

CHAPTER 1

GENERAL DESCRIPTION, SPECIFICATION,FIRST TIME OPERATION1. GENERAL DESCRIPTION

The S43 and D43 are versatile oscilloscopes offering a wide range of facilities suitable for both general purpose and specialised application. This versatility is achieved by the use of separate plug-in amplifiers for the Vertical Deflection Circuits and interchangeable time base/X amplifier units for the Horizontal Deflection Circuits.

Simplicity of circuitry and the "unit" method of construction make an extremely reliable instrument which is easily maintained.

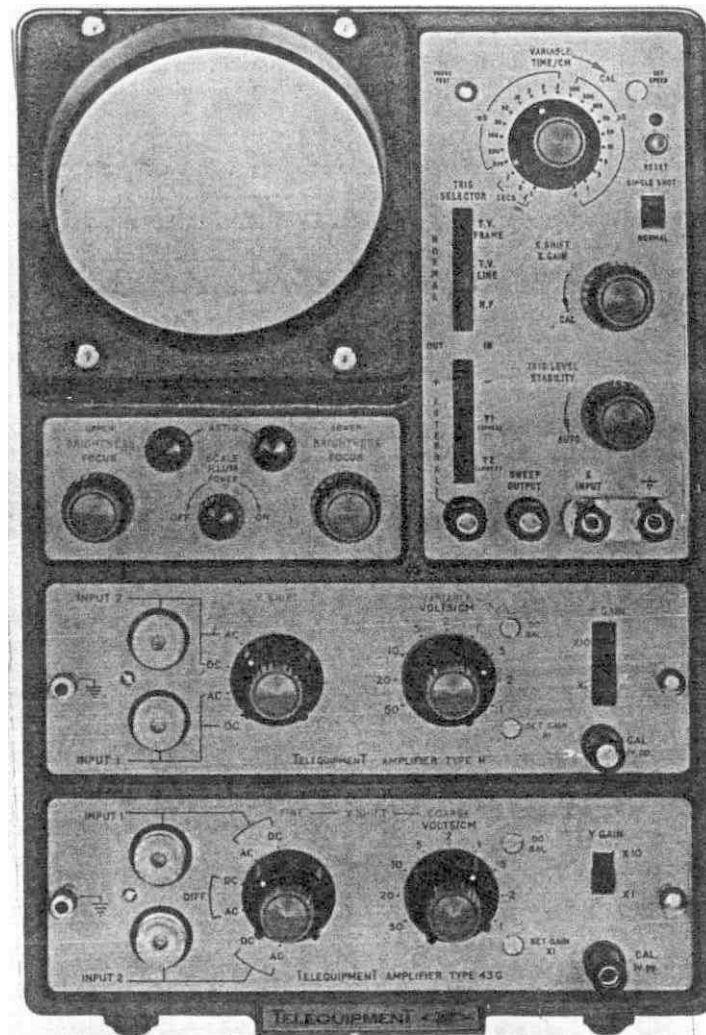
Both the S43 and D43 use identical plug-in amplifiers and similar time base units, the only differences being the CRT circuit and the HT supplies. These are dealt with separately under the appropriate chapter headings.

The following Y amplifier units are currently available.

- Type A - General Purpose Amplifier
- " B - High Gain Differential Amplifier
- " C - Very High Sensitivity Amplifier
- " D - Envelope Monitor
- " G - Wide Band Differential Amplifier
- " H - Wide Band General Purpose Amplifier

Two alternative time base/X amplifier units are available.

- T41. 18 sweep speeds
- T42. 22 sweep speeds - single shot facility.



OSCILLOSCOPE TYPE D43
(WITH G & H AMPLIFIERS
& T42 TIMEBASE)

PLATE.1.

Manual dated April 1966

2. SPECIFICATION

2.1 The Cathode Ray Tube

The 4" flat-faced CRT operates at 4 kV overall, giving an extremely bright, fine trace over the whole of the working area. A P31 phosphor is normally supplied, but longer persistence phosphors are available, if specified. A green filter is fitted to improve the contrast under conditions of high ambient light.

An illuminated graticule facilitates accurate measurement, and an extendible light hood is available as an optional extra.

2.2 Vertical Deflection Amplifiers Type A (For other types see Appendix I)

The standard model is fitted with Type A General Purpose Amplifiers. This is a four-stage, balanced, DC-coupled amplifier, driving the Y deflector plates through output cathode followers. The amplifier is compensated for optimum pulse response with no overshoot.

2.2.1 Frequency Response and Sensitivities

- (i) DC-15 Mc/s at 100 mV/cm.
- (ii) DC-.8 Mc/s at 10 mV/cm.

Preset gain controls standardize the sensitivities of the amplifiers against an internally-generated calibration waveform.

2.2.2 Input Impedance: 1 megohm, shunted by 40 pf.

2.2.3 Input Attenuators

The nine-position input attenuator is frequency compensated and permits direct reading in volts/cm. on the following ranges: 100 mV (10 mV), 200 mV (20 mV), 500 mV (50 mV), 1 V (100 mV), 2 V (200 mV), 5 V (500 mV), 10 V (1 V), 20 V (2 V), 50 V (5 V).

(The bracketed figures apply with the amplifier gain switch in the "X10" position.)

2.3 The Timebase and Horizontal Deflection Amplifier

T41 has eighteen preset calibrated sweep speeds: 500, 200, 100, 50, 20, 10, 5, 2, 1 milliseconds per cm. 500, 200, 100, 50, 20, 10, 5, 2, 1 microseconds per cm.

T42 has twenty two preset calibrated sweep speeds; 5, 2, 1 seconds/cm. 500, 200, 100, 50, 20, 10, 5, 2, 1 milliseconds per cm. 500, 200, 100, 50, 20, 10, 5, 2, 1, 0.5 microseconds per cm.

All the above are at minimum "X" expansion.

A VARIABLE control covers intermediate speeds.

The time measurement accuracy is $\pm 5\%$.

The sweep generator is a Miller circuit, giving excellent linearity. The Horizontal Deflection Amplifier X GAIN control permits the trace to be expanded to approx. 10 screen diameters. Sufficient shift is provided to enable any part of the expanded trace to be positioned centrally on the screen.

Terminal sockets on the front panel enable

- (a) an external timebase waveform to be applied in which case the internal timebase should be switched off.
- (b) the internal timebase waveform to be used for external purposes.

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.

(3) Single shot facility. (T42 only). With the Single Shot/Normal switch set to single shot, then the sweep will fire once on receipt of a trigger pulse and remain locked out until operation of the Reset push button.

2.5 Trigger Selection

Selector switches enable the timebase 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.

D.C. Restoration enables the sweep to be triggered from the LINE or FRAME pulses of a composite TV waveform without a change of picture content affecting the triggering point.

2.6 Calibration Waveform

A 1 volt peak to peak square wave, at mains supply line frequency and stabilized against line voltage variations, is available at a connector on the front panel for calibration purposes.

2.7 Trace Unblinking

A new DC-coupled flyback suppression system ensures uniform trace brightness at slow sweep speeds and complete suppression of the timebase flyback.

2.8 Z-MOD Socket

A connector on the rear of the instrument permits intensity modulation of the beam for accurate measurement of rise times, etc.

2.9 Supply Voltage and Current

(1) 90 - 130 V)
(2) 200 - 240 V) - at 50 c/s

Power consumption 132 VA (D.43) and 100 VA (S.43).

2.10 Cooling

The instrument is cooled by convection. Air enters the bottom of the case and is drawn up past the tubes and other hot components, passing out through slots at the top. The air flow must not be obstructed in any way.

2.11 Dimensions

D.43	8½" wide x 13" high x 19" long (21 cms. x 33 cms. x 48 cms.) Weight: 36 lbs (16 kilograms)
S.43	8¼" wide x 10½" high x 19" long (21 cms. x 26.7 cms. x 48 cms.) Weight: 28 lbs (12.8 kilograms)

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 thoroughly 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 as follows:

<u>INPUT SWITCH</u>	"DC"
<u>VOLTS/CM</u>	"0.5"
<u>Y GAIN</u>	"X1" IN
<u>FOCUS</u>	Mid-position
<u>ASTIG</u>	Mid-position
<u>Y SHIFT</u>	Mid-position
<u>BRILLIANCE</u>	Fully anticlockwise
<u>X GAIN</u>	Fully anticlockwise
<u>X SHIFT</u>	Mid-position
<u>STABILITY</u>	Fully clockwise
<u>TRIG LEVEL</u>	Anticlockwise to position just before switch operation
<u>TIME/CM</u>	"20 MS"
<u>VARIABLE</u>	Fully clockwise
<u>TRIG SELECTOR</u>	"NORMAL" (All out), "+" (out), "Y1" (in).
<u>SINGLE SHOT SWITCH</u> (T42 only)	NORMAL.

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 the 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 control is turned fully anticlockwise to operate the AUTO switch, the trace 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 speed 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 control 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 5, 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 "10 milliseconds" and the VARIABLE control fully clockwise, the timebase speed is 10 milliseconds per centimetre, so that one cycle should occupy two centimetres. 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 in 2 cms. 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. On 60 c/s

mains the SET SPEED should be adjusted on 10 Ms/cm so that three cycles occupy 5 cms.

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.

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 millimetres 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 is divided into two sets of three push buttons. One position, used for most purposes, selects "NORMAL" triggering. The top two buttons bring the DC Restoration 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). The third button selects H.F. operation. In this latter position the sweep is synchronized by the incoming signals. The lower three push buttons select positive or negative, Y1, Y2, or external triggering waveforms as required.

A differentiating circuit of 22 us is used in the Sync. Separator to permit triggering from the Frame pulse, effectively removing the line pulse.

For triggering from an external signal (minimum .5 volt), 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 approx. 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 on the 20 Ms/cm. range, 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.

5. VERTICAL DEFLECTION AMPLIFIER (TYPE A) 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. Two preset controls, adjacent to the Y GAIN switch, enable the gain to be standardized at either switch setting ("X1" or "X10"). With the Y GAIN switch set to "X1" the 1 volt calibration squarewave should measure 5 centimetres vertically with the VOLTS/CM switch set to 0.2 V/cm. In the "X10" position, the squarewave will occupy 5 cm. on the 2 V/cm. range. 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 5).

5.2 X1/X10 Y GAIN Switch

This switch changes the gain of the Y amplifier, the normal (X1) sensitivity being multiplied by 10 when the "X10" position is selected. The positions of the attenuator (VOLTS/CM) switch apply only for normal operation and should be divided by ten in the "X10" 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 response 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.

6. ADDITIONAL FACILITIES

6.1 Sweep Output

The terminal socket marked SWEEP OUTPUT on the timebase front panel provides a positive going sawtooth waveform of approximately 40 volts maximum amplitude, from the cathode of V107A. This valve acting as a cathode follower presents a low impedance in its cathode circuit, thus preserving the purity of the waveform. 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.

6.2 X AMP Input. T41

This terminal socket on the timebase front panel, is connected, via a series capacitor (C117) of 0.1 microfarad, to the input of the sweep amplifier.

The input impedance is approximately 170 K. shunted by 30 pf. The frequency response is 3 dB down at 10 c/s and at about 400 Kc/s but is otherwise flat over the intervening range.

The sensitivity can be varied by the X Gain control from approximately 250 mV/cm to 2.5 V/cm.

X AMP Input. T42.

This terminal socket, on the timebase front panel, is DC coupled to the input of the sweep amplifier. It is normally linked to earth when not in use.

The input impedance is 1 M Ω shunted by 30 pf. The frequency response is DC to approximately 500 Kc/s (-3dbs). The sensitivity can be varied by the X Gain control from approximately 100 mV/cm to 1 V/cm.

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

6.3 Single Shot (T42 only)

With the switch in the SINGLE SHOT position the timebase will trigger from the first trigger pulse occurring after the RESET button has been pressed, and will ignore any further trigger pulses. A neon lights when the timebase is ready for firing and goes out at the end of the sweep.

6.4 Z MOD

This connector, at the rear of the instrument, is taken, via a block capacitor, to one grid of the CRT. 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 10,000 ohms.

TIME BASE AND ASSOCIATED CIRCUITS1. THE TRIGGER CIRCUIT1.1 General

Figure 2.1 shows the trigger and TV sync. selection. The operation of the push button switches is described and a detailed summary of the switch positions is also given in this chapter.

1.2 Circuit Description

The trigger amplifier consists of a longtailed pair followed by a cathode follower. The trigger signal from Y1, Y2 or External is fed to either grid of the longtailed pair depending on the setting of S101A (+, -) the other grid being earthed. The output from the pentode anode (V101B) is taken via cathode follower (V101A) to the input of the Schmitt trigger circuit (V103 ECC88). The output D.C. level of the trigger amplifier is varied by RV115, the Trig Level control which varies the D.C. level of both input grids symmetrically, allowing the triggering point to be set to any desired point on the waveform. On the Auto position the Level control is switched out of circuit and the output of the trigger amplifier is A.C. coupled to the Schmitt trigger circuit. The input grid resistor R125 is returned to the opposite grid causing the circuit to free run at approx. 40 c/s in the absence of triggering signal. As soon as a trigger signal is applied the circuit is synchronised and the time base will trigger from a point near the mean level of the trigger waveform. This setting may be used for almost all applications involving repetitive waveform with approximately equal excursions about the mean level and repetition frequencies between 50 c/s and 1 Mc/s.

1.3 H.F. Operation

On H.F. operation S102C removes the D.C. coupling between the cathodes of the Schmitt trigger converting it into a multivibrator running at approx. 0.5 Mc/s. The circuit will then synchronise to high frequencies from approx. 1 to 15 Mc/s.

1.4 TV Sync. Pulse Selection

On these positions, + and - refer to the picture content, not the sync. pulses.

On TV Frame and TV Line positions the gain of the trigger amplifier is increased 3 times and a D.C. restoring circuit C106, R123 and MR101 introduced into the Schmitt trigger circuit input. The Trig Level control is set to trigger off the synchronising pulses. The D.C. restoration prevents change of triggering point with picture content variations. On TV Line the output of the Schmitt trigger circuit is differentiated by a short time constant C111 and R136 and fed to the timebase. On TV Frame the time constant is increased by the addition of R137. This gives a greater output from the wider frame pulses than from the line pulses and the timebase can be adjusted to trigger off the frame pulses by means of the Stability control.

1.5 Trigger Sensitivity

The trigger sensitivity control RV127 is a preset resistor between the cathodes of V103 and is set to give the maximum trigger sensitivity on the 'Cal' waveform without multi-triggering.

1.6 Facilities

The trigger selector switch is divided into two sections, each of which is operated by three push buttons. The functions of the sections are as follows:

<u>Upper Section:</u>	selects NORMAL operation, H.F. operation, or TV sync., line or frame.
<u>Lower Section:</u>	selects the polarity of the triggering signal (positive or negative) and 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:

<u>Switch</u>	<u>Position of Buttons</u>	<u>D.43 Function</u>	<u>S.43 Function</u>
Upper Section	All Out	Normal	Normal
	Top In	TV Frame	TV Frame
	Middle In	TV Line	TV Line
	Lower In	H.F.	H.F.
Lower Section	Top In	- ve	- ve
	Top Out	+ ve	+ ve
	Middle In	Y1	INT.
	Lower In	Y2	EXT.
	Both Out	EXT.	-

2. THE TIME BASE AND HORIZONTAL DEFLECTION AMPLIFIER

Figs. 2.2 and 2.3 show the T41 Timebase and Time/cm switch.

" 2.4 and 2.5 " " T42 " " " " "

2.1 Time Base Technical Description

V102B and V107A form a grid triggered Miller circuit, the timing components comprising C276, 277, 278, 279, 280, 281 and R279, 280, 281. (R285 - 290 in T42). The Miller is driven by a bistable circuit V104 via diodes MR104 and V105A. MR105 clamps the starting point of the sweep at approx. 97.5v. A fraction of the sawtooth voltage appearing at the cathode of V107A is used to reset the bistable circuit at the end of the sweep. V105B, R276, R278 and C276, 278, 279, 280 (R275, R277 and C275, 277, 278, 279, 280 in T42) prevent retriggering until the end of the hold-off period.

RV148 is the sweep length preset. The bistable circuit is triggered by a positive pulse from the Schmitt trigger circuit via V106A. Negative pulses are removed by diode MR102. The Stability control RV152 controls the potential of the grid of V104A at the end of the hold-off period and is set to a point just above the free-running condition for normal triggered operation.

V106B amplifies the time base driving waveform to provide the drive for the modulator plate of the C.R.T. This brightens the trace during the time base sweep only.

The timing and hold-off capacitors are switched in 10:1 steps, the intermediate 1, 2 and 5 steps being obtained by switching the timing resistor. RV284 (RV291 in T42) is the 'Variable' control giving a continuous variation of 2.5:1 and the calibration is correct in the fully clockwise position only. C281 (C276 in T42) is set up on the highest time base speed to give the correct sweep speed. The output is taken from the cathode of V107A to the Sweep Output terminal and to the X amplifier.

2.2 X Amplifier Technical Description

The sawtooth from the time base and the X shift voltage from RV182 are mixed in a capacity compensated mixing circuit C116, R163, R164, R165 and applied to the grid of the X amplifier. This is a longtailed pair consisting of V107B and V108B with a 10:1 X Gain control RV171 between the cathodes. The push-pull output from the anodes is directly coupled to the C.R.T. X plates. RV172 is the Set Speed control and is set up with the X Gain in the fully anti-clockwise (minimum gain) position.

The Ext X input terminal is connected via a 0.1 uf capacitor to the input grid of the X amplifier in T41. In T42, the Ext X input terminal is DC coupled to the grid of V109A, an amplifier whose anode is connected to the grid of V108B. V109B provides a low impedance variable H.T. supply for V109A. RV195 is set to centralise the X Shift control. When using this facility the timebase should be switched off by rotating the 'Variable' control fully anticlockwise. This removes the blanking voltage from the modulator plate of the C.R.T.

V108A is a cathode follower giving a low impedance 100v supply for the time base.

2.3 Facilities

(1) X Amp Input. The X Amp input socket permits an external signal to be displayed horizontally. When using this facility the time base should be switched off, by operating the switch S103, which is ganged to the control marked 'Variable'. This switch stops the bistable V104 operating and also removes the flyback suppression output at the anode of V106B from the modulator plate of the C.R.T.

(2) Sweep Output. The sweep voltage is taken from the cathode of V107A via a 0.1 microfarad capacitor (C118) to the socket Sweep Output, and can be used to drive an external circuit. This is a positive going sawtooth of approximately 40v. peak to peak amplitude.

(3) Single Shot (T42 only) TR101 and TR102 are a transistor bistable circuit, which in the Single Shot position, is triggered at the end of the sweep and holds the anode of V105B sufficiently positive to prevent the timebase being retriggered. The transistor bistable is reset by push button S105, and a neon N101 lights to indicate that the timebase is ready for firing.

3. TIME BASE CONTROLS

3.1 The Stepped Sweep Control

Figure 2.3 shows the T41 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 time base speeds. These speeds range from 1 microsecond to 500 milliseconds, in fixed steps, ascending in 1, 2, 5 steps.

Figure 2.5 shows the T42 stepped sweep control, which consists of a three-gang 24-way rotary switch (TIME/CM) to which are connected the resistor-capacitor networks for obtaining the required time base speeds. These speeds range from 0.5 microseconds to 5 seconds per cm. in fixed steps, ascending in 1, 2, 5 steps.

3.2 Stability Control

This control (RV152) varies the grid potential of the valve (V104A) and hence the switching level of the multivibrator. 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 Preset Speed Adjustment

This is formed by the combination of a small variable preset capacitor (C281, Fig. 2.3, C276, Fig. 2.5) which is mounted on the ganged switch assembly, and a preset panel control (RV172) Set Speed (Fig. 2.2 and 2.4). The latter is used for the initial calibration of the time base speed from a known 20 millisecond pulse. The capacitor is used for the highest speed only.

THE VERTICAL DEFLECTION CIRCUITS

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).

3.4 Variable Sweep Control

This control (RV284) is concentric with the TIME/CM switch. It determines the potential to which the charging resistor 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.

3.5 'X' Expansion and Trace Length

The X Gain control (RV171) varies the gain of the push-pull valves (V107B and V108B), thereby controlling the length of the trace. The trace may be expanded up to 10 screen diameters. The preset potentiometer (RV148) in the grid circuit of V104B varies the amplitude of sawtooth into the grid so that the trace length may be controlled with the X Gain at the minimum position.

3.6 X Shift Control

The variable 'X' Shift voltage, adjusted by RV182, is applied in series with the sweep voltage from V107A to the grid of V107B. By this means the trace, with or without expansion, may be moved laterally across the screen to any desired position.

VERTICAL DEFLECTION AMPLIFIER TYPE A

1.1 General

The Vertical Deflection Amplifier Type A is a dual-range general-purpose amplifier having a substantially flat frequency response from DC - 15 Mc/s at 100mV per cm. and from DC - 0.8 Mc/s at 10mV per cm. Direct coupling is used throughout to minimize phase shift, and cathode follower output stages give low impedance outputs to the C.R.T. Y plates and trigger circuit.

A nine-position input attenuator switch (VOLTS/CM) provides frequency compensated attenuation to suit a range of input levels.

1.2 CIRCUIT DESCRIPTION

The Input Attenuator (VOLTS/CM Switch)

The circuit of the Input Attenuator is shown in Figure 3.2. The input capacitor (C1) is normally in series with the input to the attenuator, but is short-circuited by S1 in DC operation.

The attenuator has four frequency compensated resistance dividers, which are used singly or in series to give nine division ratios. The first section has ratios of 1, 10 and 100; the second has ratios of 1, 2 and 5.

The Vertical Deflection Amplifier

The Vertical Deflection Amplifier circuit is shown in Figure 3.1. Two pentode valves (Type EF 184) and three double triodes (Type ECC 88) are used.

The input signal is fed from the attenuator network resistor R11 (Fig. 3.2) to the grid of V1. The input stage consists of a cathode coupled pair (V1 and V2). The inductors (L21 and L22) in the anode circuits are peaked for optimum pulse response. An out of phase signal appears at the anode of V1 and an in phase signal at the anode of V2: these anodes are direct coupled to the cathode followers V5A and V5B respectively. RV40, connected between the cathodes of V1 and V2 is the X1 preset gain control.

The potentiometer (RV29) controls the relative DC anode potentials of the valves (V1 and V2) and consequently acts as a vertical shift (Y SHIFT) control. When the amplifier is operated at high gain ("X10" condition) RV34 acts as a "fine" shift control or Vernier.

The cathodes of V5A and V5B are directly connected to the grids of the output amplifier valves (V3A and V4A). The cathodes of these amplifiers are connected via the X10 preset gain control RV41. The switch S3 (Y GAIN - "X1"/"X10") short circuits RV41 in the X1 position. The inductors (L23 and L24) in the anode circuits of V3A and V4A give compensation at high frequencies in the "X1" position.

In "X10" operation the cathode bias resistors of V3A and V4A (R45 and R46) are not returned to earth but to the preset ASTIG variable resistor (RV50). This control is used to correct the DC level of V3A and V4A cathodes when the valves are operating at high gain. Incorrect adjustment affects the potential of the Y plates of the C.R.T., causing astigmatism of the spot.

The vertical deflection outputs to the Y plates of the C.R.T. are fed from the cathode followers V3B and V4B. The series inductors (L25 and L26) give compensation at high frequencies. The signal from V3B cathode is also taken to the Y1, Y2 positions of the TRIG SELECTOR switch. The neon diodes (N1 and N2) between the grids and cathodes of V3B and V4B protect these valves from the voltages that appear at their grids immediately upon switching on, before the cathodes have reached maximum emitting temperature.

1.3 Y GAIN "X1"/"X10"

With the Y GAIN switch in the "X1" position the maximum sensitivity of the amplifier is 100 mV per cm. The gain can be adjusted by the SET GAIN "X1" control (RV40) (see Chapter 1).

When the Y GAIN switch (S3) is in the "X10" position, higher value load resistors are switched into the anode circuits of the input and output amplifier valves (V1, V2, V3A and V4A). The maximum sensitivity of the amplifier is then 10 mV per cm., and the gain can be adjusted, for calibration purposes, by the SET GAIN "X10" control (RV41).

1.4 Voltage Supplies to Input Stage

It should be noted that the anode and screen voltages for V1 and V2 are taken from a common resistor (R53) in the cathode circuits of V3B and V4B. The cathode current of the input stages therefore flows through the two output cathode followers. This is done to reduce the total current consumption of the Vertical Deflection Amplifier, and to provide a measure of stabilization, so that the overall gain is proportional to the power supply voltage.

A negative supply is obtained by rectifying the 12.6v AC heater winding. This voltage is smoothed by R57, C24 and allows the cathode resistors R23, R59 to be large, so ensuring a constant current through the input valves.

CHAPTER 4

THE CATHODE RAY TUBE CIRCUIT

(D.43)

1. THE CATHODE RAY TUBE

1.1 General

The Cathode Ray Tube used in this instrument is the M.O.V. Type 1074. It has two guns and a four-inch (10.6 cm.) aluminized screen of P31 phosphor, employs spiral post-deflection acceleration, and electrostatic focusing and deflection. The tube is particularly suitable for high speed work, having a fine spot and high sensitivity over a wide Bandwidth. The final anode voltage is 4 kV.

1.2 Flyback Suppression

An unusual means of flyback suppression is employed by including a "modulator anode" in the CRT. The blanking pulse may be fed at anode potential on to this plate, avoiding direct coupling to the grid of the tube. The advantage of this system is that direct coupling ensures uniform trace brightness at all sweep speeds and complete elimination of the timebase flyback.

2. THE CIRCUIT

2.1 The Cathode Ray Tube circuit is shown in Figure 4.1. The Oscilloscope Power Supplies are shown in Figure 5.1. A separate heater winding on the mains transformer (T1, Fig. 5.1) permits the cathode of the tube to be coupled to the heater, to avoid a large potential difference between the two. R311 (Fig. 4.1) is inserted to prevent interference from the 50 c/s heater supply when the Z MOD facility is being used.

The sawtooth scanning voltages from the timebase (see Fig. 2.2) are applied in antiphase to the two Horizontal Deflection Plates (X plates) of the CRT.

(Side-pin connections are used.) The use of push-pull scanning reduces trapezoidal distortion of the trace on the screen.

The voltage under examination is applied to the Vertical Deflection Plates (Y plates), as antiphase outputs from the Vertical Deflection amplifier, via the frequency compensation inductors (L25 and L26, Fig. 3.1).

The BRILLIANCE controls (RV301 and RV318) set the DC levels of the grids with respect to the cathodes, thus controlling the tube beam current.

The FOCUS controls (RV303, RV316) set the potentials of the second anodes, thus permitting the electron beams to be focussed.

2.2 Z MOD Socket

A socket marked Z MOD, at the rear of the instrument is connected via a blocking capacitor to one grid of the CRT. A positive marker pulse applied at this socket will brighten the trace, permitting the rise time of a squarewave to be measured. The time constant of the Z MOD input circuit is about 0.1 millisecond (i.e. 0.01 μ f x 10 K).

2.3 Graticule Illumination

The CRT graticule may be illuminated by rotating the black knob SCALE ILLUM clockwise. The scale illumination control (RV401), to which the Mains ON/OFF switch is ganged, is a 25 ohm potentiometer, used to vary the voltage supplied to the two lamps. The potentiometer is provided so that the load on the heater supply secondary remains constant, whether the scale is illuminated or not.

CHAPTER 4A

THE CATHODE RAY TUBE CIRCUIT (S.43)

1. THE CATHODE RAY TUBE

1.1 General

The Cathode Ray Tube used in this instrument is the Sylvania Type SE4D. It has a four-inch (10.6 cm.) aluminized screen of P31 phosphor, employs spiral post-deflection acceleration, and electrostatic focusing and deflection. The tube is particularly suitable for high speed work, having a fine spot and high sensitivity over a wide bandwidth. The final anode voltage is 3.5 kV.

1.2 Flyback Suppression

An unusual means of flyback suppression is employed by including a "modulator anode" in the CRT. The blanking pulse may be fed at anode potential on to this plate, avoiding direct coupling to the grid of the tube. The advantage of this system is that direct coupling ensures uniform trace brightness at all sweep speeds and complete elimination of the timebase flyback.

2. THE CIRCUIT

2.1 The Cathode Ray Tube circuit is shown in Figure 4.2. The Oscilloscope Power Supplies are shown in Figure 5.2. A separate heater winding on the mains transformer (T1, Fig. 5.2) permits the cathode of the tube to be coupled to the heater, to avoid a large potential difference between the two.

The sawtooth scanning voltages from the timebase (see Fig. 2.2) are applied in antiphase to the two Horizontal Deflection Plates (X plates) of the CRT. (Side-pin connections are used.) The use of push-pull scanning reduces trapezoidal distortion of the trace on the screen.

The voltage under examination is applied to the Vertical Deflection Plates (Y plates), as antiphase outputs from the Vertical Deflection amplifier, via the frequency compensation inductors (L25 and L26, Fig. 3.1).

The BRILLIANCE control (RV211) sets the DC level of the grid with respect to the cathode, thus controlling the tube beam current.

The FOCUS control (RV213) sets the potential of A2, thus permitting the electron beam to be focussed.

2.2 Z MOD Socket

A socket marked Z MOD, at the rear of the instrument, is connected via a blocking capacitor (C211) to the grid of the CRT. A positive marker pulse applied at this socket will brighten the trace, permitting the rise time of a squarewave to be measured. The time constant of the Z MOD input circuit is about 0.1mSecs (0.01 μ F \times 10K).

2.3 Graticule Illumination

The CRT graticule may be illuminated by rotating the red knob SCALE ILLUM clockwise. The scale illumination control (RV226), to which the Mains ON/OFF switch is ganged, is a 25 ohm potentiometer, used to vary the voltage supplied to the two lamps. The potentiometer is provided so that the load on the heater supply secondary remains constant, whether the scale is illuminated or not.

CHAPTER 5

POWER SUPPLIES

(D.43)

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

The mains transformer (T401) provides all the required voltages from its secondaries. 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 (MR401, MR402), together with C404 and C405, form a voltage doubling circuit. This supplies the various HT voltages HT 1 to HT 6 via smoothing and decoupling components. The values of the six available 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.

2.2 EHT Voltages

The EHT supply for the cathode ray tube (CRT) is derived from the 875 V tapping on the secondary of T401 via the silicon rectifiers (MR404). A 1200 V transformer tapping supplies the post-deflection accelerator voltage: MR403 and MR405 are the rectifiers in a voltage doubling circuit. The negative side of this multiplier is returned to HT+3.

2.3 Low Tension

The secondary windings of T401 include a low tension winding, giving 6.3V and 12.6V. This provides heater supplies, pilot light and graticule illumination. A separate 6.3V winding is used for the heater of the CRT (see Chapter 4 Section 2.1). This avoids a large potential difference between the heater and cathode.

2.4 Calibration Voltage

A squarewave of 1 volt peak to peak is provided for calibration purposes as described in Chapter 6. This is obtained by applying the 150 volts tapping on T401 to a zener diode MR407 via C402, R403. The voltage across MR407 is then attenuated by R404, R406, R409, RV410 to provide 1v squarewave.

The temperature coefficient of R406 is selected to match that of the zener diode, so effecting compensation over a wide variation of temperature.

The variable resistor (RV410) 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 transformer (T401) against overload. The SCALE ILLUM control is coupled mechanically to the mains switch; it varies the brightness of the lamps illuminating the graticule and consist of a potentiometer (RV401) across the 6.3V winding (see Chapter 4).

CHAPTER 5A

POWER SUPPLIES

(S.43)

1. INTRODUCTION

The Power Supply schematic is shown in Figure 5.2. All the rectifiers used are semiconductor diodes, thus ensuring a minimum of delay for the rectified voltages to obtain their maximum value.

2. CIRCUITRY

The mains transformer (T1) provides all the required voltages from its secondaries. 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 (MR5 and MR6), together with C222 and C223, form a voltage doubling circuit. This supplies the various HT voltages HT 1 to HT 6 via smoothing and decoupling components. The values of the six available HT voltages are shown in rectangles against the appropriate outputs in Figure 5.2. Voltages on valve electrodes, where applicable, are similarly shown in the related schematics.

2.2 EHT Voltages

The EHT supply for the cathode ray tube (CRT) is derived from the 760 V tapping on the secondary of T1 via the semiconductor rectifiers (MR4). The 1000 V transformer tapping supplies the post-deflection accelerator voltage: MR2 and MR3 are the rectifiers in a voltage doubling circuit. The negative side of this multiplier is returned to HT+3.

2.3 Low Tension

The secondary windings of T1 include a low tension winding, giving 6.3V and 12.6V. This provides heater supplies, pilot light and graticule illumination. A separate 6.3V winding is used for the heater of the CRT. This avoids a large potential difference between the heater and cathode.

2.4 Calibration Voltage

A squarewave of 1 volt peak to peak is provided for calibrating purposes as described in Chapter 6.

The voltage from the 150 volts tapping on T401 is applied via C424, R438 to a zener diode MR401. The voltage across MR401 is then attenuated by R437, R434, R435, RV436, to provide 1v squarewave.

The temperature coefficient of R434 is selected to match that of the zener diode, so effecting compensation over a wide variation of temperature.

The variable resistor (RV236) allows the amplitude of the calibration voltage to be set at exactly 1 volt.

2.5 General

A fuse (F1) in the primary circuit, in series with the POWER switch (S8), protects the transformer (T1) 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 (RV226) across the 6.3V winding.

MAINTENANCE, SERVICING AND SETTING-UP PROCEDURE

1. GENERAL

The simplicity of the circuitry of the oscilloscopes makes them extremely reliable instruments. 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 ensures that all components are easily accessible for testing and servicing. The Timebase and Vertical Deflection Amplifier are built as detachable units and may be withdrawn as follows:

2.1 Removing or Changing the Vertical Deflection Amplifier

The Vertical Deflection Amplifier is easily withdrawn when the two knurled nuts at either side of the front panel are removed. The amplifier may then be pulled out from the front. When replacing the amplifier (or substituting another type amplifier) the two locating pins at the back of the amplifier chassis should be directed through the holes at the rear of the main instrument chassis. Then all the amplifier connections will be made automatically as the amplifier is pushed home.

When withdrawing the amplifier a slight resistance may be experienced until the spring clips, which provide connections for the CRT Y plates and internal triggering outputs, are released.

2.2 Removing the Timebase Unit

To remove the Timebase the cover plates of the oscilloscopes 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 naval plug on the lead from the timebase unit from the main chassis wall.
- (3) Disconnect the flying leads to the X plates of the CRT (X1 plate - white, X2 plate - orange), 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.

2.3 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 tapings 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 when the left-hand side plate is removed from the instrument. They are situated at the front of the Vertical Deflection Amplifier in two parallel rows of four, separated by a metal screen. Plate 3 shows the position of each trimmer.

4.2 Apparatus and Procedure

In order to carry out this adjustment a squarewave 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 squarewave generator to give a trace of 2 - 3 cm. amplitude in each case.

<u>Input Attenuator Setting</u>	<u>Capacitor to be adjusted</u>
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 preset astigmatism control (RV50) and the high frequency compensation inductors (L21, L22, L23, and L24). The Set Gain controls are readily accessible on the front panel and their adjustment is described in Chapter 1. The remaining controls are accessible for adjustment through the bottom of the instrument. Plate 3 shows their position.

5.2 High Frequency Compensation

This should not be attempted unless a squarewave generator capable of producing an accurate square wave at 250 Kc/s, with a rise time of less than 40 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 and the Hewlett Packard Type 211a.

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. The output frequency of the meter should be between 200 and 300 Kc/s.
- (3) Adjust the inductors (L21, L22, L23 and L24) 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 inductors affect the extreme corners of the square wave and should be adjusted so that their inductances are approximately equal.

5.3 Preset Astigmatism Correction

The variable resistor (RV50) should be adjusted so that the DC potential of the Y plates of the CRT remains the same in either position of the Vertical Deflection Amplifier gain switch (Y GAIN). This control is accessible on the right-hand side at the rear of the Amplifier, as shown in Plate 3.

THE TRIGGER CIRCUIT

RV127 is adjusted to give maximum trig sensitivity and RV135 is adjusted so that the LEVEL control operates symmetrically about its mid-position.

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 set the TIME/CM switch to 500 μ s/cm.
- (2) Set the input attenuator to the 5 V/cm. range. This gives a trace 2 mm. high.
- (3) Adjust RV127 to give maximum trigger sensitivity without multi-triggering on AUTO, +ve or -ve.
- (4) Set the V/cm. switch to 0.2 v/cm. range and set RV135 so that the LEVEL control operates symmetrically about its mid-position.
- (5) Re-check RV127 setting.

7. THE SWEEP GENERATOR AND AMPLIFIER

7.1 Trace Length Control (RV148)

Set TIME/CM. to 1 Ms/cm. and STABILITY control fully clockwise, adjust Trace Length (RV148) control to give approx. 40 v at the sweep output terminal. Turn STABILITY fully anti-clockwise and if the time base does not stop, turn Trace Length (RV148) anti-clockwise until it does.

7.2 Frequency Compensation Trimmer C116

Short together pins 7 and 8 on TB power socket. On 10 μ S/cm. range with X GAIN at minimum increasing C116 will produce a small 'tail' to the left of the spot at the start of the time base. The correct setting of C116 is that at which the 'tail' just disappears into the spot. With X GAIN at maximum adjust neutralizing by bending wire connected to anode of V108B until the 'tail' just disappears. Check setting of C116 at minimum gain and repeat until rotating the X GAIN from maximum to minimum produces no 'tail' on the spot in either direction.

7.3 Preset Speed Adjustments (RV172, C281)

Set X GAIN to minimum and TIME/CM to 1 Ms/cm. Remove the short between pins 7 and 8 and display a 1 Kc/s crystal controlled waveform. Set RV172 SET SPEED control to give one cycle per cm. Turn STABILITY control fully clockwise. Set trace length (RV148) to give slightly more than 8 cms. of trace. Set TIME/CM to 1 uS/cm. and display 1 Mc/s crystal controlled waveform. Adjust C281 to give one cycle per cm. (On T42 set TIME/CM to 0.5 uSec/cm and adjust C276 to give 1 cycle per two cms).

On T42 time base set RV195 so that the X SHIFT control moves the trace by equal amounts to the left and right.

7.4 Single Shot Adjustment (RV201) (T42 only)

Display the CAL waveform, switch to SINGLE SHOT and set RV201 to the centre of the range over which the time base triggers correctly when the RESET button is pressed.

8. ADJUSTMENTS IN THE POWER SUPPLY CIRCUIT

The Calibration Voltage (D.43)

The preset variable resistor (RV410) 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 RV401 should not require adjustment. If MR407 is replaced an equivalent type must be used.

RV410 is located on the large printed circuit board at the rear of the instrument.

The Calibration Voltage (S.43)

The preset variable resistor (RV236) in the calibration voltage supply circuit (Power Supply Circuit, Fig. 5.2) 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 RV236 should not require adjustment. If MR401 is replaced an equivalent type must be used.

RV236 is located beneath the metal cover at the rear of the instrument, on a tag board under the yoke bearing the mains voltage selector panel. It is the inner of the two preset resistors on this tag board, and must not be confused with the outer, which is RV220 (Fig. 4.2) (SET SHIELD VOLTS).

9. CRT CIRCUIT ADJUSTMENTS (D.43)

There are three pre-set controls on a printed circuit board, mounted above the CRT on the power supply chassis.

RV305 adjusts the inter-deflection plate shield voltage. The potential is adjusted to give minimum pincushion and barrel distortion. The control is set during test and no further adjustment should be necessary unless the cathode ray tube is changed.

RV313 adjusts the alignment of the two traces. To do this, a sine or square waveform should be displayed across the trace, on each beam, and the two traces then superimposed on to each other. Adjustment of RV313 aligns the two traces in the centre of the screen. The traces may, however, be out of adjustment at the edges of the CRT.

Adjustment of RV310 sets the X sensitivities to be equal, so the two traces will be aligned at the edges of the CRT.

Hence, by adjustment of both RV313 and RV310, the two traces will be aligned over the whole CRT face.

CRT Circuit Adjustments (S.43)

The Cathode Ray Tube is equipped with an inter-deflector plate shield. The shield is returned to a potential divider between HT + 3 from MR2 (Fig. 5.1) and earth, formed by RV220. This potentiometer is adjusted so that the shield is at the average potential of the X and Y deflector plates. It serves to correct pincushion and barrel pattern distortion. The control is set during tests and no further adjustment should be necessary unless the Cathode Ray Tube is changed.

CHAPTER 7

COMPONENTS LIST

ABBREVIATIONS

Capacitors

SM	Silver Mica
CER	Ceramic Tubular
ELEC	Electrolytic
POLY or PS	Polystyrene
POL or PE	Polyester Film
P	Paper
PC	Polycarbonate

Resistors

C	Carbon Composition
HSC or HS	High Stability Carbon
WW	Wire Wound
MO	Metal Oxide
MF	Metal Film

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
Telegraphs Telequipt. London. N.14.

or from our Agents.

INPUT ATTENUATOR TYPE A

AMPLIFIER TYPE A

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C	Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
12M	R 1	900K	HSC	1%	1/4w	S15310	R21	15K	C	10%	1/4w
11M	R 2	990K	HSC	1%	1/4w	S10210	R22	1K	C	10%	1/4w
18M	R 3	111K	HSC	1%	1/4w	S15210	R23	1.5K	C	10%	1/4w
20M	R 4	10.1K	HSC	1%	1/4w	S10110	R24	100	C	10%	1/4w
14M	R 5	500K	HSC	1%	1/4w	S10210	R25	1K	C	10%	1/4w
13M	R 6	800K	HSC	1%	1/4w	S15310	R26	15K	C	10%	1/4w
10M	R 7	1M	HSC	1%	1/4w	S10110	R27	100	C	10%	1/4w
17M	R 8	250K	HSC	1%	1/4w	Y10310	R28	10K	C	10%	1/2w
10M	R 9	1M	HSC	1%	1/4w	6C	(RV29	25K	Potentiometer 'Y Shift'		
S10410	R10	100K	C	10%	1/4w	(RV34	100K	" 'Vernier'			
S10110	R11	100	C	10%	1/4w	Y10310	R30	10K	C	10%	1/2w
S18010	R12	18	C	10%	1/4w	S10110	R31	100	C	10%	1/4w
S10110	R13	100	C	10%	1/4w	31X	R32	7.5K	W/W	10%	3w
S18010	R14	18	C	10%	1/4w	S56310	R33	56K	C	10%	1/4w
						S56310	R35	56K	C	10%	1/4w
16K	C 1	0.1uf	POL	10%	400v	S10110	R36	100	C	10%	1/4w
16J	C 2	6-30pf	CER TRIMMER		250v	S10110	R37	100	C	10%	1/4w
16J	C 3	6-30pf	CER TRIMMER		250v	Y68205	R38	6.8K	C	5%	1/2w
16J	C 4	6-30pf	CER TRIMMER		250v	31X	R39	7.5K	W/W	10%	3w
16J	C 5	6-30pf	CER TRIMMER		250v	38C	RV40	1K	Potentiometer 'Set Y Gain X1'		
59K	C 6	100pf	SM	10%	350v	38C	RV41	1K	Potentiometer 'Set Y Gain X10'		
61K	C 7	1000pf	SM	10%	350v	Y27210	R42	2.7K	C	10%	1/2w
16J	C 8	6-30pf	CER TRIMMER		250v	Y68205	R43	6.8K	C	5%	1/2w
16J	C 9	6-30pf	CER TRIMMER		250v	S10010	R44	10	C	10%	1/4w
63X	C10	15pf	SM	5%	350v	37M	R45	10K	WW	5%	3w
64X	C11	20pf	SM	5%	350v	37M	R46	10K	WW	5%	3w
16J	C12	6-30pf	CER TRIMMER		250v	Y27210	R47	2.7K	C	10%	1/2w
16J	C13	6-30pf	CER TRIMMER		250v	S10110	R48	100	C	10%	1/4w
65X	C14	30pf	SM	5%	350v	S10110	R49	100	C	10%	1/4w
63X	C15	15pf	SM	5%	350v	60C	RV50	25K	Potentiometer 'Preset Astig Balance'		
67J	C16	0.01uf	POL	10%	400v	S10110	R51	100	C	10%	1/4w
						31X	R52	7.5K	WW	10%	3w
52D	S 1		SWITCH AC/DC			30X	R53	3.3K	WW	10%	5w
22D	S 2		SWITCH VOLTS/CM			S10110	R54	100	C	10%	1/4w
						31X	R55	7.5K	WW	10%	3w

AMPLIFIER TYPE A (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
S22210	R56	2.2K	C	10%	1/4w
S10210	R57	1K	C	10%	1/4w
S15210	R58	1.5K	C	10%	1/4w
S10310	R59	10K	C	10%	1/4w
S10310	R60	10K	C	10%	1/4w
56X	C20	8	ELEC REVERSIBLE		25v
16K	C21	0.1	POL	20%	400v
18J	C22	8	ELEC		150v
33X	C23	250	ELEC		18v
33X	C24	250	ELEC		18v
20K	C25	4700pf	P.E.	20%	125v
36Y	N1	3L	NEON		60v
36Y	N2	3L	NEON		60v
Brown	L21	3.9/7.5μH	Variable Inductor		
Brown	L22	3.9/7.5μH	Variable Inductor		
Orange	L23	7/16μH	Variable Inductor		
Orange	L24	7/16μH	Variable Inductor		
	L25	1.15μH	Chokes 16 turns on 4.7K	10%	
	L26				
10E	MR21		Diode ZS71		
28D	S3		Switch X1 - X10 'Y GAIN'		
26T	V1		Valve Mullard EF184		
26T	V2		Valve Mullard EF184		
18T	V3		Valve Mullard ECC88		
18T	V4		Valve Mullard ECC88		
18T	V5		Valve Mullard ECC88		

TRIGGER CIRCUIT & TIME BASE (T41)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
968510	R101	6.8M	C (TD41 only)	10%	1/4w
968510	R102	6.8M	C	10%	1/4w
S10110	R103	100	C	10%	1/4w
S10510	R104	1M	C	10%	1/4w
S18010	R105	18	C	10%	1/4w
S15210	R106	1.5K	C	10%	1/4w
S68210	R107	6.8K	C	10%	1/4w
S33210	R108	3.3K	C	10%	1/4w
S10110	R109	100	C	10%	1/4w
S10110	R110	100	C	10%	1/4w
S10510	R111	1M	C	10%	1/4w
S22410	R112	220K	C	10%	1/4w
S15310	R113	15K	C	10%	1/4w
933510	R114	3.3M	C	10%	1/4w
	RV115		See RV152		
933510	R116	3.3M	C	10%	1/4w
S10110	R117	100	C	10%	1/4w
S18010	R118	18	C	10%	1/4w
S10310	R119	10K	C	10%	1/4w
Y22310	R120	22K	C	10%	1/2w
S33410	R121	330K	C	10%	1/4w
S68410	R122	680K	C	10%	1/4w
S10410	R123	100K	C	10%	1/4w
S10110	R124	100	C	10%	1/4w
S47410	R125	470K	C	10%	1/4w
S68310	R126	68K	C	10%	1/4w
16C	RV127	470	Preset Potentiometer	20%	1/4w
S22210	R128	2.2K	C	10%	1/4w
S10210	R129	1K	C	10%	1/4w
S33310	R130	33K	C	10%	1/4w
S10410	R131	100K	C	10%	1/4w
S10110	R132	100	C	10%	1/4w
Y22310	R133	22K	C	10%	1/2w
S68310	R134	68K	C	10%	1/4w
112C	RV135	47K	Preset Potentiometer	20%	1/4w

TRIGGER CIRCUIT & TIME BASE (T41) (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
S10310	R136	10K	C	10%	1/4w
S22410	R137	220K	C	10%	1/4w
Y68310	R138	68K	C	10%	1/4w
S10110	R139	100	C	10%	1/4w
S10110	R140	100	C	10%	1/4w
S56310	R141	56K	C	10%	1/4w
S33205	R142	3.3K	C	5%	1/4w
S15305	R143	15K	C	5%	1/4w
S82310	R144	82K	C	10%	1/4w
S10110	R145	100	C	10%	1/4w
S18410	R146	180K	C	10%	1/4w
S68310	R147	68K	C	10%	1/4w
104C	RV148	100K	Preset Potentiometer 'T/B Length'		
S15410	R149	150K	C	10%	1/4w
S10110	R150	100	C	10%	1/4w
S22310	R151	22K	C	10%	1/4w
115C	RV115)	100K)	Potentiometer 'Level'		
	RV152)	10K)	Potentiometer 'Stability'	20%	2w
	S104)		Switch Auto ON/OFF		
S12310	R153	12K	C	10%	1/4w
S10110	R154	100	C (Positioned on copper side)	10%	1/4w
S56310	R155	56K	C	10%	1/4w
S33410	R156	330K	C	10%	1/4w
S10110	R157	100	C	10%	1/4w
S10510	R158	1M	C	10%	1/4w
S18010	R159	18	C	10%	1/4w
Y10305	R161	10K	C	5%	1/2w
Y56205	R162	5.6K	C	5%	1/2w
S33405	R163	330K	C	5%	1/4w
S56405	R164	560K	C	5%	1/4w
S51405	R165	510K	C	5%	1/4w
S10110	R166	100	C	10%	1/4w
102M	R167	22K	MO	5%	3w
S10110	R168	100	C	10%	1/4w
010310	R169	10K	C	10%	1w

TRIGGER CIRCUIT & TIME BASE (T41) (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
	RV171		See RV182		
106C	RV172	25K	Preset Potentiometer		
			'Set Speed'	20%	1/4w
S10110	R173	100	C	10%	1/4w
S10110	R174	100	C	10%	1/4w
010310	R175	10K	C	10%	1w
102M	R176	22K	MO	5%	3w
916595	R177	1.6M	C	5%	1/4w
S75405	R178	750K	C	5%	1/4w
108M	R179	150K	HSC	1%	1/4w
S18110	R180	18	C	10%	1/4w
106M	R181	82K	HSC	1%	1/4w
107C	(RV182	50K)	Potentiometer X 'Shift' X 'Gain'	20%	2w
	(RV171	10K)			
S10310	R183	10K	C	10%	1/4w
015310	R184	15K	C	10%	1w
S82410	R185	820K	C	10%	1/4w
74J	C101	3.9pf	CER (TD41 only)	+1/4pF	750v
74J	C102	3.9pf	CER	+1/4pF	750v
67J	C103	.01	POL	20%	400v
67J	C104	.01	POL	20%	400v
66J	C105	.1	POL	20%	250v
66J	C106	.1	POL	20%	250v
33K	C107	.1	POL	20%	125v
66J	C108	.1	POL	20%	250v
76J	C109	470pf	CER	10%	500v
66J	C110	0.1	POL	20%	250v
69J	C111	100pf	POLY	10%	350v
39K	C112	CER	CER	5%	750v
39K	C113	15pf	CER	5%	750v
45K	C114	10pf	CER	10%	750v
41K	C115	30pf	CER	10%	750v
75J	C116	10-40pf	TRIMMER		
65J	C117	0.1	POL	20%	400v
26K	C118	0.1	POL	20%	400v

TRIGGER CIRCUIT & TIME BASE (T41) (continued)

TIME/CM SWITCH CIRCUIT

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C	Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
71J	C119	50uf	ELEC		150v	947510	R276	4.7M	C	10%	1/2w
70J	C120	0.047	POL	20%	250v	S33410	R277	330K	C	10%	1/2w
66J	C121	0.1	POL	20%	250v	S47410	R278	470K	C	10%	1/2w
45K	C122	10pf	CER	20%	750v	10M	R279	1M	HSC	1%	1/2w
						10M	R280	1M	HSC	1%	1/2w
						107M	R281	3M	HSC	1%	1/2w
34E	MR101		Diode OA 81			922510	R282	2.2M	C	10%	1/2w
34E	MR102		Diode OA 81			912510	R283	1.2M	C	10%	1/2w
34E	MR103		Diode OA 81			103C	(S103)		Switch 'TB ON/OFF'		
34E	MR104		Diode OA 81				(RV284)	1M	Potentiometer 'Variable'	20%	1/2w
34E	MR105		Diode OA 81			S10510	R285	1M	C	10%	1/2w
34E	MR106		Diode OA 81			S10410	R286	100K	C	10%	1/2w
34E	MR107		Diode OA 81			S47410	R287	470K	C	10%	1/2w
34D	S101)		Trig. Selector Switches			37J	C276	0.2	POL	1%	160v
25D	S102)					43J	C277	2	POL	3%	160v
	S103		See RV284			37K	C278	0.02	POLY	1%	350v
	S104		See RV115 and RV152			36K	C279	2000pf	POLY	2%	350v
						46J	C280	180pf	POLY	2%	350v
10T	V101		Valve ECF 80			16J	C281	6-30pf	TRIMMER		
10T	V102		Valve ECF 80								
18T	V103		Valve ECC 88			27D	S276		TIME/CM Switch		
18T	V104		Valve ECC 88								
11T	V105		Valve EB 91								
10T	V106		Valve ECF 80								
10T	V107		Valve ECF 80								
10T	V108		Valve ECF 80								

TRIGGER CIRCUIT & TIME BASE (T42)

TRIGGER CIRCUIT & TIME BASE (T42) (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
968510	R101	6.8M	C (TD42 only)	10%	1/4w
968510	R102	6.8M	C	10%	1/4w
S10110	R103	100	C	10%	1/4w
S10510	R104	1M	C	10%	1/4w
S18010	R105	18	C	10%	1/4w
S15210	R106	1.5K	C	10%	1/4w
S68210	R107	6.8K	C	10%	1/4w
S33210	R108	3.3K	C	10%	1/4w
S10110	R109	100	C	10%	1/4w
S10110	R110	100	C	10%	1/4w
S10510	R111	1M	C	10%	1/4w
S22410	R112	220K	C	10%	1/4w
S15310	R113	15K	C	10%	1/4w
933510	R114	3.3M	C	10%	1/4w
	RV115		See RV152		
933510	R116	3.3M	C	10%	1/4w
S10110	R117	100	C	10%	1/4w
S18010	R118	18	C	10%	1/4w
S10310	R119	10K	C	10%	1/4w
Y22310	R120	22K	C	10%	1/2w
S33410	R121	330K	C	10%	1/4w
S68410	R122	680K	C	10%	1/4w
S10410	R123	100K	C	10%	1/4w
S10110	R124	100	C	10%	1/4w
S47410	R125	470K	C	10%	1/4w
S68310	R126	68K	C	10%	1/4w
16C	RV127	470	C Potentiometer Preset	20%	1/4w
S22210	R128	2.2K	C	10%	1/4w
S10210	R129	1K	C	10%	1/4w
S33310	R130	33K	C	10%	1/4w
S10410	R131	100K	C	10%	1/4w
S10110	R132	100	C	10%	1/4w
Y22310	R133	22K	C	10%	1/2w
S68310	R134	68K	C	10%	1/4w
112C	RV135	47K	Potentiometer Preset	20%	1/4w

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
S10310	R136	10K	C	10%	1/4w
S22410	R137	220K	C	10%	1/4w
Y68310	R138	68K	C	10%	1/2w
S10110	R139	100	C	10%	1/4w
S10110	R140	100	C	10%	1/4w
S56310	R141	56K	C	10%	1/4w
S33205	R142	3.3K	C	5%	1/4w
S15305	R143	15K	C	5%	1/4w
S82310	R144	82K	C	10%	1/4w
S10110	R145	100	C	10%	1/4w
S18410	R146	180K	C	10%	1/4w
S68310	R147	68K	C	10%	1/4w
104C	RV148	100K	Potentiometer Preset 'T/B Length'	20%	1/4w
S15410	R149	150K	C	10%	1/4w
S10110	R150	100	C	10%	1/4w
S22310	R151	22K	C	10%	1/4w
	RV115)	100K	Potentiometer 'Level'		
115C	RV152)	10K	Potentiometer 'Stab'	20%	2w
	ST04)		Switch Auto On/Off		
S12310	R153	12K	C	10%	1/4w
S10110	R154	100	C (Positioned on copper side)	10%	1/4w
S56310	R155	56K	C	10%	1/4w
S33410	R156	330K	C	10%	1/4w
S10110	R157	100	C	10%	1/4w
S10510	R158	1M	C	10%	1/4w
S18010	R159	18	C	10%	1/4w
Y10305	R161	10K	C	5%	1/2w
Y56205	R162	5.6K	C	5%	1/2w
S33405	R163	330K	C	5%	1/4w
S56405	R164	560K	C	5%	1/4w
S51405	R165	510K	C	5%	1/4w
S10110	R166	100	C	10%	1/4w
102M	R167	22K	MO	5%	3w
S10110	R168	100	C	10%	1/4w

TRIGGER CIRCUIT & TIME BASE (T42) (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
010310	R169	10K	C	10%	1w
	RV171		See RV182		
106C	RV172	25K	Potentiometer Preset 'Set Speed'	20%	1/4w
S10110	R173	100	C	10%	1/4w
S10110	R174	100	C	10%	1/4w
010310	R175	10K	C	10%	1w
102M	R176	22K	MO	5%	3w
108M	R179	150K	HS	1%	1/4w
S18010	R180	18	C	10%	1/4w
106M	R181	82K	HS	1%	1/4w
107C	RV182	50K)	Potentiometer 'X Shift'		
	RV171	10K)	" 'X Gain'	20%	2w
S10310	R183	10K	C	10%	1/4w
015310	R184	15K	C	10%	1w
S82410	R185	820K	C	10%	1/4w
S10510	R190	1M	C	10%	1/4w
S10110	R191	100	C	10%	1/4w
S33210	R192	3.3K	C	10%	1/4w
S15310	R193	15K	C	10%	1/4w
S10110	R194	100	C	10%	1/4w
18C	RV195	1M	Potentiometer Preset	20%	1/4w
S15510	R196	1.5M	C	10%	1/4w
S47310	R197	47K	C	10%	1/4w
S10610	R198	10M	C	10%	1/4w
S39310	R199	39K	C	10%	1/4w
17C	RV201	10K	Potentiometer Preset	20%	1/4w
S12310	R202	12K	C	10%	1/4w
S22410	R203	220K	C	10%	1/4w
922510	R204	2.2M	C	10%	1/4w
19M	R205	18K	HS	1%	1/4w
S56310	R206	56K	C	10%	1/4w
S10310	R207	10K	C	10%	1/4w
S68210	R208	6.8K	C	10%	1/4w
S10410	R209	100K	C	10%	1/4w

TRIGGER CIRCUIT & TIME BASE (T42) (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
S56310	R211	56K	C	10%	1/4w
S10410	R212	100K	C	10%	1/4w
74J	C101	3.9pf	CER (TD42 only)	+1/4pf	750v
74J	C102	3.9pf	CER	+1/4pf	750v
67J	C103	0.01	POL	20%	400v
67J	C104	0.01	POL	20%	400v
66J	C105	0.1	POL	20%	250v
66J	C106	0.1	POL	20%	250v
33K	C107	0.1	POL	20%	125v
66J	C108	0.1	POL	20%	250v
76J	C109	470pf	CER	10%	500v
66J	C110	0.1	POL	20%	250v
69J	C111	100pf	POLY	10%	350v
39K	C112	15pf	CER	5%	750v
39K	C113	15pf	CER	5%	750v
45K	C114	10pf	CER	10%	750v
41K	C115	30pf	CER	10%	750v
17J	C116	4-20pf	TRIMMER		
26K	C118	0.1	POL	20%	400v
71J	C119	50	ELEC		150v
45K	C122	10pf	CER	20%	750v
72J	C123	220pf	P.E.	20%	400v
100J	C124	100pf	CER	10%	500v
67J	C125	0.01	POL	20%	400v
100J	C126	100pf	CER	10%	500v
101J	C127	150pf	CER	10%	500v
90J	C128	0.033	POL	20%	250v
66J	C129	0.1	POL	20%	250v
34E	MR101		Diode OA 81		
34E	MR102		Diode OA 81		
34F	MR103		Diode OA 81		
34E	MR104		Diode CA 81		

TRIGGER CIRCUIT & TIME BASE (T42) (continued)

TIME/CM SWITCH CIRCUIT

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C	Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
84E	MR105		Diode OA 81			947510	R276	4.7M	C	10%	1/2w
34E	MR106		Diode OA 81			S47410	R277	470K	C	10%	1/2w
34E	MR107		Diode OA 81			S33410	R278	330K	C	10%	1/2w
34E	MR108		Diode OA 81			S39410	R279	390K	C	10%	1/2w
						S68310	R280	68K	C	10%	1/2w
34D	S101)		Trig Selector Switches			S30305	R281	30K	C	5%	1/2w
25D	S102)					S15310	R282	15K	C	10%	1/2w
	S103		Switch See RV284			S51405	R283	510K	C	5%	1/2w
	S104		Switch See RV115 & RV152			S10410	R284	100K	C	10%	1/2w
94C	S105		Reset			126L	R285	15M	HS	2%	1/2w
56O	S106		Single Shot/Normal			127L	R286	5M	HS	1%	1/2w
						128L	R287	2.5M	HS	1%	1/2w
						129L	R288	1.5M	HS	1%	1/2w
36Y	N101		Neon Type 3L			14M	R289	500K	HS	1%	1/2w
						14M	R290	500K	HS	1%	1/2w
119T	TR101		Transistor LB293 motorola			103C	(RV291	1M)	Potentiometer 'Variable'	20%	1/2w
119T	TR102		Transistor LB293 motorola				(S103)		Switch 'T/B ON/OFF'		
						912510	R292	1.2M	C	10%	1/2w
10T	V101		Valve ECF80			42K	C275	39pf	CER	5%	750v
10T	V102		Valve ECF80			16J	C276	6/30pf	TRIMMER		250v
18T	V103		Valve ECC88			102J	C277	20pf	CER	+0.25p	750v
18T	V104		Valve ECC88			103J	C278	380pf	P.S.	1%	125v
11T	V105		Valve EB91			104J	C279	4000pf	P.S.	1%	125v
10T	V106		Valve ECF80			105J	C280	0.04	P.S.	1%	125v
10T	V107		Valve ECF80			106J	C281	0.4	P.E. (0.33 1% + .068 3%)	2%	125v
10T	V108		Valve ECF80			107J	C282	4	P.E.	2%	250v
10T	V109		Valve ECF80								
						55D	S275		Switch 24 POS 'TM/CM'		

TRIGGER CIRCUIT & TIME BASE (T42) (continued)

C.R.T. CIRCUIT TYPE S43

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C	Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
111C	(RV301	1M	Potentiometer 'Brightness'			956510	R310	5.6M	C	10%	1/4w
	(RV303	1M	Potentiometer 'Focus'			111C	(RV311	1M	Potentiometer 'Brilliance'		
S82410	R302	820K	C	10%	1/2w	(RV313	1M	Potentiometer 'Focus'			
918510	R304	1.8M	C	10%	1/4w	918510	R314	1.8M	C	10%	1/4w
108C	RV305	1M	Potentiometer Preset 'I.P.S.'			510310	R315	10K	C	10%	1/4w
98C	RV306	250K	Potentiometer 'Astig'			510410	R316	100K	C	10%	1/4w
S10410	R307	100K	C	10%	1/4w	34C	RV320	1M	Potentiometer Preset 'Shield Voltage'		
98C	RV308	250K	Potentiometer 'Astig'			44C	RV321	250K	Potentiometer 'Astig' (Ganged with RV426 'Scale Illum')		
510310	R309	10K	C	10%	1/4w	510410	R322	100K	C	10%	1/4w
114C	RV310	100K	Potentiometer Preset 'X SENS'			33K	C310	0.1	POL	20%	125v
510410	R311	100K	C	10%	1/4w	20X	C311	0.01	CER	10%	1.5Kv
S39310	R312	39K	C	10%	1/4w	16K	C312	0.1	POL	20%	400v
109C	RV313	10K				16K	C313	0.1	POL	20%	400v
010410	R314	100K	C	10%	1w	48Y	N301		Neon Type XC12		
918510	R315	1.8M	C	10%	1/4w		CRT		SE 4D Sylvania Thorn		
111C	(RV316	1M	Potentiometer 'Focus'								
	(RV318	1M	Potentiometer 'Brightness'								
S82410	R317	820K	C	10%	1/4w						
S12410	R319	120K	C	10%	1/4w						
S10310	R320	10K	C	10%	1/4w						
16K	C301	0.1	POL	20%	400v						
20X	C302	0.01	CER	10%	1.5Kv						
29K	C303	0.47	POL	20%	125v						
29K	C304	0.47	POL	20%	125v						
16K	C305	0.1	POL	20%	400v						
44K	C306	5pf	CER	5%	750v						
48Y	N301		Neon Type XC12								
70T	MR301		Zener Diode (27V 1 m/a)								
	CRT		1074 M.O.V.								

POWER SUPPLY TYPE D43

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
99C	RV401	25	Potentiometer 'Scale Illum' (Ganged to S401)		
S33310	R402	33K	C	10%	$\frac{1}{2}w$
S22410	R403	220K	C	10%	$\frac{1}{2}w$
69L	R404	100K	M.F.	5%	$\frac{1}{4}w$
105L	R406	7.5K	HSC	1%	$\frac{1}{4}w$
S10210	R409	1K	C	10%	$\frac{1}{4}w$
88C	RV410	5K	Potentiometer Preset 'Setcal'		
65M	R411	1K	WW	5%	6w
	(R412	1K	WW	10%	10w
100L	(R413	1K	WW	10%	10w
	(R414	1K	WW	10%	10w
	(R415	1K	WW	10%	10w
73L	R416	680	WW	5%	3w
S22110	R417	220	C	10%	$\frac{1}{2}w$
123M	R418	15K	WW	5%	2w
16K	C401	0.1	POL		
16K	C402	0.1	POL	20%	400v
39J	C403	0.05	P	20%	400v
58J	C404	100	ELEC		2Kv
58J	C405	100	ELEC		275v
37X	C406	0.05	P		275v
1J	C407	16	ELEC		3.5Kv
1J	C408	16	ELEC		450v
1J	C409	16	ELEC		450v
20K	C410	4700pf	POL		450v
59J	(C411	32)		20%	125v
	(C412	32)	ELEC		450v
59J	(C413	32)			
	(C414	32)	ELEC		450v
59J	(C415	32)			
	(C416	32)	ELEC		450v

POWER SUPPLY TYPE D43 (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
61J	C417 C418	32) 32)	ELEC		350v
40S	T401	<u>Power Transformer</u>			
		<u>Primary (50 c/s)</u>	<u>Secondary</u>		
		0-110 V AC	150v V RMS 225 mA		
		0-110 V AC	350v V RMS 1 mA		
			875v V RMS 2 mA		
		0-5-10-20 V AC	1200v V RMS 0.1 mA		
			6.3 V RMS 1.25 amp		
			12.6 V RMS 1.8 amp		
			6.3 V RMS 0.6 amp		
	S401	POWER ON/OFF (Ganged with RV401)			
180	MR401	Silicon Diode DD056 or ZS75			
180	MR402	Silicon Diode DD056 or ZS75			
60	MR403	Rectifier Type K8/50			
70	MR404	Silicon Diode) Lucas DD058) 4off.			
60	MR405	Rectifier Type K8/50			
121T	MR406	Zener Diode 1Z10 or equiv.			
68T	MR407	Zener Diode ZC11			
Y12	F401	Fuse $1\frac{1}{2}$ amp delay Fuse 3 amp delay (5/8" long)			220v 110v


POWER SUPPLY TYPE S43

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
44C	RV426	25	Potentiometer 'Scale Illum' (Ganged with RV321 'Astig')		
S33310	R427	33K	C	10%	1/2w
121M	R428	330	WW	5%	2w
65M	R429	1K	WW	5%	10w
124M	R430	1.8K	WW	5%	10w
Y27310	R431	27K	C	10%	1/2w
Y27310	R432	27K	C	10%	1/2w
65M	R433	1K	WW	5%	10w
105L	R434	7.5K	H.S.C.	1%	1/2w
S10210	R435	1K	C	10%	1/2w
31C	RV436	5K	Potentiometer 'Set IV p-p'		
69L	R437	100K	M.F.	5%	1/2w
S22410	R438	220K	C	10%	1/2w
S68410	R440	680K	C	10%	1/2w
1J	C414	16	ELEC		450v
39J	C416	0.05	P	10%	2Kv
1J	C417	16	ELEC		450v
16K	C418	0.1	POL	20%	400v
1J	C420	16	ELEC		450v
13K	C421	0.05	P	10%	2.5Kv
58J	C422	100	ELEC		275v
58J	C423	100	ELEC		275v
16K	C424	0.1	POL	20%	400v
20K	C425	4700pf	POL	20%	125v
59J	C426	32)	ELEC		450v
	C427	32)			
59J	C428	32)	ELEC		450v
	C429	32)			
59J	C430	32)	ELEC		450v
	C431	32)			

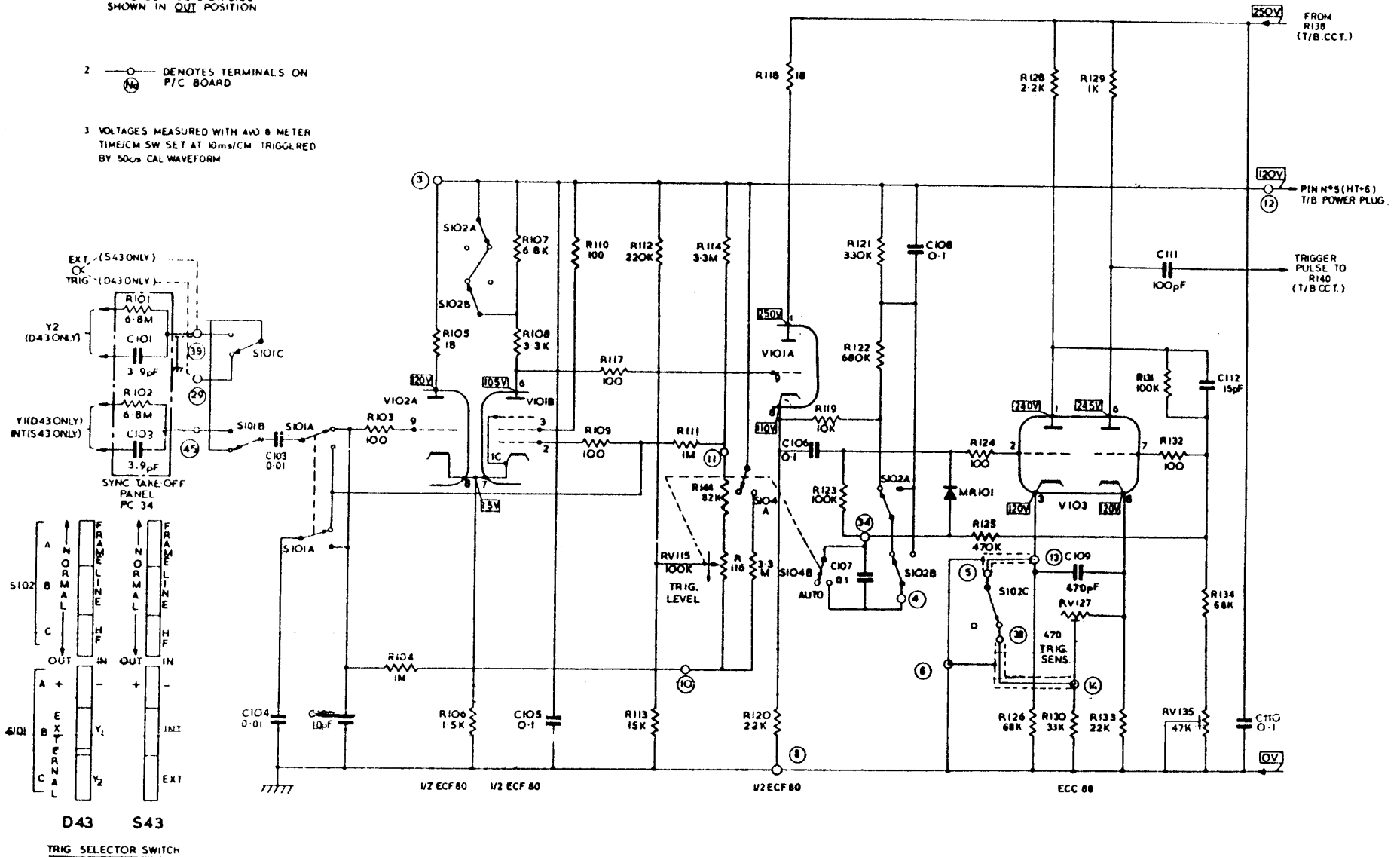
POWER SUPPLY TYPE S43 (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
68T	MR401		Zener Diode ZC11		
60	MR402		Selenium Rectifier K8/50		
60	MR403		Selenium Rectifier K8/50		
70	MR404		Silicon Rectifier 3X DDO58		
180	MR405		Silicon Rectifier DDO56 or ZS75		
180	MR406		Silicon Rectifier DDO56 or ZS75		
	S401		POWER ON/OFF (Ganged with RV426)		
43S	T401		Power Transformer		
			<u>Primary (50 c/s)</u>		<u>Secondary</u>
			0-110 V AC		150 V RMS 150 mA
			0-110 V AC		350 V RMS 1 mA
					760 V RMS 1 mA
			0-5-10-20 V AC		1000 V RMS 1 mA
					6.3 V RMS 2.5 amp
					12.6 V RMS 1 amp
					6.3 V RMS 0.3 amp
Y12	F401		Fuse 1 1/2 amp delay Fuse		220v
			3 amp delay Fuse		110v
			(5/8" long)		

NOTES-
 1 SWITCHES NOS S101, S102 SHOWN IN QUIT POSITION

2  DENOTES TERMINALS ON P/C BOARD

3 VOLTAGES MEASURED WITH AVO METER TIME/CM SW SET AT 10ms/CM TRIGGERED BY 50 μ s CAL WAVEFORM



TRIGGER CIRCUIT
 TYPE TS41, TD41, TS42 & TD42

FIG. 2.1.

TRIGGER CIRCUIT

TYPE D43

VOLTAGES MEASURED
WHILE DISPLAYING
2 CM Y DEFLECTION
OF 50 CH 6 TRIG
SELECTOR AT
NORMAL, + VE, INTERVAL
VOLTMETER USED
AVO B

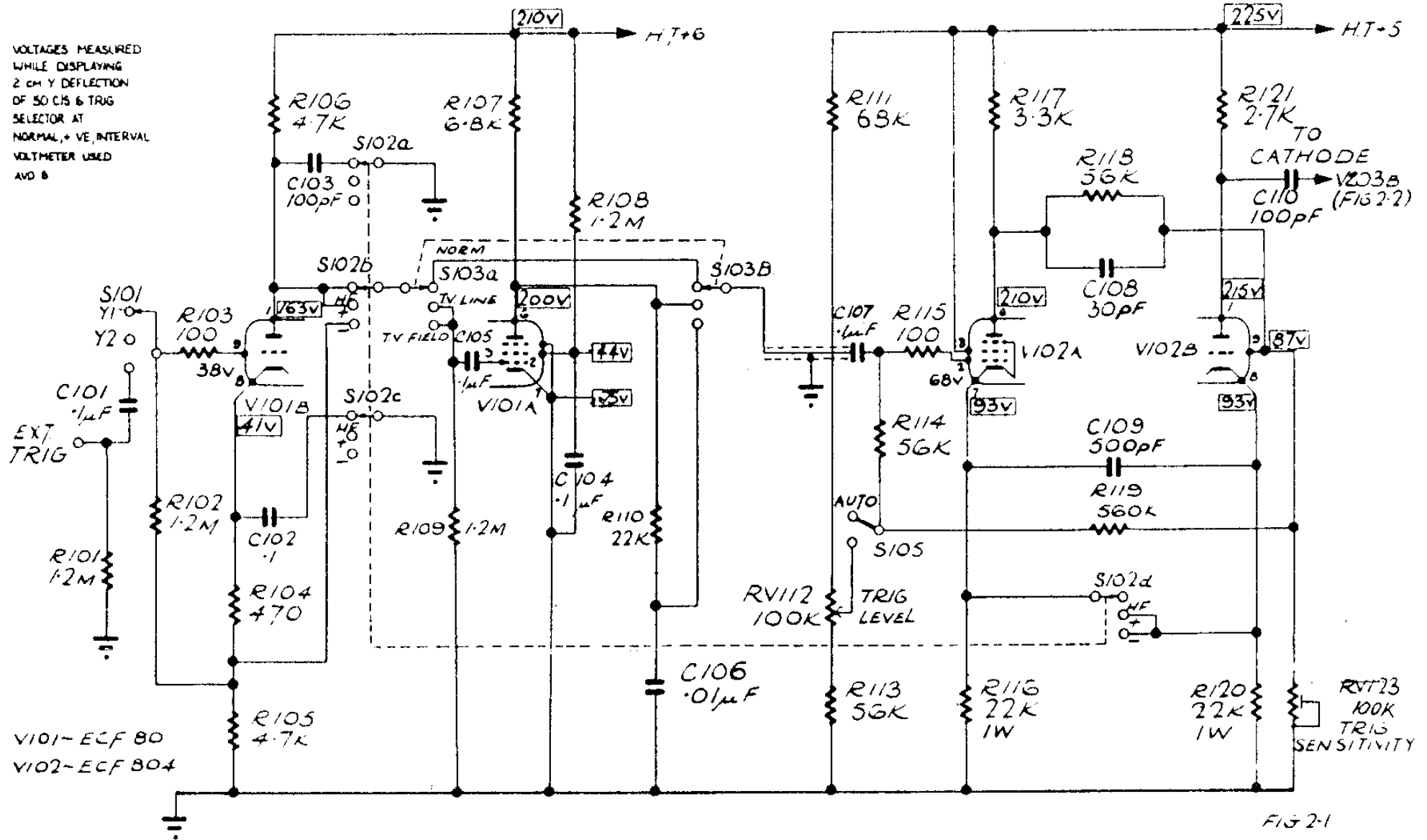


FIG 2-1

TIME / CM SWITCH

TYPE D43

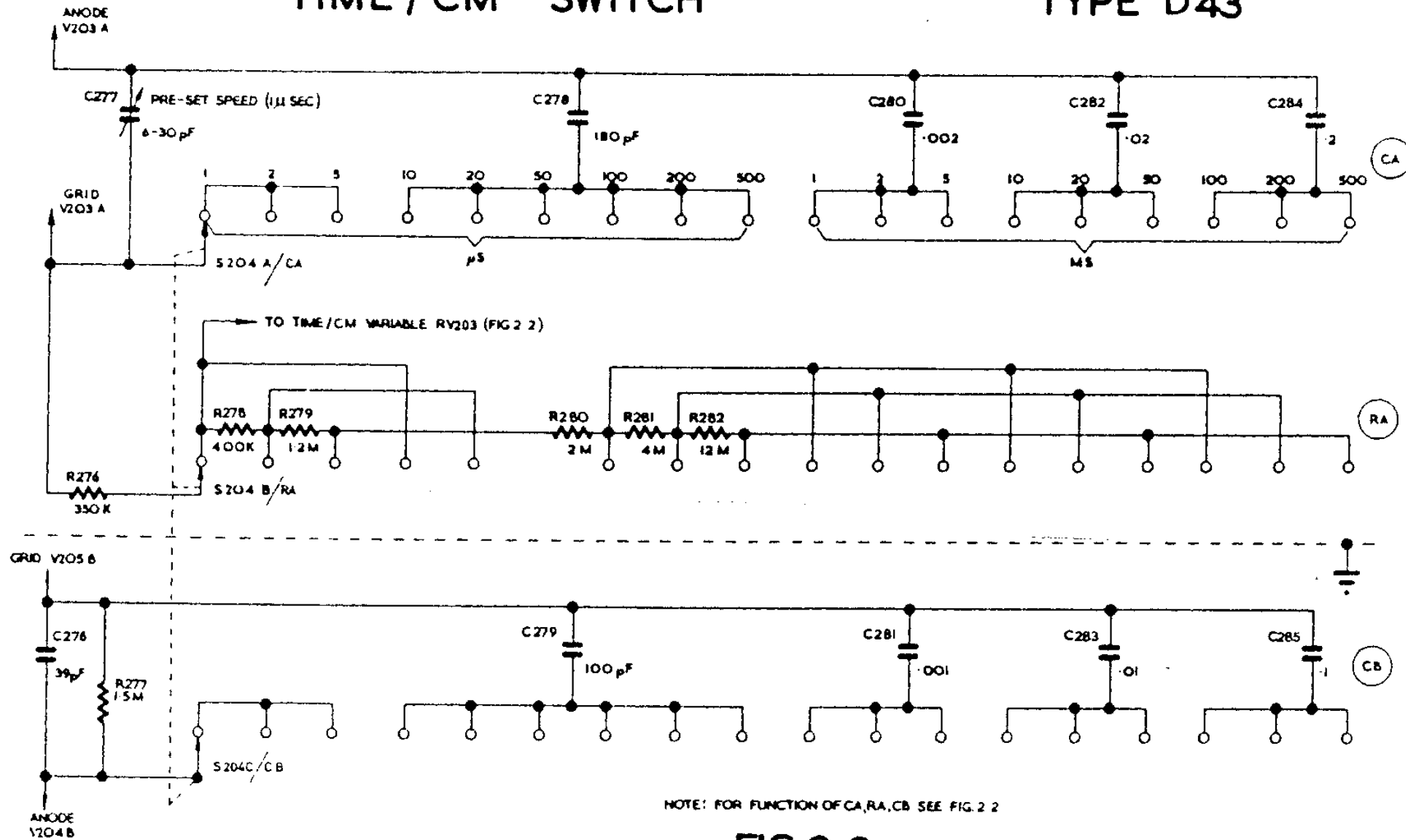
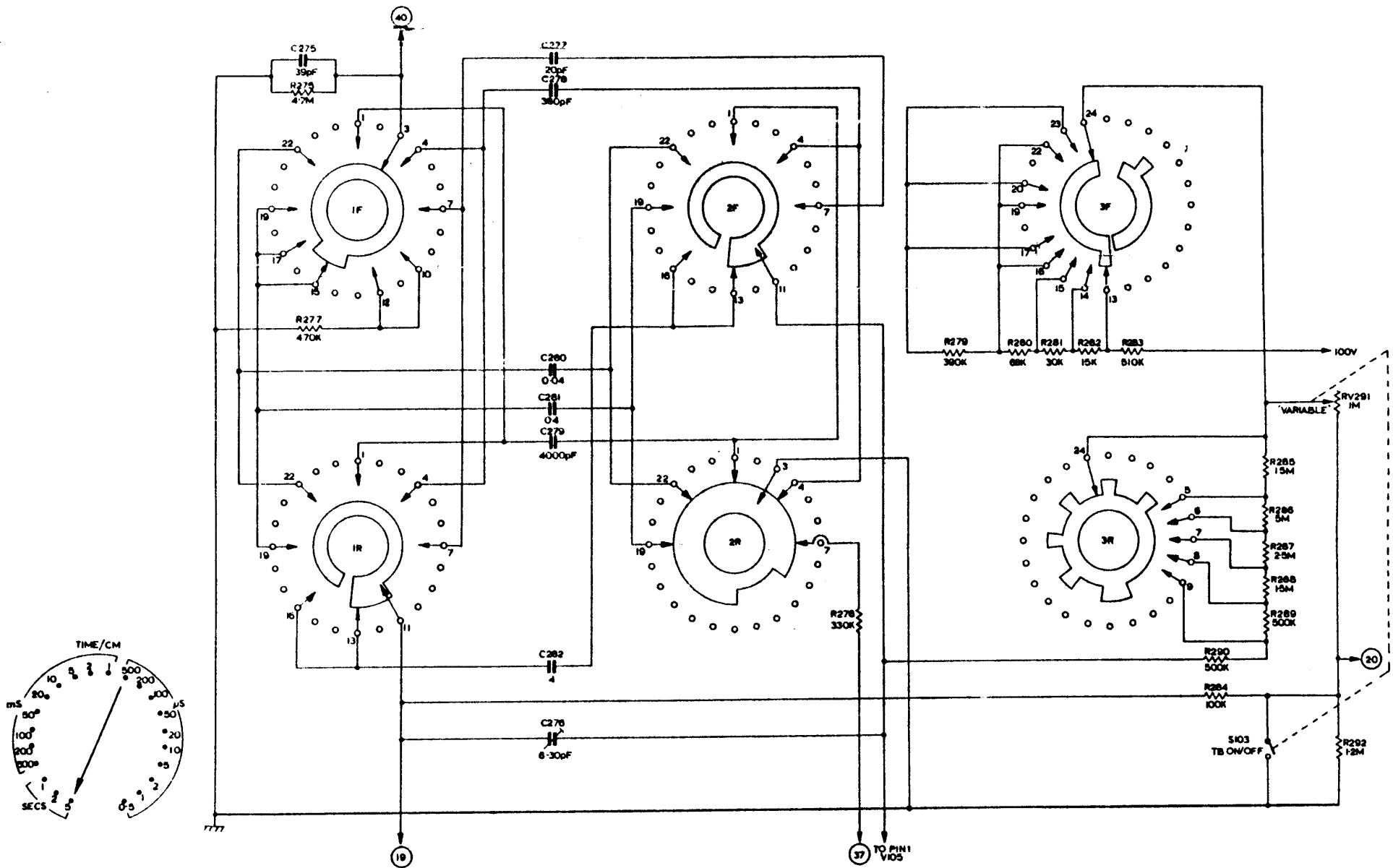


FIG 2-3



NOTES
 1 (NH) DENOTES PRINTED CIRCUIT PCB TERMINAL NUMBERS
 (see timebase and horizontal amp. cct.)

TIME/CM SWITCH FIG 2-5
 TYPE TD42 & TS42

INPUT ATTENUATOR

TYPE.43A.

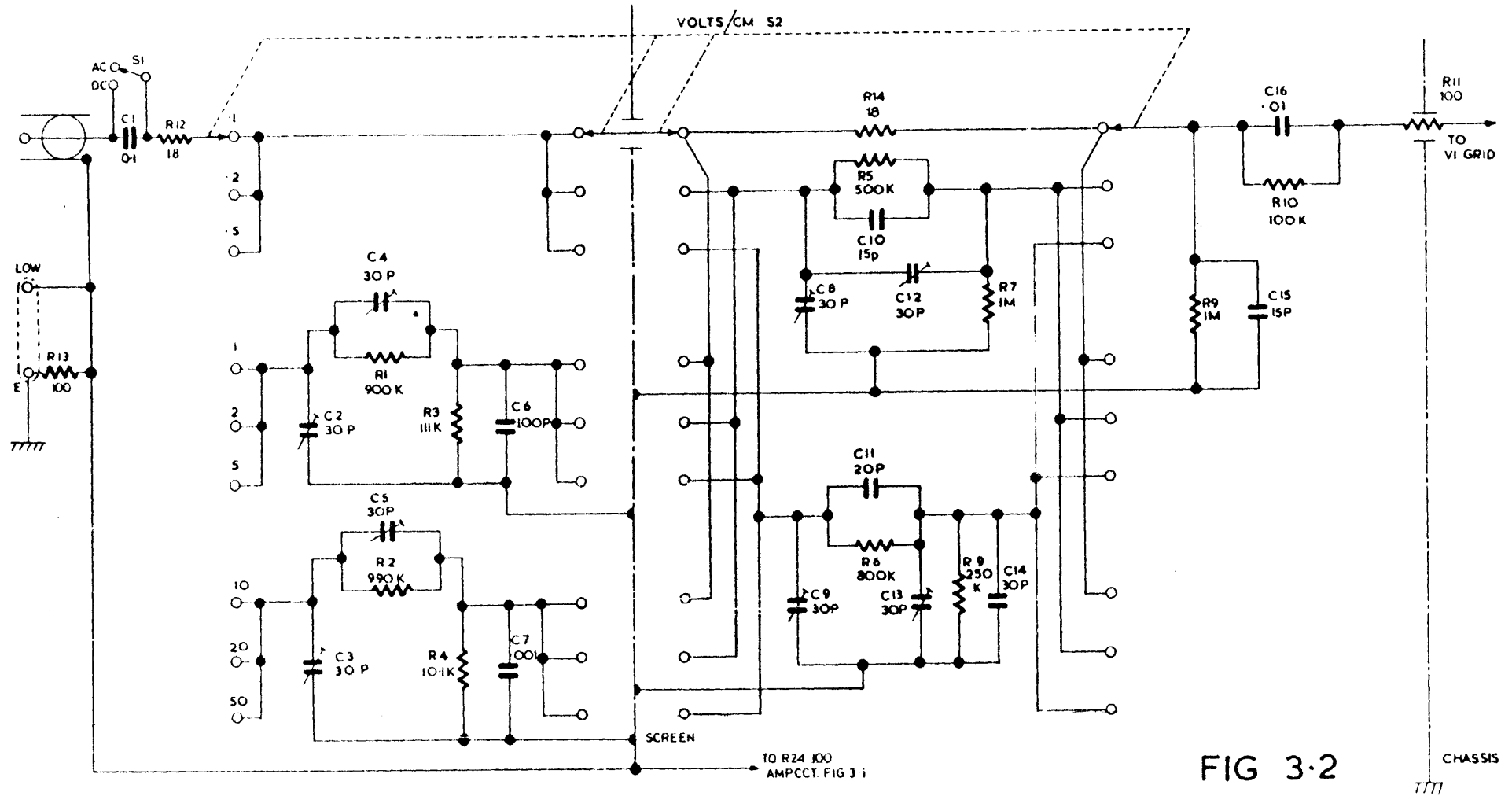
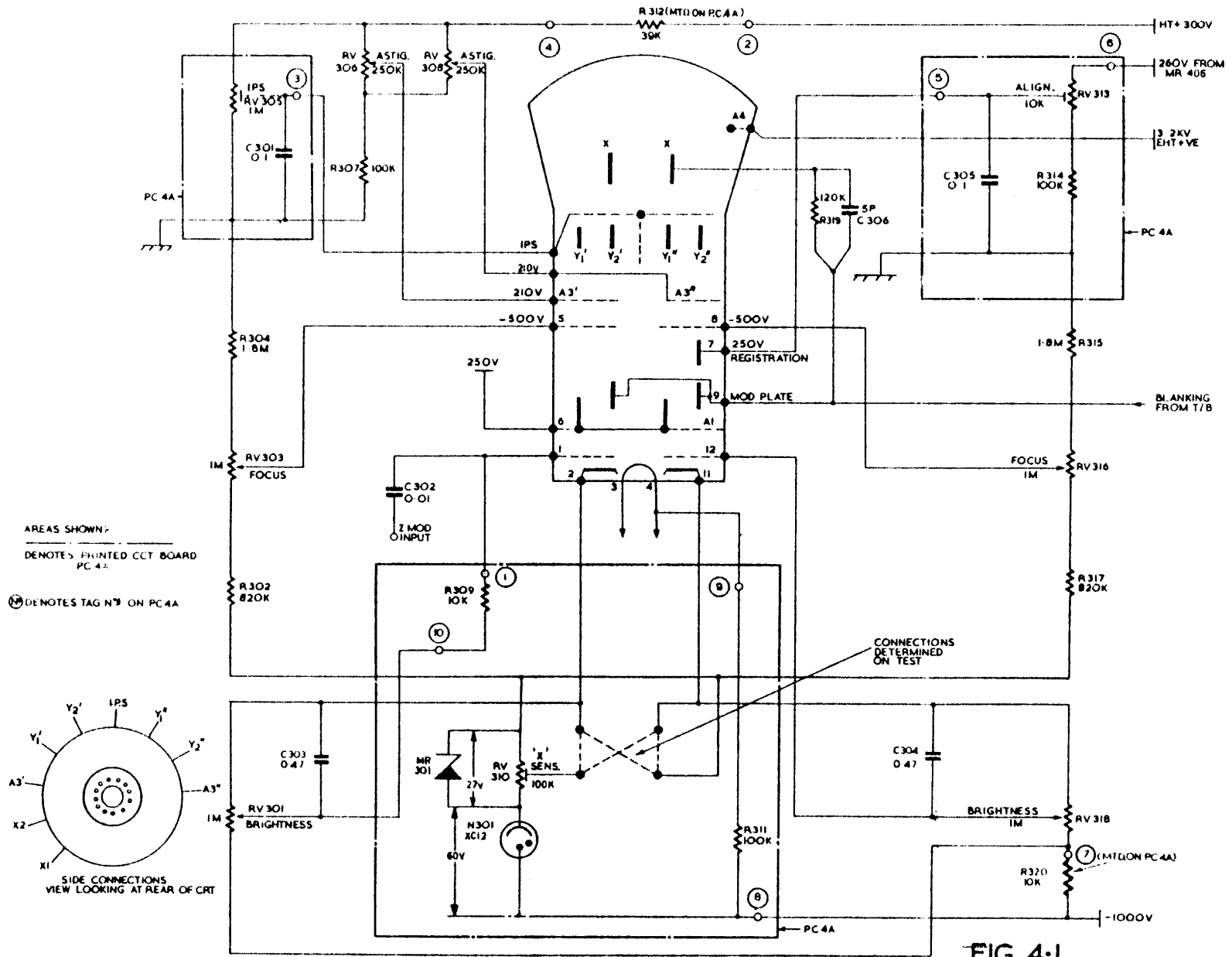


FIG 3-2

CRT CCT. TYPE D 43



C.R.T. CIRCUIT

TYPE S43

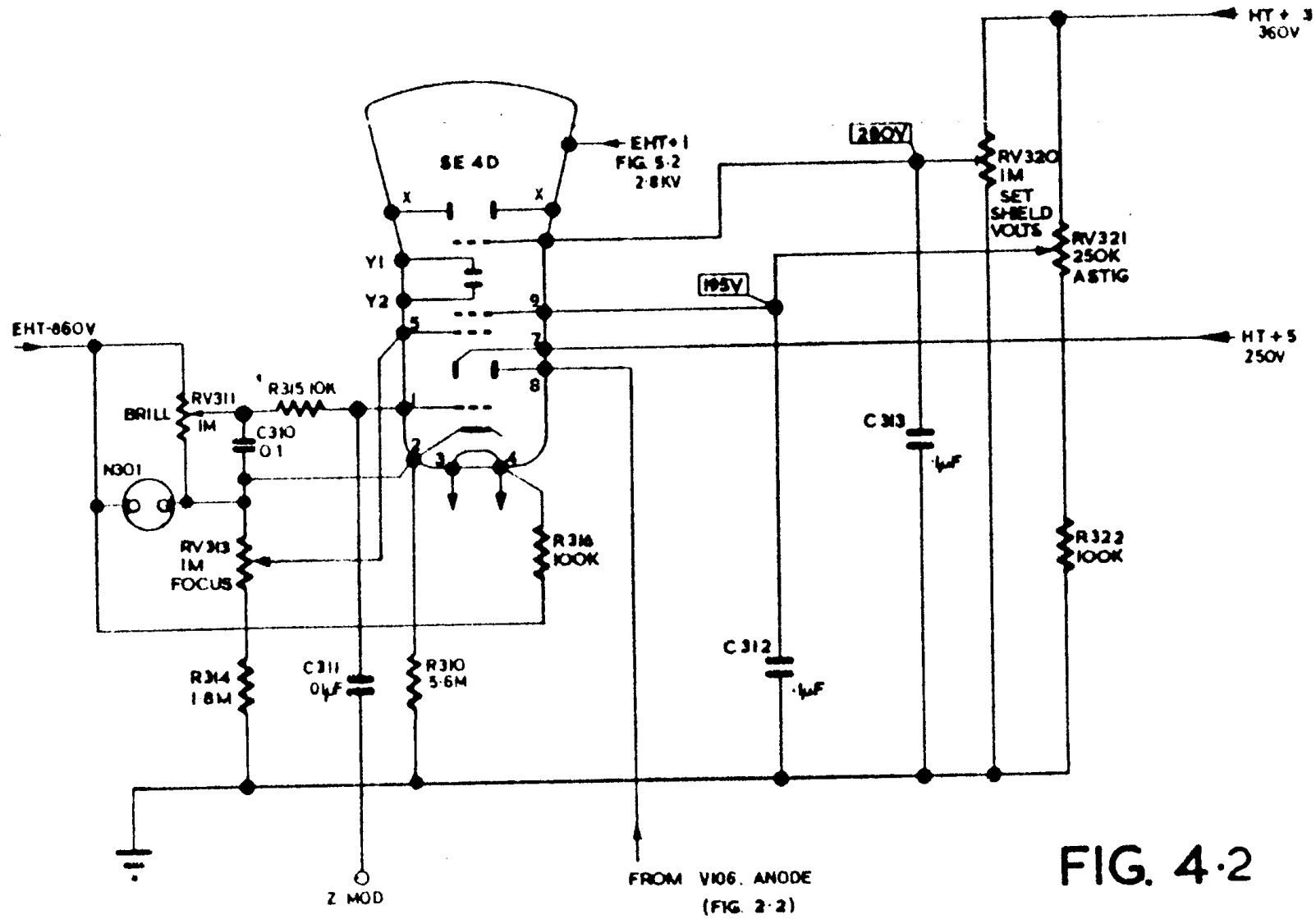
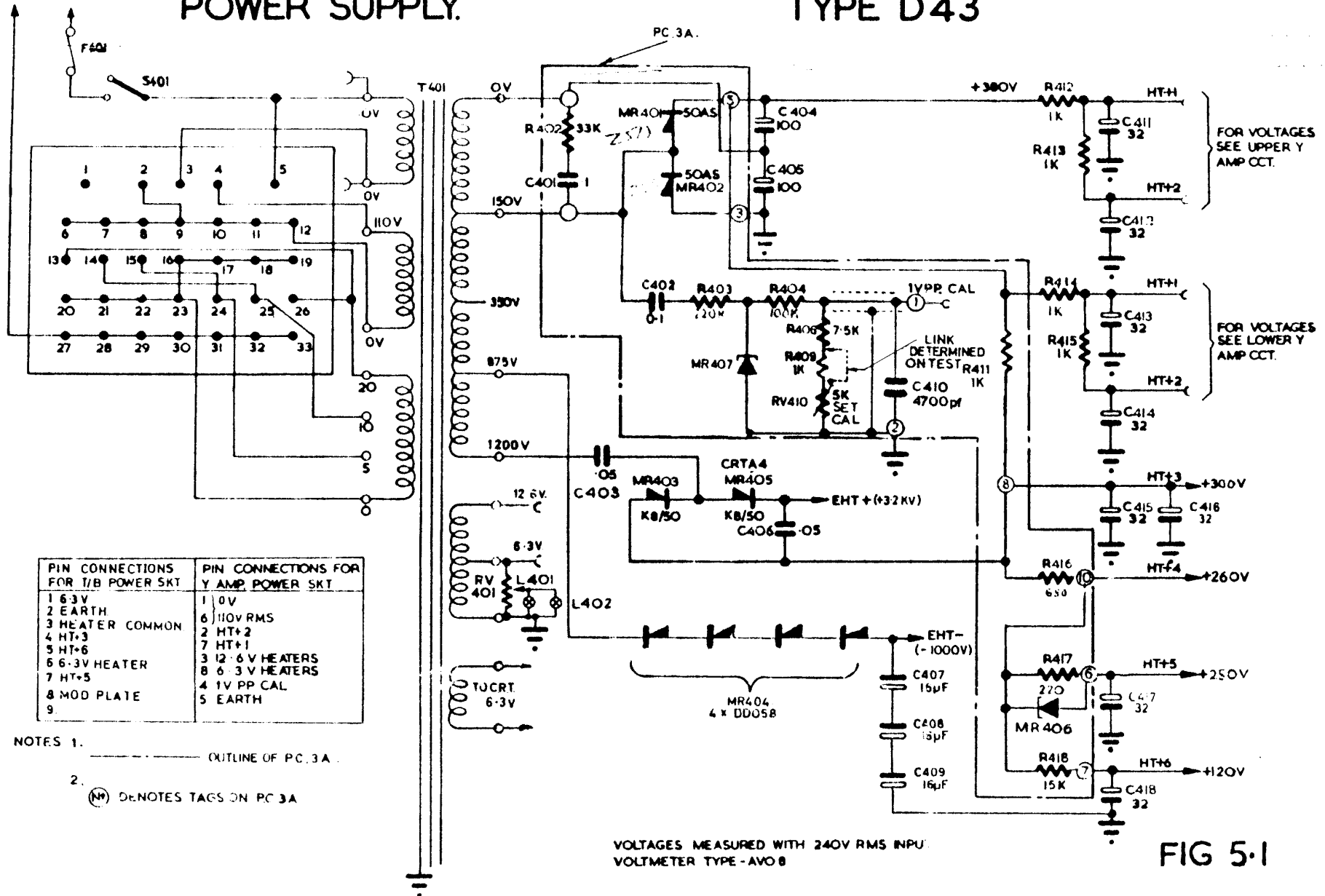


FIG. 4.2

POWER SUPPLY.

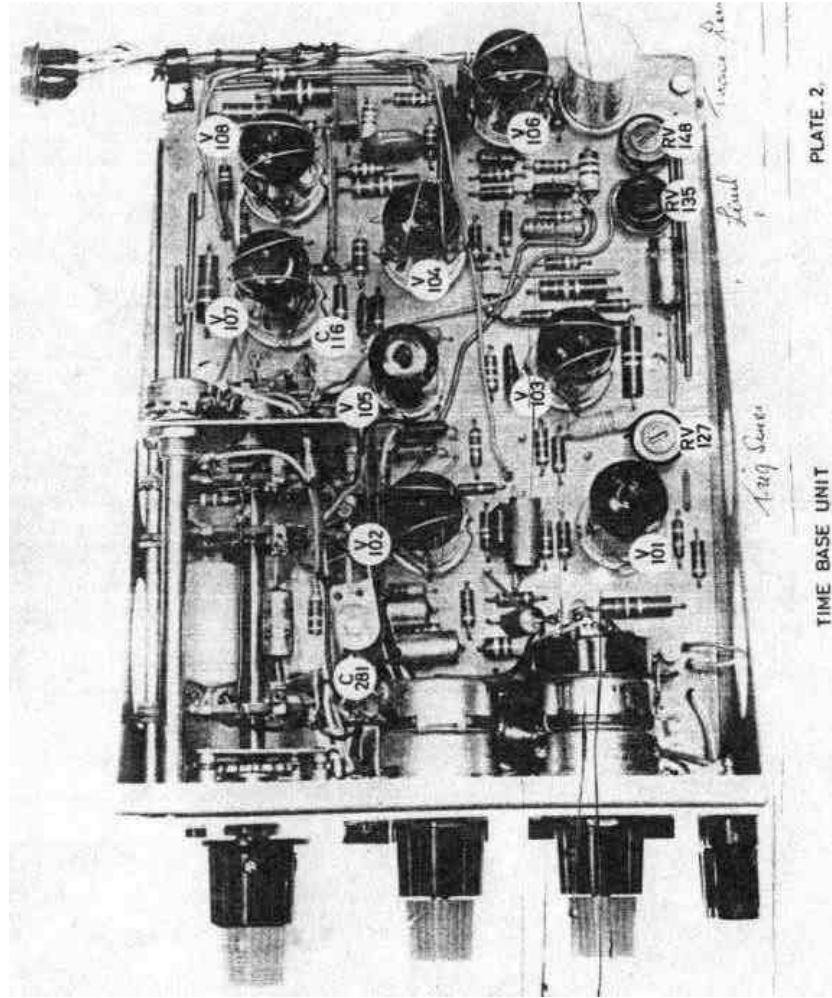
TYPE D43



PIN CONNECTIONS FOR T/B POWER SKT	PIN CONNECTIONS FOR Y AMP POWER SKT
1 6.3V	1 0V
2 EARTH	6 110V RMS
3 HEATER COMMON	2 HT+2
4 HT+3	7 HT+1
5 HT+6	3 12.6V HEATERS
6 6.3V HEATER	8 6.3V HEATERS
7 HT+5	4 1V PP CAL
8 MOD PLATE	5 EARTH
9	

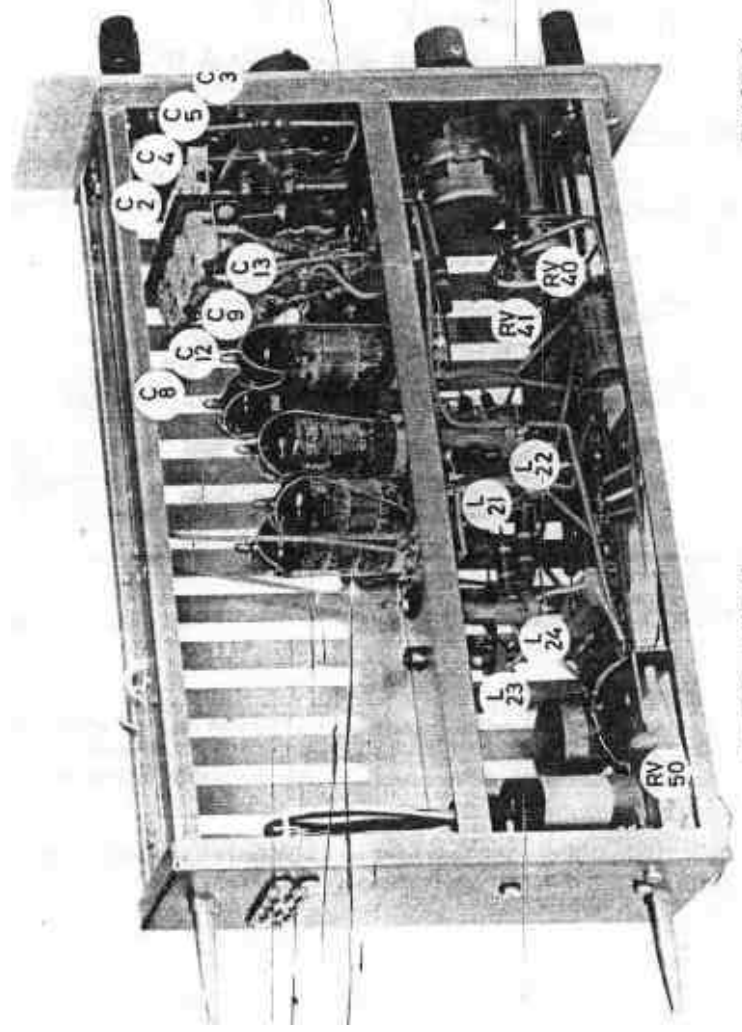
- NOTES 1. ----- OUTLINE OF PC 3A .
2. (D) DENOTES TAGS ON PC 3A

FIG 5.1



TIME BASE UNIT

PLATE 2



PRESETS. AMPLIFIER TYPE 'A'

PLATE 3