optimum pulse response.
Maximum Sensitivity	100 mV/cm. at all frequencies.
Rise Time	0.023 usec. (less than 2% overshoot)
Maximum "Y" Deflection	6 cms. at all frequencies.

2.10 Input Attenuators

Nine position, frequency compensated.

Direct reading in Volts/cm. :-
100 mV, 200 mV, 500 mV, 1V, 2V, 5V, 10V, 20V, 50V/Cm.

Input Impedance 1 Megohm + 40 pf (approx.)

Voltage Measuring Accuracy ± 5%.

A variable control provides continuous gain variation between the fixed steps.

2.11 Marker

A 10 Mc/s marker may be switched in to give Z-modulation at 0.1 us intervals, for the purpose of accurate measurements of rise times, etc. This is available on the upper beam, and using timebase "A".

2.12 Supply Voltage & Current

90 - 240v 50 c/s VA = 275

2.13 Valve Content

Qty		Type	Qty		Type
12	-	ECF 80	2	-	EL86
7	-	ECC 88	2	-	85A2
4	-	E810F	1	-	C.R.T. 1374K, G.E.C.
4	-	ECF804			

2.14 Cooling

Convected air thermo-syphon cooling.

2.15 Dimensions

9.7/8" wide x 17" high x 19" long.

(24 cms. x 43 cms. x 48 cms.)

Weight: 50 lbs.

3. FIRST TIME OPERATION

3.1 Introduction

The following detailed instructions are intended for those unfamiliar with this type of oscilloscope. It is suggested that the user should carefully carry out this procedure several times, in order to become throughly familiar with the instrument before putting it into use.

Throughout this handbook all front panel controls and sockets are shown in CAPITALS UNDERLINED; preset (internal) controls are shown in CAPITALS only.

3.2 Operation

Set the front panel controls for both Amplifiers and both Time-bases as follows:

INPUT SWITCH	"DC"
VOLTS/CM	"0.5"
Y GAIN	Fully clockwise
FOCUS	Mid-position
ASTIG	Mid-position
Y SHIFT	Mid-position
BRILLIANCE	Fully anticlockwise
X GAIN	Fully anticlockwise
X SHIFT	Mid-position

STABILITY	Fully clockwise
TRIG LEVEL	Anticlockwise to position just before switch operation
TIME/CM	"20 MS"
VARIABLE	Fully clockwise
TRIG SELECTOR	"NORMAL" (Both out), "+" in, "INT" in.
DISPLAY	Y1 by "A" Y2 by "B" and SWEEPS "A" and "B"

3.2.1 Set the links on the Voltage Selector Panel, at the rear of the instrument, according to the mains supply voltage to be used. Plug in, rotate the POWER switch clockwise, to the "ON" position, and allow a few minutes for the instrument to warm up. (Further clockwise rotation of the POWER switch will simply increase the graticule illumination.)

3.2.2 Advance each BRILLIANCE control until a trace appears; position the trace in the centre of the screen by means of the X SHIFT (Horizontal) and Y SHIFT (Vertical) controls. Adjust the ASTIG and FOCUS controls, in conjunction with one another, for a well-defined trace.

3.2.3 Now back-off each STABILITY control until the sweep just fails to free run. This is the normal position of this control, and, once set, it should not require any readjustment except at the very highest sweep speeds. The instrument is now ready for use.

3.3 Triggering

If the TRIG LEVEL controls are turned fully anticlockwise to operate the AUTO switch, the traces will reappear. In this condition the instrument is ready to accept almost any input waveform and will automatically be triggered by it. The only adjustments required are the selection of the appropriate sweep speeds and "Y" sensitivity (VOLTS/CM). However, in order to use the instrument to best advantage, the functions of the controls should be fully understood. The following procedure will demonstrate their use:

3.3.1 Return the TRIG LEVEL control anticlockwise to the position just before the switch operates. There should now be no trace visible on the screen.

Join a short connector between the CAL terminal and each INPUT socket and rotate the TRIG LEVEL controls clockwise, until the traces just appear. (If the sweep is not triggered, the STABILITY control has been backed off too far.)

The oscilloscope is now displaying the CALIBRATION VOLTAGE waveform (see Chapter 4, Section 2.4), which should be a square wave of 2 cm. amplitude, with one cycle occurring every centimetre. This is a very convenient waveform for demonstrating the functions of the controls.

3.4 Focus and Astigmatism

By adjusting the FOCUS control, either the horizontal or vertical edges of the squarewave can be brought into focus, but only if the ASTIG control is correctly adjusted will it be possible to focus the whole of the waveform simultaneously. Once the ASTIG control is set, it should require no further adjustment and a well-defined trace will be obtained over the whole of the screen.

3.5 Speed Calibration

The calibration waveform is at supply-line frequency, so that when the instrument is operated on 50 c/s mains, 1 cycle occupies 20 milliseconds. With the TIME/CM switch set to "20 milliseconds" and the VARIABLE control fully clockwise, the timebase speed is 20 milliseconds per centimetre, so that one cycle should occupy one centimetre. The SET SPEED control, adjacent to the TIME/CM switch, is used to adjust the sweep speed on this calibration waveform to give precisely 1 cycle per cm. This standardizes the whole of the time calibration of the instrument, all other ranges being direct multiples of this. Speed calibrations only apply when the VARIABLE control is in the fully clockwise position.

For most purposes, when accurate time calibration is not required, the above controls are used to produce a picture of convenient size, with the TIME/CM switch as the "coarse" control and the VARIABLE control for "fine" adjustments.

3.5.1 Slower Sweep Speeds

If the instrument is calibrated as above, the slowest sweep speed obtainable will be 500 Ms/cm. Slower speed speeds may be obtained, if required, by adjustment of the SET SPEED control (RV202). At its minimum position, the slowest sweep speed is extended to about 2 seconds per cm. If the instrument is then calibrated on the 5 ms/cm. range, using the internal calibration waveform, and the preset control is adjusted to give 1 cycle per cm., all the time ranges are multiplied by a factor of four.

4. SWEEP CONTROLS

4.1 Trig Level

The Trigger Level control is used to set the precise part of the slope of the input waveform at which the sweep is triggered. The use of this control may be demonstrated as follows :

Set the TIME/CM switch to 5 m/s, as described in Chapter 2, to give one cycle of the square wave, 4 cm. long. Now rotate the TRIG LEVEL control. It will be found that the starting point of the trace can be moved up and down the sloping edge of the square wave. If the control is turned too far clockwise, this point rises above the top of the square wave and the sweep stops. Similarly, rotation too far anticlockwise produces the same effect.

This facility is useful for displaying complex waveforms, when a normal type of sweep generator will either fail to trigger the sweep or cause double trigger action, producing a multiple pattern. It may also be used as an amplitude discriminator, so that signals of small amplitude are ignored and the sweep is triggered only when the input voltage reaches a predetermined value. Positive or negative going edges may be selected by using the TRIG SELECTOR switch.

Adjustment of the sweep speed controls does not shift the starting point of the sweep but expands the trace from this point. Thus it is possible to examine a section of the waveform in detail by setting the TRIG LEVEL control so that the sweep is triggered just in advance of the portion to be examined and then expanding this portion as required by means of the sweep speed control(s).

4.2 Auto

On this setting no control over the trigger level is available; the sweep automatically adjusts itself to trigger at the mean level of the input waveform. This setting may be used for almost all applications involving repetitive waveforms of a simple nature. The sweep generator will be automatically triggered by signals between about 50 c/s and 1 Mc/s. In the H.F. position the sweep generator will synchronize to incoming signals up to at least 15 Mc/s provided their amplitude gives about 2 centimetres vertical deflection.

In the "AUTO" position with no input signal the trace will become progressively fainter as the sweep speed is increased. This is due to the sweep running free at about 40 c/s in the absence of a trigger signal, regardless of the setting of the speed controls. As soon as an input signal is applied, the sweep is immediately synchronized by it and the trace reverts to its full brightness.

4.3 Trig Selector

The Trigger Selector switch (S103A/B) is divided into three sections. One position, used for most purposes, selects "NORMAL" (internal) triggering. The other two positions bring the internal Sync. Separator into circuit. This enables the sweep to be triggered from the Line or Frame pulses of a TV waveform (normally negative going) independent of the picture content (positive going). Another switch (S102A/B/C/D) may be set in two of its positions to give either a positive or negative triggering waveform as required. Its third position selects H.F. operation. In this latter position the sweep is synchronized by the incoming signals.

An integrating circuit is used in the Sync. Separator to permit triggering from the Frame pulse, which also acts as a lowpass filter, effectively removing the line pulse. The "FRAME" position may therefore be used to advantage wherever such frequency discrimination might improve triggering, as in the case of an audio signal containing a large proportion of H.F.

For triggering from an external signal, set the switch to EXT, both buttons out, and connect the signal to the EXT TRIG terminal socket.

4.4 X Gain and Shift

The X GAIN control expands or contracts the length of the trace from approximately one screen diameter in the anticlockwise position to a maximum of a little above 10 screen diameters when rotated fully clockwise.

The X SHIFT control is used to centre the trace symmetrically about the ruled graticule or to display any portion of the expanded trace on the screen for examination.

The time calibration holds good only at the minimum setting of the X GAIN control. It is possible to measure time intervals at other settings, however, by using the internal calibration waveform as a standard. For instance, if the X GAIN control is adjusted so that one cycle of the calibration waveform occupies 5 centimetres, then the gain is exactly five times on all ranges and, provided the X GAIN control is not touched, all sweep speeds will be multiplied by a factor of 5. Any multiplication factor between 1 and 10 is possible.

4.5 Display Switch

4.5.1 The DISPLAY switch, switches the output sawtooth waveforms from timebases "A" and "B" to the appropriate pair of C.R.T. "X" plates.

In the "Y1 Y2 by A" position, both Y1 and Y2 amplifier signals are displayed by the "A" timebase only.

Similarly, in the "Y1, Y2 by B" position, both Y1 and Y2 amplifier signals are displayed by the "B" timebase only.

In the Y1 by A) Y2 by B) position,

the Y1 amplifier signal is displayed on the "A" timebase and the Y2 amplifier signal is displayed on the "B" timebase. Under these conditions, the timebase trigger selector buttons should be switched to the appropriate amplifier and trigger conditions.

4.5.2 Display push button switches, Sweeps A and B.

The preceding paragraph refers to the top push button position marked "SWEEPS A & B", i.e. both sweeps are used as selected by the DISPLAY switch.

4.5.3 "A delayed by B".

When the push button "A delayed by B" is selected, then the "B" timebase is triggered from any selected source, "Y1 or Y2 or EXT" and a pulse is produced, part of the way along the sweep, which is automatically used to trigger timebase "A".

The displayed waveform will show the "B" sweep with a brightened portion. The length of the brightened portion is the time duration of sweep "A", and its position can be varied along the trace using the DELAY control.

If now, the same signal is connected to both Y1 and Y2 inputs, and the DISPLAY switch set to "Y1 by A: Y2 by B", and "A delayed by B", then the "B" trace will show the waveform with a brightened portion, and the "A" trace will show the brightened portion only. Hence, an expanded portion of the "B" trace may be viewed simultaneously with the unexpanded wave train.

4.5.4 "A gated by B".

In this position, pulses from timebase "A" trigger circuit are added to the pick-off circuit to ensure that the "A" timebase is completely triggered with a reduction in jitter.

To set up the correct conditions, switch to "Sweeps A and B" and trigger both timebases from the appropriate trigger sources. These can, of course, be two independent but time related sources.

Then switch to "A gated by B", and adjusting the delay control will vary the position of the bright up portion of the "B" time-base waveform in a series of discrete jumps instead of a smooth variation as in the "A delayed by B" position.

5. VERTICAL DEFLECTION AMPLIFIER CONTROLS

5.1 VOLTS PER CM Switch

This nine-position switch inserts a series of frequency compensated attenuators between the coaxial INPUT socket and the Vertical Deflection Amplifier. If the gain of the amplifier is calibrated, direct readings of input voltages may be obtained. An internal preset control enables the gain to be standardized. The 1 volt calibration squarewave should measure 2 centimetres vertically with the VOLTS/CM switch set to 0.5 V/cm. It is most important that the amplitude of the calibration squarewave should be measured between the horizontal flat portions. The overshoot at the rising or falling edge of each pulse should be disregarded (see Chapter 4).

5.2 Variable Gain Control

The Variable Gain Control is mounted concentric with the VOLTS/CM switch and varies the gain of the amplifier to cover the range between the VOLTS/CM switch positions. The amplifier gain is only calibrated when the Variable Gain Control is in the fully clockwise position.

5.3 DC/AC Switch

This switch will normally be used in the "AC" position, in which a blocking capacitor removes the DC component of the input signal to the Vertical Deflection Amplifier. The time constant of the input circuit in this position is such that the reponse is 3 dB down at 2 c/s, which, whilst adequate for most normal purposes, may prove critical in some applications. (For example, in the "AC" position, the 50 c/s calibration waveform acquires a pronounced tilt.) If a longer time constant is required, an external blocking capacitor must be used, with a value suitably greater than 0.1 microfarad and the input switch set to "DC".

The "DC" position is also used if it is specifically desired to include the DC component of the input waveform to be measured.

CHAPTER 2.

TIMEBASE AND ASSOCIATED CIRCUITS

In the D55A, two similar Timebases "A" and "B" are incorporated. The Circuit Description refers to either timebase unless specifically stated otherwise.

1. THE TRIGGER SELECTOR

1.1 General

Figure 2.1 shows the Trigger Selector and TV Sync. Separator. The circuit uses a single triode-pentode valve, type ECF 80. The triode section (V101B) receives signals from either vertical deflection amplifier or from an external source, depending upon the setting of S101. The pentode section (V101A) is a TV sync. pulse separator. The operation of the switches (S102 and S103) is shown on the circuit diagram. A detailed summary of the switch positions is also given in this chapter. When EXTERNAL sources are selected, V101A also acts as a sync. amplifier.

1.2 Circuit Description

Unless "H.F." operation is selected, V101B operates as a phase inverter, having equal anode and cathode load resistors (R104 and R106). The signal applied to the grid appears in phase at the cathode, but in opposite phase at the anode. This enables positive or negative triggering inputs to be switched to the trigger circuit by selecting from anode or cathode, as required.

1.3 H.F. Operation

For high frequency operation (above 1 Mc/s) V101B is used as an amplifier instead of a phase-splitter. This is effected by switching a bypass capacitor (C111) across the cathode load resistor to remove the in phase signal. The value of the anode load resistor (R104) is 4.7 K. and is so chosen to give a suitably wide bandwidth for amplification up to 15 Mc/s.

1.4 The setting of S102 controls the operation of V101B. It determines whether the output is from anode or cathode and passes it to the next stage. The setting of S103 selects this stage, which may be either the TV Sync. Separator or the Trigger circuit.

1.5 TV Sync. Pulse Separator

If the timebase is to be triggered from a composite TV waveform, the output of V101B is injected into the grid of V101A, the Sync. Separator. The latter valve accepts a negative going input waveform (i.e. with the sync. pulses positive) and provides negative going sync. pulses at its anode. This waveform is integrated by the combination of R111 and C106. The combined pulse output is taken from the anode of V101A. The integrating circuit also acts as a lowpass filter, effectively removing the line pulses and leaving only the frame pulses across C106.

1.6 In the "TV LINE" position of S103 the Schmitt (V102A and B) is triggered by the line pulses: in the "TV FIELD" position it is triggered by the frame pulses.

In "INTERNAL" "NORMAL" positions, V101A is bypassed by switching S103 to the "NORMAL" position. The selected output from V101B is then passed directly to C107 in the trigger circuit.

On "EXTERNAL" "NORMAL" positions V101A acts as an amplifier, accepting signals from the phase splitter and passing them to C107.

1.7 Facilities

The Trigger Selector switch is divided into three sections, each of which is operated by two push buttons. The function of the sections are as follows:

Lefthand switch: selects NORMAL operation or switches the TV Sync. Separator into circuit.

Centre switch: selects the polarity of the triggering signal (positive or negative) or H.F. operation.

Righthand switch: selects the source of the triggering signal (internal Y1 or Y2 : external).

In order to clarify the operation of the selector switches, their positions are summarized below :

Switch	Function	Position of buttons
	NORMAL	Both out
Left	TV FRAME	Top in
	TV LINE	Lower in
	+ ve	Top in
Centre	- ve	Lower in
	H.F.	Both out
	Y1	Top in
Right	Y2	Lower in
	EXT.	Both out

2. THE TRIGGER CIRCUIT

For the trigger circuit a single triode-pentode valve, type ECF 804, is used (V102, Fig. 2.1). The operating conditions of this valve are varied to suit the type of triggering selected, which may be AUTOMATIC or MANUAL. A further modification is introduced for synchronizing from high frequency (H.F.) input signals.

2.1 Automatic and Manual Synchronization

The switch (S105) is ganged to the TRIG LEVEL control. When it is open (maximum anticlockwise position) the circuit is set for automatic synchronous operation (AUTO): when closed manual triggering, using the TRIG LEVEL control, is possible.

2.1.1 Automatic Synchronization

With the TRIG LEVEL control in the "AUTO" position, the circuit is that of a cathode-coupled multivibrator. In the absence of an input signal the circuit oscillates at a frequency determined by the time constant of C107, R115 and R120. When a signal is applied to C107, the frequency changes and, since the grid of V102A is returned to that of V102B, the output trigger is synchronized to the signal frequency. The "AUTO" position is the one used in almost all applications of this oscilloscope (see Chapter 1).

2.1.2 Manual Triggering

For manual triggering, unless H.F. operation is selected, the circuit is that of a conventional Schmitt trigger, which produces a square wave output whenever the input waveform exceeds a specific voltage. This voltage is determined by the setting of the TRIG LEVEL control (RV112), which determines the bias voltage of V102A when S105 is closed. The TRIG LEVEL potentiometer is part of a bleeder network across the HT line and the bias voltage at the junction of R115 and R120 overrides that obtained at the junction of RV123 and R119 in the "AUTO" position. The DC level at which triggering starts is therefore controlled by RV112, permitting the sweep to be triggered from any part of the slope of the input waveform (see Chapter 1).

2.2 H.F. Operation of the Trigger Circuit

When the trigger selector switches are in the "H.F." position (see section 1.3), S102 introduces capacitive coupling between the cathodes of V102A and V102B. (These are directly connected in all other switch positions.) The cathode resistors (R118 and R121) are of equal value, and the time constant given by either of these with C109 is very short compared with that governing normal operation (R115 + R120 x C107). The switching periods of the multivibrator are therefore controlled by the cathode network, and the trigger runs freely at about 0.5 Mc/s. Any high frequency input signal applied to C107 will cause it to lock at the nearest direct multiple to 0.5 Mc/s.

In this position the circuit will be synchronized from repetitive high frequency input signals, giving at least 2 centimetres vertical deflection, up to a frequency of 15 Mc/s.

2.3 Trigger Sensitivity

The TRIGGER SENSITIVITY control (RV123) is a preset variable resistor which is in series with R117 and R119. It may therefore be used to adjust the bias level of V102B and is set to give the maximum sensitivity consistent with reliable triggering.

2.4 Action of Trigger on Timebase

The differentiated trigger output is applied to the cathode of V202B, as described in section 3.1.

3. THE TIMEBASE AND HORIZONTAL DEFLECTION AMPLIFIER

3.1 Technical Description

It will be seen from Figure 2.2 that V202A is a Miller valve with its run-down speed controlled by CA and RA. The values of CA and RA are determined by the setting of the TIME/CM switch, which is shown expanded in Figure 2.3.

The Miller valve is keyed by a DC-coupled multivibrator (V201B and V203B), which is in turn controlled by the output from the trigger circuit (see section 2) via V202B. The trigger output, in the form of positive and negative pulses, is fed into the cathode of V202B, via a capacitor (C110, Fig. 2.1). This capacitor, in conjunction with R221, forms a differentiating circuit, whilst the germanium diode MR201, shunted across R221, clips off the positive component of the triggering pulse. The pulse at the cathode of V202B is therefore negative going. The valve, which is strapped as a diode, acts as a DC Level clamp, passing pulses of the correct amplitude to the grid of V201B.

A sawtooth voltage plus a DC component is developed across the resistor-capacitor network from the anode of V202A (i.e. R215/CV202, C107, R222, RV223 and part of RV224). A portion of the combined voltages is applied to the grid of V201A, which operates in push-pull with V203A to amplify the sawtooth waveform. The fixed capacitor C207 and the trimmer CV202 act as a variable frequency compensator, which is preset during the initial setting-up of the instrument.

The amplified sawtooth output voltages at the anodes of V201(a), V203(a) are D.C. coupled to the grids of the cathode-followers V204(a) and V204(b), the cathodes of which are connected to the sliders of the TRACE EQUALIZATION potentiometers.

The outer terminals of these potentiometers are connected to the SWEEP SELECTOR SWITCH (figure 4.1), the operation of which is described in Section 6.

3.2 Facilities

(1) X AMP INPUT The X AMP input socket permits an external signal to be applied to the grid of V201A via a 0.22 microfarad capacitor (C205). When using this facility the timebase should be switched off, by operating the switch S201, which is ganged to the control marked "VARIABLE".

(2) SWEEP OUTPUT The sweep voltage is taken from the cathode of V201A to the socket SWEEP OUTPUT, and can be used to drive an external circuit.

3.3 Timebase Controls

3.3.1 STABILITY Control

This control (RV126) varies the grid potential of the valve (V203B) and hence the switching level of the multivibrator formed by this valve and V201B. It is set to the point just below the free-running condition. The control adjusts the sensitivity of the sweep circuit to incoming signals.

3.3.2 Stepped Sweep Control

Figure 2.3 shows the stepped sweep control, which consists of a three-gang, 18-way rotary switch (TIME/CM) to which are connected the resistor-capacitor networks for obtaining the required timebase speeds. These speeds range from 1 microsecond/cm. to 500 milliseconds/cm. in fixed steps, ascending in multiples of 1, 2 & 5.

The networks are typified by CA, RA and CB in Figure 2.2. CA and RA control the run-down speed of the Miller valve (V202A); CB controls the time constant between the anode of V201B and the grid of V203B in the multivibrator controlling the Miller valve.

3.3.3 Preset Speed Adjustment

This is formed by the combination of a small variable preset capacitor (C277, Fig. 2.3), which is mounted on the ganged switch assembly, and a preset panel control (RV202) SET SPEED (Fig. 2.2). The latter is used for the initial calibration of the timebase speed from a known 20 millisecond pulse. The capacitor is used for the highest speed (1 microsecond) only.

Details of this adjustment are given in the setting-up instructions (Chapter 6). These calibrations are correct when the RED knob marked VARIABLE is set fully clockwise, and when the BLACK knob X GAIN is set fully anticlockwise (i.e. at minimum "X" expansion).

3.3.4 Variable Sweep Control

This control (RV205) is concentric with the TIME/CM switch. It determines the potential to which the charging resistor RA is returned and affords a continuously variable control between the fixed sweep speeds, by decreasing the speed from that set on the stepped sweep control to the next lower setting on the scale.

3.3.5 "X" Expansion and Trace Length

The X GAIN control (RV237) varies the gain of the push-pull valves (V201A and V203A), thereby controlling the length of the trace. The trace may be expanded up to 10 screen diameters. The preset potentiometer (RV223) in the grid circuit of V201A varies the amplitude of sawtooth into the grid so that the trace length may be controlled with the X GAIN at the minimum position.

3.3.6 X SHIFT Control

The variable "X" shift voltage, adjusted by RV224, is applied in series with the sweep voltage from V202A to the grid of V201A. By this means the trace, with or without expansion, may be moved laterally across the screen to any desired position.

3.3.7 Preset X SHIFT Control

The potentiometer (RV241) adjusts the grid potential of V203A, thus enabling the trace to be displayed symmetrically about the centre of the screen with the X SHIFT control in the mid-position. Adjustment of this control is only necessary in the initial setting-up of the oscilloscope (see Chapter 5).

4. DELAYING CIRCUIT (Fig. 2.4) (See also Horizontal System, Block Schematic)

The purpose of this circuit is to enable timebase "A" to be triggered from any portion of the linear sawtooth voltage waveform, produced at the anode of the Miller valve in timebase "B", (V202(a), fig. 2.2).

Any short duration waveform, occurring during the time of one excursion of the lower trace, may be examined on the fast Y1 (upper) trace and an indication of the position (in time) of this waveform is given in the form of a bright up pulse on the slow Y2 (lower) trace.

4.1 Operation

A double triode valve V150, forms a Schmitt trigger circuit. A stabilised DC voltage is applied to one grid via a 10 turn potentiometer, and the sawtooth voltage from timebase "B" is applied to the other grid. As the grid potential of V150(a) runs down, it will reach a potential equal to that of V150(b), and a square wave will be produced at V150(b) anode, by normal Schmitt trigger action. V151(b) acts as a constant current source for the common cathodes.

When the SWEEP 'A & B' button is depressed, the output waveform at V150(b) is decoupled to earth and both timebases act independently.

When the "A delayed by B" switch is depressed, the output waveform at V150(b) is differentiated by C153 and R221 (Fig. 2.2) and used to trigger timebase "A".

Depressing the "A Gated by B" switch injects sync. signals from C110 on timebase "A" into V151B grid, which pulses the cathode current of V150, and so causes the pick off valve V150 to lock on to a signal.

The trigger circuits on timebase "A" should be set to the required positions, e.g. Y1, Y2 and EXT and the Trig Level control switched to AUTO and adjusted to the required level.

This can most easily be done, by switching to "SWEEPS A & B" position, and adjusting both timebases to trigger as required. Then switching back to "A gated by B" will produce the required timebase delayed picture.

V151(a) acts as a cathode follower, and couples the bright up pulse from the screen grid of the Miller valve V202(a) on timebase "A" to the front panel. This comes out at approximately 0.5 volts amplitude and is used as a marker pulse for pulsing an external circuit, such as a television picture monitor, to show what timebase "A" is displaying.

5. TRACE BRIGHT-UP

This forms part of the C.R.T. circuit (Fig. 4.1). Two identical bright-up circuits are employed, one for each of the upper and lower traces respectively. In addition, an extra bright up, a marker generated by timebase "A", is superimposed on a signal displayed on the lower trace, when the delayed sweep facility is used.

5.1 Operation

V301 acts as a bistable circuit and is used to couple a rectangular bright up pulse, from the timebase, to the C.R.T. cathode, which is approximately 1 KV negative to chassis.

A separate 150V winding on the mains transformer is rectified and smoothed by MR301, C301, R301, C302, and the positive side of the H.T. supply is connected to EHT negative. V301 is wired across the H.T. supply, which is at C.R.T. cathode potential.

Initiation of the time base causes a pulse to be applied to V301(b) grid, and the resulting pulse at V301(a) anode is coupled to the appropriate C.R.T. cathode. At the end of the sweep, the circuit is returned to its original condition, so that a rectangular pulse is DC coupled to the C.R.T. cathode, via the switch S301C.

A small portion of timebase "A" bright up is added to the timebase "B" bright up waveform when sweep delay is required. Here the relay RL301 is operated, taking the pulse from across R308 and coupling it via C304 to the lower gun grid.

5.2 10 Mc/s Oscillator

This circuit is again associated with the C.R.T. and is shown in Fig. 4.1. V302(b), arranged as a cathode coupled oscillator, is adjusted to 10 Mc/s by L301. V302(a) is normally heavily conducting and damps the tuned circuit; however, when timebase "A" starts, a pulse generated across R331 switches V302(a) off, causing oscillations to start and these oscillations are applied to the grid of the upper gun of the C.R.T. RV329 adjusts the amplitude of oscillation.

6. TRACE SWITCHING

The ganged double pole three way switch S301 is the DISPLAY switch.

The three positions of the switch are :

1. (Y1 sweep A
   (Y2 " A

2. (Y1 sweep A
   (Y2 " B

3. (Y1 sweep B
   (Y2 " B

S301C switches the bright up pulses from the bistable circuits to the required C.R.T. gun, while S301A and S301B switch the sweep output leads to the requisite pair of X plates associated with the required gun.

7. ADDITIONAL FACILITIES

7.1 Sweep Output

The terminal socket marked SWEEP OUTPUT on the timebase front panel provides a negative going sawtooth waveform of approximately 25 volts maximum amplitude, from the cathode of the first sweep amplifier valve (V201A). This valve acting as a cathode follower presents a low impedance in its cathode circuit, thus preserving the purity of the waveform. A blocking capacitor may be required when using this waveform to drive an external circuit. The output is only linear when the X GAIN control is set fully anticlockwise. When an external circuit is being driven from this source the STABILITY control must be turned clockwise until the sweep, as displayed on the oscilloscope, runs free.

7.2 X AMP Input

This terminal socket, on the timebase front panel, is connected, via a series capacitor (C205) of 0.22 microfarad, to the input of the Sweep Amplifier. It will accept signals between 1 volt and 25 volts peak to peak, and the X GAIN control may be used to give up to 10 times gain.

When using this facility, the timebase must be turned off by turning the VARIABLE control fully anticlockwise to operate the switch ganged to it.

The input impedance is approximately 500 K. shunted by 100 pf. The frequency response is 3 dB down at 5 c/s and at about 400 Kc/s, but is otherwise flat over the intervening range.

7.3 Z MOD

This connector, at the rear of the instrument, is taken, via a blocking capacitor, to the upper gun grid. A positive pulse applied here will brighten the trace, permitting squarewave rise times to be measured. The time constant of this circuit is formed by 0.01 microfarad and 220K ohms.

CHAPTER 3.

VERTICAL DEFLECTION CIRCUITS

1. INTRODUCTION

The oscilloscope contains two identical "Y" amplifiers, each with its own switched attenuator network; this network may be varied in steps up to a division ratio of 1:500.

A switch provides facilities for alternating or direct voltage inputs and is connected directly in the input circuit.

The amplifiers employ D.C.-coupling and are frequency-compensated throughout, thus giving substantially uniform amplification from D.C. to 15 Mc/s with a sensitivity of 100 mV/cm at all frequencies.

Maximum visible "Y" deflection is 6 cms at all frequencies. Rise time of 0.023 microsecond, with less than 2% overshoot.

2. INPUT ATTENUATORS (Fig. 3.2).

These are identical for the upper and lower trace amplifiers, therefore the description given will suffice for either amplifier.

An AC.DC rotary switch (S 1, black knob) brings a capacitor (C1) in series with the INPUT coaxial socket (Amphenol Type 83-1R) and the attenuator, in the "A.C." position.

The VOLTS/CM stepped switch (S2, black knob) may be set to one of nine positions marked .1, .2, .5, 1, 2, 5, 10, 20 and 50 read in a counterclockwise direction; these figures indicate volts per centimetre. Four frequency-compensated resistance-divider networks are used; these will be obvious from the appropriate figure.

They may, however, be used singly or in cascade, as will be seen by the various positions of the ganged switch (S2).

The first attenuator section has ratios of 1, 10 and 100 and the second section, 1, 2 and 5.

The attenuated output from R11 is taken to the grid of V26(a) (fig. 3.2).

Input impedance to the attenuator is one megohm + 30 picofarads (approx) with a voltage measuring accuracy of ± 5%.

3. VERTICAL DEFLECTION AMPLIFIERS (Fig. 3.1).

Apart from HT supplies, these amplifiers are identical for upper and lower trace in each case; both HT supplies, however, are taken from the same winding on T402 through a voltage-doubling network (fig. 4.1). Let us therefore consider the upper-trace amplifier.

3.1 Input Circuit

A signal (A.C. or D.C.) is fed into the control grid of V26(a) from the associated attenuator.

V26(a) and V27(a) form a cathode-coupled pair. The cathodes are coupled through RV56, a variable gain control, and the cathode currents are supplied through cathode resistors R57, R58 and RV33. RV33 is a DC BALANCE control and is adjusted so that there is no trace shift as the VARIABLE gain control is rotated.

A negative supply of -10 volts is available to provide the valve current, and also the shift voltage. This is applied to the grid of V28(a) via RV28.

The peaking inductors L26 and L27 in the anode circuits of V26(a) and V27(a) respectively are compensation for high-frequency inputs, L26 only being variable.

3.2 Anode Supply to Input Valves

Part of the supply to the anodes and screens of V26(a) and V27(a) is somewhat unusual and is obtained from the common-cathode resistor R48 of V30(a) and (b) cathode-followers; hence the cathode current of the input stages flows through these two output cathode-followers.

This is done to reduce the total current consumption of the amplifier and to provide a measure of stabilization, so that the overall gain of the amplifier is proportional to the power supply voltage.

3.3 Y Shift

This is obtained from a potentiometer network connected between the minus 10 volt supply and the input stage H.T. supply. The negative line is obtained by rectifying the 12.6 volt heater and smoothing with C27, R26, C28.

3.4 Pre-stage Cathode-followers and Final Amplifiers

V26(a) and V27(a) are D.C.-coupled to the grids of their respective (triode) cathode-followers, the outputs of which are fed to the grids of the output amplifying valves V28 and V29 respectively.

3.5 Pre-set Gain

The cathodes of V28 and V29 are connected by the pre-set variable resistor RV42 (SET GAIN) in series with the frequency-compensating network RV45, C33 and R48.

3.6 Output Cathode-followers

V28 and V29 are D.C.-coupled to the grids of the cathode-followers V30(a) and (b).

These valves have small NEON LAMPS, N26 and N27 connected between their grids and cathodes; this is done to prevent the high HT + potential being applied to the grids of V30 (via D.C. coupling) from the anodes of V28 and V29 when switching-on, as these former valves are initially non-conducting.

These neon lamps will automatically be extinguished when the amplifiers have warmed up.

The outputs from both cathode-followers are then fed to the "Y" plates (upper gun); while that of V30(b) is also fed through R52, C29 and R53, C32 to the TRIGGER SELECTION switch. See Chapter 2, Section 1.7.

CHAPTER 4.

POWER SUPPLIES

1. INTRODUCTION

The Power Supply schematic is shown in Figure 5.1. All the rectifiers used are semiconductor diodes, thus ensuring a minimum of delay for the rectified voltages to obtain their maximum value.

2. CIRCUITRY

Two mains transformers provide all the required secondary voltages. The primary may be adjusted, by means of a double-link input voltage selector panel, for operation on alternating voltages from 90 - 130 V and 200 - 240 V, 50 - 60 cycles.

2.1 HT Supplies

The silicon rectifiers (MR402, MR403), together with C403 and C404 form a voltage doubling circuit. This supplies the various HT voltages HT4 to HT7 via smoothing and decoupling components. The values of the HT voltages are shown against the appropriate outputs in Figure 5.1. Voltages on valve electrodes, where applicable, are similarly shown in the related schematics.

Silicon rectifiers MR405 and MR406 together with C408 and C409 form another voltage doubling circuit. The output voltage supplies two conventional stabiliser circuits and outputs HT 10, 2, 8, 9 are provided.

2.2 EHT Voltages

The EHT supply for the cathode ray tube is derived in two ways.

The negative supply of 1.2 KV, is obtained by half wave rectifying the 1000 volt winding of T402, via MR408-411, and smoothing with C405, 406, 410, 422.

The positive supply of 4.7 KV is obtained by voltage doubling, the same 1000 volt winding, via MR404, 407 and then adding another doubler, from the 750 volt winding of T401, via MR412, 413. The second doubler is stacked on top of the first doubler to give 4.7 KV in all, to earth.

2.3 Low Tension

The secondary windings include low tension windings giving 6.3 V and 12.6 V. These provide heater supplies, pilot light and graticule illumination. A separate 6.3 V winding is used for the heaters of the CRT and bright-up circuits (see Chapter 2, Section 5).

2.4 Calibration Voltage

A squarewave of 1 volt peak to peak is provided for calibrating purposes. This is obtained from a two-stage clipper circuit using three neon diodes (N401, N402 and N403).

The voltage from the 350 V tapping on T402, at line frequency, is taken via C418 and R412 to the first stage of clipping, N401 and N402 in series. An approximately square wave, of 200 V peak to peak, appears across these tubes. It is applied via R413 to N403, where further clipping takes place, giving a square wave of 100 V peak to peak. This is attenuated by the network R414, R415, RV416, and applied to the connector CAL 1 V P-P on the panel of the vertical deflection amplifier. The capacitor (C419) removes some of the overshoot on the squarewave, which is due to the difference between the striking and burning potentials of the neon diodes. Some overshoot is left, however, to provide a sharp pulse to facilitate setting the Time Calibration. The mean amplitude should always be taken as the reference level when adjusting for volts/cm. measurements.

The variable resistor (RV416) allows the amplitude of the calibration voltage to be set at exactly 1 volt.

2.5 General

A fuse (F401) in the primary circuit, in series with the POWER switch (S401), protects the transformers against overload. The SCALE ILLUM control is coupled mechanically to the mains switch; it varies the brightness of the lamps illuminating the graticule and consists of a potentiometer (RV401) across the 6.3 V winding (see Chapter 1).

CHAPTER 5.

MAINTENANCE, SERVICING AND SETTING-UP PROCEDURE

1. GENERAL

The simplicity of the circuitry of the D55A makes it an extremely reliable instrument. For the most part, servicing will be limited to the replacement of defective valves, but should a less common fault occur no difficulty should be experienced in detecting the source, if the circuit diagrams are used, in conjunction with normal test procedure. Test voltages at critical points are shown on the circuit diagrams, and the location of major components is given on Plates 2 - 4.

2. DISMANTLING FOR SERVICING

The "unit" method of construction used for the D55A ensures that all components are easily accessible for testing and servicing. The Timebases are built as detachable units and may be withdrawn as follows :

2.1 Removing the Timebase Unit

To remove the Timebase the cover plates of the oscilloscope must be removed, by loosening the Philips type screws securing the carrying handle (the handle need not be removed). Then proceed as follows :

(1) Remove the upper and lower fixing screws at the rear of the chassis.

(2) Disconnect the noval plug on the lead from the timebase unit from the main chassis wall.

(3) Disconnect the flying leads to the cathode follower valves, and the two leads for the internal triggering inputs from the amplifiers.

(4) Withdraw the timebase by sliding it forward out of the front of the instrument.

2.2 Access to the Power Supply and CRT Circuitry

Access to the Power Supply and CRT Circuitry is by removal of the rear cover plate of the oscilloscope. This is secured by the two screws at either side of the voltage selector panel. The components in these circuits are easily identified from the circuit diagrams. The voltage tappings on the transformer are marked.

3. REPLACEMENT OF DEFECTIVE VALVES

When replacing valves in the Vertical Deflection Amplifier it is necessary to select pairs of valves having approximately the same characteristics, so that the Y SHIFT control operates symmetrically about the centre of the screen. Apart from this, little effect on the performance of the Vertical Deflection Amplifier should be experienced when valves are replaced, and no further readjustments should be necessary.

In the Sweep Generator and associated Amplifier the valve characteristics are not critical, and valves may be replaced without readjusting the preset controls.

If the internal preset controls should require readjustment, the following detailed instructions should be followed.

4. SETTING-UP PROCEDURE

4.1 Input Attenuator

The eight trimmer capacitors of the Input Attenuator Switch (C12, C13, C4, C8, C9, C5, C2 and C3) are accessible for adjustment from underneath the instrument.

4.2 Apparatus and Procedure

In order to carry out this adjustment a square wave generator is required, giving a frequency of approximately 2 Kc/s; its output must be variable between 0.2 V and 100 V. The rise time of the squarewave need not be particularly fast, but it must have good, flat tops and bottoms. The adjustment procedure is as follows :

(1) Connect the square wave generator to the INPUT socket and adjust its output to approximately 0.2 V.

(2) Set the input attenuator to 0.1 volt/cm. Adjust the sweep controls to display three cycles of the squarewave on the screen.

(3) Adjust each capacitor in turn, to give square corners to the waveform. The input attenuator switch should be turned to the appropriate setting as shown in the table below. At the same time, adjust the output of the square wave generator to give a trace of 2 - 3 cm. amplitude in each case.

Input Attenuator Setting	Capacitor to be adjusted
0.2 volt/cm.	C12
0.5 " "	C13
1.0 " "	C4
2.0 " "	C8
5.0 " "	C9
10.0 " "	C5

When this procedure is correctly carried out, the 20 volts/cm. and 50 volts/cm. ranges are automatically correct.

4.3 Adjustments for Using Probe

The capacitors C2 and C3 affect compensation only when the High Impedance probe is in use. To adjust them proceed as follows :

(1) Remove the square wave generator from the input socket and plug in the High Impedance probe. Connect the output of the generator to the probe tip.

(2) Set the input attenuator to 0.1 volt/cm. and the square wave generator output to give approximately 2 cm. vertical deflection.

(3) Adjust the probe trimmer, which is accessible through a hole in the probe body, to give a flat top to the square wave.

(4) Switch the input attenuator to the 1 volt/cm. range. Readjust the square wave generator output as before, and adjust C2. Set the input attenuator to the 10 volts/cm. range and adjust C3. All other ranges will automatically be correct.

4.4 Adjustment of High Impedance Probe Compensation Trimmer

This adjustment is best carried out with a square wave generator at an output frequency of 1 Kc/s. Connect the probe to the INPUT socket and apply it to the signal generator output. The compensation trimmer is accessible through the hole in the body of the probe and should be adjusted to give square wave corners to a few cycles of the 1 Kc/s square wave displayed on the screen.

5. VERTICAL AMPLIFIER ADJUSTMENT

5.1 General

The preset controls on the Vertical Amplifier Type A are the high frequency compensation and the Set Gain controls which are accessible for adjustment through the bottom of the instrument. The Set Gain controls should be set before adjusting the high frequency compensation.

5.2 High Frequency Compensation

This should not be attempted unless a square wave generator capable of producing an accurate square wave at 500 Kc/s, with a rise time of less than 4 millimicroseconds, is available. It must also be absolutely free from ring or overshoot.

The H.F. compensation circuits are extremely stable, and unless such a generator is available, it is best not to attempt any readjustment. Suitable square wave generators are the Tektronix Type 107 and Cossor Type 1090.

If such a generator is available, the following procedure should be adopted :

(1) Connect the square wave generator to the input socket. Set the attenuator switch to 0.1 volt/cm.

(2) Adjust the output of the generator to give a vertical deflection of 2 - 3 cm.

(3) Adjust the inductor L26, capacitor C33 and Resistor RV45 to obtain a flat topped square wave with a fast rise time, square corners and no overshoot. It may be necessary to adjust any or all of these to obtain the desired result. The inductor affects the extreme corners of the square wave while the trimmer and variable resistor adjust the flatness at the start of the flat top.

6. THE TRIGGER CIRCUIT

The only preset control in the Trigger circuit is the TRIG SENSITIVITY control (RV123). This should be set so that the Trigger circuit will operate when the trace amplitude on the screen exceeds 2 mm. If any attempt is made to increase the sensitivity beyond this point, erratic operation will almost certainly result. The position of RV123 is clear from Plate 2.

Procedure

The internal calibration signal may be used to make this adjustment.

(1) Connect the CAL O/P 1 V P-P and INPUT sockets and adjust the sweep controls to display about 5 cycles of the calibration waveform.

(2) Set the input attenuator to the 5 V/cm. range. This gives a trace 2 mm. high.

(3) Adjust the TRIG SENSITIVITY control so that at a critical setting of the TRIG LEVEL control the sweep will just trigger.

(4) Reduce the trace amplitude to 1 mm. and make sure that the sweep will not trigger on this signal.

7. SWEEP GENERATOR & AMPLIFIER

To make a complete readjustment of the Sweep Generator and Amplifier the preset controls must be adjusted as described below. The location of these components is given in Plate 2.

7.1 Trace Length Control (RV223)

(1) Set the TIME/CM switch to 1 m.sec., and the VARIABLE control fully clockwise. Advance the STABILITY control until the sweep runs free.

(2) With the X SHIFT control in its mid-position and the X GAIN control at minimum, adjust the TRACE LENGTH potentiometer (RV223) to give a trace 10 cm. long.

7.2 Frequency Compensation Trimmer (CV202)

(1) Adjust RV303 on the relevant printed board, PC11, tube circuit FIG. 4.1 to stop the retrace blanking.

(2) With the controls set as above, advance the BRILLIANCE control until a spot is visible at the beginning of the trace. By adjusting the trimmer (CV202) a small "tail" is produced, to one side of the spot.

(3) The correct setting of CV202 is that at which this "tail" just disappears into the spot. The setting can be checked by displaying a 100 Kc/s signal on the screen. The correct setting gives optimum linearity at the beginning of the trace.

7.3 Retrace Blanking

Adjustment of RV303 will show that there are three separate modes of operation for the Retrace blanking generator. These are :
1. The trace is uncontrollably bright and the retrace is apparent.
2. The retrace is blanked. 3. The full trace is blanked. The correct position of the potentiometer within the centre section is such that increasing the brightness does not affect the trace length.

7.4 Preset Speed Adjustments (RV202, Fig.2.2 and C277, Fig.2.3)

(1) Set the TIME/CM switch to 20 milliseconds. Now display the calibration voltage waveform, and adjust the SET SPEED control (RV202) on the front panel so that 1 cycle of the calibration waveform occupies exactly 1 cm. (Check that the X GAIN control is still at its minimum position.)

(2) Set the TIME/CM switch to 1 u.sec. Inject an accurate 1 Mc/s signal into the input and adjust the VOLTS/CM switch to give a vertical deflection of about 2 cm.

(3) Adjust the trimmer (C277, Fig. 2.3) so that each cycle of the 1 Mc/s signal occupies 1 cm.

7.5 Trace Equalization

(1) Timebase "A"

Using both Y SHIFT controls, bring the two traces so that they are almost touching each other.

Set DISPLAY Switch to (Y1 SWEEP A)
(Y2 SWEEP A)

Adjust both upper TRACE EQUALIZATION potentiometers, RV230, 234, together to make the start and finish of both traces coincident.

(2) Timebase "B"

Set DISPLAY switch to (Y1 SWEEP B)
(Y2 SWEEP B)

Adjust both lower TRACE EQUALIZATION potentiometers together to make the start and finish of both traces coincident.

8. ADJUSTMENTS IN THE POWER SUPPLY CIRCUIT

The Calibration Voltage

The preset variable resistor (RV416) in the calibration voltage supply circuit (Power Supply Circuit, Fig. 5.1) is provided so that the output voltage can be set to precisely 1 volt peak to peak. This adjustment can only be made by comparing the calibration voltage with a known, accurate 1 volt peak to peak signal.

In practice RV416 should not require adjustment. The neon diodes (N401 and N402) have no effect on the amplitude of the output waveform, but if N403 is replaced an equivalent type must be used.

9. CRT CIRCUIT ADJUSTMENTS (Fig. 4.1)

9.1 10 Mc/s Markers

Switch the MARKERS on, and switch the DISPLAY switch to
Y1 by A
Y2 by A sweeps A and B.

Set Timebase "A" T/cm switch to 1 usec/cm., and check that markers are 10 Mc/s, i.e. 10 per cm. at minimum X expansion. Adjust L301, available through the printed circuit board PC13, mounted on the side of the H.T. chassis. The amplitude of markers is adjusted by RV329. There should be approximately 15V at the CRT grid.

CHAPTER 6.

COMPONENTS LIST

ABBREVIATIONS

Capacitors

MP	Moulded Paper
SM	Silver Mica
CER	Ceramic Tubular
ELEC	Electrolytic
POL	Polyester Film
P	Paper

Resistors

C	Carbon Composition
HSC	High Stability Carbon
WW	Wire Wound
CP	Preset Carbon (Internal Adjustment)

In the following component lists, no manufacturers' names have been included. When replacing components, locally available alternatives may be used if exact replacements are not to hand, provided the physical size is the same.

It is, however, preferable to use exact replacements whenever possible and these should be ordered direct from :

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

Telephone: FOX Lane 1166
Telegraph: Telequipt. London. N.14.

or from our Agents.

INPUT ATTENUATOR

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
12M	R 1	900 K	Resistor	HSC	1	$\frac{1}{4}$w
11M	R 2	990 K	"	HSC	1	$\frac{1}{4}$w
18M	R 3	111 K	"	HSC	1	$\frac{1}{4}$w
20M	R 4	10.1 K	"	HSC	1	$\frac{1}{4}$w
14M	R 5	500 K	"	HSC	1	$\frac{1}{4}$w
13M	R 6	800 K	"	HSC	1	$\frac{1}{4}$w
10M	R 7	1 M	"	HSC	1	$\frac{1}{4}$w
17M	R 8	250K	"	HSC	1	$\frac{1}{4}$w
10M	R 9	1 M	"	HSC	1	$\frac{1}{4}$w
31L	R10	100 K	"	C	10	$\frac{1}{4}$w
6L	R11	81 OHM	"	C	10	$\frac{1}{4}$w
26K	C 1	0.1 uf	Capacitor	POL	10	400v
16J	C 2	6-30 pf	Trimmer	CER		250v
16J	C 3	6-30 pf	Trimmer	CER		250v
16J	C 4	6-30 pf	"	"		250v
16J	C 5	6-30 pf	"	"		250v
59K	C 6	100 pf	Capacitor	SM	10	350v
61K	C 7	1000 pf	"	SM	10	350v
16J	C 8	6-30 pf	Trimmer	CER		250v
16J	C 9	6-30 pf	"	"		250v
42K	C10	39 pf	Capacitor	"	5	350v
40K	C11	20 pf	"	"	5	350v
16J	C12	6-30 pf	Trimmer	"		250v
16J	C13	6-30 pf	"	"		250v
41K	C14	30 pf	Capacitor	"	5	350v
39K	C15	15 pf	"	"	5	
25K	C16	0.01 uf	"	MP	10	500v

NOTE: 2 PER INSTRUMENT.

Y1 and Y2 AMPLIFIERS

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
12L	R25	560	Resistor	C	10	¼w
12L	R26	560	"	C	10	¼w
24L	R27	10K	"	C	10	¼w
62C	RV28	100K	Potentiometer 'Shift'			
24L	R29	10K	Resistor	C	10	¼w
36L	R30	560K	"	C	10	1/8w
29L	R31	56K	"	C	10	¼w
14L	R32	750	"	C	10	¼w
23C	RV33	1K	'BAL' Potentiometer			
14L	R34	750	Resistor	C	10	¼w
31L	R35	100K	"		10	¼w
8L	R36	100	"	C	10	¼w
54L	R37	15K	"	C	10	1w
54L	R38	15K	"	C	10	1w
8L	R39	100	"	C	10	¼w
46L	R40	2.2K	"	C	10	1w
	R41	3.9K	"	W/W		3w
38C	RV42	1K	Potentiometer 'Set Gain'			
	R43	3.9K	Resistor	W/W		3w
46L	R44	2.2K	"	C	10	1w
11C	RV45	50	Potentiometer	C	20	¼w
8L	R46	100	Resistor	C	10	¼w
	R47	10K	"	W/W		3w
L6	R48	82	"	C		¼w
33M	R49	4.7K	"	W/W		5w
	R50	10K	"	W/W		3w
8L	R51	100	"	C	10	¼w
21L	R52	4.7K	"	C	10	¼w
21L	R53	4.7K	"	C	10	¼w
3L	R54	18	"	C	10	¼w
3L	R55	18	"	C	10	¼w
	RV56	500	Potentiometer Variable			
17L	R57	1.5K	Resistor	C	10	¼w
17L	R58	1.5K	"	C	10	¼w

(continued)

Y1 and Y2 AMPLIFIERS (continued)

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
33X	C26	250 uf	Capacitor	ELEC		18v
"	C27	250 uf	"	"		18v
"	C28	250 uf	"	"		18v
16K	C29	0.1	"			400 v
59J	C30	32ufx32uf	"	ELEC		450v
29K	C31	0.47 uf	"	POL		125v
16K	C32	0.1 uf	"			400v
15J	C33	450 pf	Variable Capacitor	CER		
36Y	N26		Neon 3L			60v
36Y	N27		Neon 3L			60v
	L26		Choke			
	L27		Choke			
10E	MR26		Diode type ZS 71			
	V26		Valve ECF 804			
	V27		" ECF 804			
	V28		" E 810F			
	V29		" E 810F			
	V30		" ECC88			

TRIGGER CIRCUIT (TIMEBASES "A" & "B")

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
38L	R101	1.2M	Resistor	C	10	$\frac{1}{4}$w
38L	R102	1.2M	"	C	10	$\frac{1}{4}$w
8L	R103	100	"	C	10	$\frac{1}{4}$w
21L	R104	4.7K	"	C	10	$\frac{1}{4}$w
11L	R105	470	"	C	10	$\frac{1}{4}$w
21L	R106	4.7K	"	C	10	$\frac{1}{4}$w
38L	R107	1.2M	"	C	10	$\frac{1}{4}$w
16L	R108	1K	"	C	10	$\frac{1}{4}$w
23L	R109	6.8K	"	C	10	$\frac{1}{4}$w
38L	R110	1.2M	"	C	10	$\frac{1}{4}$w
26L	R111	22K	"	C	10	$\frac{1}{4}$w
47C	R112	100K	Potentiometer "Trig Level"	C		
29L	R113	56K	Resistor	C	10	$\frac{1}{4}$w
30L	R114	68K	"	C	10	$\frac{1}{4}$w
29L	R115	56K	"	C	10	$\frac{1}{4}$w
8L	R116	100	"	C	10	$\frac{1}{4}$w
20L	R117	3.3K	"	C	10	$\frac{1}{4}$w
57M	R118	22K	"	C	10	1w
29L	R119	56K	"	C	10	$\frac{1}{4}$w
36L	R120	560K	"	C	10	$\frac{1}{4}$w
57M	R121	22K	"	C	10	1w
19L	R122	2.7K	"	C	10	$\frac{1}{4}$w
93C	RV123	100K	Potentiometer Pre-Set			
K16	C101	0.1 uF	Capacitor	POL		400v
K53	C102	100 pF	"	CER		
K16	C103	0.1 uF	"	POL		400v
K18	C104	.001 uF	"	POL		400v
K28	C105	0.01 uF	"	POL		400v
K16	C106	0.1 uF	"	POL		400v
K16	C107	0.1 uF	"	POL		400v

(continued)

TRIGGER CIRCUIT (TIMEBASES "A" & "B")

(continued)

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
K41	C108	30 pF	Capacitor	CER		
K31	C109	500 pF	"			
K53	C110	100 pF	"	CER		
K16	C111	0.1 uF		POL		400v
	V 101		Valve ECF 80			
	V 102		Valve ECF 804			

NOTE: 2 PER INSTRUMENT.

TIMEBASES "A" & "B"

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
32L	R201	220K	Resistor	C	10	¼w
24C	RV202	100K	Potentiometer Pre-Set ("Set Speed")	C	10	
29L	R203	56K	Resistor	C	10	¼w
36L	R204	560K	"	C		¼w
50C	R205 S201	50K	Potentiometer ("On/Off" "Variable")			
26L	R206	22K	Resistor	C	10	¼w
50L	R207	4.7K	"	C	10	¼w
8L	R208	100	"	C	10	¼w
8L	R209	100	"	C	10	¼w
50M	R211	39K	Resistor	C	10	¼w
50M	R212	39K	"	C	10	¼w
39L	R213	1.5M	"	C	10	¼w
38L	R214	1.2M	"	C	10	¼w
42L	R215	4.7M	"	C	10	¼w
47C	RV216	1M	Potentiometer("Stability")	C		
59L	R217	100K	Resistor	C	10	¼w
51M	R218	100K	"	C	10	2w
31L	R219	100K	" (Timebase "B" only)	C	10	¼w
59L	R220	100K	Resistor			1w
50L	R221	4.7K	"			¼w
36L	R222	560K	"			¼w
35C	RV223	1M	Potentiometer Pre-set ("Trace Length")			
59L	R225	100K	Resistor	C	10	1w
18L	R226	2.2K	"	C	10	¼w
21L	R227	4.7K	"	C	10	¼w
50M	R228	39K	"	C	10	¼w
60M	R229	56K	"	C	10	1w
31C	RV230	5K	Potentiometer Pre-Set			
8L	R231	100	Resistor	C	10	¼w

(continued)

TIMEBASES "A" & "B" (continued)

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
60M	R232	56K	Resistor	C	10	1w
8L	R233	100	"	C	10	¼w
31C	RV234	5K	Potentiometer Pre-Set			
60M	R235	56K	Resistor	C	10	1w
50M	R236	39K	"	C	10	¼w
42C	(RV237	10K	Potentiometer ("X" Gain)			
	(RV224	100K	" ("X" Shift)			
21L	R238	4.7K	Resistor	C	10	¼w
12L	R239	560	"	C	10	¼w
60M	R240	56K	"	C	10	1w
35C	RV241	1M	Potentiometer Pre-set ("Shift")			
38L	R242	1.2M	Resistor	C	10	¼w
78M	R243	680K	"	C	10	¼w
32L	R244	220K	"	C	10	¼w
28K	C201	0.01	Capacitor T/B "B" only	POL	1	400v
16J	C202	6-30 pf	Trimmer	CER		
51J	C203	8	Capacitor T/B "B" only	ELEC		450v
51J	C204	8	Capacitor	ELEC		450v
26K	C205	0.1	"	POL		500v
10J	C206	0.22	"	POL	10	400v
26K	C207	0.1	"	POL	10	500v
34E	MR201		Diode OA81 or equiv.			
59F	MR202		" K8/20			
Y36	N201		Neon 3L			
Y36	N202		Neon 3L			
	V201		Valve ECF 80			
	V202		" ECF 80			
	V203		" ECF 80			
	V204		" ECC 88			

TIME/CM SWITCH

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
16M	R276	350K	Resistor	HSC	1	$\frac{1}{4}$w
15M	R278	400K	"	HSC	1	$\frac{1}{4}$w
9M	R279	1.2M	"	HSC	1	$\frac{1}{4}$w
8M	R280	2 M	"	HSC	1	$\frac{1}{4}$w
6M	R281	4 M	"	HSC	1	$\frac{1}{4}$w
4M	R282	2 x 6 M	"	HSC	1	$\frac{1}{4}$w
42K	C276	39 pf	Capacitor	CER	10	350v
16J	C277	6-30 pf	Trimmer	CER		250v
9K	C278	180 pf	Capacitor	SM	2	350v
53K	C279	100 pf	"	CER	10	350v
36K	C280	0.002 uf	"	POL	2	350v
18K	C281	0.001 uf	"	MP	10	500v
37K	C282	0.02 uf	"	POL	2	350v
25K	C283	0.01 uf	"	MP	10	500v
27K	C284	2 x 0.1 uf	"	POL	5	400v
26K	C285	0.1 uf	"	POL	10	400v

NOTE: 2 PER INSTRUMENT

DELAY CIRCUIT

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
56T	V150		Valve ECC 88			
54T	V151		" ECF 80			
8L	R150	100	Resistor	C	10	¼w
54L	R151	15K	"	C	10	1w
9L	R152	180	"	C	10	¼w
8L	R153	100	"	C	10	¼w
19L	R154	2.7K	"	C	10	¼w
24L	R155	3.3K	"	C	10	¼w
31L	R156	100K	"	C	10	¼w
	R157	330	"	C	10	¼w
22L	R158	5.6K	"	C	10	¼w
86C	RV160	100K	Knobpot			
26L	R161	22K	Resistor	C	10	¼w
16K	C150	0.1 uf	Capacitor	POL		400v
16K	C151	0.1 uf	"	POL		400v
51J	C152	8 uf	"			450v
31K	C153	500 pf	"			
53K	C154	10 pf	"	CER		400v
53K	C155	100 pf	"	CER		400v
34E	MR150		Diode type OA 81			

C.R.T. CIRCUIT

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
50L	R301	4.7K	Resistor	C	10	1w
97C	RV303	1M	Potentiometer		10	$\frac{1}{4}$w
42L	R305	6.8M	Resistor	C	10	1w
50L	R306	4.7K	"	C	10	1w
49L	R307	3.9K	"	C	10	1w
11L	R308	470	"		10	$\frac{1}{4}$w
50L	R309	4.7K	"	C	10	1w
32L	R310	220K	"	C	10	$\frac{1}{4}$w
31L	R311	100K	"	C	10	$\frac{1}{4}$w
C98	RV 312.333	.250K	Potentiometer 'Astig'			
29L	R 313.334	56K	Resistor	C	10	$\frac{1}{4}$w
41L	R314	2.2M	"	C	10	$\frac{1}{4}$w
46C	(RV315 (RV318	1 M 500K	Potentiometer (Focus. Bright)			
36L	R316	560K	Resistor	C	10	$\frac{1}{4}$w
32L	R317	220K	"	C	10	$\frac{1}{4}$w
32L	R319	220K	"	C	10	$\frac{1}{4}$w
41L	R320	2.2M	"	C	10	$\frac{1}{4}$w
46C	(RV321 (RV323	1M) 500K)	Potentiometer (Focus. Bright)			
36L	R322	560K	Resistor	C	10	$\frac{1}{4}$w
31L	R324	100K	"	C	10	$\frac{1}{4}$w
31L	R325	100K	"	C	10	$\frac{1}{4}$w
54L	R326	15K	"	C	10	1w
12L	R327	560	"	C	10	$\frac{1}{4}$w
38L	R328	1.2M	"	C	10	$\frac{1}{4}$w
32C	RV329	5K	Potentiometer	C		
50L	R330	4.7K	Resistor	C	10	1w
16L	R331	1K	"	C	10	$\frac{1}{4}$w
24L	R332	10K	"	C	10	$\frac{1}{4}$w

(continued)

C.R.T. CIRCUIT (continued)

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
43X	C301	32 uf	Capacitor	ELEC		275v
43X	C302	32 uf	"	"		275v
49K	C303	30 pf	"	CER		500v
16K	C304	0.1	"	POL		400v
16K	C304	0.1 uf	"			400v
16K	C305	0.1 uf	"			400v
20X	C306	0.01 uf	"	CER		1.5KV
18K	C307	1000 pf	"	POL		400v
46K	C308	5 pf	"	SM		250v
	C309	470 pf	"	CER	20	1.5KV
16K	C310	0.1 uf	"	POL		400v
20M	C311	0.01 uf	"	CER	20	1.5KV
95C	RA301		Relay			
180	MR301		Rectifier			
	L301		Coil			
	V301		Valve ECC 88			
	V302		Valve ECC 88			

POWER SUPPLIES

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
C99	RV401	25	Potentiometer Scale Ill. On/Off			
28L	R402	33K	Resistor	C	10	¼w
28L	R404	33K	Resistor	C	10	¼w
100M	R406	2K	"	W/W		10w
100M	R407	2K	"	W/W		10w
30M	R408	500	"	W/W		5w
30M	R409	500	"	W/W		5w
30M	R410	500	"	W/W		5w
30M	R411	500	"	W/W		5w
36L	R412	560K	"	C	10	¼w
36L	R413	560K	"	C	10	¼w
8M	R414	2M	"	HS	1	½w
19M	R415	18K	"	HS	1	½w
32C	RV416	5K	Potentiometer Pre-Set	C		
40L	R417	2.2M	Resistor	C	10	¼w
	R418	7.5	"	W/W		4w
38L	R482	1.2M	"	C	10	¼w
36L	R483	560K	"		10	¼w
8L	R484	100	"	C	10	¼w
60M	R485	56K	"	C	10	1w
12M	R486	900K	"	HS	1	½w
16M	R487	350K	"	HS	1	½w
30L	R488	68K	"	C	10	¼w
31L	R489	100K	"	C	10	¼w
14M	R490	500K	"	HS	1	½w
97M	R491	680K	"	HS	1	½w
60M	R492	56K	"		10	1w
36L	R493	560K	"	C	10	¼w
8L	R494	100	"	C	10	¼w
38L	R495	1.2M	"	C	10	¼w
16K	C401	0.1 uf	Capacitor	POL		400v
16K	C402	0.1 uf	"	POL		400v
58J	C403	100 uf	"	ELEC		275v

(continued)

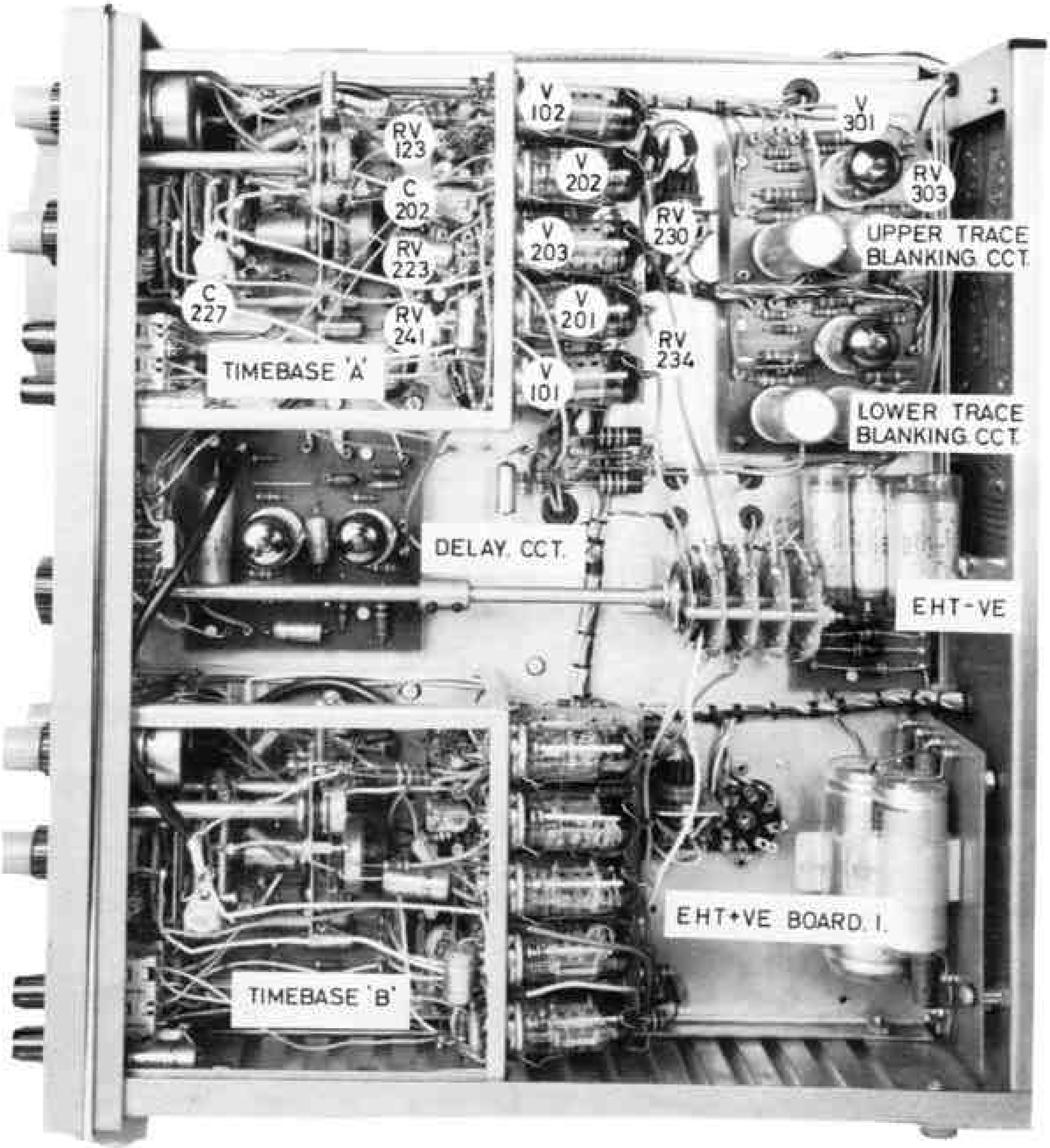
POWER SUPPLIES (continued)

TELEQUIPMENT Part No.	Circuit Ref.	Value	Description	Type	Tol.%	Rating
58J	C404	100 uf	Capacitor	ELEC		275v
	C405	16 uf	"	"		450v
	C406	16 uf	"	"		450v
39J	C407	.05 uf	"			2 KV
58J	C408	100 uf	"	ELEC		275v
58J	C409	100 uf	"	"		275v
	C410	16 uf	"	"		450v
59J	C411) C412)	32 uf	"	"		450v
59J	C413) C414)	32 uf	"	"		450v
37X	C415	.05 uf	"			3.5KV
59J	C416) C417)	32 uf	"	ELEC		450v
16K	C418	0.1 uf	"			400v
20K	C419	0.005 uf	"			400v
47X	C420) C421)	1000 uf	"	ELEC		18v
	C422	16 uf	"	"		450v
39J	C423	.05 uf	"			2 KV
37X	C424	.05 uf	"			3.5KV
28K	C493	0.01	Capacitor	POL		450v
16K	C494	0.1	"	POL		400v
42X	C495) C496)	32 uf	"	ELEC		450v
16K	C497	0.1 uf	"	POL		400v
28K	C498	0.01 uf	"	POL		400v

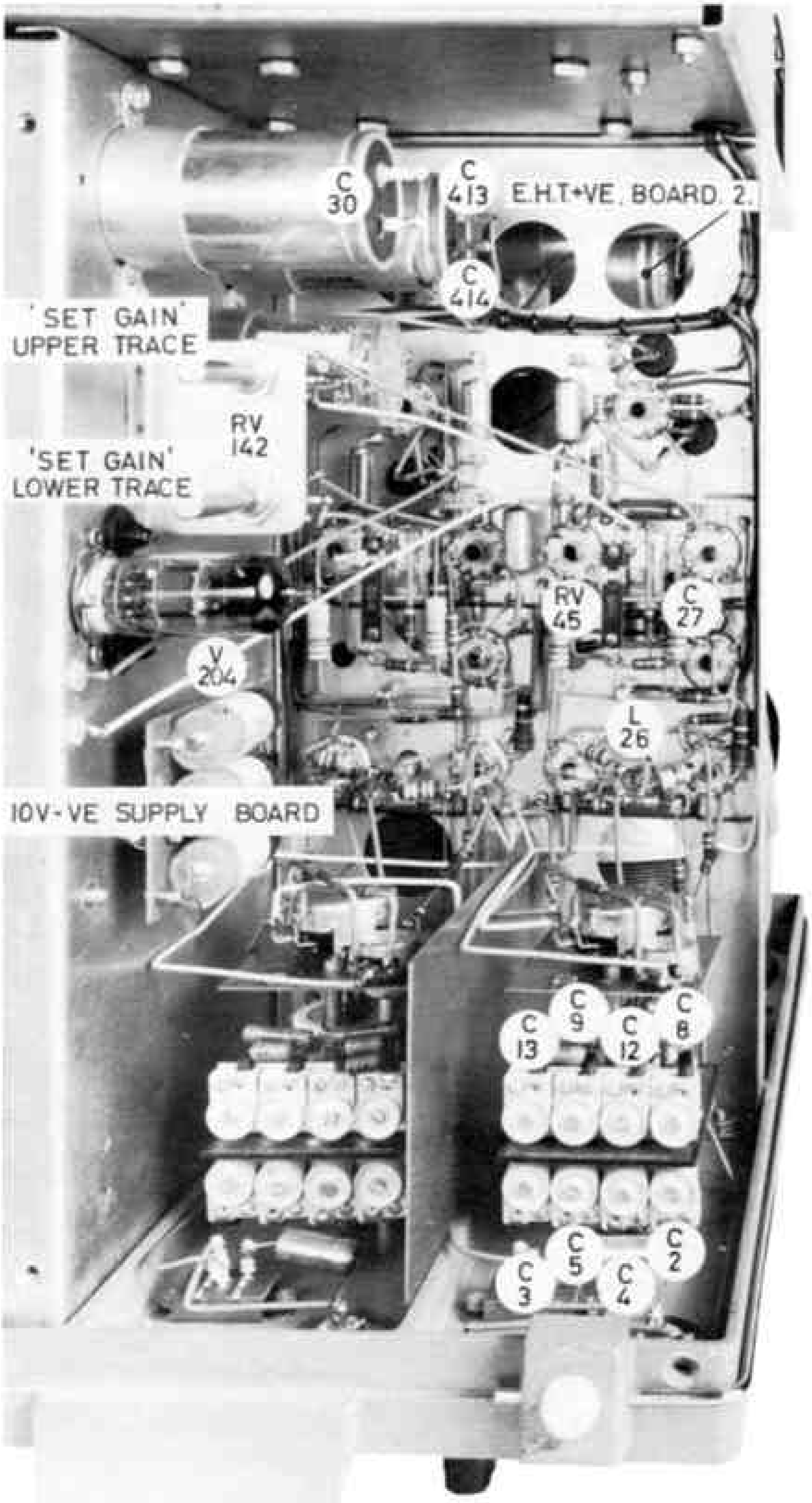
(continued)

POWER SUPPLIES (continued)

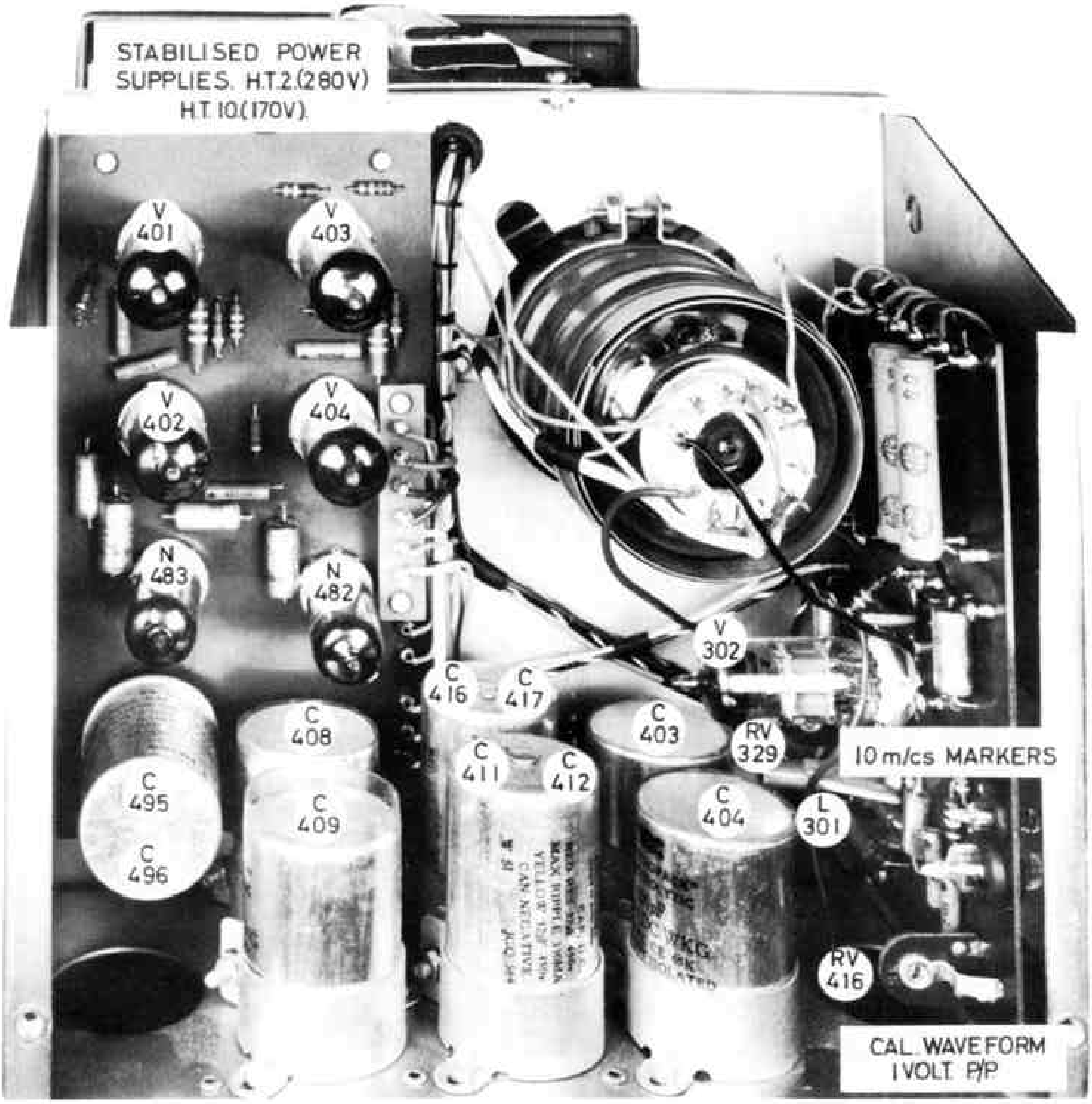
TELEQUIPMENT Part No.	Circuit Ref.	Description
10E	MR401	Diode ZS 71
18O	MR402	Diode DD 056
18O	MR403	Diode DD 056
6 O	MR404	Rectifier K8/50
18O	MR405	Diode DD 056
18O	MR406	Diode DD 056
6 O	MR407	Rectifier K8/50
	MR408	Diode DDO58
	MR409	" "
	MR410	" "
	MR411	" "
6 O	MR412	Rectifier K8/50
6 O	MR413	" "
36Y	N401	Neon 3L
36Y	N402	Neon 3L
20Y	N403	Neon XC 15
1 T	N482	Neon 85A2
1 T	N483	Neon 85A2
52S	T401	Transformer
52S	T402	Transformer
4Y	L1 & L2	Lamp
		Valve ECF 80
		Valve EL 86



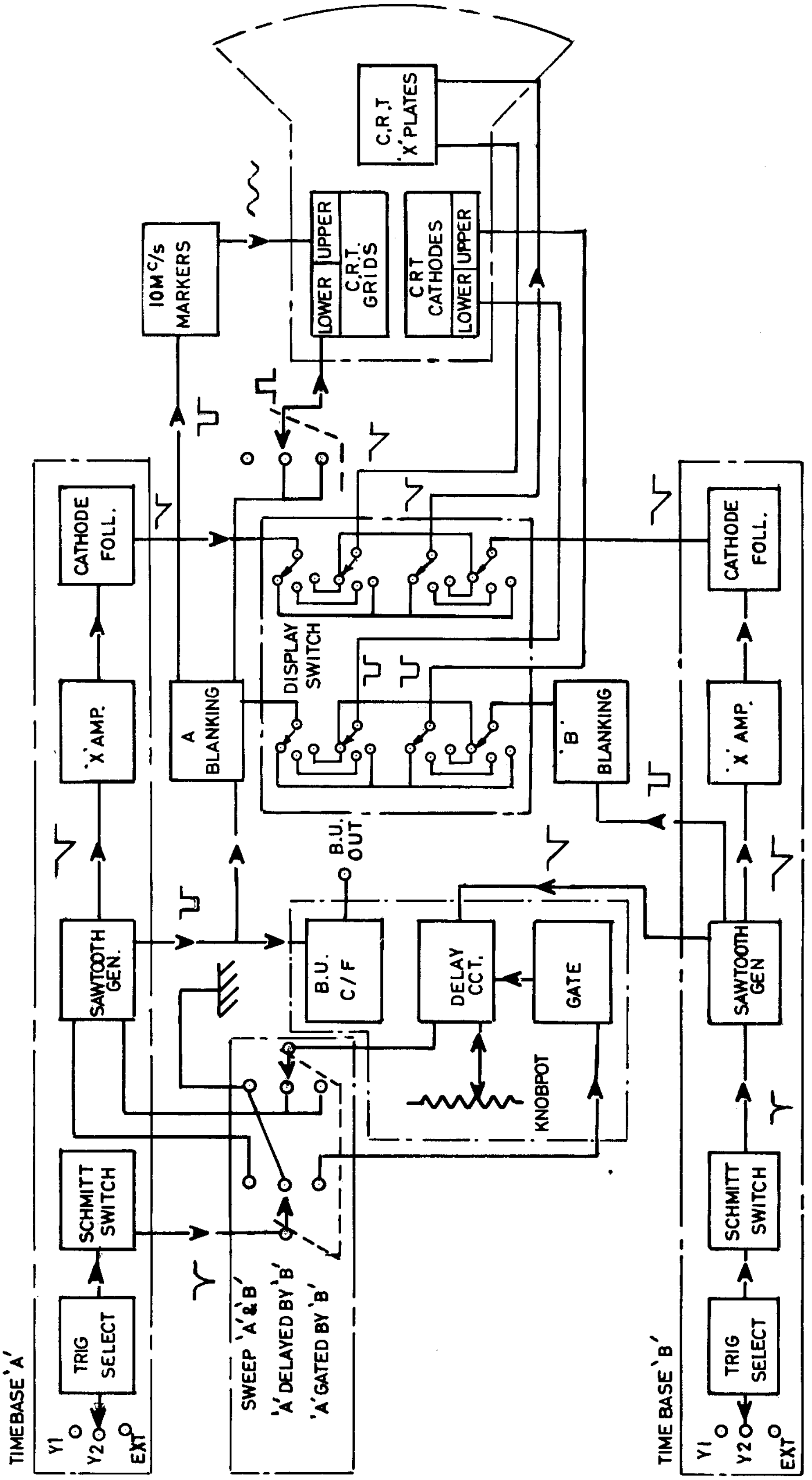
VIEWED AT SIDE PLATE. 2.



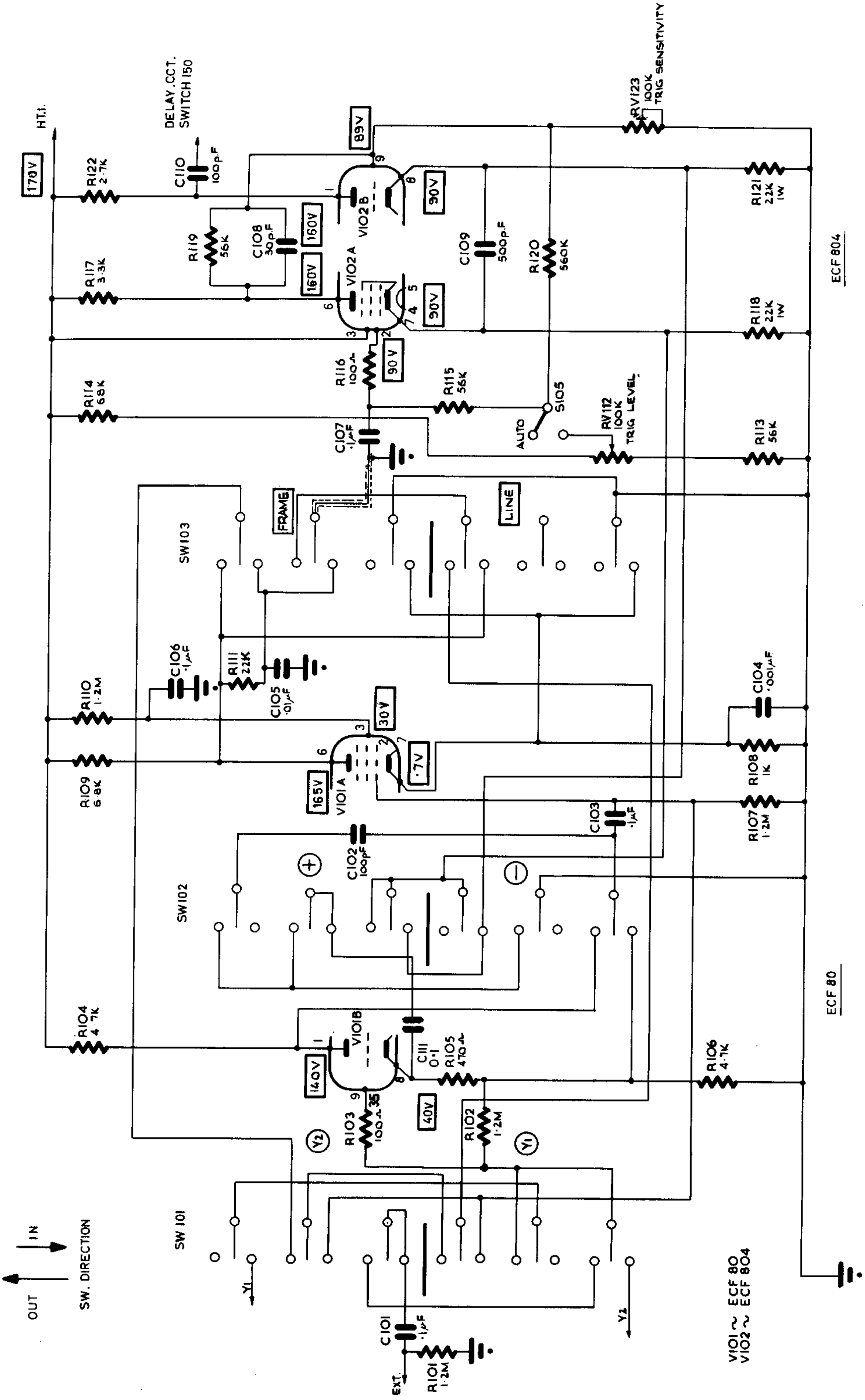
VIEWED AT BOTTOM. PLATE. 3.



VIEWED AT REAR. PLATE 4

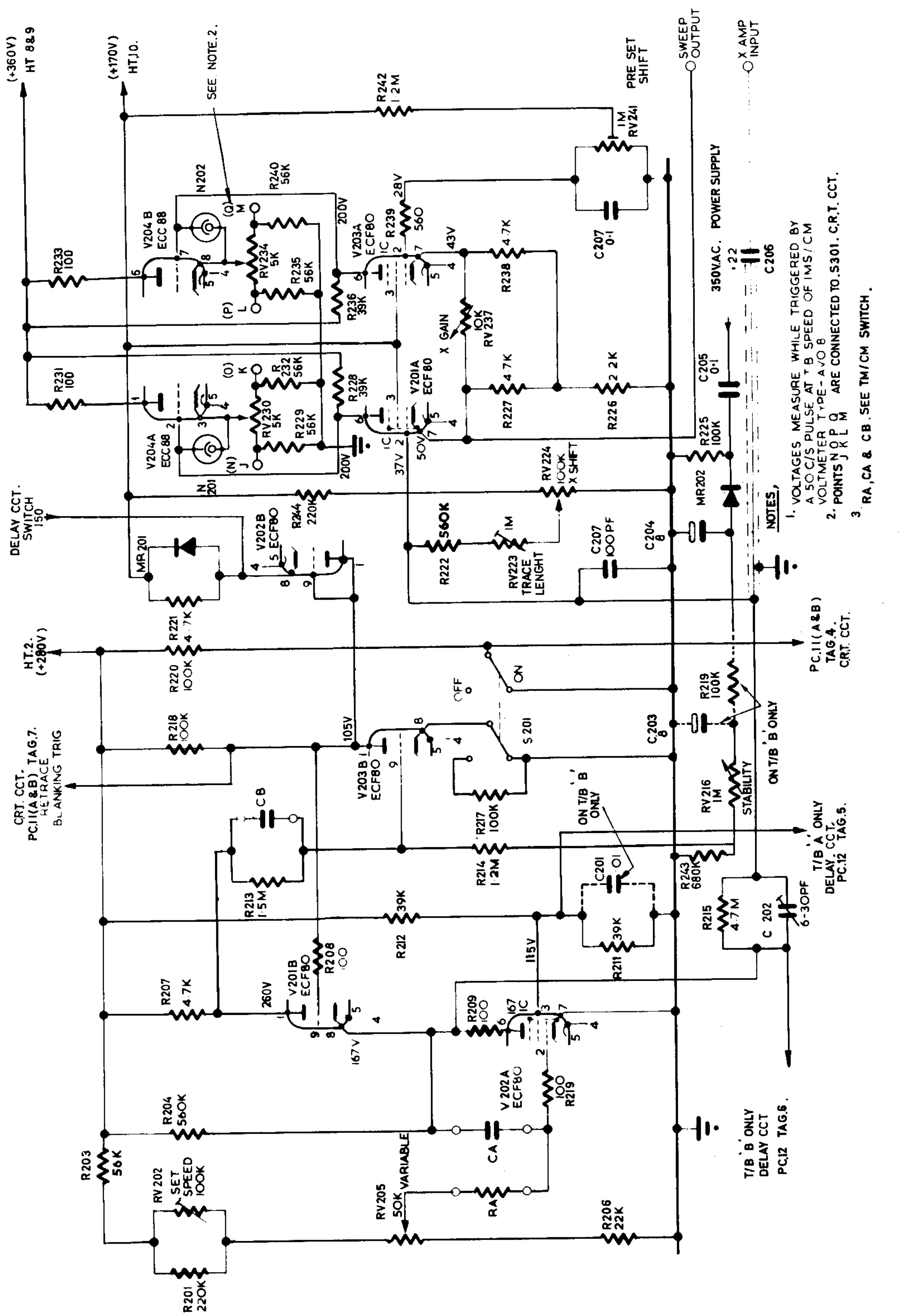


HORIZONTAL SYSTEM BLOCK DIAGRAM. TYPE. D55A. FIG.1.



TYPE. D55A. FIG.2·1.

TRIGGER CCT. (T/B A&B)



TYPE . D 55A . FIG.2.2.

TIME BASE & HORIZONTAL AMPLIFIERS A & B

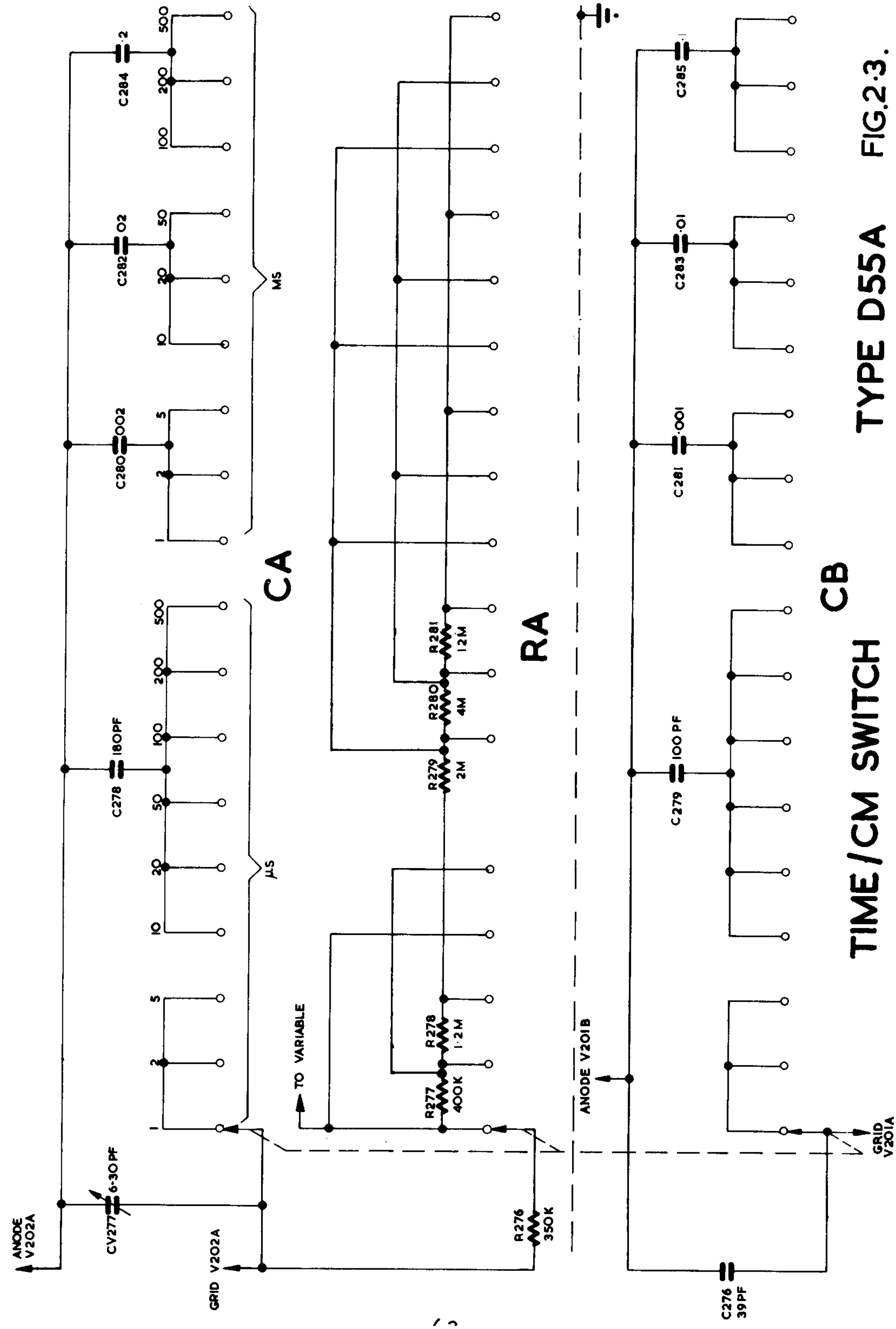
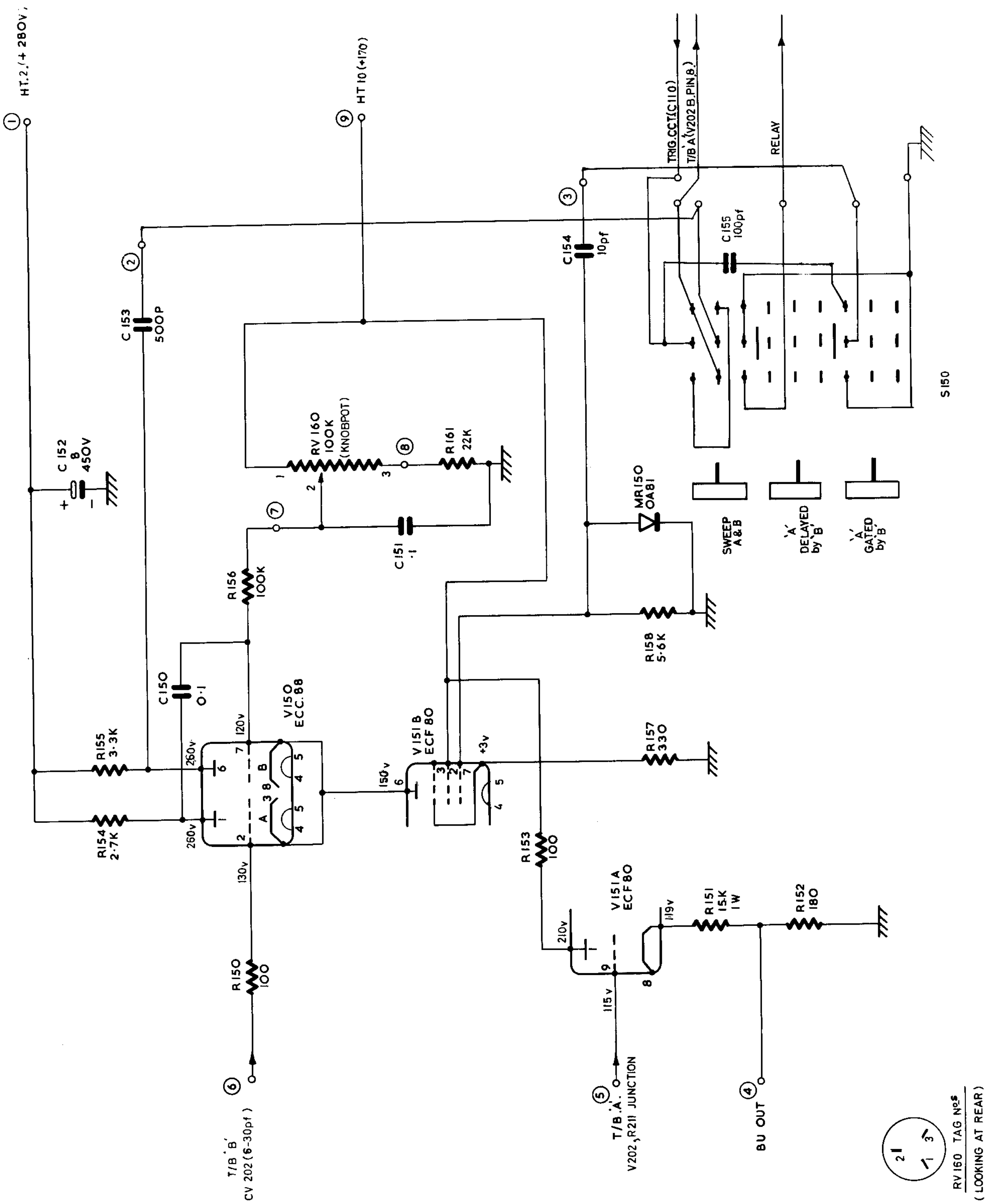
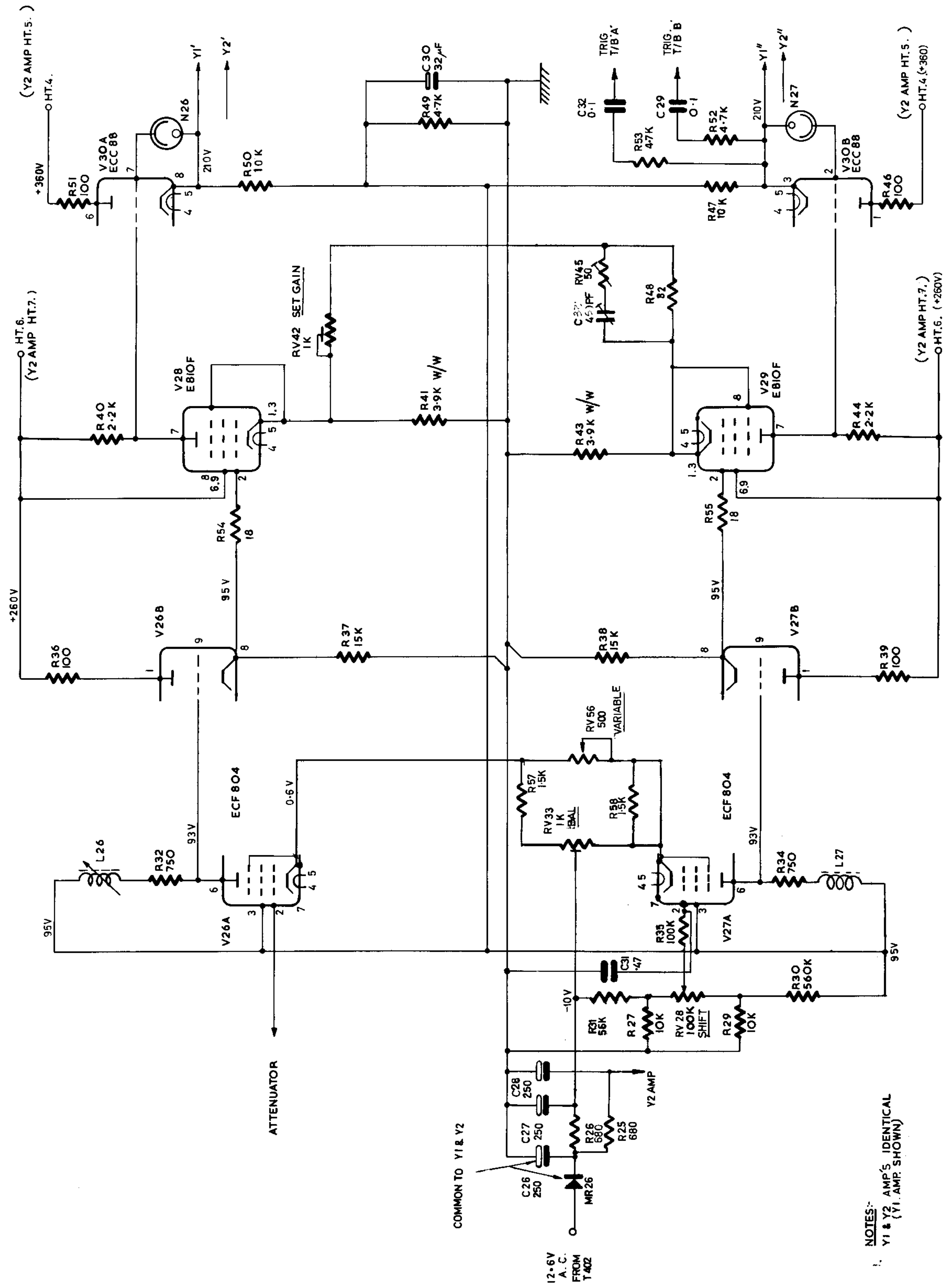


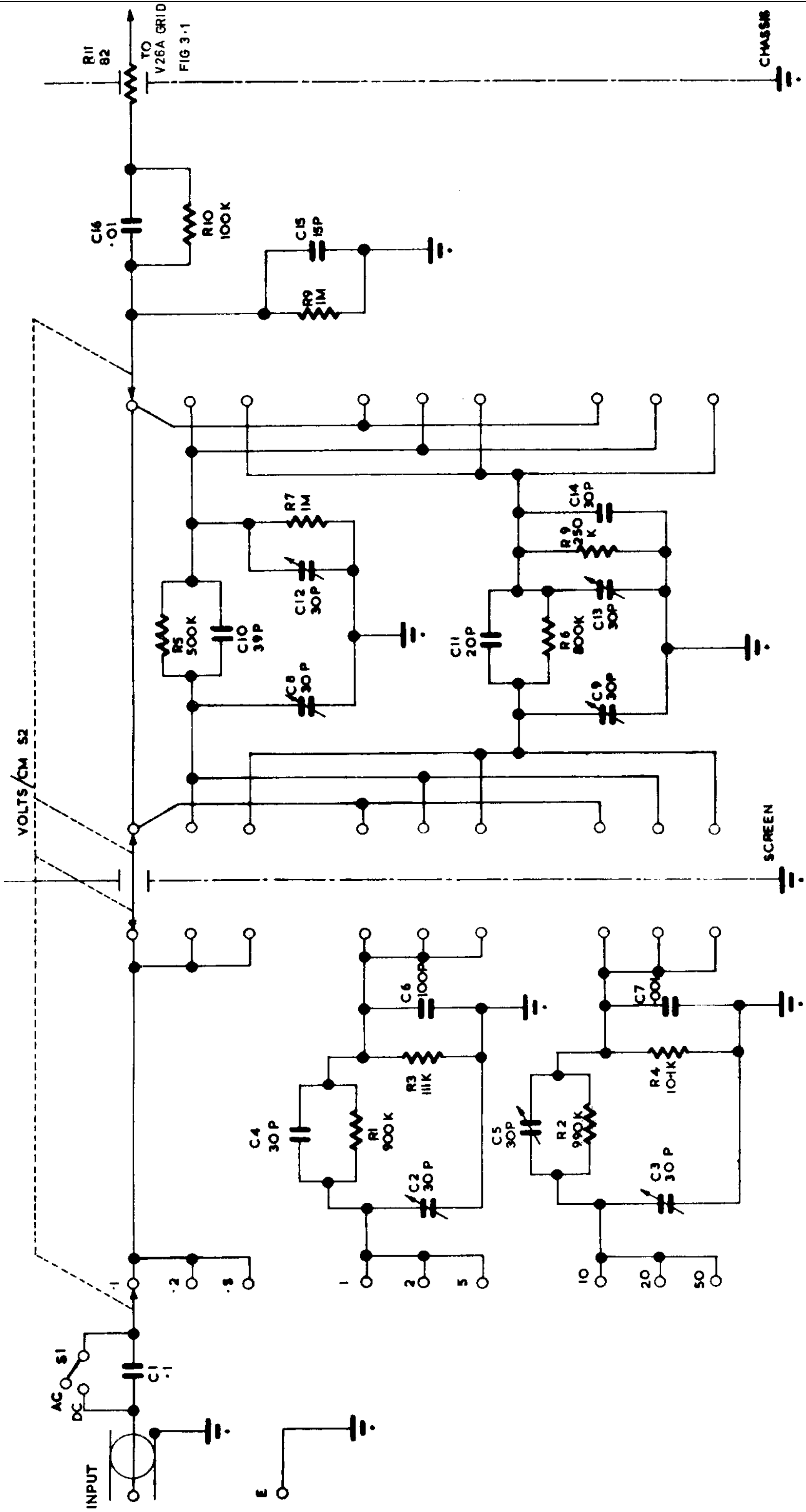
FIG.2.3. TYPE D55A TIME/CM SWITCH



DELAY CIRCUIT TYPE . D55A . FIG 2·4

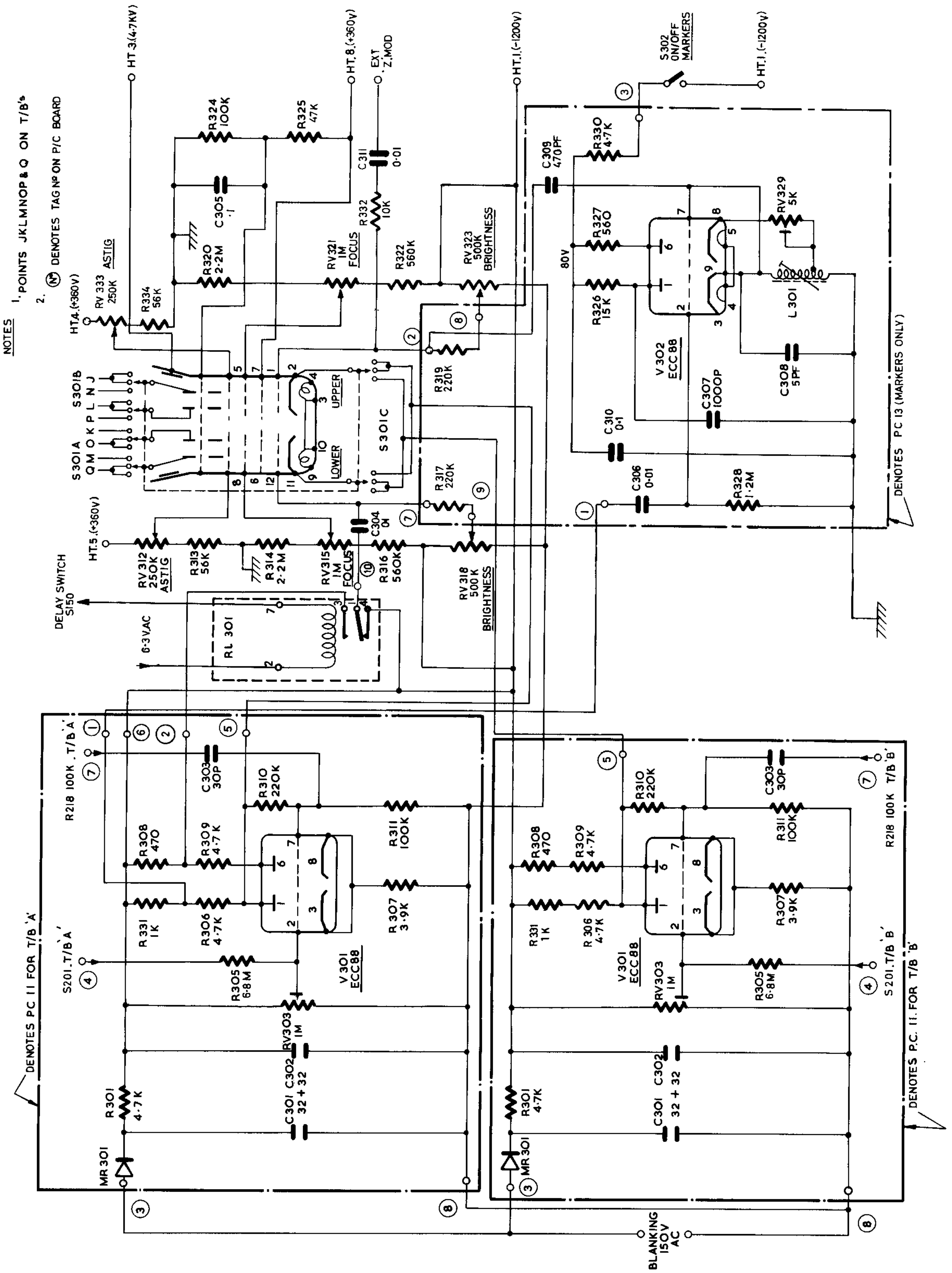


Y1. (UPPER) & Y2. (LOWER) AMPLIFIERS TYPE D55A
FIG 3·1

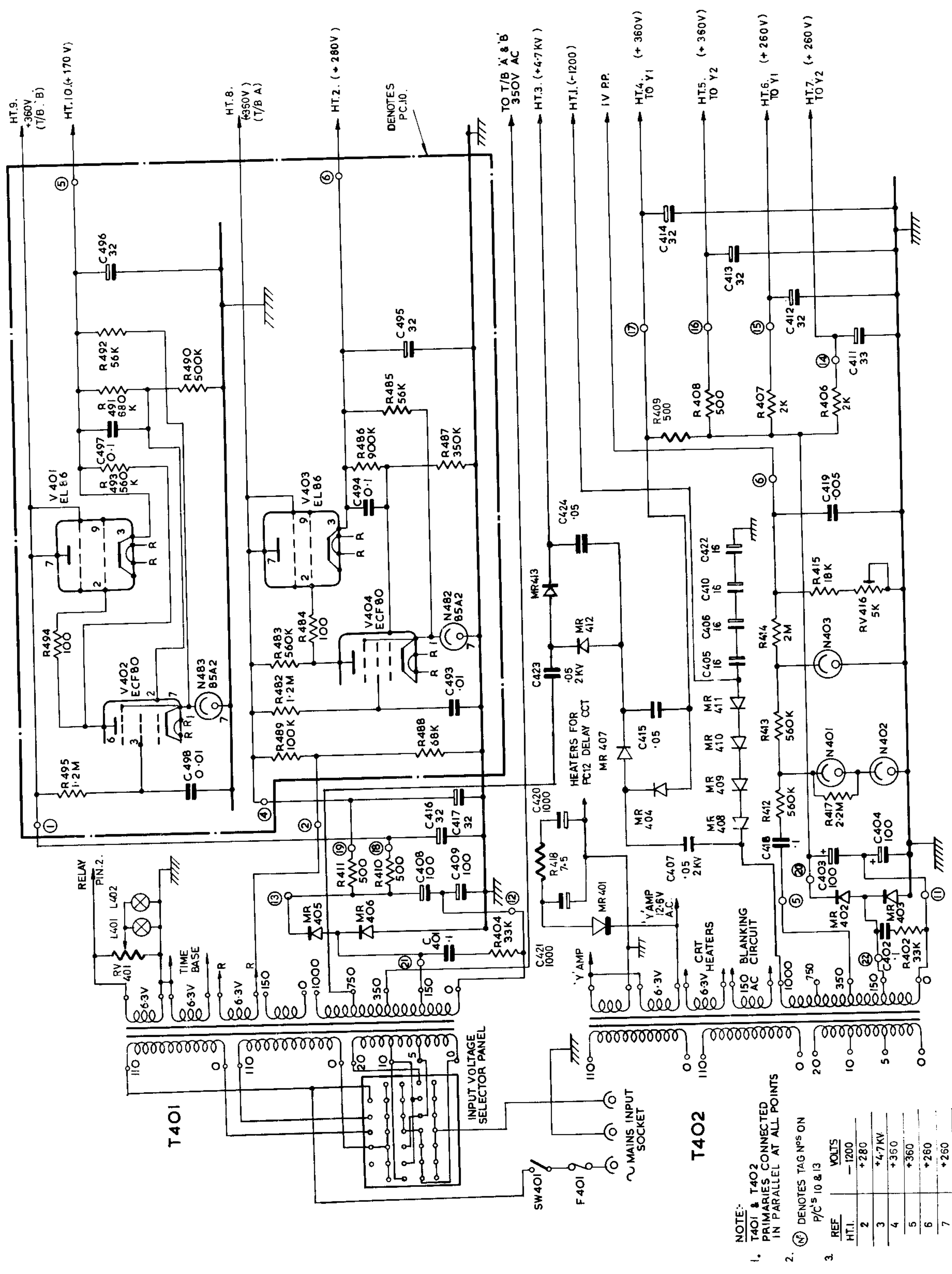


INPUT ATTENUATOR

TYPE. D 55A . FIG. 3.2.



C.R. TUBE CIRCUIT TYPE . D55A . FIG 4·1



NOTE:-
1. T401 & T402 PRIMARIES CONNECTED IN PARALLEL AT ALL POINTS
2. (N) DENOTES TAG Nos ON P/C's 10 & 13
3.

REF	VOLTS
HT.1.	−1200
2	+280
3	+4·7KV
4	+360
5	+360
6	+260
7	+260
8	+360
9	+360
10	+170

POWER SUPPLIES TYPE D55A FIG 5·1